Notes for pre-decision conference with ACCC on INC proposal, 14 December 2015

Introduction of ANU team: Julie Smith, Libby Salmon and Phillip Baker

Overview

The case for not authorising the proposed replacement for 1992 MAIF for 10 years, instead requiring amendments to improve its effectiveness, and interim authorisation only, and requiring full public review before final authorisation.

Discussion of Net Public Benefit from the proposed agreement

- Unquestionable potential public benefits of effective restraint of marketing of commercial breastmilk substitutes to prevent undermining of breastfeeding, ensure provision of only scientific and accurate information, and prevent conflicts of interest for health workers.
- The 1992 MAIF did not fully meet Australia's obligations under the WHO Code.
- The 1992 MAIF was not effective, and there is not reliable evidence that it is the most cost effective regulatory model available (see expert opinion from Dr Ginny Sargent on NOUS report).
- Proposed agreement is significantly different from 1992 MAIF.
- The proposed agreement may have less benefit than even the 1992 MAIF, as its effectiveness is uncertain and the replacement agreement offers less effective restraint in marketing of breastmilk substitutes than the 1992 MAIF.
- Costs to public sector of effective regulation is overstated in the ACCC's Draft Determination because it ignores health savings and exaggerates regulatory costs of more effective alternative regulatory approach.

Discussion of Public Detriment from the proposed agreement

- There is also a high 'public detriment' to economic efficiency from the current proposal.
- Authorisation of the proposed agreement would allow increased marketing to health services and health workers, and directly to mothers via social media, and would not ensure accurate and scientific information.
- Allowing companies to market to health workers and health institutions through permitting samples and low cost supplies legitimises marketing through aggressive pricing strategies, which is unfair and inefficient.

- Allowing such marketing also results in dynamic inefficiency by reducing the incentive for innovation and reducing the viability of these producers, who compete with formula companies for sales at retail and institutional level.

Conclusion

'Net Public Benefit' of an effective agreement is potentially very high and government health system savings far exceed government regulatory costs, but net public benefit is much lower in the 10 year current proposal because it would be poorly governed, relatively ineffective and out of line with obligations and policies.

The current proposal also risks more significant 'Public Detriment' than it needs to because it still allows aggressive marketing including pricing which adversely affects competitors and economic efficiency.

Therefore ACCC should not accept the proposed agreement but consider beneficially exercising its powers to:

- reduce the length of time for which it issues any authorisation,
- require amendments to increase effectiveness and reduce public detriment, and
- require a process for wide, and timely public review in 2016-17 as global regulatory developments evolve.

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To whom it may concern.

I have been asked to provide an opinion on 'whether the report study design and the nature of the underpinning evidence support the conclusions on p 24 of the NOUS report that there is: "*insufficient evidence to suggest a more heavy-handed mechanism would deliver additional benefit in achieving the stated aims of the MAIF Agreement*."' In particular with regards to whether the MAIF agreement protects breastfeeding, and whether the standard of evidence presented by these reports meets WHO or NHMRC standards of evidence.

I have reviewed the Nous document and the University of Sydney report, and these are my comments.

In stating Recommendation 2 that "*The voluntary, self-regulatory nature of the MAIF Agreement is the most cost effective regulatory mechanism*", the Nous report:

1. Uses evidence drawn from the University of Sydney report and states (p3) that '*there does not appear to be any causal relationship between the level of regulation of infant formula (or implementation of the WHO Code) and breastfeeding rates'*

2. States (p3) "*The self-regulation model is operating effectively. Self-regulation encourages high levels of consultation between government and industry and creates a sense of ownership by industry*."

3. Furthermore on p24 the Nous report states "*The Review found insufficient evidence to suggest that a more heavy-handed regulatory mechanism would deliver additional benefit in achieving the stated aims of the MAIF Agreement*".

Upon studying the methods for both the Nous report and the University of Sydney report, cited on occasion in the Nous report for supporting evidence, I could find no evidence that the appropriate data were collected to substantiate these claims. Hence, this recommendation is unsubstantiated.

FURTHER DETAIL

The University of Sydney reported on a cross-country comparison of the implementation of the WHO code via a variety of regulatory mechanisms. They outline various country statistics and which sections of the WHO code have been implemented by country, along with breastfeeding rates. These are tabulated on p105 and 106 of the report. There is no evidence presented on cost-effectiveness. They do report that Norway, the country with the highest level of legislation, is recorded as having the highest level of 'any' breastfeeding at 6 months. However, they rightly make no statements about causality. They also state in the limitations (p103) "This study was conducted in a rapid time-frame and attempts to cover a wide range of factors beyond the

implementation of the WHO Code. For the comparisons between countries, a systematic approach to the identification of literature was possible to a limited extent and website searches, references and information sources cited within identified references were also relied on. While every effort was made to extract data without bias, without a formal systematic review, this type of comparative study is at risk of selection bias in the identification and inclusion of studies and data."

The Nous group did not report collecting any further data which would have informed the question as to whether different forms of regulation result in increased or decreased effectiveness. It must be noted that it is this neglect to collect appropriate evidence that has resulted in the absence of such data. It is disingenuous to state then that this absence is 'insufficient evidence'.

Yours faithfully

Dr Ginny Sargent

Dr Ginny Sargent

Appointment, Role and Expertise

Research Fellow, National Centre for Epidemiology and Population Health, ANU College of Medicine, Biology and the Environment

Role to supervise medical and PhD research education and training, co-convene courses in the Master of Public Health and Qualitative Research Analysis, and teach epidemiological method.

Expertise includes public health and epidemiological research methods and evidence-based-medicine, including standards of evidence.

Qualifications

2011	**Doctor of Philosophy (PhD)** University of New South Wales (UNSW), Faculty of Medicine, Rural Clinical School. *Development of an evidence-based intervention for the treatment of overweight and obese children in general practice*.
1994	**First Class Honours Degree** Department of Biological Sciences, Flinders University of South Australia. *Phylogenetic analysis of extinct and extant Diprotodontian marsupials using DNA sequencing*.
1993	**Bachelor of Science Degree** Australian National University (ANU) GPA 5.5. Biology Major (Biology, Zoology, Genetics, Biochemistry, Ecology, Chemistry, Physics), Geology Major (Palaeontology, Geology, Biogeography) and Mathematics Minor: Mathematics, Statistics.

Infant food marketing strategies undermine effective regulation of breast-milk substitutes: trends in print advertising in Australia, 1950–2010

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Abstract

Objective: This study addresses the issue of whether voluntary industry regulation has altered companies' marketing of breast-milk substitutes in Australia since the adoption of the World Health Organization (WHO) International Code on the Marketing of Breast-milk Substitutes 1981.

Methods: Print advertisements marketing breast-milk substitutes were systematically sampled from the Australian Women's Weekly (AWW) magazine and the Medical Journal of Australia (MJA) for the 61 years from 1950 to 2010.

Results: Breast-milk substitute advertising in both the MJA and the AWW peaked and began declining before the introduction of the WHO Code in 1981. Although there was almost no infant formula advertising in AWW after 1975–79, other breast-milk substitute advertising has been increasing since 1992, in particular for baby food, toddler formula and food and brand promotion.

Conclusions: Companies have adopted strategies to minimise the effects of the Code on sales and profit in Australia, including increasing toddler formula and food advertisements, increasing brand promotion to the public, and complying with more limited voluntary regulatory arrangements.

Implications: Comprehensive regulation is urgently required to address changed marketing practices if it is to protect breastfeeding in Australia.

Key words: infant formula, infant food, marketing, bottle feeding, World Health Organization

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This study addresses the question of whether voluntary regulation of breast-milk substitutes (BMS) has altered advertising trends and patterns since its introduction around three decades ago, and subsequently protected the practice of breastfeeding, as was its intention.

Breast milk is a complete source of nutrition for the first six months of life, and a valuable contribution to a healthy diet for young children. The World Health Organization (WHO) recommends continued breastfeeding to two years of age and beyond after the introduction of solid food.[1] In Australia, the *Infant Feeding Guidelines* recommend exclusive breastfeeding until around six months and continued breastfeeding to 12 months and beyond.[2]

Premature weaning from exclusive breastfeeding is accepted to confer a heightened risk of several infectious illnesses in infancy.[2] It has also been associated in many studies with an increased risk of Sudden Infant Death Syndrome[3] and chronic disease in the longer-term, including obesity.[4-6] A large cluster randomised trial by WHO has shown poorer cognitive development at aged six years for infants experiencing earlier weaning.[7] Impacts on mothers increase with reduced exclusiveness and duration of breastfeeding, and include higher risk of some cancers including breast and ovarian cancers.[4,8] The wider, health system cost of early weaning is now well recognised, including by the 'Best Start' Parliamentary inquiry into the benefits of breastfeeding.[9]

National targets – for 80% of infants to be fully breastfed for around six months[2] – remain elusive. The Australian Infant Feeding Survey[10] recently found current breastfeeding initiation rates of 96%. Compared to past breastfeeding trends,[11] this represents the highest recorded initiation rate since 1939. However, the short duration of breastfeeding continues to be a significant problem. In 2010, only 42% of infants between six and 12 months received any breast milk, and only 7% of toddlers at 19–24 months.[12] This follows a general upward trend in consumption of commercial infant milk between 1939 and 1998.[11] Premature introduction of both formula and solids remains high.[10]

Infant food marketing has been identified as a barrier to improving breastfeeding duration in Australia, alongside the rising labour force participation by new mothers.[13] Employed mothers have increased risk of early weaning from breastfeeding.[14] Market research attributes rapid growth in the formula market in 2011 to high economic growth rates "and its corollary the growing number of working women"[15] (p.3).

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The WHO *International Code on the Marketing of Breast-milk Substitutes* (the 'WHO Code') introduced in 1981 recognised that in view of the "vulnerability of infants in the early months of life and the risks involved in inappropriate feeding practices, including the unnecessary and improper use of breast-milk substitutes, the marketing of breast-milk substitutes requires special treatment, which makes usual marketing practices unsuitable for these products".[16] In 1979, WHO had convened a meeting at which government, consumer and industry delegates agreed to stop the promotion of BMS to the public.[26] In 1981, this was formalised as the WHO Code.[16] Compliance was voluntary but the Code proscribed all marketing of BMS and bottles and teats to the public, and restricted advertising to health professionals.[26] The aim of the Code was to "[protect] and [promote] breastfeeding ... by ensuring the proper use of breast-milk substitutes ... through appropriate marketing and distribution".[16] While recognising a legitimate market for BMS, the Code sought to ensure products were not marketed and distributed to mothers and health professionals in ways that interfered with breastfeeding. In 2003, the World Health Assembly (WHA) members unanimously agreed to the 'Global Strategy for Infant and Young Child Feeding',[17] which stated that "infants should receive nutritionally adequate and safe complementary foods while breastfeeding continues for up to two years or beyond" (p.8), thus effectively extending the agreements to restrict marketing of toddler foods and formulas.

In Australia, a 1983 industry agreement disallowed direct advertising of infant formula by manufacturers and importers to the public, but continued to allow almost all other advertising.[18] Public advocacy for greater alignment with the WHO Code[18] resulted in the Marketing in Australia of Infant Formulas: Manufacturers and Importers Agreement of 1992 (MAIF Agreement). The 1992 Agreement was deemed to apply to formula for infants up to 12 months of age.[19] It prohibited marketing to the public and placed restrictions on marketing to health professionals, including the requirement that claims be scientific, and forbidding the use of free supplies or incentives. However, it applied only to manufacturers and importers, not retailers, and exempted all bottles and teats, and infant food and drinks (excluding infant formula).[15] 'Toddler formula' was also excluded. The Agreement is a self-regulatory, voluntary code monitored by the Advisory Panel on the Marketing in Australia of Infant Formula (APMAIF), selected by the Commonwealth Department of Health and Ageing. All six major infant formula manufacturers are signatories.[20]

In 2007, the Commonwealth Parliament House of Representatives Standing Committee on Health and Ageing considered evidence on the effects of commercial marketing on breastfeeding decisions. Its *Best Start* report concluded that full implementation of the World Health Organization International Code of Marketing of Breast-milk Substitutes (WHO Code) was needed to increase breastfeeding to adequate levels in Australia (Recommendation 22).[9] However, the National Breastfeeding Strategy agreed by Australian Health Ministers in November 2010[21] stated that breastfeeding protection including restrictions on marketing of infant formula was one of several "complex issues that do not lend themselves to immediate solutions" (p. 24). In late 2011, the federal Department of Health and Ageing commissioned a study on the implementation of the WHO Code in Australia including the effectiveness of the MAIF Agreement in achieving its aims. In July 2013, the consultant's report was released.[22] It recommended no change to the voluntary industry self-regulatory model, no change to the scope of the MAIF, and no extension of MAIF to formulas marketed for toddlers. Instead, the report recommended 'consideration' of restricting labelling of toddler milk drinks so consumers could distinguish these from infant formula, but this was ruled out by the Department in releasing the report. That is, five years on, no significant action has been taken, nor now seems likely to be taken, to implement the 2007 recommendation of the Australian Parliamentary Committee that the WHO Code be fully implemented in Australia.

The effect of breast-milk substitute advertising on breastfeeding

According to the WHO Code, 'marketing' of BMS includes "product promotion, distribution, selling, advertising, product public relations, and information services".[16] Common marketing mediums include print, television, information help lines, online promotion, point of sale advertising and free supplies.[23] In the past decade, new communications technology has provided a range of alternative avenues for promotion and marketing.[24] Prohibited marketing may overtly state or just imply the 'naturalness' of the products, ease-of-use and equivalence or superiority compared to breast milk.[25]

It has long been known that marketing may subtly bias choices by shaping perceived social norms concerning alternatives to breastfeeding, and creating a distorted view of what is the most 'scientific' or optimal food for infants.[25] Recent research in neuroeconomics highlights how marketing might take advantage of normal neurological processes to increase the likelihood of consumer 'mistakes', manipulating choice contexts to increase time pressures or stress, and influencing how much emphasis is given to various product attributes in consumer decision-making.[25]

Methodologically, the effect of commercial marketing on breastfeeding is difficult to isolate.[25] Several studies, including a randomised trial, point to adverse effects of marketing on breastfeeding exclusivity and duration.[11,27-29] Marketing to health professionals, who have been found to be a major influence on mothers' infant feeding decisions, is suggested to promote BMS use.[23] High rates of brand recognition have also been shown to be linked to reduced breastfeeding.[30] Advertising of solid foods and toddler formulas directly reduces breastfeeding rates through promoting premature weaning from exclusive breastfeeding, and by cross-marketing infant formula.[26,25] A number of researchers have also examined media messages on infant feeding using content analysis,[31,32] including in Australia.[33] Few studies[28,34] have specifically focused on how commercial marketing strategies respond to public controversy on infant food marketing, or to threats of regulation of marketing.

To inform public policy discussion of this issue, this study looks at trends and patterns in print advertising of breast-milk substitutes in Australia before and after the signing of the WHO Code in 1981. We aimed to identify the impacts of voluntary regulation of marketing by industry through the 1992 MAIF Agreement, and contrast this with the objectives underpinning the WHO Code itself.

We hypothesised that the level and nature of advertising would alter in response to public controversies such as those preceding the adoption of the WHO Code. We also expected that companies would modify their marketing and adopt strategies that minimise the effects of such constraints on marketing, sales, and profitability, but are just sufficient to avoid effective public regulatory restrictions.

Method

This study used quantitative analysis to capture long-term changes in the volume and product composition of print advertising of BMS to mothers and the health professionals to explore how marketing strategies have responded to changes in public and medical opinion and the regulatory environment. Other quantitative studies of magazine content in the US have examined the frequency of messages about infant feeding, and the apparent impacts on women's decisions.[29,31]

Women's magazines are used by pregnant women to gain information about infant care and parenting issues. Partly as a result, the medical profession have come to be seen as 'experts' in the 20th Century era of 'scientific mothering'.[31] Hence, a popular public magazine – the *Australian Women's Weekly* (AWW) – and a health professional journal – the *Medical Journal of Australia* (MJA) – were chosen to observe marketing trends given their differing target audiences, and the specific WHO Code and MAIF Agreement restrictions for each group.

The AWW and MJA were selected because their long-running circulation allows for time series analyses of advertising trends: print advertisements were collected from January 1950 to December 2010 (61 years). Additionally, the popularity of the AWW and MJA meant they are likely to reflect the content of other publications targeting similar audiences. In July to December 2011, AWW had a printed circulation of more than 470,000.[35] In September 2011, MJA printed circulation was 29,587, with many more online visits.[36]

The years 1950–2010 were chosen for sampling because this period covers major increased industry competition and supply that occurred in Australia during the mid-1950s, changes to birth practices and breastfeeding patterns and women's work practices (demand) from the 1960s, and major changes in regulation and public opinion from the beginning of the 1970s.[18,23]

The scope of data collection included all text or pictorial advertisements considered to market BMS, as defined by the WHO Code, whether this was directly stated, or just implied in the advertisement. BMS are defined as "any food being marketed or otherwise presented as a partial or total replacement for breast milk, whether or not suitable for that purpose".[19,37] This includes all food and formula marketed for children of an age where breastfeeding is recommended (less than two years of age),[1] including infant food, infant formula, toddler food and follow on or toddler formula, as well as bottles and teats, sterilising solution, breastfeeding aids and general brand promotion. Toddler food and toddler formula advertisements were collected after 1980, though not evident previously.

Excluded were infant feeding implements other than bottles, as these were not a major focus of the study. Also excluded were advertisements by formula companies for non-BMS products, although these may cause some cross-promotional marketing and products considered to be medical treatments. Definitions of included products are shown in Table 1.

Sampling strategy

A previous collection of data on advertising of infant milk and formula products covers the period 1950–1985.[11] For the present study, the above data collection was extended to 2010 using comparable sampling methods.

To maintain a manageable sample size, data was collected from all issues of the MJA in every fifth year. For the AWW, advertisements were also collected using systematic sampling. Data was collected from all issues in January, May and September of every fifth year from 1950 to 2010. A similar strategy has been used elsewhere in analysis of *Parents' Magazine* content.[29,31] Data was also collected

Table 1: Definitions used for classifications of products in this study.

Infant formula	Modified non-human milk products described or sold as an alternative for human milk for the feeding of infants up to the age of twelve months.[19] NOTE: This includes 'follow-on' formula which is suitable for infants aged 6 to 12 months and condensed, concentrated and evaporated milks marketed as being suitable for infants less than 12 months or products marketed as making non-human milk suitable for infant consumption.
Toddler formula	Modified non-human milk products marketed or presented as being appropriate for children 12 months or older.
Baby food	Food (solids or liquids) presented as a source of nourishment for infants up to 12 months of age, NOTE: for clarity of exposition, the definition of infant food in this paper excludes infant formula, though this is not common usage.
Toddler food	Food (solids or liquids) presented as a source of nourishment for infants older than 12 months of age.
Bottles/teats	Bottles or teats designed for hand-feeding of infants less than 12 months of age
Sterilizing solution	Sterilizing solution designed for infant bottle cleaning
Breastfeeding aid	Supplement or other formulation marketed as enhancing lactation.
Brand promotion	Marketing where specific products are not the focus but a brand is being marketed in relation to artificial infant feeding, such as a competition or a baby care helpline.

from the January issue in all other years over that period, so that advertisements appearing in January have a higher probability of inclusion than other months. January was selected because this month often contained special feature articles of interest to new mothers and more regularly contained advertisements for baby products. This approach was directed at achieving systematic but efficient sampling over an extended time period within tight resource constraints,[38] while also allowing for representation of seasonal differences in the volume of advertising per issue by the sampling of some May and September issues.

Every weekly issue before 1983 was sampled from target months, but since the AWW became a monthly in January 1983, only the single monthly publication was sampled.

Data collection, coding and analysis

Data were collected through hand-searching of volumes from the National Library of Australia. BMS advertisements found were photocopied or scanned for storage. These were coded into categories as discussed above and in Table 1. Individual advertisements could be allocated to a maximum of two categories if they promoted more than one product. Those that advertised more than two categories were considered 'general brand promotion'. The publication, date and category of each advertisement were recorded in Microsoft Excel.

The volumes of advertisements before and after the WHO Code were compared for each of the publications. We also analysed changes in the number and proportion of advertisements in each category. The period from 1980 onwards was considered to be 'post-Code', as provisional agreements were made in 1979.[37]

Results

Trends in total BMS advertising

A total of 238 AWW issues and 478 MJA issues were examined. Using the inclusion criteria above, 223 advertisements were identified in the AWW and 123 advertisements in the MJA.

As shown in Figure 1, advertising in the AWW peaked with 50 advertisements in 1970–74, before the Code was introduced. After the Code was introduced, AWW advertising began falling between 1985 and 1989 and fell further to a minimum of four advertisements in 1990–94.

Advertising in the MJA peaked earlier, with 41 advertisements in 1965, after which there was a steep decline until 1975, well before the introduction of the WHO Code. After 1990, advertising in the MJA declined, and there were no advertisements recorded after 1995.

However, advertising in the AWW increased from four advertisements between 1990–4 and 2005–09 to 23 advertisements in 2005–09, a more than five-fold increase (575% increase). This is the largest volume of advertising observed since the Code was introduced.

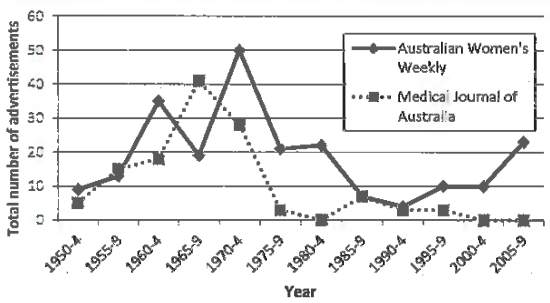
Product composition of advertising

Infant formula made up the majority of advertisements for BMS for all years in which BMS were advertised in the MJA. Volume of infant formula advertising peaked in 1965 with 27 advertisements. Levels after the WHO Code were lower, with a maximum of seven in 1985. No infant formula advertisements were recorded after 1995. There was little other advertising in the MJA.

Unlike the MJA, BMS advertising in the AWW was predominately for baby food not formula. Before the Code was introduced, baby food excluding infant formula comprised the greatest contribution to BMS advertisements at 43% of total advertising (63 advertisements), and infant formula an additional 20% (30 advertisements) (Table 2). The decline in baby food advertising began around 1970–74. After the Code was introduced there were fewer baby food advertisements (17 advertisements, 22% of the total). However, since 1990–94, when there were no advertisements, baby food advertising has slowly increased (to five advertisements in 2005–09).

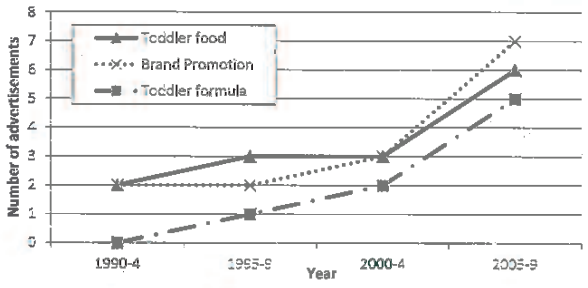
Infant formula accounted for just 20% of all BMS advertising before 1980 (Table 2). After this time, just one infant formula advertisement was recorded, in 1995 by Wyeth.

Figure 1: Comparison of longitudinal trends in volume of breastmilk substitute advertising between *Medical Journal of Australia* and the *Australian Women's Weekly*, 1950-2009.



MJA, n=123 advertisements, AWW, n= 223 advertisements.

Figure 2: Growing markets: advertising for toddler food, brand promotion and toddler formula in the *Australian Women's Weekly* 1990-2009.



Toddler formula, n= 8 advertisements, toddler food, n= 14 advertisements, brand promotion, n=14 advertisements.

Increase in other BMS advertising since WHO Code

As in Table 2, 37% of pre-Code advertisements and 77% of post-Code advertisements were for products other than infant formula and baby food. Bottles, teats and sterilising solution advertising peaked in 1970–74 with 19 advertisements, then declined until none were recorded after 1989.

Toddler formula first appeared in 1995 and toddler food in 1987. The 450% increase observed in advertisement of 'other' products in the past 15 years in the AWW was roughly equally spread between brand promotion (39%), toddler food (33%) and toddler formula (28%) (Figure 2).

Discussion

The level and nature of BMS advertising to mothers and health professionals changed following the expression of public concern at unethical marketing of infant foods during the 1970s; concerns that culminated in the WHO Code in 1981. Both trends peaked and began to decline prior to the introduction of the WHO Code. There was an earlier peak in MJA, and very little advertising in MJA post-Code. This indicates that as expected, companies' advertising responded to public or health professional opprobrium, as well as perhaps in anticipation of, and to avert, public regulation. However, compliance with voluntary regulation is not complete;[20] individual corporations have strong strategic incentives to break agreements in order to enter new markets, introduce new products, or exploit new avenues for promotion and marketing.

It could also be expected that the companies would adopt strategies to minimise the effects of the Code on sales and profit, and this is supported by AWW data. Baby food advertising, while covered by the WHO Code, continues to be present in AWW. Although post-Code there was almost no infant formula advertising in AWW, total BMS advertising is increasing, in particular for baby food, toddler formula and food and brand promotion. This expectation was not proved to be true in MJA, where no BMS advertising was recorded after 1995.

The earlier peak in advertising in MJA is supported by Thorley[23] and Minchin[18] who reported that most infant formulas and milks were marketed directly towards health professionals in the first half of the 20th Century, after which time marketing to mothers increased. Similarly, the drop in advertising in the AWW in 1965–69 – the peak period for advertising in the MJA (1965) – may indicate that marketing was being redirected towards health professionals at this time. The subsequent drop in the MJA may coincide with the rise in health professionals speaking out against infant formula, which increased rapidly from the mid-1960s, as the benefits of breastfeeding became more widely accepted.[39] Reduced print advertising to health professionals may also reflect promotion and expanding sales in product markets which are perceived as less contentious. Examples include the success of industry advocacy for new dietary guidelines to recommend feeding only commercial formula (and not other forms of cows' milk) to non-breastfed infants in the first year[18] and the sponsoring of health professional conferences.[40]

Minchin's review of marketing practices reports there was no direct advertising of infant formula to the public from 1979 until the Mead-Johnson campaign of 1991.[18] The lack of any formula advertising in AWW 2000–09 is consistent with the maximum of one breach recorded per year by APMAIF since 2001.[20]

The large increase in toddler formula advertisements in the AWW since the Code aligns with Australian research by Berry et al.,[26,28] which found more advertising of toddler formula and follow-on formula (where permitted) in Australia and other countries where infant formula advertising was not permitted. This Australian research is supported by a 2012 UK analysis which also found that "consumers recall follow-on advertising as advertising for infant formula".[34] The German Federal Institute for Risk Assessment recently commented that toddler formula is "superfluous" in a balanced diet, and may have adverse long-term health consequences due to an "oversupply of nutrients".[41]

Table 2. Comparison of numbers of advertisements and proportions of categories of breastmilk substitutes before and after the WHO Code in the *Medical Journal of Australia* and the *Australian Women's Weekly*.

	MJA				AWW			
	Pre-Code**		Post-Code***		Pre-Code**		Post-Code***	
	No.	%	No.	%	No.	%	No.	%
Infant formula	84	76	12	92	30	20	1	1
Baby food	16	15	0	0	63	43	17	22
Brand promotion	7	6	0	0	4	3	17	22
Breastfeeding aid	3	3	0	0	3	2	0	0
Bottles/teats	0	0	0	0	24	16	12	16
Sterilising solution	0	0	0	0	23	16	5	7
Toddler food*	NA	NA	0	0	NA	NA	16	21
Toddler formula*	NA	NA	1	8	NA	NA	8	11

**Advertisements for toddler formula and food were collected from 1981-2010 only. Pre-Code MJA, n= 110 advertisements, Post-Code MJA, n= 13 advertisements, Pre-Code AWW, n= 147 advertisements, Post-Code AWW, n= 76 advertisements. **Pre 1980 considered 'Pre-code'. ***Post 1979 considered 'Post-Code'.*

Mechanisms

Changes in public and professional opinion

While more advertising to health professionals is allowed under the Code than to the public,[15] less advertising was found in the MJA compared to the AWW. Thorley[23] suggested that manufacturers shifted from marketing to health professionals to find new markets in mothers. This may have been due to health professional marketing becoming less effective, as a review found that post-Code there was increased dissemination of information on dangers of infant formula to health professionals, as well awareness of their obligations under the Code and the need to encourage breastfeeding within the field.[2,42] By August 1971, the American Journal of Clinical Nutrition had a special issue on the benefits of breastfeeding compared to bottle-feeding.[43]

The decline in the late 1970s in the AWW coincided with an increase in breastfeeding advocacy,[44] and a public backlash over perceived irresponsible marketing practices culminating in the Nestlé boycott beginning in 1977.[18] This may be evidence of an important effect of public opinion on marketing practices.

The MAIF Agreement: an effective regulatory choice?

The decline in infant formula advertising, despite the increase in total BMS advertising, suggests that the MAIF Agreement helped to secure compliance with part of the WHO Code. Such a decline is not evident in the comparable US study.[25] However, the continued marketing of baby food, which is clearly prohibited by WHA amendments,[45] and the decline in BMS advertising pre-Code raises the question: is the MAIF Agreement the most effective response for reducing BMS marketing and promoting breastfeeding in Australia?

According to the Australian Competition and Consumer Commission (ACCC), voluntary codes of conduct, such as the MAIF Agreement, have the advantage of being able to respond quickly to changing industry needs.[46] Other acknowledged benefits to the government include reduced costs of administration and of changing policy if costs are met by industry and for harbouring a "responsible spirit" and therefore cooperation of the industry.[47] Benefits to industry include improving its public image and a low impact on marketing, as well as the likelihood of discouraging harsher, more comprehensive legislation.[48]

However, voluntary codes of conduct, particularly in the case of tobacco advertising, have repeatedly been shown to produce suboptimal results.[48] A report by the World Bank found that bans on advertising of tobacco are only effective if they include brand names and logos, as partial regulations cause companies to shift advertising spending.[49] Although tobacco and BMS are clearly different products, the observed behaviour of tobacco companies is consistent with that seen in Australian BMS marketing.[50]

The insufficiency of the MAIF Agreement to protect breastfeeding is indicated by the increase in print BMS advertising in the AWW after 1992. In particular, the increase in toddler formulas signals that Australian infant formula manufacturers are using line extension marketing strategies, using similar packaging and the same brand and logo in their permitted infant food products to indirectly advertise infant formula.[51]

Even more subtle than line extension, is 'brand stretching' marketing, which was not captured by this study. This technique has been documented in studies of internal papers within the tobacco industries of Australia and the UK and involves the labelling of a product in a new market with a well known brand name.[28,52,53] Brand stretching has been found to encourage sales of new products, if customers perceive that the brand is associated with good "image, credibility and reputation".[54] Comparably, an advertisement in the AWW in June 1995 which was excluded from this study depicted a smiling infant alongside the brand name 'Wyeth'. In fact, the advertisment was for a pneumococcal vaccine, however, the association created beween Wyeth and a healthy infant in this context may indirectly promote infant formula through the use of 'brand stretching'.

Increase in non-print marketing

The decline in BMS advertising in the MJA, and the emergence of print advertisements not covered by the MAIF Agreement in both the MJA and the AWW, raises the issue of whether other forms of non-print promotion may have increased. The International Baby Food Action Network (IBFAN) report *Australia: Code violations 2007*[55] noted the persistence of commercial sponsorship of health professional conferences and information pamphlets displaying product ranges to doctors, not covered by the MAIF Agreement. IBFAN has also identified the worldwide emergence of digital and direct marketing of products covered by the WHO Code.[40] The significance of the Internet as a source of health information for parents has been emphasised in a UK study of corporate website advertising of formula products.[34]

Abrahams has also drawn attention to the new and more effective opportunities for promotion and advertising of infant feeding products through companies' exploitation of interactive social media.[24] This study found violations of the WHO Code as well as promotional practices unforeseen by the Code, such as blogs, social networking sites such as Facebook, micro-blogging services like Twitter, content communities like YouTube and collaborative projects like Wikipedia.

The media's portrayal of infant feeding also plays a role in shaping perceived social norms, choice contexts, and influencing the emphasis mothers give to the various attributes of different infant feeding methods. Research has pointed to the increasing use of the media by the pharmaceutical industry to promote its products through 'disease mongering',[56] a strategy evident also for infant feeding.[57]

Implications

The increase in advertising of products, including baby food and toddler food and formula, beyond the scope of the MAIF Agreement but within the scope of the WHO Code, may lead to early weaning and reduced exclusivity of breastfeeding, and undermine efforts

to increase the duration of breastfeeding. New forms of marketing such as social media and Internet advertising are also unaddressed by current policies. To implement the WHO Code fully, legislation is likely to be needed and effective.[34]

Strengths and limitations of this study

This study covered a period spanning 30 years prior to the Code and almost 30 years afterwards, which allowed for influences on advertising trends beyond the immediate impact of the Code such as the MAIF Agreement to be considered. It also looked at a wide range of products that could directly or indirectly promote BMS use. However, as bottles, teats and sterilising solution may be used either for breast milk or infant formula feeding, the inclusion of advertisements for these products may have falsely increased the recorded volume of marketing promoting BMS use because of increased expressing of breast milk for premature infants or for employed mothers.

Examination of the MJA and AWW allows consideration of advertising trends to both the public and health professionals. The MJA was only sampled every fifth year; extreme transient advertising trends in a sampled year could therefore potentially distort the data. As the AWW was sampled every year in January, but five-yearly for the May and September issues, it is possible that extreme results may be overrepresented if they occurred in January. More intensive sampling of the AWW and MJA is needed for more detailed statistical analysis.

Changes in journal formatting and length during the sampling period may have altered the space available for advertisements and therefore the number and size of advertisements present.

Further research

Further study is needed to determine whether our findings about print advertising trends can be generalised to other forms of BMS marketing over time. This would include and compare trends and patterns of advertising via television and radio, the Internet and social media. There is a need to examine trends for areas not covered by the MAIF such as retail advertising. A discourse analysis of Australian advertising images and text could determine the effect of the Code in combating marketing of product attributes, such as that implying the superiority or 'scientific' advantage of BMS over breast milk. An analysis of the changing content of marketing messages over time may also provide important insights to inform counter-marketing strategies and regulatory strategy. It would be valuable to document the extent of promotion through supporting health professional education, and the level of professional disclosure of support.

It would also be informative to compare the effectiveness of different policy approaches to implementing the Code in various countries and Australia using summary indicators of breastfeeding prevalence, and WHO Code implementation at the country level.

Conclusions

The level and nature of BMS advertising to mothers and health professionals began changing before the WHO Code 1981 following public concern about the issue. Subsequently, companies have adopted strategies to minimise the effects of the Code on sales and profit, including increasing toddler formula and food advertising and brand promotion to the public, including online marketing. This disputes the relevance of the current MAIF Agreement to changing marketing practices and its effectiveness in protecting and supporting breastfeeding.

Despite the limitations of voluntary codes outlined, legislation can only be effective if it is enforced and has social backing.[18,47,48,53] Minchin[18] has highlighted the difficulty in gaining legislative support for public health regulation, observing the difficulty and time taken in obtaining community and legislative support to make laws against tobacco. In the case of BMS, in 2007 a bipartisan committee recommended full implementation of the WHO Code in Australia. However, no action had been taken by the middle of 2013.

This six-year intermission illustrates that a delayed response advantages the industry through ongoing sales and profit, at the expense of more than a million infants whose mothers have been exposed over that period to marketing outside ethical boundaries set by the WHO Code and the World Health Assembly.

A joint campaign by public health and breastfeeding advocacy groups is needed to reinvigorate the Australian Government's response to the inquiry's original recommendation, and ensure that the growing exploitation of online promotion and marketing avenues is urgently and effectively addressed.

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Circumventing the WHO Code? An observational study

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ABSTRACT

Background This study compares the formula milk advertisements that appeared in parenting magazines published in two countries that have enacted measures to restrict the advertising of infant formula products in response to the international code with two that have not.

Methods Content analysis was used to compare the type and frequency of formula milk advertisements that appeared in parenting magazines collected from the USA, Canada, the UK and Australia during 2007, and to examine whether there was a relationship between these frequencies and advertising regulations.

Findings Advertisements that promoted formula products or brands occurred in all of the magazines sampled but the type of product advertised differed. Follow-on formula advertisements occurred more frequently in titles from the UK, where infant formula advertising is prohibited (RR 3.82, 95% CI 2.65 to 5.50, $p<0.0001$) than they did in titles from the USA/Canada where infant and/or follow-on formula advertising is permitted. Toddler milk advertisements appeared more frequently in titles from Australia, where infant and follow-on formula advertising is prohibited, than they did in titles from countries where direct-to-consumer infant and/or follow-on formula advertising is permitted. Rate ratios were as follows: UK only 0.03 (95% CI 0.01 to 0.11, $p<0.0001$); USA/Canada only 0.02 (95% CI 0.01 to 0.06, $p<0.0001$).

Interpretation Bans on the advertising of infant formula products do not prevent companies from advertising (follow-on or toddler formula). These products are presented in ways that encourage consumers to associate the claims made in them with a group of products (a product line) that includes infant formula.

What is already known on this topic

- Exposure to formula milk advertising has been associated with a shorter duration of exclusive breastfeeding and shorter overall breastfeeding duration.
- The *International Code of Marketing of Breastmilk Substitutes* aims to protect mothers and their infants from the marketing of breastmilk substitutes, including formula milk.
- Companies resist national efforts to implement the *International Code of Marketing of Breastmilk Substitutes*, whether by legislation or voluntary industry self-regulation.

What this study adds

- Formula advertisements appeared in British, Australian, American and Canadian parenting magazines regardless of regulations designed to prohibit the marketing of breastmilk substitutes.
- Line extension and brand-focused advertising reduce the effectiveness of national restrictions on the advertising of infant formula products.

Exclusive breastfeeding for the first 6 months of life followed by an extended period during which breastmilk makes a substantial contribution to a young child's mixed diet is recommended with remarkable unanimity across the globe.[1–5] Replacing breastmilk with other foods, including infant formula, is known to carry important health risks for both infants and their mothers.[6–8] Nonetheless, adherence to these recommendations is poor in Australia, Canada, the UK and the USA.[9–12]

There is some evidence that exposure to advertising for formula milk products is associated with poorer breastfeeding outcomes.[13–18] However, there is a significant gap in the literature about the effect of the regulation of breastmilk substitute advertising on breastfeeding rates. In acknowledgement of the difficulties associated with detecting an effect of advertising exposure on the behaviours of populations[9–22] and the money that is spent undertaking it, the World Health Assembly (WHA) has expressed the view that formula milk advertising is likely to influence infant feeding behaviour, and called upon advertisers to demonstrate that their advertising has no deleterious effect on breastfeeding rates.[23]

INFANT FORMULA ADVERTISING REGULATION AND RESPONSE

In 1981 the member states of the WHA adopted the International Code of Marketing of Breastmilk Substitutes (WHA 32.22), which prohibits the advertising of infant feeding products (including milk or infant formula, teas and other foods represented as suitable for infants less than 6 months old and infant feeding bottles/teats) when they are 'marketed or otherwise represented as a partial or total replacement for breast milk'.[24]

Member states must enact national measures to give effect to this resolution. Australia restricts

the advertising of any formula milk product represented as suitable for infants under a year old, including follow-on formula, by a self-regulatory instrument known as the Marketing in Australia of Infant Formulas (MAIF) Agreement.[25] The UK prohibits the advertising of infant formula products—but not follow-on formula products—to the general public,[26] and neither the USA nor Canada restricts the advertising of any type of formula milk product.

National efforts to regulate the advertising of infant feeding products are often met with resistance from infant formula manufacturing companies.[27–35] Furthermore, when national measures are taken to prohibit the marketing of infant formula (suitable for use as sole nutrition from birth), 'follow-on formula' (suitable for use as a partial nutrition from 4 to 6 months) is often promoted aggressively.[27 30] The manufacturers of these products argue that follow-on formula escapes the definition of 'breastmilk substitute'—and can be freely advertised to mothers—because it is represented as suitable for infants at the age when complementary feeding is recommended in addition to breastfeeding.[36] 'Toddler milk' is similar to 'follow-on formula' in that it is presented in packaging very similar to that of infant formula, but escapes the legal definition of 'infant formula' and can be advertised freely where infant and follow-on formula advertising is prohibited (as in Australia).

It has been suggested that these companies might be advertising follow-on formula products including toddler milks in a manner calculated to circumvent national regulations devised to restrict the advertising of infant formula products.[27 30 37–40]

Evidence suggests that women do not differentiate between advertising for toddler milk or follow-on formula and advertising for infant formula. The results of an Australian study indicated that women identified toddler milks (a type of follow-on formula) as part of a product line that they described collectively as 'formula', and which included infant formula.[37] This finding is consistent with findings from a British study indicating that mothers perceived follow-on formula advertisements to be advertising infant formula.[38 39]

In this context it is useful to examine the advertising strategies employed in response to national prohibitions on the advertising of some formula milk products.

AIMS

This study utilised content analysis to determine whether prohibition of the advertising of one or more formula milk products (such as the prohibition of infant formula advertising, or the prohibition of infant and follow-on formula advertising) decreased the frequency with which advertising for formula milk products or brands appeared in parenting magazines. It also examined whether toddler milk advertisements appeared more frequently in parenting magazines published in Australia, where the advertising of infant and follow-on formula products are prohibited, than they did in those published in countries where the advertising of infant and/or follow-on formula products is permitted; and whether follow-on formula advertisements appeared more frequently in titles published in the UK, where the advertising of infant formula products is unlawful, than it did in titles published in the USA and Canada where the advertising of infant formula products is permitted.

METHODS

Data collection

Concurrent 12-month samples of the most widely read parenting magazines (based on 2005 Audit Bureau of Circulation and 2005/6 Morgan Readership Survey data) from Australia, the USA, the UK and Canada were collected during 2007 for analysis. The titles are displayed in table 1.

Blocks of advertising for any product or service one sixth of a page or larger were counted and tallied. Advertisements for formula milk products or brands were identified and classified.

Advertisements that promoted infant or follow-on formula, toddler milk, growing up milk, 'mothers' club', telephone or online information service or proprietary ingredients (such as patented proteins or probiotics) and shared a brand identity with infant formula products were included in the definition of formula advertisements. If there was any confusion about whether or not these products or services were part of a formula range, confirmation was sought from company websites.

Formula advertisements were coded using four categories (table 2). The categories were not mutually exclusive and each

Table 1 Frequency of formula milk advertisements by type

Regulation type	Country	Title	Total pages of ads	Total formula	Infant formula	Follow-on formula	Toddler milk	GUM	Formula brand
Infant formula ads unlawful	UK	Prima Baby and Pregnancy	994	76*	0	47	0	14	29
		Practical Parenting UK	846	45*	0	41	0	13	4
		Mother & Baby UK	1504	64*	0	34	0	13	30
		Totals	3344	185	0	307	0	40	63
No regulation	Canada	Today's Parent	1289	33*	28	24	3	0	1
	USA	Parents	1473	27	19	8	0	0	0
		Parenting	1166	36	34	2	0	0	0
		Totals	3928	96	81	34	3	0	0
Voluntary prohibition of infant formula and follow-on formula ads	Australia	Australian Practical Parenting	667	19	0	0	18	0	1
		Australian Parents	306	17	0	0	13	0	4
		Totals	1280	36	0	0	31	0	5

*Infant formula, follow-on formula, toddler formula and/or growing up milk (GUM) are frequently presented in a single ad. Totals are therefore less than the sum of the other categories. Ads spanning two pages were counted as one.

Table 2 Formula advertising coding frame

Code	Description
Infant formula	A product based on milk or other edible food constituents of animal or plant origin, which is suitable for use as the sole source of nourishment for infants from birth
Follow-on formula	A product based on milk or other edible food constituents of animal or plant origin, which is suitable for use as the principal liquid source of nourishment in a progressively diversified diet for infants aged from 6 months who are not breastfed
Toddler milk	A fortified milk-based product only suitable for children more than a year old that is packaged in a container that is the same size and shape as a container that contains infant formula and marketed as part of a line of formula products
Brand advertising	An advertisement that bears the same brand marker(s) as an advertisement for infant, follow on or toddler formula but does not advertise a milk product. These advertisements included advertisements for helplines, mothers' clubs, websites and proprietary ingredients

advertisement was coded for all of the formula milk types it depicted. When a single advertisement promoted more than one type of formula milk that advertisement was only counted as one instance of advertising.

Data analysis

Poisson regression was used to test three hypotheses:

1. H_1—The regulatory environment had no effect on the frequency of all types of formula advertisements after adjusting for the total number of pages of advertising.
2. H_2—The regulatory environment had no effect on the frequency of follow-on formula advertisements after adjusting for the total number of pages of advertising.
3. H_3—The regulatory environment had no effect on the frequency of toddler milk advertisements after adjusting for the total instances for formula advertising.

The Poisson models were fit to the counts and use the log of the denominators (total pages of advertising or total instances of formula advertising) as offset variables. Data analysis was conducted using STATA data analysis and statistical software version 11.

Reliability

In order to assess the reliability of the coding frame the same researcher recoded a randomly selected 25% sample of each title 2 months after the initial data collection (stability). In addition a second researcher, not associated with the project, coded a randomly selected 25% sample of each title (reproducibility). Counts of formula advertising were identical. Bland–Altman limits of agreement were calculated for counts of total pages of advertising. Although the limits of agreement could have been smaller, they indicate that appropriate stability (–5.3, 3.3) and reproducibility (–6.3, 4.5) was achieved, given the required purpose.

RESULTS

Advertising comprised between 45% and 60% of the magazines' content. Formula advertisements were generally large and prominent. Most instances (91.8%) of formula advertising were full-page advertisements.

Table 1 illustrates the frequency with which the five types of formula advertisements (infant formula, follow-on formula, toddler formula, growing-up-milk and formula brand) occurred in each title across the year.

All formula advertisements

Poisson regression revealed that there was a statistically significant difference in the number of formula advertisements that occurred in each of the three regulation groups (no regulation, infant formula ads unlawful and voluntary prohibition of infant formula and follow-on formula ads) after adjusting for the total number of advertising pages (χ^2=41.99, p<0.0001). Thirty-three per cent fewer formula advertisements appeared in titles from the no regulation group than in those from the voluntary prohibition of infant formula and follow-on formula ads (RR 0.67, 95% CI 0.46 to 0.99), and 46% more formula advertisements appeared in titles from the infant formula ads unlawful group than in those from the voluntary prohibition of infant formula and follow-on formula ads group (RR 1.46, 95% CI 1.03 to 2.09).

Infant formula advertisements

Eighty-one direct advertisements for infant formula products were observed. As expected, all of these appeared in titles that were published in the USA and Canada (no regulation). Further analysis of this subgroup was thus not feasible.

Follow-on formula advertisements

One hundred and fifty-six follow-on formula product advertisements were observed. Of these 122 appeared in British titles (infant formula ads unlawful) and 34 in titles published in the USA or Canada (no regulation).

Poisson regression was used to determine whether follow-on formula product advertisements occurred more frequently in British titles (infant formula ads unlawful) than they did in titles from countries where infant formula product advertisements are permitted, after adjusting for the total pages of advertising. Follow-on formula advertisements appeared almost four times more frequently in titles from the UK (RR 3.82, 95% CI 2.65 to 5.50, p<0.0001) than they did in titles from the no regulation group.

Toddler milk advertisements

Thirty-four advertisements that promoted only toddler milks were observed. Three advertisements for toddler milk were found in the Canadian titles (no restriction) and 31 in Australian titles (voluntary prohibition of infant formula and follow-on formula ads).

Poisson regression determined that toddler milk advertisements occurred more frequently in Australian titles (voluntary prohibition of infant formula and follow-on formula ads) than they did in titles from countries where infant and/or follow-on formula product advertisements are permitted, after adjusting for the total number of (any) formula advertisements. There were 97% fewer toddler milk advertisements in titles from the infant formula ads unlawful group (RR 0.03, 95% CI 0.01 to 0.11, p<0.0001) and 98% fewer toddler milk advertisements in titles from the no regulation group (RR 0.02, 95% CI 0.01 to 0.06, p<0.0001) than occurred in titles from the voluntary prohibition of infant formula and follow-on formula ads group. Framed another way, toddler milk advertisements appeared over 33 times more frequently in titles from Australia (where neither infant nor follow-on formula advertising is permitted) than they did in titles from the UK (where follow-on formula advertising is permitted) and 50 times more frequently in Australian titles than they did in titles from Canada (where both infant and follow-on formula advertising is permitted).

Formula brand advertisements

Advertisements promoting ingredients or services associated with infant formula brands only occurred in titles published in the UK and Australia (infant formula ads unlawful and voluntary prohibition of infant formula and follow-on formula ads groups). Advertisements that promoted marketing strategies such as a telephone/email helpline, a website, or a 'mum's club' that shared a brand identity with a line of formula products only appeared in British magazines and advertisements for proprietary ingredients (Nestle bifidusBL) only in Australian titles. These are shown in table 1 under the column labelled 'brand'.

DISCUSSION

Neither the British statutory instrument nor the Australian MAIF agreement reduced the frequency with which formula advertisements per se appeared in parenting magazines. In fact, formula advertisements appeared with greater frequency in the British and Australian titles than they did in the American and Canadian ones. However, both the Australian and British regulations appeared successfully to prevent the advertising of certain formula milk products. This pattern is consistent with the observation that follow-on formula product promotion is common in countries where steps have been taken to implement the international code.[27 30 40–43]

While this may suggest that the regulations are counterproductive, other explanations are more plausible. First, it is more likely that there are more direct advertising opportunities (such as paying hospitals to distribute infant formula samples to new mothers) available to companies where there are no restrictions placed on the advertising of formula milk products. Second, it will be argued here that when the advertising of one or more formula milk products is prohibited, advertising for a different product using the same brand identifiers seems to take its place.

The ubiquity with which formula advertising occurs is concerning. Although there is a significant research gap in this area, several studies have found a relationship between exposure to formula advertising and declines in breastfeeding initiation, duration or intensity. Research conducted in developed countries has found that mothers who see formula advertising during their pregnancies or shortly after birth were more likely to be using infant formula at 0–2 weeks and 8–10 weeks and less likely to be breastfeeding at all time points.[18 44 45] Furthermore, Filipinas who were able to recall seeing a formula milk advertisement were less likely to intend to breastfeed and were less likely be breastfeeding by day 2 of their infants' lives.[15] Those who were able to recall seeing a formula milk advertisement were also less likely to be breastfeeding exclusively when their infants were 2, 4 and 6 months of age.[16] Similarly, St Vincent mothers' total breastfeeding duration decreased by 19 days and the introduction of non-human milk occurred 3.5 days earlier for every infant food brand name she could recall.[14]

Advertising for follow-on formula, toddler milk or any other product or service that shares a brand identity with infant formula is likely to influence infant feeding behaviour in much the same way as advertising for infant formula does because consumers do not differentiate between them.[37 38] Therefore, the reduction in frequency of infant formula (or infant and follow-on formula) advertising observed in the UK and Australia is unlikely to mitigate the effect of formula milk advertising per se on infant feeding practices.

It is likely that the consumer perception that advertisements for any formula milk product or service is an advertisement for infant formula is the result of a deliberate advertising strategy. Both follow-on formula and toddler milk products are clear examples of a strategy described in the marketing literature and known as line extension.

'Line extensions occur when a company introduces additional items in a given product category under the same brand name, such as new flavours, forms, colors, ingredients, or package sizes.'[46] Importantly, line extensions offer consumers the perception that products that share a brand are the same in most important ways. For example, Coca-Cola uses line extension to present Diet Coke and Coke Zero as the same as Coca-Cola in every way (colour, flavour, packaging, price, texture) except that they do not contain sugar.

Line extension enables advertisers to focus their advertising on brand attributes common to all products bearing their brand in the knowledge that consumers will apply what they have learnt about one product to all the others in that line.[47] Sixty-nine advertisements for related services (eg, telephone helplines, marketing clubs, free gifts and websites) or proprietary ingredients (such as Nestle's Bifidus BL) that shared a brand identity with an infant formula product appeared in magazines from the UK and Australia. Only one such advertisement appeared in magazines from the USA or Canada. This suggests that formula milk advertisers are using line extension to enable them to evade national advertising restrictions.

The results of this study are consistent with the results of other efforts to restrict the advertising of certain products (such as tobacco) in the interests of public health, which demonstrate that companies faced with restrictions on the advertising of their products will use indirect advertising strategies to enable them to continue promoting the use of their products.[48–50] Infant formula manufacturers in Australia appear to be using toddler milk advertisements to enable them to promote groups of products that include those subject to the MAIF agreement without ever referring to them directly; just as follow-on formula advertisements appear to be used to mitigate the British legislation. It is worth noting that the industry's own trade-based press has reported this observation[51] and the WHO has encouraged national governments to re-examine the advertising of follow-on milks in the light of consumer perceptions.[52]

Limitations

This study has several limitations. First, practical considerations limited the study to print advertisements published in parenting magazines. A more thorough examination of other advertising media (television, internet, wider print media, etc) might have revealed a different pattern of formula advertising. Second, although the quality of national data about infant feeding practices is inconsistent, it appears that infant feeding practices may differ among the four countries examined here.[9–12] Most significantly it appears that more British women cease breastfeeding by 6 months than women from the USA, Canada or Australia (but this may reflect differences in data collection practices), and this might influence advertising patterns. Conversely, more aggressive formula advertising might contribute to the greater use of formula milk products (and so lower breastfeeding rates) in Britain. Also, because autonomous nations are responsible for regulating advertising and no two sets of regulations are identical, two of the regulation groups included titles from only one country. It is possible that the differences in formula advertising frequency are

attributable to factors other than the regulations, factors that are unique to each country.

CONCLUSION

Restrictions on the advertising of infant formula products (including follow-on formula products) do not appear effectively to reduce direct to consumer formula advertising per se. Line extension is used to encourage consumers to apply what they learn about formula milk from follow-on formula or toddler milk advertisements to infant formula. In this way the efficacy of the MAIF agreement and the British statutory instrument is diminished.

Current efforts to prohibit the advertising of formula milk products in accordance with the intent of the international code have not resulted in ethical marketing practices and are characterised by self-interest and hostility on both sides of the debate.[53] It is time for national governments to reconsider the intent of the international code and to devise effective, transparent and independent processes by which the advertising and promotional practices of formula milk manufacturers and importers can be effectively regulated in the public interest.

Contributors NB conducted the research, performed the initial data analysis and responded to the reviewers' feedback. The authors designed and reported the study collaboratively.

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Circumventing the WHO Code? An observational study

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Toddler milk advertising in Australia: Infant formula advertising in disguise?

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ABSTRACT

The Marketing in Australia of Infant Formula: Manufacturers' and Importers' Agreement prevents manufacturers and importers from advertising infant formula. However, toddler milks, which share brand identities with infant formula, are advertised freely; and recent research suggests consumers fail to distinguish between advertising for infant formula and for toddler milk. This study examined whether Australian parents recalled having seen advertisements for 'formula'. Most respondents (66.8%) reported seeing an advertisement for infant formula, with those who had only seen non-retail advertising more than twice as likely to believe that they had seen such an advertisement as those who had only seen retail advertising. This suggests that toddler milk advertisements are functioning as defacto infant formula advertisements in Australia.

1. Introduction

Infant formula use is increasing amongst Australian mothers (Australian Bureau of Statistics, 2003) in spite of public health recommendations that infants should be fed nothing but human milk for the first 6 months of life, and continue consuming human milk in addition to complementary feeding until they are at least a year old (NHMRC, 2003). There is clear evidence of a dose–response effect of infant formula use that persists throughout the life course (Horta et al., 2007; Ip et al., 2007). Furthermore data collected for the Millennium Cohort Study (in the UK) established a causal relationship between exposure to infant formula and hospitalisation for gastroenteritis and lower respiratory tract infection by controlling for other foods the infant had consumed. This study clearly demonstrated that it is not deprivation of breastmilk (as in the case of breastfed infants also fed solid foods prematurely) but exposure to formula milk that is associated with hospital admission (Quigley et al., 2009).

In recognition of the role of the marketing of breastmilk substitutes in the worldwide decline in breastfeeding, the World Health Assembly devised the *International Code of Marketing of Breastmilk Substitutes* (WHA 34.22 1981). This resolution, which was supported by the Australian Government, calls on national governments to prohibit the advertising of infant feeding products to the general public on the grounds that it is unethical because it undermines breastfeeding (Baumslag and Michels, 1995; Minchin, 1998; Palmer, 2009; Richter, 2001).

In response to WHA 34.22, the infant formula industry in Australia has entered into a voluntary agreement with the Government of Australia. Parties to the Marketing in Australia of Infant Formula: Manufacturers' and Importers' Agreement (MAIF) agree to refrain from advertising infant formula products represented as suitable for children who are less than a year old. The MAIF Agreement is monitored by an advisory panel (the APMAIF), which consists of a public health nutritionist, a lawyer, a community representative and a representative of infant formula industry's peak body. The MAIF Agreement does apply to retailer advertising. (The APMAIF has defined retailer advertising as advertising that contains only a pack shot and price information.) The APMAIF found no breaches of the MAIF Agreement in the 5 years prior to the study. Therefore, it is reasonable to conclude that there have been no infant or follow-on formula advertisements (apart from those which contain only pack shots and prices) since 2003.

Since the introduction of the MAIF Agreement prohibiting the advertising of both infant and follow-on formulas, 'toddler milks' (also known as 'toddler formula', 'growing-up-milk', 'GUM' or '1-2-3 milk') have been introduced to the Australian market. The presentation of these products displays an obvious similarity to that of follow-on formulas in that although toddler milks are modified powdered milk products not suitable for use as the sole diet of an infant, they are presented in packaging that is nearly identical to that of infant formulas. Toddler milk packages generally bear the same brand identifiers and design features as infant formula but include the word 'toddler' in the product name. For example, Wyeth produces infant formulas called 'S-26 Gold Alpha Pro' and 'S26 Gold Progress'. Its toddler milk is called 'Wyeth S-26 Gold Toddler'. The MAIF Agreement places no restriction on the advertising of toddler milks.

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The similarity of the presentation of toddler milks to that of infant formula is unlikely to be accidental. The use of consistent visual elements, such as colour, shape, typeface and logo, is fundamental to successful branding. It enables advertisers to create strong brands, enabling consumers to identify a group of products as belonging to a single brand – and carrying all of the important characteristics of that brand (Aaker and Keller, 1990; Aaker and Biel, 1990).

Qualitative research suggests that the use of common branding for infant formula and toddler milk products is having just this effect. Australian mothers do not draw a distinction between toddler milk and infant formula, referring to both products as 'formula' and when shown toddler milk advertisements, they believe them to be advertising infant formula products (Berry et al., 2010). This perception raises the question of whether the advertising of toddler milk in Australia is an example of the use of line extension to mitigate the impact of regulation on infant formula advertising.

Of particular concern is that consumers tend to accept advertisers' claims that 'formula' products, including both toddler milks and infant formula, are healthy or beneficial to a child's health (Berry et al., 2010). These messages are not consistent with the large body of evidence that demonstrates an association between the use of infant formula (or any other breastmilk substitute) and significant health risks (Horta et al., 2007; Ip et al., 2007; Quigley et al., 2009; Stuebe, 2009).

This study investigated whether the perception that toddler milk advertising promotes infant formula is prevalent amongst Australian parents by determining whether they recalled seeing advertisements for infant formula products – in spite of the provisions of the MAIF Agreement – and what messages they remembered these advertisements containing.

2. Methods

A convenience sample of 439 parents of a child less than 5 years old, or who were expecting a child, was recruited by intercept over 2 days at the 2008 Pregnancy, Babies and Children (PCB) Expo in Sydney. Respondents completed a survey instrument, developed for this study in consultation with experts in the fields of infant feeding and survey research.

Respondents who indicated that they had seen 'formula' advertised, were asked to indicate which, if any, of five infant formula products depicted in full colour on the survey they had seen advertised (Heinz Nurture Gold Starter, Nutricia Karicare Gold Plus From Birth, Bellamy's Organic Infant Formula; Nestle Nan 1 Gold Starter and Wyeth S26 Gold Alpha Pro). Infant formula pack-shots were used in order to provide confirmation of whether respondents believed they had seen infant formula advertised and these were reproduced at approximately the same size as pack shots that appear in Australian toddler milk advertisements.

Respondents were then asked to indicate which, if any, of seven advertising claims (is like breastmilk, is convenient, makes babies healthy/happy, improves brain development/contains nutrients such as omega 3, iron or probiotics, ensures proper growth and development) were made about the product(s) they had seen advertised. These claims were drawn from mothers' responses to toddler milk advertisements (Berry et al., 2010). Variations of these claims appeared in advertisements for toddler milks that were in circulation during 2007. For example, a Heinz Nurture Gold Toddler advertisement contained the text "Formulated with NPD, a unique scientific combination of nutrients, it includes pre and probiotics and more Omega 3 DHA than any other…"; a Nutricia Karicare Gold PLUS Toddler advertisement began with the banner headline "How to support your toddlers' immunity" and moved on to claim that "Probiotics, found naturally in breast milk, help children build immunity against infection and allergy Mums can now ensure toddlers benefit from probiotics when they use Karicare Toddler GOLD plus"; and a Wyeth S26 Gold Toddler advertisement stated "S26 Toddler GOLD, with the advanced Wyeth Biofactors System, provides an age appropriate combination of nutrients to help support their cognitive, visual and physical development".

In order to ascertain whether respondents had seen retailer advertisements for infant formula or commercial advertisements, they were also asked where they had seen the products advertised (tv, magazine, brochure, expo conference, sample bag, catalogue, somewhere else) and what types of formula they had seen advertised (suitable from birth, suitable from 4 to 6 months, suitable from 12 months).

In consideration of the time taken to complete the survey, respondents were given the opportunity to win a $400 gift voucher from a major retail chain. Survey responses were provided anonymously and the study received approval from the university's Human Research Ethics Committee.

3. Data analysis

Two by two contingency tables and Pearson's chi-square tests were used to assess whether having seen infant formula advertised (yes/no) was contingent upon having used infant formula (yes/no); and whether having seen infant formula advertised (yes/no) was contingent upon the type of formula advertisement seen (retail/non-retail). This test is appropriate for examining relationships between categorical variables.

4. Results

Most (82.7%) respondents were female, aged between 24 and 35 years (81.1%), married or living with a partner (95.3%) and had a household income between $25,000 and $75,000 pa (52.6%). The age, marital status and income profile of the sample reflect the pattern observed in national census data (Laws and Hilder, 2008). However, parents who held either undergraduate or postgraduate qualifications were over-represented in the sample (51.7%) compared with the population of Australian parents (34.7%), possibly because the study was conducted in a capital city. Most respondents (85.3%) were the parents of one or more children and the remainder (14.7%) were expecting a first child. Both breastfeeding (89.2%) and formula feeding (76.2%) were very common amongst parents. (These figures add to well over 100% as the majority of parents reported both formula feeding and breastfeeding.)

4.1. Advertising exposure

Almost all respondents (92.1%) reported that they had seen an advertisement for 'formula'. Of those, 93.3% indicated that they had seen an advertisement that did not originate from a retailer (i.e., not in a supermarket or pharmacy catalogue). Fewer than half the respondents (44.5%) indicated that they had seen formula advertised by retailers.

In order to determine whether those parents whose babies had been fed infant formula were more likely to recall having seen a 'formula' advertisement (perhaps as a justification for their own behaviour), contingency table analysis was conducted. No significant relationship was found.

Most respondents (66.8%) reported that they had seen a formula product suitable for use from birth (infant formula) advertised. Fewer than half (45.1%) indicated that they had seen a formula product suitable from 4 to 6 months (follow-on formula) adver-

tised. More than half (55.9%) reported that they had seen a formula product suitable from 12 months (toddler milk) advertised. Almost all respondents (91.0%) indicated that they had seen advertisements for at least one of the infant formula products depicted on the survey.

A Pearson's chi-square test of contingencies (with $\alpha = 0.05$) across a 2×2 contingency table was used to determine whether reporting having fed a baby infant formula was related to reporting having seen an advertisement *infant* formula advertisement. No significant relationship was found ($\chi^2(df = 1, N = 348) = 0.741$, $p = 0.389$).

In order to ascertain whether advertisements for toddler milk and other products are commonly understood to be advertisements for infant formula, a second Pearson's chi-square test of contingencies (with $\alpha = 0.05$) was conducted. A 2×2 contingency table was used to establish whether there was a significant relationship between the type of advertisements respondents had seen (retail or non-retail) and having reported seeing an advertisement for infant formula (as retailers are not party to the MAIF Agreement, they are allowed to advertise infant formula using pack shots and price information). In order to determine whether the type of advertisement seen affected whether respondents believed they had seen an advertisement for infant formula, respondents who reported having seen both retail and non-retail formula ads were excluded from this analysis. A significant relationship was found between the variables, $\chi^2(df = 1, N = 238) = 19.423$. More than twice as many respondents who indicated they had seen *only* non-retail formula advertisements (67.0%) believed that they had seen an advertisement for infant formula as those who indicated they had *only* seen a retail formula advertisement (28.9%).

Close to three quarters (74.3%) of respondents believed that they had seen an advertisement for Wyeth S26 Alpha Pro infant formula and a similar proportion (72.8%) believed they had seen an advertisement for Karicare Gold Plus Infant Formula. More than half (52.1%) believed they had seen an advertisement for Heinz Nurture Gold Starter infant formula and more than a third (35.0%) believed they had seen an advertisement for Nestle Nan 1 Gold Starter infant formula. Just over a fifth (21.5%) believed they had seen Bellamy's Organic Step 1 Infant Formula. On average respondents indicated that they had seen 2.5 infant formula products advertised.

More than 90% of respondents recognised at least one advertising message. On average, respondents recognised 2.6 advertising messages. Sixty-nine point nine percent of respondents indicated that the formula advertisement(s) they had seen claimed that the product contained nutrients such as omega 3, iron or probiotics. More than half (52.9%) indicated that they had seen a formula advertisements claiming that the product ensures proper growth and development. A third (32.9%) indicated that they had seen a formula advertisement claiming that the product improves babies' brain development. Almost a third indicated they had seen an advertisement claiming that a formula product could make babies happy/healthy (30.6%) or that it was convenient (29.1%). More than one in four respondents indicated they had seen a formula advertisement claiming that the product 'is like breastmilk' (27.1%) or 'strengthens immunity' (25.1%). Many of these messages also appear on infant and/or follow-on formula packaging.

5. Discussion

Exposure to advertising for formula products approached universality amongst respondents and yet none of the hundreds of complaints received by the APMAIF since 2002/3 have been deemed to be infant or follow-on formula and therefore in violation of the Agreement (Knowles, 2003; Advisory Panel on the Marketing in Australia of Infant Formula, 2004, 2005, 2008, 2009).

Most respondents had seen advertisements that did not originate from a retailer. Since there have been no breaches of the MAIF Agreement reported since 2002/3, these advertisements were almost certainly advertisements for toddler milk and were certainly not advertisements for infant formula. Even so, 67% of those who had only seen non-retail advertisements reported that they believed they *had* seen an advertisement for infant formula. This result is consistent with the results of British research which found around 60% of mothers and expectant mothers thought follow-on formula advertising was promoting infant formula (National Childbirth Trust/Unicef UK, 2005; NOP World for Department of Health, 2005) and is a clear indication that advertisements for toddler milks are widely understood to be advertising infant formula – and therefore functioning as defacto infant formula advertisements.

This conclusion is supported by the observation that almost all of the respondents who reported having seen formula advertised reported that they had seen an advertisement for at least one of five infant formula products depicted on the survey. The products depicted on the survey were selected because they are part of product lines, which include infant and follow-on formula as well as toddler milk. As such they share brand identifiers with toddler milk. The brand identifiers link toddler milk so strongly to the same brand of infant formula that respondents believed that they had seen advertisements for infant formula products even though most of them could not have. In fact, respondents who had seen only advertisements that could *not* have depicted infant formula (and were almost certainly toddler milk advertisements) were more than twice as likely to believe that they had seen infant formula advertised as those who had only seen retail advertisements that could have depicted infant formula. Furthermore, a large proportion of respondents recognised advertising messages as messages they had seen in formula advertising.

The salience of the brand identities on these product packages might help to explain why so many mothers recognised them as 'formula'. Identifiers such as packaging, colour or logos are effective category labels. Category labels encourage consumers to transfer what they know about a familiar brand or group of products (known as a line) to a new product (Kotler and Armstrong, 2001; Moreau et al., 2001; Whan Park et al., 1991; Yamauchi and Markman, 2000). The use of category labels that are shared with infant formula suggests that the use of toddler milk advertising as part of a line extension strategy enables advertisers to infant formula products without violating the MAIF Agreement.

Advertising only one product in a line can then effectively promote all the others by eliciting positive associations for a brand, which consumers then apply to all of the products bearing that brand (Whan Park et al., 1991). This is important as research indicates that people exposed to advertising are more likely to purchase the brands they have recently seen advertised even when they do not recall seeing the advertisement (Kardes, 2002; Schachter, 1997).

Line extensions also operate in reverse, enabling advertisers to advertise only 'a small percentage of products in the total line, knowing that a large number of other items will also benefit from that advertising' (Morein, 1975). It is notable that many of the same trademarks (Wyeth's 'Biofactors System', Heinz' 'NPD' and Karicare's 'GOLD PLUS Nutricia Prebiotics') highlighted in advertising for toddler milks are also highlighted on the packaging of infant formula. The prominence of these trademarks appears to be designed to link toddler milk advertising with infant and follow-on formula, and to encourage consumers to transfer what they learn about these ingredients from toddler formula advertisements to infant and follow-on formula.

Indirect advertising strategies such as brand extension and line extension have been used to circumvent advertising prohibitions applied to other product types. Following the introduction of comprehensive bans on the promotion of tobacco in Singapore, Philip Morris extended the 'Alpine' brand to a beverage product in the months prior to its Alpine cigarettes launch. This enabled the company to bring its 'Alpine' brand into the minds of consumers, create brand associations and positive regard for the brand without contravening the Singaporean law (Assunta and Chapman, 2004).

The nature of the advertising messages recognised by respondents demonstrated the potential this advertising has to undermine breastfeeding promotion. One in four respondents reported having seen formula advertising claiming that formula 'strengthens immunity' and one in three a formula advertisement claiming that formula 'improves brain development'. These advertising messages undermine public health messages and mislead consumers by minimising the differences between infant formula and human milk; misrepresenting the weight of available scientific evidence and presenting formula as healthy, benign alternative to breastfeeding. This is likely to make mothers more comfortable with the use of infant formula. Recent research suggests that women who are more comfortable with the idea of formula feeding (measured antenatally) are less likely to intend to breastfeed or breastfeed exclusively (i.e., avoid infant formula) than women who are less comfortable with the idea of formula feeding (Nommsen-Rivers et al., 2010).

6. Conclusion

The advertising of infant and follow-on formula is prohibited in Australia by the MAIF Agreement. However it appears that line-extension is being used to mitigate, perhaps entirely the effects of the Agreement. Since industry self-regulation has failed to protect Australian mothers and infants from formula milk advertising, as is recommended by the WHO, perhaps it is time consideration was given to enacting legislation that prohibits the advertising of any and all products or services that share a brand identity with infant formula – including toddler milks.

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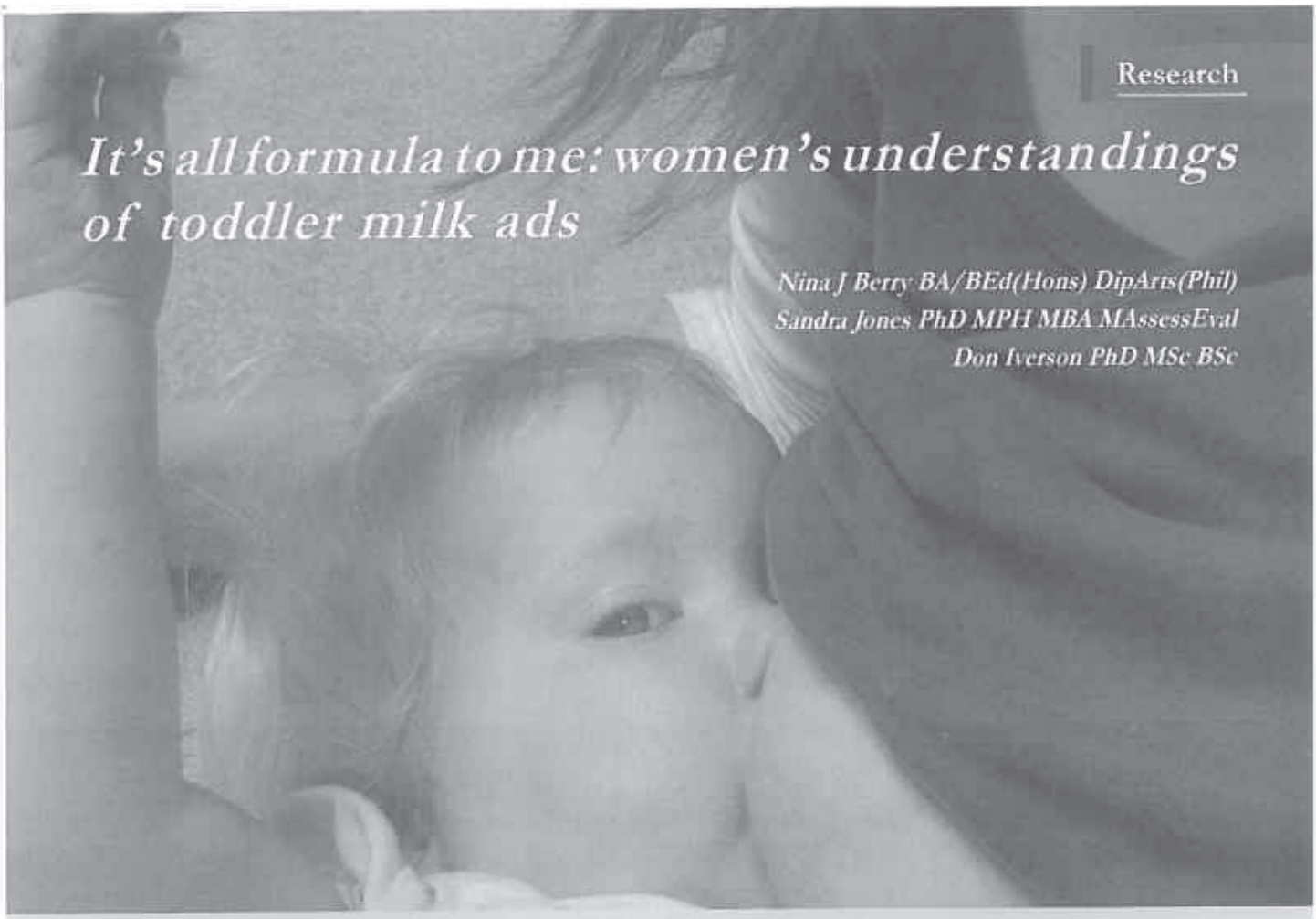

Research

It's all formula to me: women's understandings of toddler milk ads

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ABSTRACT

This study utilised semi-structured interviews to investigate how women expecting a first baby perceived print advertisements for 'toddler milks' in order to determine whether they function as indirect advertising for infant and follow-on formula. Examination of the marketing literature, analysis of the advertisers' websites and the advertisements themselves provided sources of triangulation. Fifteen women expecting a first baby were recruited from antenatal classes conducted by staff of the Northern Sydney Central Coast Area Health Service. These respondents clearly understood toddler milk advertisements to be promoting a range of products that included infant and follow-on formula and accepted their claims quite uncritically. These claims contradicted public health messages about breastfeeding and the evidence of health risks associated with formula feeding. Toddler milk advertisements appear to function as indirect advertising for infant and follow-on formula. The Marketing in Australia of Infant Formula: Manufacturers' and Importers' Agreement is failing to protect the Australian community from the advertising of breastmilk substitutes as required by World Health Assembly Resolution 33.47, the International Code of Marketing of Breastmilk Substitutes. Further research is recommended to determine whether the responses of this group of primiparous women from a single area in NSW are representative of the wider population of Australian mothers.

Keywords: advertising, follow-on formula, infant feeding, International Code of Marketing of Breastmilk Substitutes, toddler formula

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INTRODUCTION

The World Health Organization (WHO) recommends that infants be breastfed for at least two years, the first six months of which should be exclusive breastfeeding. Australian recommendations reflect those of the WHO (National Health and Medical Research Council 2003). Almost 90% of Australian mothers begin breastfeeding their babies, and while national data on exclusive breastfeeding is not available, it is clear that only a small proportion of mothers achieve the recommended pattern. Fewer than half of all mothers continue breastfeeding for six months and only 1 in 100 is still breastfeeding on her child's second birthday (Australian Bureau of Statistics 2003). There is

some evidence suggesting that exclusive breastfeeding in the first six months is rare. A small population study (n= 203) conducted in Queensland found that 23% of mothers began regular formula feeding before their babies reached a month old; by the time their babies reached six months of age about 90% of respondents had fed their babies infant formula in the past 24 hours (Gabriel et al 2005). Poor infant feeding practices have important implications for the health of both infants and their mothers (Horta et al 2007; Ip et al 2007).

In recognition of the role of the marketing of breastmilk substitutes in the worldwide decline in breastfeeding, the World Health Assembly devised the International Code of Marketing of Breastmilk Substitutes (WHA 34.22 1981). This resolution, which was supported by the Australian Government, calls on national governments to prohibit the advertising of infant feeding products to the general public on the grounds that it is unethical because it undermines breastfeeding (Baumslag & Michels 1995; Minchin 1998; Palmer 2009; Richter 2001).

Since the adoption of the International Code, many countries have moved to protect breastfeeding by restricting or prohibiting the advertising of products that fall within its scope through legislation or voluntary codes of practice. Some controversy has arisen around the definition of 'breastmilk substitute'. Many national governments have interpreted this term as referring only to infant formula products represented as suitable as a replacement for breastmilk in the first 4–6 months of life only. For example, in the UK it is illegal to advertise infant formula that is represented as a replacement for breastmilk from birth. This situation has resulted in companies continuing to advertise formula products for children over four months old, such as follow-on formula and toddler milk, arguing that these are not breastmilk substitutes but complementary foods (Baumslag & Michels 1995; International Association of Infant Food Manufacturers 2008; Palmer 1998; Popkin 1990; Richter 2001). However, it is known that any bottle-fed milk will replace breastmilk in a child's diet (Hornell, Hofvander & Kylberg 2001a, 2001b).

Effects of advertising on infant feeding

Research into the marketing of infant formula has consistently found a relationship between mothers' exposure to the advertising of infant formula brands and a decline in breastfeeding initiation and duration. The effect has been found both in the developed and the developing world (Donnelly et al 2000; Grantham-McGregor & Beck 1970; Greiner & Latham 1982; Guilkey & Stewart 1995; Howard et al 2000; Stewart et al 1991). Since the determinants of infant feeding behaviour are complex (Scott & Binns 1998; Scott et al 2001; Scott et al 2006a; Scott et al 2006b; Scott, Shaker & Reid 2004; Shaker, Scott & Reid 2004; Sittlington et al 2006) and quantitative methodologies only have a limited capacity to detect the influence(s) of advertising on complex health behaviour (Chapman 1986), the size of the effects found in the studies cited above is probably less significant than the detection of an association, per se. Consequently, qualitative and analytical approaches have been identified as offering the most appropriate avenues for the investigation of the effects of advertising on health behaviour (Chapman 1986, 1993).

Toddler Milk Advertising in Australia

Australia's response to the Code is called the *Marketing in Australia of Infant Formula – Manufacturers' and Importers' Agreement 1991* (MAIF) (Australian Government Department of Health and Ageing 1992). It is a voluntary code of practice that prohibits members of the Infant Nutrition Council (formerly the Infant Formula Manufacturers' Association of Australia) from advertising both infant and follow-on formula (as defined by Food Standard 2.9.1). However, the agreement places no restriction on the advertising of toddler milks, which are marketed as suitable for infants over 12 months old. Toddler milks are presented in packaging that is nearly identical to that of infant formula (Figure 1).

Figure 1: Similarities in the labelling of infant formula and toddler milk products (*www.wyethnutrition.com.au* and *www.nutricia.com.au*).

Toddler milks are advertised on television, in print and at point of sale. This study considers the possibility that toddler milk advertising is a form of indirect advertising for infant formula.

METHODS

In order to determine whether toddler milk advertising might function as indirect advertising for infant and follow-on formula, this study employed a qualitative methodology to explore mothers' decoding processes in response to print magazine advertising for three brands of toddler milks. Semi-structured interviews were undertaken to examine what women expecting a first baby believed that advertisements for toddler milks were trying to tell them and how they responded to those messages.

In recognition that the discipline of media studies has long since abandoned the idea that mass media have a simple causal relationship with behaviour (Morley 1992; Seale 2002), this study is informed by encoding/decoding theory. Encoding/decoding research is characterised by the use of semi-structured interviews and emergent coding strategies. It recognises that texts make meaning within semiotic and sociocultural contexts, invoking and either reinforcing or challenging ideologies shared by the intended readers (Morley 1992). In the case of an advertising text, this model might examine how the text and graphics operate by invoking, reinforcing and/or challenging dominant ideas, fears or beliefs around health or in the texts under examination here, infant feeding (Chapman 1986; Seale 2002).

Interviews

Six advertisements were identified from a convenience sample of Australian parenting magazine titles including Woolworths Parents, Practical Parenting, Sydney's Child and Coles Baby. Following an initial examination of the toddler formula advertisements, a series of six questions was developed into a self-completed questionnaire addressing the readers' understandings of and responses to the claims made in the advertisements (see Box 1).

Box 1. Interview questions

Interview questions

1. What product is being advertised?
2. What is the main message of the advertisement?
3. What does this advertisement tell you about this product?
4. How do you feel about this product? Is this a good product?
5. Who is this product aimed at? Who would find this product useful?
6. Is the information in this advertisement true?

The questions were piloted with two women, both expecting a first child, who were recruited from the main campus of an Australian university. Examination of the pilot data revealed that the written responses provided no data that was not also elicited from the verbal responses and so the methodology was changed to a directed discussion using an interview guide. This guide was derived from eight themes that were identified from examination of the pilot transcripts. Key questions used to guide interviews are listed in Box 2.

Respondents

Women attending seven antenatal education classes conducted on the NSW Central Coast (a suburban area north of Sydney) during the second half of 2007 were invited to participate in the study. Women older than 18 who had not previously given birth to a live child were eligible to participate. A total of 15 mothers participated in the study. Respondents were offered a $20 gift voucher from a local retail chain as compensation for their time.

All of the interviews were conducted on the understanding that they would remain confidential, that no identifying details would be recorded on the transcripts and that respondents would be offered the opportunity to check their transcripts for accuracy. Approval was granted for the conduct of the study by the University of Wollongong and the Northern Sydney Central Coast Area Health Service Human Research Ethics Committees.

Data Collection

Interviews were carried out by the first author on premises of the Northern Sydney Central Coast Area Health Service and recorded digitally. Following completion of a formal consent procedure, some time was spent building rapport and each respondent was shown one randomly selected advertisement. In order to mimic reading conditions experienced by consumers reading magazines, informants were asked to identify the product being advertised within moments of being handed the stimulus advertisement. Each respondent was then asked to read aloud the entire text of the advertisement and report her thoughts as she read. During the conversation that ensued, the themes outlined in the interview guide were explored.

Box 2. Final interview guide

Interview guide

- What are your first impressions of the advertisement? What is the product being advertised?*
- If you saw this advertisement in a magazine, do you think you would stop to read it?*
- Have you seen the product/advertisement before?#
- Could you tell me about the product being advertised?*
- Could you read the advertisement aloud and tell me what you are thinking as you read?*
- Can you describe someone who would use this product?*
- What do you think is the main message of the advertisement?*
- What does the picture tell you about the product?*
- Could you describe a situation where a mother would find this product useful?
- Do you think this is a product that all mothers should use? What makes you say that?#
- Do you think this is a healthy product? What tells you that?*
- Do you think mothers should use this product instead of some other product?#
- Do you think you will use this product or one like it?#
- What is the purpose of this product?#

* Original themes
# Themes added after the first interview

Conversations between the interviewer and respondents were allowed to range freely so as to explore the respondents' understandings of the advertisements as comprehensively as possible. The interviewer used open-ended questioning, reflective questioning, clarification, repetition of ideas that appeared from the respondents' tone or body language to be significant to them and summarising of participants' responses to facilitate a thorough exploration of respondents' readings of the advertisements. Indirect (structured projective) questioning (Donoghue 2000; Fisher 1993; Liamputtong & Ezzy 2005) was also used to facilitate honest responses where these might be either socially undesirable or the direct questioning might be threatening. For example, respondents were asked whether the mothers they knew would believe the claims made in the advertisements since respondents might be unwilling to admit to the interviewer that they accept advertising messages uncritically.

In order to minimise any influence the interviewer might have exerted on the responses given, recordings and transcripts of the interviews were examined by the second author in order to ensure that the interviews facilitated frank discussion. Detailed field notes

were also kept during the period of data collection to enable the interviewer to reflect upon her role in the interview process and to ensure that she had retained the role of neutral observer for the duration of each interview (Liamputtong & Ezzy 2005).

Data Analysis

Data collection and analysis were conducted simultaneously and recruitment continued until saturation had been reached for each advertisement. Transcription of the recordings of interviews was conducted personally by the interviewer within 48 hours of the interview in order to facilitate detailed analysis through immersion in the data. A thematic approach, known as 'framework analysis', was used to derive patterns from the participants' responses (Krueger 1994; Ritchie & Spencer 1994). Transcripts were coded by hand (Glaser 1992; Liamputtong & Ezzy 2005).

Validity

A number of steps were taken to validate the analysis (Liamputtong & Ezzy 2005). The coding scheme was developed collaboratively by the authors, one of whom has significant expertise in the area of marketing (SJ) and the other, significant experience working with new mothers (NB). Responses that were inconsistent with emerging patterns were sought and reported where they occurred. Expert validation of the coding scheme and its application was provided by a third researcher who has published qualitative research on infant feeding and who was not otherwise involved in the project. Analysis of the structure and composition of the advertisements themselves with specific reference to marketing theory was used as a source of triangulation (Rossiter & Bellman 2005). Because each of the three advertisements referred consumers to commercial websites, these were used as a further source of triangulation. Verbatim quotations, reported using pseudonyms, have been used to illustrate patterns in the women's responses and, as is the custom with qualitative research, the results and discussion are presented simultaneously (Liamputtong & Ezzy 2005).

RESULTS AND DISCUSSION

Characteristics of respondents

The demographic features of the women who participated in this study are reported in Table 1.

All but one of the participants indicated they planned to breastfeed their babies. Two mothers planned to combine breastfeeding and bottle-feeding from birth. The intentions of these women appear to be consistent with those of Australian mothers generally. A recent study of 667 first-time mothers receiving antenatal care in Western Sydney found that 94% intended to initiate breastfeeding (Wen et al 2009) and 87% of NSW mothers initiated breastfeeding in 2003–4, (Australian Bureau of Statistics 2003; NSW Centre for Public Health Nutrition and NSW Department of Health 2004).

Table 1. Demographic features of participants.

Characteristic	Number (%) n = 15
Age	
18–19	4 (27)
20–24	2 (13)
25–29	4 (27)
30–34	5 (33)
Marital status	
single	1 (7)
married or defacto	14 (93)
Combined household income	
< $6000	2 (13)
$6001–$25,000	1 (7)
$25,001–$75,000	5 (33)
$75,001–$150,000	7 (47)
Level of education[a]	
school certificate (secondary) or lower	4 (29)
higher school certificate (matriculation)	3 (21)
post secondary qualification	5 (36)
undergraduate degree	1 (7)
postgraduate degree or diploma	1 (7)

[a]One respondent did not answer this question

Identifying toddler milk as 'formula'

On their initial readings, only three of the fifteen respondents were able to correctly identify that the product being advertised was suitable for 'toddlers'. The remaining mothers initially described or recognised the product as 'formula', 'infant formula', 'baby formula' or 'babies' milk'. Jodie's response—'baby formula for bottles'—was particularly specific, describing both the product and her understanding of its intended mode of delivery. These responses are consistent with the results of British research which found around 60% of mothers and expectant mothers thought follow-on formula advertising was promoting infant formula (National Childbirth Trust/UNICEF UK 2005; NOP World for Department of Health 2005).

It was only after they had been asked to read all of the text contained in the advertisement that the respondents revised their identification of the products to indicate that they were suitable for toddlers. However, all but one of the mothers commented that they would ordinarily not have read far enough into the advertisement to have discovered that the advertisements were not promoting infant formula. Furthermore, they all expressed the view that 'formula' products would be properly used in place of breastfeeding. Joanne thought that the advertisement was for a product that would be used by 'People that aren't breastfeeding'. Jessica said that the product she had seen advertised would be used 'When you can't or you stop breastfeeding' and Jemima said she would use the product if they [doctors] said, 'ok, well now it's time to start bottle feeding'.

Identifying the product as 'formula' or 'baby formula' did not preclude a simultaneous understanding that the advertisement presented a version of infant formula suitable for older children. When June was asked, 'what is the product?' she replied 'Um it's baby formula'. The very next question posed to her was, 'tell me about who you think the ad might be aimed at?' and she replied, 'Mothers or parents with very young toddlers'. Similarly identifying the products as suitable for toddlers did not preclude the belief that it was 'formula'. Jemima read the name of the product correctly as Toddler Gold Plus and simultaneously identified the product as formula saying, 'Toddler Gold Plus I am assuming is the formula'.

These comments suggest that the respondents recognised 'formula' or 'baby formula' as a category rather than an individual product and that the category includes but is not limited to infant and follow-on formulas. Jodie's surprise upon realising that the advertised 'formula' was not intended for babies provided a clear indication that this new information extended her definition of 'formula'. She said, 'Ooh so it's more for older kids. I didn't know that this would even, came for older kids. I thought it was just for babies'. Jaime's identification of Wyeth S26 Gold Toddler as 'a formula feeding suitable for toddlers' appears to be contradictory unless she thinks of 'formula' as a group, rather than a single product. These responses also suggest that the respondents perceive that 'formula' necessarily includes infant formula.

Examination of other marketing materials and advertising literature suggests that this might be the way these advertisements were intended to be understood. At the bottom of the Karicare Gold Plus Toddler Milk web page there are links to 'Other Karicare Gold Plus Formulas' including infant formula and follow-on formula. The page on Wyeth Nutrition's website entitled Step 3 – S26 Gold begins with the statement, 'S26 Gold Toddler is the third step in the Wyeth Nutrition Gold 1-2-3 Range'. The Heinz Nurturebaby website exhorts parents to 'Choose the right formula for your baby's age' while depicting infant formula, follow-on formula and toddler milk packages. (H.J. Heinz Company (Australia) Limited 2007; Nutricia Limited 2006; Wyeth 2008)

Line extension: advertising one product to promote others

Respondents' readiness to identify toddler milks as 'formula' is particularly interesting because the word 'formula' does not appear in any of the advertisements used for this study. The salience of the brand identities on these product packages might help to explain why so many mothers recognised them as 'formula'. Eight respondents clearly indicated that it was the pack shot that identified the product as formula. Judy said, 'Well, looking at the nature care [indicates pack shot] it is obviously a formula'.

Identifiers such as packaging, colour or logos are often used as category labels by advertisers as part of a process known as *line extension*. Category labels encourage consumers to transfer what they know about a familiar brand or group of products (known as a *line*) to a new product (Kotler & Armstrong 2001; Moreau, Markman & Lehmann 2001; Whan Park, Milberg & Lawson 1991; Yamauchi & Markman 2000). For example, Coca Cola used line extension to encourage consumers to use their experience of Coca Cola (the product and the brand) to inform their expectations of Diet Coke.

Importantly, line extensions also operate in reverse, enabling advertisers to advertise only 'a small percentage of products in the total line, knowing that a large number of other items will also benefit from that advertising' (Morein 1975, p63). This benefit is achieved by increasing the prominence of the logo and product name on the entire range of products. Brand features such as logos, graphic, package type, colour, shape and product name are much more salient in toddler milk advertisements than the text that clarifies the appropriate age at which these milks should be offered. This observation lends support to the notion that toddler milk advertising is designed to promote advertisers' entire line of formula products including infant and follow-on formula.

It is notable that many of the same trademarks (Wyeth's Biofactors System, Heinz' NPD and Karicare's GOLD PLUS Nutricia Prebiotics) highlighted in advertising for toddler milks are also highlighted on the packaging of infant formula. Accepted marketing theory (Clifton, Simmons & Ahmad 2004; Giddens 2002; Mitchell 1986; Morein 1975; Wheeler 2003) suggests that the prominence of these trademarks may be designed to link toddler milk advertising with infant and follow-on formula and to encourage consumers to transfer what they learn about these ingredients from toddler formula advertisements to infant and follow-on formula.

Advertising only one product in a line can effectively promote all of the rest by eliciting positive associations for a brand that consumers then apply to all of the products bearing that brand. People exposed to advertising are more likely to purchase the brands they have recently seen advertised even when they do not recall seeing the advertisement (Kardes 2002; Schachter 1997).

This sort of advertising strategy has been used to minimise the effects of regulation in other product categories. For example, following the introduction of comprehensive bans on the promotion of tobacco products in Singapore, Philip Morris began advertising an alcoholic beverage bearing the Alpine brand as a precursor to its launch of Alpine cigarettes. Advertising for the beverage product was used to engender positive brand associations in the minds of potential purchasers without contravening local laws prohibiting tobacco advertising (Assunta & Chapman 2004).

There is no reason to think that advertising for formula products functions any differently from any other kind of advertising. Hence it is plausible that advertising for toddler milks might be designed to evade the restrictions imposed by the MAIF Agreement by creating positive brand associations in the minds of consumers that they will then apply to all the products bearing the same brand, including infant and follow-on formula.

Positioning formula: 'pretty close' to breastmilk

According to the marketing literature, one of the most significant roles of advertising is to position the brand with regard to competing brands (Kotler & Armstrong 2001; Ries & Trout 2001). It would seem sensible to regard breastfeeding as the most

important competition for infant formula in Australia given that almost all Australian mothers choose to breastfeed their babies. Eleven of the fifteen respondents indicated that the product was an alternative to breastfeeding, similar to Jane's assertion that the advertisement was aimed at 'someone who's still deciding between breastfeeding and formula'.

Examination of the advertisements themselves also suggests that they are designed to position formula brands relative to breastfeeding. Two of the advertisements use a strategy described as *probabilogic* to compare their products favourably with breastfeeding (Rossiter & Bellman 2005). This strategy uses an incomplete syllogistic pattern, in which two true statements guide the reader to infer, illogically, a third. The text of the Karicare Gold PLUS ad begins with the following statement, 'Prebiotics, found naturally in breastmilk, help children to build immunity against infection and allergy' and then claims that 'Mums can now ensure that toddlers benefit from Prebiotics when they use Karicare Toddler Gold Plus'. In this case, the first claim is that prebiotics (many thousands of which occur naturally in breastmilk (Bye 2004; Newburg 2000)) protect children. The second claim is that (an unspecified blend of) prebiotics are included Karicare formula. And although it does not necessarily follow (Coppa, Zampinia & Galeazzia 2006), the reader is left to infer that Karicare formula protects children just like breastmilk does. The alignment of this brand with breastfeeding is reinforced by the use of two text boxes in the left hand column. The first says, 'The WHO recommends that infants be exclusively breastfed until around six months of age and continue breastfeeding until at least 2 years. Breast milk has … the correct balance of nutrients … such as enzymes, antibodies and immune stimulators' and the second says, 'Karicare Toddler Gold PLUS contains omega 3 DHA, Iron [and] Gold PLUS Nutricia Prebiotics which provide your toddler with better digestion, softer more regular stools and supported natural immune system'. The juxtaposition of these two boxes leaves the reader to form the impression that this brand meets with the approval of the WHO. Three of the four respondents who saw the Karicare advertisement felt that it claimed some sort of equivalence with breastmilk. Janet made this quite explicit when she said, 'it's trying to convince you that it's just as good as breastmilk… by bringing in the World Health Organization's 'breast is best' and saying that it's giving the same kind of advantages'. Similar sentiments were also expressed by Jessica and Jemima; and although she did not indicate that she thought this advertisement was claiming that equivalence with breastmilk, Joanne did say she understood it to be claiming that Karicare Gold PLUS is 'good for the immune system'.

Heinz also uses an incomplete syllogistic pattern, invoking the words of a paediatrician who 'recommends that toddlers get enough Omega 3 DHA for brain and eye development'. While she does not actually recommend the product or the brand, the juxtaposition of her statement with the claim that Heinz Nurture Gold contains 'more Omega 3 DHA than any other toddler milk', leads the reader to infer an endorsement. Jennifer observed, 'it says a doctor recommends it'.

Wyeth uses a more subtle approach to compare its formula brand with breastfeeding. The advertisement claims that 'the advanced Wyeth Biofactors System, provides an age appropriate combination of nutrients to help support their cognitive, visual and physical development'. This statement echoes public health messages that are designed to promote breastfeeding such as those found in NSW Health's *Breastfeeding Your Baby* booklet (NSW Department of Health 2006), 'Breastfeeding provides all your baby's essential needs for growth, development and protection …'; the South Australian Health website (SA Department of Health 2009), 'Breast milk is a complete food for your baby's growth and development. Breast milk contains long chain fatty acids that help your baby's brain develop'; and the Australian Breastfeeding Association's website (Australian Breastfeeding Association 2005), 'Breastfeeding aids the development of your baby's eyesight, speech and intelligence'. After reading this advertisement Jaime commented, 'you use it if you can't breastfeed, um and can't use breastmilk etc because it has all the nutrients that its supposed breastmilk has'. When asked what the main message of the advertisement was, Jacinta said, 'that it provides all the nutrients they need' and added, 'it supports their visual and physical development'; she thought it was a healthy product because of 'what it says it does'. Thus familiar sounding text in this ad seems to lead these readers to associate the S26 Gold brand with the qualities breastmilk is said to possess, thereby inferring substantive equivalence.

Targeting mothers who choose to breastfeed

All but one of the respondents planned to breastfeed their babies but only one planned to breastfeed for more than twelve months. Furthermore, they all indicated that they believed that breastfeeding success was uncommon. Some, like Jemima who told the story of her aunt's failure to produce sufficient milk for her baby, even seemed to expect to fail. There is some evidence that these advertisements are targeted at mothers who have chosen to breastfeed but expect to fail. By claiming that their brands can provide babies with the benefits mothers associate with breastfeeding, these advertisements seem to suggest mothers can avoid the problems they associate with formula feeding by choosing their brand. Janet said, 'it's trying to convince you that it's just as good as breastmilk' and Jessica said, 'if you couldn't breastfeed, you know … you would consider using a product that mimics what breastmilk does'.

The use of problem-avoidance and/or problem-solution executions is common to all of the advertisements. These strategies are used when the target audience is loyal to a competing brand (Rossiter & Bellman 2005). The competing 'brand' appears to be breastfeeding because, although the respondents in this study found slightly different messages in each of the advertisements, the notion that 'formula' or its ingredients can confer certain health benefits usually associated with breastfeeding (improved immunity, improved nutritional status, improved cognitive, visual or physical development, improved brain growth) was understood by readers of all of the advertisements. For example, Jennifer said 'It's meant to be good for your baby's brain'. These

messages minimise the differences between formula feeding and breastfeeding and contradict the significant body of evidence associating formula feeding with important health risks (Chen & Rogan 2004; Horta et al 2007; Ip et al 2007; Kramer et al 2008; Kramer & Kakuma 2004; Paricio Talayero et al 2006; Quigley, Kelly & Sacker 2009). These messages appear to be designed to persuade mothers who have chosen to breastfeed that there is an alternative that is able to confer many, if not all, of the important benefits of breastfeeding.

The problem-solution execution is also evident in elements of these ads that suggest that their brands offer mothers an easy solution to common feeding problems. The Heinz advertisement depicts a toy tip-truck dumping a load of sardines. This image, which a number of the respondents found unappetising, appears to convey they idea that children are more likely to play with nutritious food than eat it. Jacqueline's first comment in response to this advertisement was, 'Yuk! Fish' and Judy's sarcastic tone on declaring, 'A tip truck full of salmon, mm-mmm!' conveys a similar message. This image seemed to arouse the mothers' anxieties about their capacities to ensure their children are properly nourished and then to offer the Heinz Nurture Gold formula brand as a palatable solution. Jane said, 'this is one way of making sure that they can cross off the omega three make sure their child's getting enough'.

The Karicare ad highlights the WHO recommendation that mothers breastfeed their children until they reach at least two years of age. Several of the mothers who saw this ad mentioned that they had no intention of conforming to this recommendation, suggesting it was unrealistic. The ad then offers to solve the tension between non-adherence to health recommendations and the provision of proper nutrition by claiming that the Karicare brand contains ingredients 'similar in form and function' to those found in breastmilk. Janet, Jessica and Jemima, who all saw this advertisement, thought it was claiming that Karicare Gold Plus was similar or equivalent to breastmilk.

The message of the Wyeth ad was read similarly although it is framed more positively. The advertisement claimed that 'it's important they get the nutrients they need to help them every step of the way' and offering S26 is 'feeding your toddler's potential from head to toe'. This observation is particularly important given that ten of the fourteen respondents who planned to breastfeed expected to encounter difficulties with breastfeeding; and only one respondent expressed a breastfeeding goal that was consistent with public health recommendations. Joanne's response was typical 'If it goes well, I'll do what they say to do, you know start introducing solids at six months but, you know, no more than probably eight months'.

The Wyeth S26 brand offers mothers a way to avoid worrying that their children's failure to eat properly will compromise the development of their potential. Given that the Wyeth S26 range includes an infant formula, consumers might well infer that S26 also offers a solution to the problems mothers encounter with (breast) feeding an infant according to public health recommendations. Three of the five respondents who saw this ad gave responses similar to Jaime's, 'It's going to fulfil all the nutrient requirements'.

Believability

In order to ascertain how persuasive these advertisements might be, respondents were asked whether they thought that the claims made in them would be believed by mothers that they knew. This validated interview technique, known as *structured projective questioning*, is designed to mitigate or eliminate response patterns by enabling respondents to distance themselves from their beliefs, feelings and ideas by projecting them on to others (Donoghue 2000; Fisher 1993). What was striking was that all but three of the respondents accepted the claims made by these advertisers, or thought that mothers they knew would do so, quite uncritically. In particular, respondents found the use of scientific or technical sounding language particularly persuasive; a strategy that has been used to convince mothers of the legitimacy of formula for decades (Apple 1986; Palmer 2009). Jacqueline said that 'All the words I don't understand' told her that the Heinz Nurture Gold Toddler would be a healthy choice for her baby and Jemima that, 'It all sounds really technical and you know good for the baby I would assume.' This response pattern is of particular concern when the claims are applied to infant formula, because these claims clearly contradict public health messages about infant feeding and are therefore likely to mislead consumers about the health effects of feeding their babies infant formula in place of human milk.

Of the three mothers who expressed doubts about the veracity of claims only June said that she would seek independent verification from a health professional. The other two respondents who indicated that they would seek verification of the advertisers' claims said that they would consult advertisers' websites or other mothers — sources unlikely to furnish them with the information they need to evaluate the claims. This finding suggests that many consumers either do not feel it necessary to assess the veracity of the claims made in formula advertising or do not perceive a need to seek independent, informed verification of advertising claims.

As the respondents were not asked directly whether they would seek independent verification of the claims made in the advertisements, it is possible that they would do so but did not think to mention it. On the other hand, it is possible that June only thought to seek independent verification as a result of being interviewed.

CONCLUSION

Toddler milk advertisements appear to be functioning as de facto advertising for infant and follow-on formulas in violation of the intent, if not the letter of the MAIF Agreement and the International Code. Mothers glancing at advertisements for toddler formula, as they would when reading a magazine, overwhelmingly believed that they were seeing advertisements for infant formula. This finding is consistent with the results of British research which found around 60% of mothers and expectant mothers thought follow-on formula advertising was

promoting infant formula (National Childbirth Trust/UNICEF UK 2005; NOP World for Department of Health 2005).

Even after developing an understanding that the product depicted in these advertisements was suitable for children over the age of one, they still thought they were seeing an advertisement for a line of products, collectively known as 'formula'. These perceptions were consistent with the characterisation of toddler milks as part of the advertisers' 'formula range' found on their websites and with the established marketing practice known as line extension. This finding suggests that regulations preventing the advertising of breastmilk substitutes based on the age of child for which they are said to be suitable will be ineffective because advertisers will simply extend their formula lines to include new formula products that evade the restrictions.

The advertising strategies observed in the advertisements used in this study suggest that 'formula' advertising positions its products in competition with breastfeeding, rather than with other brands and in doing so undermines public health messages about infant feeding. The advertisements evoked the respondents' anxieties about infant feeding, reinforced a perception that infant feeding recommendations are unattainable and presented 'formula' as a healthy alternative to breastfeeding. Furthermore, most of the mothers interviewed for this research appeared ready to accept the claims made in these advertisements quite uncritically.

Given that the respondents believed that they were seeing advertisements for a range of products that includes infant and follow-on formula, it is likely that they will generalise the messages they contain to all formula products. All of the respondents expressed the view that these advertisements were claiming that 'formula' or its ingredients can confer certain health benefits upon children that are usually associated with breastfeeding. These messages, when applied to infant formula, minimise the differences between formula milk and human milk and contradict the significant body of evidence associating formula feeding with important health risks.

This study suggests that any advertising that bears a brand identifier in common with infant formula is likely to be perceived by consumers as advertising infant formula. Although it is not possible to ascertain the intentions of the advertisers in this case, marketing texts suggest that a single brand identity is used to unify a group of products in the minds of consumers. Advertisers may contend that the use of these brand identifiers is intended to encourage mothers who are familiar with infant formula brands to use a toddler from the same brand family once their babies no longer need infant or follow-on formula. However, this study suggests that whatever the intention, consumers understand toddler milk advertisements to be promoting a group of products that includes infant formula. The inescapable corollary is that the MAIF Agreement is failing to protect mothers and infants from potentially misleading formula advertising — advertising that contradicts both public health messages and the established body of evidence about the importance of breastfeeding to the health of infants and their mothers.

It should be noted that the small sample sizes associated with qualitative enquiry constitute an inherent limitation to the generalisability of the findings. Therefore the results of this study should be interpreted in light of this limitation. Quantitative enquiry is required to investigate the extent of the perception that toddler milk advertising also effectively advertises infant and follow-on formula in the wider population.

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Editor's note: The Australian Breastfeeding Association prefers to use the terms 'artificial feeding' or 'artificial baby milk' to describe milks other than breastmilk that are marketed as suitable for human babies. However, the term formula is in common use and is what the respondents in this study used.

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The impact of amended controls on the advertising of infant formula in the UK: findings from a before and after study

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The impact of amended controls on the advertising of infant formula in the UK: findings from a before and after study

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To assist in the promotion of breastfeeding, most European governments control the labelling, advertising and promotion of infant formula products. In the UK, regulations prohibit the advertising of infant formula, but permit the advertising of follow-on formula to the general public. There is some evidence that the promotion of follow-on formula can be mistaken for the promotion of infant formula. Following a European Union directive, modified regulations were introduced in the UK in 2007. This article reports on research funded by the Food Standards Agency and the Department of Health that assessed the impact of the modifications by examining the nature of formula advertising before and after the new controls were introduced. The findings show that the advertising changed in line with the regulations. There were also signs in the data of a shift in the promotional strategies of formula manufacturers in the later period towards higher frequency and more widely distributed advertising. This advertising contained a greater emphasis on brands. The article suggests therefore that although regulatory controls might succeed at one level, they may fail at another and concludes with a call for further research into the relationships between formula advertising content, perceptions of advertising and infant feeding practices.

Keywords: infant formula advertising; regulation; content analysis

Introduction

As Elizabeth Murphy has observed, infant feeding is a feature of family life that has long been the subject of government concern and significant state intervention (Murphy 2003, p. 434). Murphy notes that the tools used to intervene have been largely persuasive, being chiefly instructional and educational. Making reference to Foucault's term 'bio-power' (Foucault 1980 cited in Murphy 2003), Murphy (2003) explains how the 'medicalized expert discourses' (2003, p. 437) and associated 'quiet coercions' (2003, p. 438) embodied in the promotion of breastfeeding are key elements of government policy designed to protect and promote the welfare of the population. She goes on to show how mothers resist such interventions through the development of their own feeding practices, suggesting that the government promotion of breastfeeding can be read as an attack on individual self-regulation and autonomy.

In addition to the instructional and educational tools of government which are central to Murphy's critique, other aspects of 'bio-power' in this health domain can also be identified. These take the form of measures designed to restrict the public flow and circulation of commercial information. What follows is a report on some findings from a study concerned with the nature and effectiveness of one such measure – the regulation of infant formula advertising. It concludes with some suggestions for potentially fruitful lines

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of further academic enquiry in this area. The article has relatively modest ambitions focusing narrowly on a rarely acknowledged dimension of government health promotion and its operation in an attempt to edge forward our understanding of the mechanisms of government health regulation and their consequences.

Background

Although most European governments are committed to the promotion of breastfeeding, they recognise that, as Murphy and other scholars have shown, not all mothers choose or are able to breastfeed their babies and that many will make use of infant formula products (Murphy 1999, 2003, 2004, Bean 2001, Bolling 2006, Lee 2007, 2008). These products fall into two categories: those that are suitable for infants during the first 6 months of life (infant formula) and those intended for older infants (known as 'follow-on formula' in the UK). The labelling, advertising and promotion of infant formula products are subject to government controls that take their lead from the International Code of Marketing of Breast Milk Substitutes which was adopted by the 34th World Health Assembly in 1981 (WHO 1981). In the UK, the regulations prohibit, with some exceptions,[1] the advertising of infant formula, but the advertising of follow-on formula (a class of products that did not exist when the international code was drawn up) is permitted.

A concern within the health promotion and policy-making community is that, within this control framework, there is potential for expectant parents, parents and carers to mistake advertising that promotes follow-on formula for advertising for infant formula with the possible effect that support for and uptake of breastfeeding are undermined. Research on women's attitudes to infant feeding in the UK (Department of Health 2005) found that more than two out of every three respondents (67%) said they had seen or heard an advertisement for infant formula even though, because of advertising controls, this was unlikely. Other UK-based research (NCT/UNICEF 2005) found that 60% of respondents claimed to have heard or seen such advertisements. This suggests a clear information need on the part of mothers and mothers-to-be that it appears is being met imperfectly.

In 2006, the European Commission issued a directive[2] which explicitly required the labelling, advertising and presentation of formula products to ensure that they are promoted in ways that do not discourage mothers from breastfeeding and that advertising contains clear information about their appropriate use. In response to the directive, in 2007, the UK Minister of State for Public Health announced new measures to strengthen the regulation of formula advertising in the UK.[3] A year later, the UK Department of Health and the Food Standards Agency convened an expert panel to carry out a review of the effects of the new controls (Food Standards Agency 2010).

The pages that follow contain a report on some independent research commissioned and funded by the Food Standards Agency and the Department of Health to assist the expert panel to review the nature of formula advertising before and after the new regulations were introduced. The research findings offer some insight into the challenges faced by regulators in exercising control over the information disseminated to mothers and suggest that further research on formula advertising and its contribution to consumers' knowledge and understanding of formula products is needed.

Research objectives

The 2007 controls were intended to reduce the potential for confusion between infant formula and follow-on formula. The expert panel was asked to

> Assess whether the new controls on the way in which follow-on formula is presented and advertised have been effective in making clear to parents/parents-to-be and carers that advertisements for follow-on formula are meant only for babies over six months and are not perceived or confused as infant formula advertising, which is prohibited. (Food Standards Agency 2010, p. 4)

For the research reported here, the two principal research objectives stipulated by the Food Standards Agency and Department of Health were that the research should:

- provide an accurate representation of infant formula and follow-on formula advertising and presentation before and after the new controls were introduced.
- analyse the content of such advertising and the nature of presentation to establish whether these changed following the introduction of the new controls.

The ways formula advertising is received and interpreted by mothers and mothers-to-be were not a focus for this study, although, as we suggest in our conclusion to this article, may need to be in future research of this sort if policy is to be properly informed about the actual and potential interplay between advertising messages, advertising techniques and infant feeding practices.

Method

The empirical research comprised an analysis of the textual and visual content of the advertising for formula products in all media in the UK for two 12-month periods (January to December 2006; March 2008 to February 2009). The digital advertising archive maintained by the media monitoring company Ebiquity was made available to the research team and was used by them to locate the advertisements to be analysed.[4] Keyword searches were performed using the archive's web portal to collect the details of all the infant formula ad copy published during the two sampling periods. This copy was then downloaded for analysis. Data were also collected from retail sites situated in Belfast, Cardiff, Edinburgh and Leicester by Site Reports Ltd, a market research company. Site Reports' field researchers visited supermarkets, convenience stores and pharmacies in inner city, suburban and rural neighbourhoods in each of the targeted cities. Three stores of each type were visited per neighbourhood in each city between December 2008 and January 2009, researchers visiting a total of 108 retail sites. At each site visit researchers photographed store displays for formula products and recorded the size and prominence of these and the shelf locations of each formula product on sale.

Analysis of advertising content

McGuire's communication–persuasion matrix, compiled on the basis of a review of research on persuasive communication (McGuire 1989, 2001), was used as the framework for the design of the content analysis coding schedules. The coding schedules were designed by the research team to measure a range of variables in the advertisements that are known to mediate consumers' responses to advertising content. Following McGuire's matrix, the schedules measured content factors falling into four categories: source factors, message factors, channel/format factors and receiver factors. After initial inspection of the advertisements located in the Ebiquity archive, several sub-factors were identified from previous research on advertising (e.g. print font styles were found to be potentially important sub-factors in the analysis of message factors) and these were included in the coding schedules to enable more detailed analysis of the ad content. Eight different coding

schedules were designed to analyse: (1) moving image ads, (2) radio ads, (3) print media ads, (4) Internet ads, (5) outdoor ads (posters and billboards), (6) point-of-sale ads, (7) point-of-sale displays and (8) direct mail leaflets. Coding reliability checks were run on sub-samples of the print and television formula advertisement samples to pilot test the coding schedule variables and to ensure that they would produce consistent measures of advertisement attributes. In the print pilot on eight print advertisements (seven for follow-on formula and one for infant formula), a total of 1072 coder judgements were made by two coders working independently with the same advertisements. There were 76 disagreements between coders, giving a total agreement rate of 93%. In the television pilot on four advertisements, 608 coder judgements were made by two coders. There were 42 disagreements giving a total agreement rate again of 93%. These agreement rates indicated that in general the coding frames worked effectively and the variables in each coding schedule were clearly and unambiguously defined.

Findings

Formula advertising – general

A total of 93 different follow-on formula advertisements (that is 93 unique pieces of advertising copy appearing across all media) were identified over the 24 months of the sampling period. These appeared in four media, most either in print ($n = 49$) or on television ($n = 29$). A further three appeared on the Internet and two were distributed as direct mail. A total of 33 infant formula advertisements were located in health professional journals, of which 11 appeared in 2006 and 22 in 2008–2009. Table 1 provides a summary of the overall distribution of formula product advertising.

The total number of follow-on formula advertisements dropped significantly from 2006 to 2008–2009. Infant formula advertisements showed the opposite trend, increasing in number in 2008–2009 over 2006. Because the sample was dominated by print advertisements, the remainder of this article will discuss the findings from the analysis of print advertising for follow-on formula, although it should be noted that similar results were obtained from the analyses of advertising in other media.[5] The analysis shows some clear contrasts between the advertising found for the two periods in the study.

Follow-on formula advertising in print media

Of the 49 print advertisements for follow-on formula found in advertisements appearing during the two periods, two-thirds ($n = 33$) appeared in 2006 and one-third ($n = 16$) appeared in 2008–2009.

Table 1. Formula product advertising.

Product type and medium	2006 *n*	2008–2009 *n*	All *n*
Follow-on formula	56	27	93
Print	33	16	49
Television	22	7	29
Internet	1	2	3
Direct mail	0	2	2
Infant formula	11	22	33

Notes: $\chi^2 = 25.9$, df = 7, $p < 0.001$.

General features

Follow-on formula advertisements were found mainly in magazines for mothers and mothers-to-be (49%) and to a lesser extent in celebrity and fashion magazines (27%). These advertisements were given wider distribution in terms of publication outlets in 2008–2009 than in 2006 (Table 2).

In 2006, all follow-on formula print advertising was divided between magazines for celebrity and fashion and magazines for mothers or mothers-to-be. In 2008–2009, this advertising was found in magazines for mothers/mothers-to-be, other magazines, celebrity and fashion magazines and in a national Sunday newspaper.

Most follow-on formula advertisements featured in campaigns lasting up to 6 months (73%). Such relatively short campaigns were more prevalent in 2006 (94% of all ads) than in 2008–2009 (64%), and there was some evidence of increased use of longer campaigns in 2008–2009. In 2006, one in two follow-on formula advertising campaigns (51%) comprised small numbers of ad appearances, usually no more than three. In 2008–2009, campaigns were run in which advertisements averaged nearly 16 appearances compared with around 6 appearances in 2006. Follow-on formula advertisements occupied more page space on average in magazines from 2008 to 2009 than in those from 2006. Average ad size in 2008–2009 was 1809 cm^2 compared with 940 cm^2 in 2006. Expenditure on follow-on formula print advertising campaigns ranged from £2000 to £250,000, average expenditure being £41,221 per campaign. Average expenditure was higher in 2008–2009 (£48,546) than in 2006 (£26,114). Although there was a clear preference in 2008–2009 over 2006 for cheaper campaigns that cost no more than £4000, the higher average expenditure on advertising in 2008–2009 was caused by the fairly high prevalence of £100,000 + campaigns that year (38% of all ads). In 2006, such expensive campaigns were completely absent.

Overall then, in print media, although a smaller number of different advertisements for follow-on formula were being used in 2008–2009 than in 2006, these were more prominent in the later period. Advertisers were placing their ads in a wider range of publications and were spending more on their campaigns and running them for longer periods, and each ad tended to occupy more page space. Analysis of the nature of these advertisements, to which the present discussion now turns, showed a number of other differences between the two periods.

Source factors

The types of actors or sources that are presented in advertisements as product users or endorsers are features that can influence the degree to which consumers identify with the advertised product. Identification can be triggered by demographic or cultural similarities between actors or sources in advertising and consumers (Debevec and Iyer 1986, Quinn and Holland 1987, Roth and Moorman 1988). This type of response has been shown to

Table 2. Location of print advertising of formula products.

Print medium	2006 *n* (%)	2008–2009 *n* (%)	All *n* (%)
Magazines for mothers/mothers-to-be	7 (56)	17 (52)	24 (49)
Celebrity/fashion magazines	9 (44)	4 (12)	13 (27)
Other magazines	0 (0)	11 (33)	11 (22)
Sunday newspaper	0 (0)	1 (3)	1 (2)

Notes: $\chi^2 = 13.9$, df = 3, $p < 0.003$.

occur among ethnically similar sources/actors in advertising and consumers (Whittler and DiMeo 1991, Deshpande and Stayman 1994). Differences between consumers and actors within advertisements have been found to weaken the impact of the advertising (Brumbaugh 2002). Research also shows that celebrity and expert endorsers can produce a positive impact on consumer attitudes towards an advertisement and the associated brand, and on purchase intention (Goldsmith *et al.* 2000, Erdogan *et al.* 2001).

One in four follow-on formula print advertisements in this study contained an adult actor and they were always female and classified as white-British. This pattern was similar in 2006 and 2008–2009. Child actors were significantly more prevalent in 2008–2009 advertisements than those in 2006. In 2006, nearly 4 out of 10 follow-on formula print advertisements (6; 38%) contained a white-British child actor; in 2008–2009, nearly all such advertisements (31; 94%) contained a white-British child actor ($\chi^2 = 19.8$, df = 2, $p < 0.0001$). In both periods, just one advertisement contained an ethnic minority child actor (Black-Afro-Caribbean-British in each case).

There were no significant differences between 2006 and 2008–2009 in terms of endorsement. Only one follow-on formula print advertisement was found that contained any expert endorsement and this appeared in 2006. There was no use of celebrity endorsement in this advertising in either period.

Message factors

Advertising messages are designed primarily to provide information about products from which consumers can take personal decisions about which products to purchase. This information may describe the distinctiveness of the product, or it may provide facts about the way it should be used, the benefits it will bring, the reasons for choosing it over others and advice about any risks associated with it or its incorrect use. Most advertising contains features that are designed to differentiate specific brands from others in the same product category. This might be achieved by presenting, through words and images, specific characteristics of a brand or by making direct comparisons with competing brands. Both of these features have been found to be linked positively to ad and brand recall (Stewart and Furse 1985). Brand recall can be further reinforced by repeat mentions of the brand name within an advertisement. With this in mind, the content analysis assessed the visibility and readability of text of various sorts in the ads appearing over the two periods.

A number of text types were identified in the advertisements: brand names, product names, identification of follow-on formula, price information, statements asserting the superiority of breastfeeding, recommended age of use and other product-related support information. These were assessed as they appeared both in the text of the advertisement and in the text shown on packs visible in the advertisements. In each instance, three text format variables were examined: case, font and colour contrast. These factors have been found to influence the readability of printed words (Tinker 1963, Jha and Daftuar 1981, Krulee and Novy 1986, Schindler 1986, Sanocki 1988, Yager *et al.* 1998, Bix 2002). For example, lower case lettering has been found to be more readable than upper case lettering, although the latter can sometimes have more impact when there is a need to draw special attention to a point. There is some evidence also that sans serif font can be more readable than serif font and certain colour combinations of text and background have been found to enhance readability.

Most of the follow-on formula print advertisements contained brand-differentiating attributes. The brand name was usually displayed in at least one part of the advertisement, and pack displays were used to enhance brand prominence still further. The product pack

was present in all print advertisements found in 2008–2009 (33; 100%), significantly more so than in 2006 (6; 38%; $\chi^2 = 25.9$, df = 1, $p < 0.0001$). All of these advertisements displayed the name of the manufacturer. All of these advertisements, either on a pack or elsewhere in the advertisement, the fact that the product was follow-on formula. All advertisements also showed the name of the product. At this level, there were no notable differences in the attributes of ads shown in 2008–2009 compared with ads shown in 2006, but the words 'follow-on formula' were significantly more likely to be visible on packs in advertisements appearing in 2008–2009 (32; 97%) than in 2006 (6; 38%; $\chi^2 = 26.0$, df = 2, $p < 0.0001$).

The ads in 2008–2009 were more likely to contain statements about the health benefits of these products than those appearing in 2006 (24; 73% compared with 4; 25%; $\chi^2 = 10.0$, df = 1, $p < 0.002$). Although health claims were prevalent, the use of scientific support for such claims was rare (occurring in six advertisements only), the use of unqualified health claims being somewhat more prevalent, appearing in 18 advertisements in 2008–2009. The presence of these sorts of health claims was more common in 2008–2009 than in 2006 ($\chi^2 = 13.8$, df = 1, $p < 0.0001$).

Nearly all follow-on formula advertising contained some form of risk warning. All but one of these advertisements made it clear that the product should not be used as a substitute for breast milk. In around 8 out of 10 cases, this information was also visible on product packaging appearing in the advertisement. In both sampling periods, other warnings about inappropriate preparation of the product tended to be more visible on product packs in the advertisements than in the main body of the commercial message.

A statement concerning the superiority of breastfeeding appeared more often in advertisements sampled from 2008 to 2009 (28; 85%) than in those from 2006 (2, 13%; $\chi^2 = 23.8$, df = 1, $p < 0.0001$). Analysis of the style of presentation in such sentences showed that a minority of advertisements in 2006 and in 2008–2009 used sentence case, sans serif fonts and high-resolution colour combinations. In 2008–2009, this text was more prevalent and used mostly sentence case (73% of ads) and occasionally upper case only (6%) or lower case only (3%). Most of the advertisements that contained this text in 2008–2009 used high-resolution colour combinations of text and background (73% of ads), with a few (12%) using a relatively low-resolution combination. Advertisements from 2006 and from 2008 to 2009 differed significantly in the text styles of 'superiority of breast-feeding' statements in terms of case ($\chi^2 = 21.5$, df = 3, $p < 0.0001$), font ($\chi^2 = 20.3$, df = 1, $p < 0.0001$) and colour contrast ($\chi^2 = 26.2$, df = 4, $p < 0.0001$).

The statement that use of the product with infants before they are 6 months old should only occur on the advice of a suitably qualified medical or health professional occurred in the text of the advertisement in just two cases. However, this recommendation was displayed on product packs appearing in ads in 8 out of 10 cases in 2006 and in every advertisement in 2008–2009 (a difference that was not statistically significant). An age of use recommendation on pack shots in the advertisements was far more likely to be present in advertisements sampled in 2008–2009 (24; 73%) than in those coded for 2006 (5, 31%; $\chi^2 = 26.1$, df = 2, $p < 0.0001$). There were only minor differences in terms of text styles used in these between the two sampling periods.

In general across the different pieces of text in the advertising analysed, lower case fonts or combinations of lower with upper case and sans serif fonts were the styles used most often. High-resolution combinations (text and background) were used much more often, with the exception of brand name where low-resolution combinations were just as prevalent. The general pattern over time was for a shift towards greater use of high-resolution colour combinations in 2008–2009 than in 2006 ($\chi^2 = 24.3$, df = 8, $p < 0.002$).

The use of thematic attributes such as humour or other emotion-promoting themes to create an atmosphere or mood has also been found to enhance both memory for the advertising and trigger positive attitudes towards the brand (Aaker *et al.* 1986, Friestad and Thorson 1986). One such feature designed to trigger an appropriate emotional response is the use of voices, sounds and images in advertisements that convey emotional warmth. Such features can enhance recall of an advertisement and the brand and product advertised (Friestad and Thorson 1986). The themes of family, friendship or romance are commonly associated with emotional warmth and have been shown to increase product/brand purchase likelihood when used in advertising. Warmth can also be displayed through scenes that depict people laughing or otherwise showing that they are happy. Again, these features can increase purchase likelihood (Lutz 1985).

Several advertisements in the sample contained such themes. These elements included pictures of babies laughing (one in four advertisements overall) or of mothers and babies together (one in five advertisements overall). These themes more than doubled in prevalence in 2008–2009 (33%) compared with in 2006 (12%).

Channel/format factors

These factors comprise a range of picture-related and narrative-related attributes. Pictures are potentially important in terms of enhancing consumers' emotional reactions to and memory for the advertisements and advertised brands. The narrative elements are important to the readability of the information in the advertisements; high levels of both are essential if an ad is to have any subsequent cognitive, emotional or behavioural impact (Stewart and Furse 1985).

All follow-on formula print advertisements contained some pictorial material. This was most likely to comprise images of babies or infants, sometimes with, but usually without, the product. Other picture material showed the infant and a female adult together. In many cases, the setting was not clearly visible or discernible. Where such details could be identified, the usual settings were in the home or at an outdoor location such as a garden or park. The 2006 and 2008–2009 distributions were significantly different ($\chi^2 = 11.6$, $df = 3$, $p < 0.009$), these depictions appearing more often in advertisements in 2008–2009 than in 2006. There was also an increase between 2006 and 2008–2009 in the prevalence of the use of images of outdoor settings.

Receiver factors

Receiver factors are concerned with advertising attributes that might draw the consumer into the message through identification with its contents. This part of the analysis examined the appearance of babies and infants, mothers and fathers, relationship themes and the use of colours to create particular moods or atmospheres. There is evidence that such factors can influence consumers' attitudes towards advertising and brands which may in turn influence purchase decisions (Lutz 1985, Friestad and Thorson 1986).

Most advertisements (8 in 10) displayed a baby or infant. Almost all those advertisements appearing in 2008–2009 did so. Advertisements were coded for the presence of specific attributes or behaviours by the depicted babies or infants that suggested their age to be above 6 months (that is were in the age category for recommended use of follow-on formula). Coding recorded whether the infant had hair, exhibited a high degree of head control, was sitting upright, displayed some dexterity of arm movements, had teeth, was self-feeding and was or was not smiling – all attributes characteristic of infants older

than 6 months. In the majority of cases, the infant had hair (71%) and displayed head control (57%). In one in two cases, she/he was depicted as sitting upright (49%). Smiling was depicted in nearly 4 in 10 cases (39%), whereas dexterity of arm movements, having teeth and self-feeding were apparent in between 14 and 29% of cases. The year-to-year differences were significant for head control ($\chi^2 = 28.8$, df = 3, $p < 0.0001$), dexterity of arm movement ($\chi^2 = 20.1$, df = 3, $p < 0.0001$), self-feeding ($\chi^2 = 22.6$, df = 3, $p < 0.0001$), hair ($\chi^2 = 22.3$, df = 3, $p < 0.0001$), teeth ($\chi^2 = 21.3$, df = 3, $p < 0.0001$), sitting upright ($\chi^2 = 19.2$, df = 3, $p < 0.0001$) and smiling ($\chi^2 = 19.1$, df = 3, $p < 0.0001$).

Adult females were visible in one in four advertisements, but there were no advertisements featuring adult males. Affectionate touching between an adult female/mother figure and baby/infant occurred in two print advertisements in 2006 (13%) and in eight in 2008–2009 (24%). The use of soft pastel colours in images featuring babies occurred in over one in three advertisements, most of which (16 out of 18) occurred in 2008–2009 ($\chi^2 = 6.7$, df = 1, $p < 0.05$). The use of bold primary colours on product packs was far more prevalent in advertising in 2008–2009 (24; 73%) than advertising in 2006 (6; 38%). This difference was significant ($\chi^2 = 5.6$, df = 1, $p < 0.02$).

Discussion

The main findings of this study show that advertisers had responded to the controls on the advertising of formula products introduced in 2007. Child actors, though more prevalent than before, were more clearly in the appropriate age category than previously; ads contained text that was more readable and presented in higher resolution to indicate the age of infant these products are intended for, to describe the product's appropriate use and to state that breastfeeding is the best method of feeding infants. The words 'follow-on formula' were significantly more likely to appear somewhere in the ads published after the new controls came into force than they were previously.

However, while making changes of this sort, there were clear signs in the data of a shift in the promotional strategies of formula manufacturers. There was evidence that they were spending more on their campaigns in the printed media, and were running them for longer and in a wider range of publications. They also altered the visual approach of their print ads, making more use of product packs and using more outdoor settings in the images included in their ads. These and several other features that were likely to increase recall of brands and raise the likelihood of purchase were found to have increased in frequency over the two periods studied: there was greater brand prominence and more cues to elicit positive emotions that could be linked with brands; the product packs depicted displayed brands more clearly and used brighter colours, and babies were more likely to be shown and to appear dressed in clothing of pastel colours or against backgrounds of that sort; there was increased prevalence of the use of mother and child imagery; more recommendation information and greater use of unqualified health claims.

Given the continued pervasiveness of advertising for infant formula products, it is likely to continue to be a major concern for public health regulators. In the course of this study, it became clear that the techniques infant formula advertisers are now using to promote brand awareness suggest that these may be more important than the more obvious attributes of individual ads such as the distinction between infant and follow-on formula products, the depiction of babies of appropriate age and the presence of messages about the superiority of breastfeeding. The tendency towards wider brand promotion detected is

evidence of broader trends in the growth of brand-focused advertising at the present time (Hackley 2010).

Advertising regulations and controls designed to restrict the dissemination of information in the attempt to protect the health of consumers have for many years stimulated advertising agencies to seek less direct methods of promotion where brands rather than products are the focus. Examples of this strategy are the well-known award-winning advertising for Benson & Hedges, Silk Cut and other cigarette brands prominent throughout the 1970s, 1980s and 1990s. Where these advertisers relied on surrealist imagery to make their mark, it would seem that formula manufacturers use the romantic, realist imagery of happy, healthy babies and laughing, loving parents to link the symbolism of successful parenting with their brands.

Whether controls over the detailed content of advertisements like these can achieve what is expected of them in the urge to prevent advertising from undermining the support and uptake of breastfeeding remains an empirical question. The authors of a recent review of food advertising regulation in New Zealand (Thornley *et al.* 2010) show how the monitoring of such regulation can usefully contribute to the formulation of public health policies in this area. These authors found that for a number of reasons, regulation had only a marginal impact on the content of food advertising to children in New Zealand. They found that there were therefore strong grounds for regulatory reform. One of the most interesting and, from the regulatory point of view, challenging findings from this study is that even when regulatory controls are tightened and advertisers can be seen to respond in the required ways, controls may not be sufficiently sensitive to the evolutionary nature of advertising and the adaptive skills of advertisers to be able to shape advertising in the desired direction. In other words, advertisers are, for regulators, a moving target. In this case, the issue of code compliance might be less of a concern to those critical of formula advertisers than the issue of the increasing importance of the brand in formula marketing.

When commercial appeals promoting infant formula are very much less specific than regulations dealing with the details will allow, some may see it as appropriate to consider whether the commercial promotion of formula products should be banned altogether, despite the very clear information needs of mothers who choose not to breastfeed (Murphy 2003). This is indeed the view of several campaigning groups.[6] However, research evidence to support such measures is scant. To date, there have been no academic studies carried out in Britain to explore the precise relationships between advertising content, perceptions of advertising and infant feeding practices. The findings from this study represent a modest starting point for further research on the topic and suggest some directions that such work might take. We would argue, for example, that future research must be sensitive to the thematic dimension in formula ads, perhaps by taking a more qualitative and interpretive approach to the analysis of their content and employing techniques that would complement those adopted in this study. Among other things such research might shed light on the finding that more than two-thirds of women in the UK believe they have seen advertisements for infant formula even though they are unlikely to have done so (Department of Health 2005). Studies of advertising that have used semiological approaches to uncover cultural meanings in ads (e.g. Williamson 1978) offer a way forward in this respect. Just as important would be research that takes mothers' interpretations of formula advertising into account in developing – alongside the findings from research such as Murphy's on infant feeding practices (Murphy 2003) – a more complete understanding of the processes involved in decision-making about infant feeding. The research reported here represents a first and relatively modest step in this

direction. Further work that can explore these relationships closely would seem to be increasingly overdue.

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Notes

1. The regulations allow advertisements to be placed in publications specialising in baby care which are distributed only through the healthcare system; in scientific publications or publications that are used to advertise to the trade.
2. Directive 2006/141/EC.
3. The new controls included stricter rules on the labelling of all types of formula clarifying that follow-on formula should only be used by infants from 6 months old; allowing only a small number of approved health and nutrition claims to be displayed on infant formula milk packaging; restrictions preventing infant formula being advertised directly to parents; new rules on how follow-on formula and infant formula are advertised so that there is no confusion between the two products and new guidance for industry and regulators concerning the application of these new rules.
4. Ebiquity maintains a continuously updated archive of advertising and media output in several countries ('60 markets' according to their website http://www.ebiquity.com/). Its clients include marketing companies, manufacturers and retailers who use the archive to monitor the placement and frequency of advertising and to track media coverage of commercial brands and products.
5. A detailed report on all advertising analysed in the research is available from the authors.
6. See, for example the recent statement on behalf of the National Childbirth Trust summarising the issues and making the case for a ban. Available from: http://www.nct.org.uk/sites/default/files/related_documents/2BF7RegulationsonInfantFormula.pdf [Accessed 3 July 2012].

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Hospital system costs of artificial infant feeding: estimates for the Australian Capital Territory

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Abstract

Objective: To estimate the attributable ACT hospital system costs of treating selected infant and childhood illnesses having known associations with early weaning from human milk.

Method: We identified relative risks of infant and childhood morbidity associated with exposure to artificial feeding in the early months of life vs. breastfeeding from cohort studies cited by the American Academy of Pediatrics in 1997 as establishing the protective effect of breastfeeding. Data for ACT breastfeeding prevalence is assessed from a 1997 prospective population-based cohort study of 1,295 women. ACT Hospital Morbidity Data and DRG treatment costs were used to estimate the attributable fraction of costs of hospitalisation for gastrointestinal illness, respiratory illness and otitis media, eczema, and necrotising enterocolitis.

Results: Although initiation rates were high (92%), less than one in 10 ACT infants are exclusively breastfed for the recommended six months, mainly due to supplementation or weaning on to formula within the first three months and the early introduction of solids by breastfeeding mothers. This study suggests the attributable hospitalisation costs of early weaning in the ACT are about $1-2 million a year for the five illnesses.

Conclusions and implications: Early weaning from breastmilk is associated with significant hospital costs for treatment of gastrointestinal illness, respiratory illness and otitis media, eczema, and necrotising enterocolitis. These costs are minimum estimates of the cost of early weaning as they exclude numerous other chronic or common illnesses and out-of-hospital health care costs. Higher rates of exclusive breastfeeding would reduce these costs. Interventions to protect and support breastfeeding are likely to be cost-effective for the public health system.

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Breastfeeding is recognised as making a key contribution to infant and maternal health and providing economic benefits to the health care system. The Commonwealth Government's National Breastfeeding Strategy is a key component of its *Health Through Life* initiative.[1] The health care cost savings of breastfeeding for developing countries have long been accepted. Recent research has highlighted significant potential savings in developed countries such as Australia,[2] the United States,[3-5] and the United Kingdom as well.[6]

Questions were raised during the 1980s about the health policy significance of breastfeeding for industrialised countries[7] and the quality of existing studies.[8] Subsequently, the American Academy of Pediatrics' (AAP) recent 'Policy Statement on Breastfeeding and the Use of Human Milk',[9] has cited epidemiological research using predominantly middle-class populations from developed countries providing strong evidence that human milk and breastfeeding of infants significantly decreased risk for a large number of acute and chronic diseases including reducing the incidence and/or severity of diarrhea, lower respiratory infection, otitis media, bacteremia, bacterial meningitis, botulism, urinary tract infection and necrotising enterocolitis (NEC). There is also substantial evidence of long-term protective effects.[10-16]

Empirical studies in the US and the UK have assessed potential cost savings from increased breastfeeding by applying epidemiological methods to infer excess or attributable risks of illness from national data, on comparative incidence of illness in breastfed versus formula-fed infants.[3-5,17] In some cases these estimates were of hospitalisation costs, in other cases of health services expenditures (consultation, prescription and hospitalisation) or indirect costs garnered from various sources.[18-21]

Another study[2] estimated the avoidable costs of gastroenteritis, NEC, insulin-dependent diabetes mellitus (IDDM), eczema and neurodevelopmental impairment among term and pre-term infants in Australia. It used US and European estimates of incidence and hypothetical breastfeeding rates to model potential cost savings from various breastfeeding prevalences.

The aim of this study was to estimate for the Australian Capital Territory (ACT) the attributable hospital system costs of treating illnesses for which breastfeeding is established to be protective. We link for the first time at the population level estimates of ACT hospitalisation episodes for selected feeding-related morbidities with breastfeeding prevalence data from a corresponding local population, and then calculate the attributable cost of artificial feeding in this population using consistent, national, case-weighted data for public hospitals on treatment cost per episode.

The value of such a study for public health policy lies in its ability to:

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- Provide information and assist analysis of how health care resources are currently allocated.
- Identify potential health improvements or resource savings from interventions.
- Aid economic appraisal of cost effectiveness and policy priority setting.

Such information can also bring newly identified risk factors on to the policymaking, political or community agenda.

Method

Data for this study was derived from a number of independent sources. This information was used to estimate the attributable fraction of ACT costs of hospitalisation for selected conditions that are related to artificial feeding.

Prevalence of exposure to formula or early solids

The prevalence of infants' exposure to artificial feeding was estimated using data from a prospective population-based study commenced in the ACT in 1997. The study population is described elsewhere.[22] In summary:

- The source population comprised all women resident in the ACT and planning to do so for at least six months, who were aged ≥16 years and gave birth to a live baby between March and October 1997 in any of the ACT's two public hospitals, two private hospitals, or at home.
- Exclusions: Women whose babies were admitted to the neonatal intensive care unit or adopted, and women who were critically ill, unable to give informed consent or complete the questionnaires for any reason or were participating in any other study.
- Study population: Of the women eligible and approached, 1,295 (70%) agreed to participate in the study, and of these, 1,193 (92%) were retained in the cohort to six months postpartum. Compared with all women who gave birth in the ACT in 1997, participants were slightly older, more likely to be in married or de facto relationships, to have given birth in private hospitals, to be private patients and to be of English speaking background.
- Exposure variables. Data were collected at four days, eight, 16 and 24 weeks postpartum for type of milk consumed, including breast milk alone, breast milk plus formula milk and other fluids only (formula), as well as separate data for each feeding group on consumption of solids. The World Health Organization (WHO) defines 'exclusive breastfeeding' as breast milk only, whether expressed, from a wet-nurse, or suckled by the mother. 'Predominantly breastfed' is where breast milk is the predominant source of nutrition and includes unlimited amounts of water or juices in addition to breastmilk.[23] We use the term 'exclusive' breastfeeding to mean breastfeeding or breastmilk only, with no solids. However, our survey did not collect separate information on consumption of juice or water. Thus our 'breastfeeding' category corresponds more closely to 'full' breastfeeding according to the detailed schema set out by Labbock and Krasovec,[24] who recommend that 'full' breastfeeding include 'exclusive' (no other liquid or solid given to the infant) and 'almost exclusive' (vitamins, minerals, water, juice, or ritualistic feeds given infrequently) breastfeeding.

Morbidity/outcomes

- Data source: ACT public and private hospital separations for the 12-month period 1 July 1996-30 June 1997 derived from ACT Hospital Morbidity Data.[25]
- Outcomes: The number of episodes of hospitalisation for gastrointestinal illness, NEC, respiratory illness, otitis media and eczema among infants and children up to and including four years of age.
- We excluded hospitalisation episodes among older children, where breastfeeding is less strongly protective. Evidence from the literature suggests breastfeeding has continued significant protective effects to at least two years for gastrointestinal illness;[26] 2-6 years for respiratory illness;[12,27] 3-10 years for atopic eczema;[12,28] and three years for acute and recurrent otitis media.[29-32]
- Diagnostic Classification: Data for age groups 0-12 months and 1-4 years were classified by principal diagnosis at the three or four-digit level according to the International Classification of Diseases, 9th Revision, Clinical Modification (ICD-9-CM). This morbidity data was then mapped to AR-DRG 4.0 by identifying separations where the principle diagnosis at the ICD-9-CM three- digit level best corresponded to the morbidity outcomes measured in the epidemiological studies (i.e. 'gastrointestinal illness', 'respiratory illness', 'otitis media', 'eczema' and 'NEC').

Relative risk of morbidity

Relative risks (RR) of infant and childhood morbidity associated with exposure to artificial feeding in the early months of life versus breastfeeding were extracted from high-quality cohort studies cited by the American Academy of Pediatrics in 1997 as establishing the protective effect of breast feeding. The following principles guided our decisions for choice of RR estimates:

- To confine the scope of this study to a manageable number of conditions.
- To use only those conditions for which the epidemiological evidence was best substantiated.
- To provide a more systematic framework for selecting relative risks than previous studies of this kind.[2-5,17]

According to the AAP, the best evidence of a protective effect of breastfeeding is for diarrhea, lower respiratory infection, otitis media, bacteremia, bacterial meningitis, botulism, urinary tract infection and NEC. Therefore we:

- Examined all 21 studies that were cited by the AAP as constituting 'strong evidence' for the protective effects of human milk feeding against these conditions.
- Identified a range of relative risks for each condition from these studies.
- Through these studies and through a Medline search from 1996 to 2002, identified and examined 11 other studies from developed countries that estimated relative risks for

gastrointestinal illness, 16 for respiratory illness, six for otitis media and one for NEC, and six recent meta-analyses or systematic reviews.

- Selected a preferred estimate of relative risk for each condition based on study quality, rather than taking a weighted average. Where studies were of similar quality, we followed the approach taken by others[33] of giving greater credibility to studies that clearly measured the exclusivity and duration of breastfeeding because clear definition of infant feeding categories is particularly important for accurate estimation of relative risks in this area.[11,24]

The important methodological standards for assessing quality, based on methodological criteria established for breastfeeding research by Baucher[8] and Kramer,[34] were:

- Adequate statistical power.
- Avoidance of detection bias.
- Clear definition of 'breastfeeding', i.e. distinguishing 'exclusive breastfeeding' for at least four months from other categories of exposure to non-human milk intake, including feeding of solids.[11,24]
- Control for important confounding variables (for example, socio-economic status, maternal education, parental smoking, child care attendance, siblings).
- Clearly defined outcome events and information on the severity of outcome.

In addition, the following factors were taken into account:

- Estimating the population-attributable risk from case-control studies can be problematic if the prevalence of exposure in the control group is not known to represent that in the population as a whole.[35] As cohort study estimates were unavailable for botulism, bacteremia, bacterial meningitis and urinary tract infection, these conditions were excluded from our estimates.
- Breastfeeding research meeting appropriate methodological standards has been lacking until very recently.[11] This limits the usefulness of pooled estimates, although meta-analyses are available for otitis media,[36] asthma,[37] and eczema.[38] Reflecting this situation, most studies cited by the AAP in its 1997 statement met only a few of the required methodological criteria. We therefore tested the plausibility of the relative risk estimates we extracted from the AAP studies by comparing them with findings from other studies identified in the literature search, as well as with results of recent published meta-analyses and reviews.

Cost of treatment

- The cost of each episode of hospitalisation was estimated as the average cost for the corresponding diagnostic related group (DRG) in Australian public hospitals (AR-DRG Version 4.0) for 1997-98.[39]
- DRG costs are derived from the annual National Hospital Cost Data Collection (NHCDC), which encompasses the average duration of hospitalisation associated with a particular DRG and includes estimates of average direct and overhead costs (for example, ward medical, nursing, pharmacology, pathology, catering and depreciation). The NHCDC for AR-DRG Version 4.0 was based on a retrospective collection and processing of 1997-98 data from a sample of 150 public hospitals and 46 private hospitals.
- Because ACT hospital cost data is not published at the level of detail required, we use national public sector hospital cost data. A weighted average cost is calculated where DRG average costs are applicable for several relevant DRG categories. The DRG average is weighted by NHCDC estimates of number of separations from national public hospitals in each relevant DRG category.
- These estimated average treatment costs per episode of hospitalisation are applied to corresponding categories of ACT hospital discharge data classified by the ICD-9-CM system to arrive at an estimate of aggregate costs of hospitalisation of infants and children in the relevant age groups for each of the conditions under study.

Table 1: Infant milk feeding in the Australian Capital Territory.

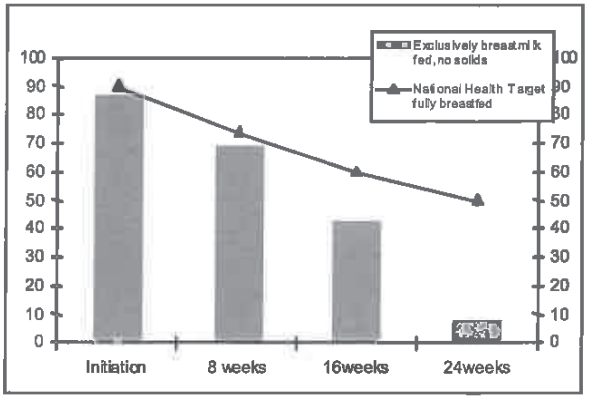
	Human milk only n (%)	Human milk plus formula n (%)	No human milk n (%)
Week 1	1,118 (87.3)	76 (5.9)	87 (6.8)
8 weeks	857 (68.3)	143 (11.4)	253 (20.2)
16 weeks	689 (56.6)	139 (11.4)	390 (32.0)
24 weeks	574 (48.2)	136 (11.4)	482 (40.4)

Source: Unpublished data from 'The ACT Experience – A Survey of Mothers', 1997.

Results

Complete data on time of introduction of solids and of type of milk fed was available for 1,183, 1,176, and 1,187 participants in the study at eight, 16, and 24 weeks postpartum respectively. Table 1 shows the type of milk consumed by ACT infants up to 24 weeks postpartum, and Figure 1 compares ACT feeding pattems with

Figure 1: ACT breastfeeding prevalence compared to national health targets for breastfeeding.



Note: The National Health Targets are for 'fully breastfed'. This means 'exclusively' or 'almost exclusively' breastfed. ACT infants fed human milk only with no formula or solids, are categorised as 'fully breastfed'.[22,69]

Table 2: ACT hospital separations, infants and children (aged 0-4), 1996-97: conditions where there is 'strong evidence' that breastfeeding is protective.

Category of illness	ICD-9-CM codes	Total infant feeding related separation
Gastrointestinal	008-009, 530.81, 558.9, 783.1, 783.4	235
Acute otitis media	381-382	270
Respiratory	460, 462-466, 480, 485-487, 493, 786.2	692
Eczema	691,693	4
NEC	777.5, 777.8	9

Source: ACT Hospital Morbidity Data, 1996-97.

the National Health Targets for full (exclusive or near exclusive) breastfeeding.

By 24 weeks postpartum, only 8% of infants were still fully breastfed, solids most commonly having been introduced between 17 and 24 weeks postpartum. Of 820 women who reported providing only human milk to their babies at eight weeks postpartum, six had introduced solids within the first eight postpartum weeks. Thus at eight weeks postpartum 814/1,183 or 68.9% of infants received only human milk and no solids, while at 16 weeks the prevalence of full (i.e. exclusive and nearly exclusive or predominantly) breastfeeding had fallen to 43.4% (see Figure 1). With this 43% prevalence of full breastfeeding at 16 weeks, we use an estimate of exposure prevalence of 60% to examine the attributable cost of exposure to artificial feeding.

Table 2 reports the number of hospitalisations in the ACT in 1996-97 for the illnesses specified. It excludes all hospitalisations of children aged five or more and estimates the proportion of hospitalisations in age categories 1-4 years by assuming an even spread of hospitalisations within this age category. Six hundred and ninety-two infants and children aged 0-4 years were hospitalised for respiratory illness, 270 aged 0-3 years for acute otitis media, 235 aged 0-2 years for gastrointestinal illness, four aged 0-4 years for eczema and nine for NEC. NEC was only identified in hospitalised infants under 12 months of age.

The relative risks of illness for not 'breastfed' compared with 'breastfed' infants from the literature cited by the AAP on these illnesses are summarised in Table 3. All studies controlled for important potential confounding variables and the relative risk estimates below are for morbidity, not for hospitalisation, unless otherwise specified.

The relative risk of gastrointestinal illness estimated in the five studies cited by the AAP statement ranged from 1.9 to 13.5. We used 5.5 as our preferred relative risk estimate. This is based on the Dundee study[40] and shows the effects on hospitalisation for gastrointestinal illness in the first year of life of exclusive breastfeeding for at least the first 14 weeks compared with no breastfeeding.

Establishing the most plausible relative risks for 'respiratory illness' is complex because this includes respiratory infection as well as allergic conditions such as asthma or recurrent wheeze. Because of the ambiguity in measuring morbidity outcomes and risks of exposure, some studies' inadequate treatment of confounding factors (notably smoking and allergic parental history) and lack of data on the atopic status of patients hospitalised for respiratory illness, we assumed a relative risk of 2.4 for respiratory illness in the total population.[41] This had regard to evidence of a two-fold higher risk of respiratory infection that has since been found for children aged seven years in the Dundee study follow-up,[13] and also corresponds closely to findings for recurrent wheeze at age two years.[42]

Estimates of the relative risk of acute otitis media ranged from 1.1 to 3.7 in healthy term infants[29,43] and 11.5 in breastmilk fed infants with cleft palate.[31] Our preferred estimate for hospitalisation due to otitis media is 2.1.[44] Again, the estimate of relative risk from this study is conservative, as the reference population of 'not breastfed' included a large proportion of infants who were fully or partially breastfed to four months of age which was compared with those exclusively breastfed for more than six months.

A prospective cohort study of 256 Finnish infants found a six times lower incidence of atopic dermatitis at age three years among those with a history of prolonged breastfeeding (that is, breastmilk the sole source of milk to age six months) than those with little

Table 3: Relative risk of illness in non-breastfed infants compared with breastfed infants from literature cited by AAP: conditions where there is 'strong evidence' that breastfeeding is protective.

Outcome	Low estimate	High estimate	Preferred estimate	Source of preferred estimate	Definition of exposure variables[a]	Population attributable risk[b]
Gastrointestinal illness[c]	1.9	13.5	5.5	(Howie 1990)	never bf or bf <14 weeks vs ebf >13 weeks	73
Acute otitis media	1.1	3.7	2.1	(Duncan 1993)	bf <4 mo vs ebf >6 mo	40
Respiratory illness	1.3	6	2.4	(Wright 1989)	never bf or bf <4 mo vs bf >4 mo	55
Eczema	3.2	6	6	(Saarinen 1979)	bf <2 mo vs bf >6 mo	75
NEC	2	23.6	2	(Lucas 1990)	never bf vs any bf	38

Notes:
(a) 'bf' means 'breastfed'; 'ebf' means 'exclusively breastfed'.
(b) The population attributable fraction was computed using $P_e(RR-1)/(1+P_e(RR-1))$ where P_e is the prevalence of exposure to artificial feeding, and RR is the relative risk calculated as the ratio of the incidence of morbidity in artificially fed infants to the incidence in breastfed infants.
(c) Hospitalisation in first 12 months of life.
Source: see text under 'Relative risk of morbidity' heading.

Table 4: Treatment costs per episode of illness, DRG average cost, 1997/98.

Category of illness	ICD-9-CM	DRG	DRG description	Average cost per DRG ($)	Weighted average cost ($)
Gastrointestinal	008-009, 530.81, 558.9,	G68A	Gastroenteritis A <10 +Cc	2,962	
	783.1, 783.4	G68B	Gastroenteritis A <10 -Cc	1,275	1,484
Acute otitis media	381-382	D63A	Otitis media + URI+Cc	2,143	
		D63B	Otitis media + URI -Cc	1,237	1,422
Respiratory	460, 462-466, 480	E62A	Respiratory infection/inflamm + Ccc	5,726	
	485-487, 493, 786.2	E62B	Respiratory infection/inflamm+Smcc	3,634	
		E62C	Respiratory infection/inflamm-Cc	2,147	
		E67A	Respiratory signs and symptom+Cscc	2,173	
		E67B	Respiratory signs and symptom A<3-Cscc	1,275	
		E67C	Respiratory signs and symptom A>3-Cscc	1,076	
		E69C	Bronchitis and asthma A<50 -Cc	1,227	
		E72Z	Respiratory problems from neonatal period	3,611	
		E73A	Pleural effusion+Ccc	5,133	
		E73B	Pleural effusion+Scc	2,961	
		E73C	Pleural effusion-Ccc	1,935	2,412
Eczema	691, 693	J61Z	Severe skin disorders	1,603	
		J66A	Moderate skin disorders+Cscc	3,688	
		J66B	Moderate skin disorders-Cscc	1,695	
		J67A	Minor skin disorders+Cc	2,296	
		J67B	Minor skin disorders+Cc	810	1,303
NEC	777.5, 777.8	P04Z	neo, Admwt 1500-1999G+Sig Or Pr	41,516	
		P65A	neo, Admwt 1500-1999G-Sig Or Pr+Mmp	20,205	28,648

Source: See text under heading 'Cost of treatment'.

breastfeeding (less than two months of exclusive breastfeeding).[12,28] This study is preferred over a British randomised controlled trial (RCT) comparing 777 pre-term atopic infants supplemented with human milk to those fed preterm formula.[45] The latter was for preterm, atopic infants fed some human milk until discharge from hospital only, while the former was for healthy infants breastfed fully till six months compared with babies weaned before two months, measured severity as well as incidence and controlled for solid feedings. The Finnish study is therefore more comprehensive and more relevant to a general population than the RCT

The preferred study of the relative risks of NEC is a RCT study of 926 preterm infants in the UK.[46] Infants of less than 30 weeks' gestation fed only formula milks had twice the risk of developing confirmed NEC than those fed any human milk, while among infants of longer gestation the relative risk of confirmed NEC for artificial milk fed babies was much higher. The study controlled for differences in feeding groups for various medical factors associated with NEC.

Calculation of measures of disease frequency including attributable and population-attributable risk is according to the standard formula[35] and assumes exposure to artificial feeding of 60% in the ACT population. This corresponds approximately to the ACT full (exclusive or nearly exclusive) breastfeeding rate of 43% at 16 weeks. Table 3 shows calculations of the population attributable risk (%) in the ACT for breastfeeding prevalence of 40%.

Table 3 also shows that the population attributable risk (%) varies between 38% and 75% at a 60% prevalence of exposure to artificial feeding and using the relative risks identified for these five conditions above. That is, between one-third and three-quarters of infant and child hospitalisations for these conditions in the specified age groups could have been avoided through exclusive or more prolonged breastfeeding in infancy.

Table 4 shows the DRG-based treatment costs per episode of hospitalisation for gastrointestinal illness, respiratory illness, otitis media, eczema, and NEC among infants and children aged 0-11. Because hospital separations data is classified by ICD-9 codes, and treatment costs by DRG, we have linked them with the categories of illness in the literature according to the definitions reported in this table.

Table 5 summarises the direct hospitalisation costs associated with artificial infant feeding for various relative risk assumptions. This table is adjusted on the basis discussed above to exclude hospitalisations of children assumed to be too old to be protected by breastfeeding in infancy. Our main estimates of relative risk are based on studies of the health risks of artificial infant milk feeding available to the AAP in 1996.

A small number of high-quality prospective studies and several meta-analyses have recently been published that provided further estimates of relative risk for some conditions.

Using these studies, we tested the sensitivity of cost estimates to different assumptions of relative risk. Table 5 shows the

Table 5: Relative risk (RR) of illness in non-breastfed infants compared with breastfed infants; sensitivity to relative risk and exposure estimates.

Outcome	Low RR estimate	'Pooled' RR estimate	Upper RR estimate	Attributable cost: low RR estimates ($)	Attributable cost: 'pooled' RR estimates ($)	Attributable cost: 60% exposure/ preferred RR estimates ($)	Attributable cost: upper RR estimates ($)
Gastrointestinal	1.9	1.8	13.5	236,736	218,963	492,667	595,708
Acute otitis media	1.1	1.4	3.7	28,324	96,851	198,953	309,405
Respiratory	1.3	1.25	3.1	243,967	208,609	730,132	891,665
Eczema	3.2	1.5	6	2,966	1,203	3,910	3,910
NEC[a]	2	(2)	23.6	96,686	(96,686)	96,686	240,121
Total				608,679	522,312	1,522,347	2,040,810

Note:
(a) No pooled or relevant new estimates are available for NEC.
Source: 'Low' estimates are from Beaudry,[70] Owen and Baldwin,[43] Frank et al.,[71] Saarinen[28] and Lucas and Cole[46] for gastrointestinal illness, acute otitis media, respiratory illness, eczema and NEC respectively. Recent or 'pooled' estimates are from Raisler[42] and Scalati et al.,[42] Uhari and Mantysaari[36] Peat[47] and Gdalevich et al.[38] for gastrointestinal illness, acute otitis media, respiratory illness (asthma), and eczema respectively. High estimates are from Popkin and Adair,[72] Saarinen,[28] Wright et al.,[73] Saarinen[28] and Lucas and Cole[46] respectively.

various alternative relative risk estimates: 'pooled' estimates of 1.4 for otitis media,[36] 1.25 for respiratory illness,[47] and 1.5 for eczema[38] and a relative risk of 1.8 for gastrointestinal illness;[43,49] and 'lower bound' and 'upper bound' estimates from Table 3. The attributable hospitalisation cost of 60% of infants not breastfeeding in the ACT falls to $0.61 million and $0.62 million for the 'pooled' and lower bound estimates respectively. This shows that our results for attributable cost are most sensitive to the estimates of relative risk for respiratory illness. Using 'upper bound' relative risk estimates, the avoidable hospitalisation cost for a 60% exposure rate increases to $2.1 million.

To assess the effects of changing breastfeeding prevalence, we have modelled the attributable costs for breastfeeding prevalences between 5% and 90% (see Table 6). This shows that if virtually all infants were exclusively breastfed as recommended to around six months, with a small proportion of mothers physiologically unable to lactate, there would be up to a 5%[50] prevalence of exposure to artificial feeding in the ACT. At the other end of the spectrum, the 8% exclusive breastfeeding rate in the ACT at 24 weeks approximates a 90% exposure to the health risks associated with artificial infant feeding. Using a conservative definition of current exposure (the proportion of infants receiving no human milk at 24 weeks), 40% of infants are exposed to artificial feeding in the ACT. On this basis, the avoidable hospitalisation costs of artificial feeding are around $1.2 million a year in the ACT for the five conditions examined in this study.

Table 6: Attributable costs for various prevalence of exposure.

Exposure (%)	Attributable costs ($)
5	268,041
10	480,700
20	805,470
30	1,047,673
40	1,238,176
50	1,393,179
60	1,522,347
70	1,631,949
80	1,726,289
90	1,808,447

Discussion

Study results and significance

This study showed that less than 10% of ACT infants are exclusively breastfed for around the first six months of life, due to a) supplementation or weaning within the first three months and b) early introduction of solids among exclusively breastfeeding mothers.

Although uncertainty about relative risk estimates and breastfeeding prevalence produces a wide range of cost estimates, this study shows that early weaning is likely to add between around $1 and $2 million annually to ACT hospitalisation costs of treatment of infants and children for gastrointestinal illness, respiratory illness, otitis media, eczema and NEC. This suggests that higher exclusive breastfeeding rates could produce significant potential savings in ACT hospitalisation costs for children aged 0-4 years. Extrapolated nationally, savings across the Australian hospital system could be $60-$120 million annually for these illnesses alone. Conversely, any decline in breastfeeding from current levels has substantial and adverse cost implications for the ACT public health system.

The largest costs savings come from reduced hospital admissions for respiratory illness and gastrointestinal illness. In the United States, NEC treatment and deaths are a substantial component of the economic costs of artificial infant feeding.[5] In 1992, authors of the UK randomised controlled trials on NEC foresaw that "early introduction of breastmilk into the diets of pre-term infants could make necrotising enterocolitis beyond 30 weeks a rarity".[46] This study bears out that prediction: in our study, where virtually all pre-term infants in the ACT receive human milk, NEC was only a minor cost component.

Study limitations

A weakness of our study is that we match hospitalisation data with risk exposures at the population level, not the individual level. The incidence of illness is implicitly incorporated in the results through using ACT hospitalisation data on the relevant ICD-9-CM categories. This approach permits more accurate and clinically relevant estimates of the cost of artificial feeding to the health system in a specific regional population, and are thus more likely to influence hospital decision-makers.[51] However, our method assumes that the prevalence of exposure to non-exclusive breastfeeding in the ACT hospitalised population of infants and children aged 0-4 years old can be accurately inferred from our population-based survey of breastfeeding prevalence. This means factors other than infant-feeding patterns cannot be excluded as factors contributing to the hospitalisation rate. It has been suggested, for example, that breastfed children may be less likely to be hospitalised than artificially fed children with the same illness, reflecting confounding factors such as mother's education levels or caregivers' propensity to hospitalise.[7,8] If so, the proportion of artificially fed infants in the sample population used to measure breastfeeding prevalence will differ from the proportion of hospitalised infants who are artificially fed. However, recent population studies using active surveillance and controlling for confounders such as socio-economic status suggest artificially fed infants are slightly more likely to need hospitalisation than those breastfed.[40,52] If this finding can be extended to the ACT, our assumption may underestimate artificial feeding prevalence among hospitalised infants and children. The implication is that our results would understate the attributable hospitalisation costs of artificial infant feeding. We have therefore shown how our attributable cost estimates would vary for different assumptions about breastfeeding prevalence in the hospitalised infants and children.

The breastfeeding survey data relates to infants born between March and October 1997, whereas hospitalisation data on which our estimates are based relate to 1 July 1996 and 30 June 1997. However, with breastfeeding prevalence stabilising in Australia from the 1980s after strong increases since 1972,[53] it is likely that our ACT breastfeeding prevalence data reasonably reflects its prevalence during the previous four years.

Lack of precision in categorising infant feeding method hindered our evaluation of exposure to risk of illness from artificial feeding as previously published studies have used unsatisfactory definitions of 'breastfed' or 'formula-fed'. Blurring the distinction between breastfed and formula-fed infants will tend to understate the relative risk of artificial feeding compared with breastfeeding. On the other hand, comparing exclusive breastfeeding for six months with exclusive formula feeding from birth would not accurately represent the comparative health risks for the ACT population.

Pooled risk estimates may also underestimate relative risks associated with formula feeding where the existing literature does not meet current standards for accurately measure breastfeeding exclusivity or duration.

Our study may somewhat overstate the attributable costs of artificial feeding for NEC in the ACT, as the prevalence of human milk feeding by premature infants was assumed in this study to be the same as for term infants, when it is much higher.

Limitation of the costing methodology

The economic costs estimated here are minimum estimates of the true public and private economic cost of early weaning because they exclude indirect and intangible costs and are limited to costs incurred in hospital. A full economic costing would include other direct costs of illness borne by the community, such as non-hospital medical and pharmaceutical costs, as well as indirect costs represented by lost household and workforce productivity associated with time and effort spent nursing sick infants and children at home, and effects on the quality of life. Out-of-hospital costs are potentially significant. In the United States, for example, for every $100 spent on treating hospitalised infants with gastrointestinal illness, a further $80 was spent on out-of-hospital treatment and indirect costs.[5] However, cost of illness studies often omit indirect and intangible costs because they are difficult to measure in dollar terms and because appropriate indicators of quality of life are still being developed, and treatment costs are much more difficult to estimate outside the hospital setting.

It should be noted that the DRG system is used to classify acute admitted patient hospital episodes and groups together similar clinical conditions with similar usage of hospital resources, in order to facilitate comparison of hospital costs and case-mix funding. It uses 'cost modelling' or data extracted from hospital clinical costing systems. Because the ICD-9-CM system is an indexing system for hospital and medical records, it is more precise than DRG groupings and reflects different considerations. Hence, patient-level costings using ICD-9-CM classifications may give different results from those using average DRG costs. Nevertheless, in the absence of patient-level cost data, the DRG average cost data provides a reasonable basis for costing ACT hospital separations.

Despite its limitations, this study is nevertheless useful for public policy because it shows that the attributable hospitalisation cost of artificial infant feeding is considerable in itself. It also indicates that indirect and intangible costs are also likely to be substantial as our estimates exclude several other chronic and costly conditions linked by research to lack of breastfeeding, such as insulin-dependent diabetes mellitus, Crohn's disease, ulcerative colitis, lymphoma, allergic diseases and other chronic digestive diseases. There is recent evidence of long-term adverse effects of artificial formula feeding on later obesity, high blood pressure and heart disease,[13,54] as well as pneumonia, gastroenteritis, respiratory illness, allergy and NEC.[14,55-57] Evidence is accumulating on significant advantages provided for cognitive development by breastfeeding.[15,58-60] It also benefits the long-term health of mothers.[61]

Future applications

Our study design did not permit individual matching of ACT hospital separation data with infant feeding data. Ideally, data collection for hospitalisation of infants and children would include such information to permit more accurate estimates. Future

research needs to update the estimates of relative risk in the present study to extend the analysis to conditions for which the AAP considered breastfeeding was 'possibly protective', or for which recent research has recently identified artificial infant feeding as a risk factor. It is important that research in this area consistently defines 'breastfeeding' according to recommended schema in order to avoid biased estimates. Future work should also extend the analysis to non-hospitalisation costs of illness, including medical, pharmaceutical and household productivity or time costs.

From a preventative health policy viewpoint in an industrialised country such as Australia, assessing the effects of changing the size of the exposed population is more relevant than changing relative risks. A recent large experimental study showed that breastfeeding support programs in a community setting can substantially increase breastfeeding and thereby reduce illness rates.[55] The significance of the PROBIT study, a cluster randomised trial in Belarus,[62] lies in its finding that a hospital-based intervention, the Baby Friendly Hospital Initiative,[63] can produce a 12-fold increase in exclusive breastfeeding at six months and double the probability of any breastfeeding throughout the first year of life, with benefits to child health even in a high breastfeeding population.[64]

Conclusion and implications

WHO and UNICEF recommend exclusive breastfeeding for around six months.[65] The AAP[9] concluded that:

exclusive breastfeeding is the ideal nutrition and sufficient for approximately the first 6 months after birth. ... In the first six months, water, juice, and other foods are generally unnecessary for breastfed infants.

This study has shown that only a fraction of ACT infants (8%) are exclusively breastfed for around the first six months of life. This low prevalence of full/exclusive breastfeeding at six months is surprising in this relatively well-educated and affluent population. The ACT is already well below National Health Targets for full (exclusive or nearly exclusive) breastfeeding at six months, mainly because many breastfeeding mothers introduce solids from 16 weeks contrary to WHO recommendations. Although initiation rates of breastfeeding in the ACT are high, this drops off rapidly by eight weeks when one in five babies are no longer breastfeeding at all. Data from the National Health Survey[66] suggests this occurs disproportionately in lower socio-economic groups.

This study shows that early weaning may add between around $1 and $2 million annually to ACT hospitalisation costs of treatment of infants and children for gastrointestinal illness, respiratory illness, otitis media, eczema, and NEC. Extrapolated nationally, savings across the Australian hospital system could be $60-$120 million annually for these illnesses alone.

Public policies and breastfeeding support programs enabling mothers to avoid supplementation in the early weeks, or reducing cultural and commercial pressures on mothers for early introduction of solids, could significantly raise full or exclusive breastfeeding rates and reduce health costs. There is clear evidence that higher breastfeeding rates in the early weeks depends fundamentally on improved health care practices,[63] including in particular appropriate support and management of perceived inadequate milk supply and sore nipples.[67] Recent research in Western Australia[68] suggests that inappropriate advice from health professionals results in premature introduction of solids in the Australian population of breastfeeding mothers.

Along with recent evidence that interventions to support breastfeeding can substantially raise the prevalence of breastfeeding, this study suggests that public policies encouraging breastfeeding mothers to delay introducing solids to six months and reducing the extent of artificial feeding of infants under six months of age are likely to be cost-effective.

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Cancers in Australia in 2010 attributable to total breastfeeding durations of 12 months or less by parous women

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Abstract

Objectives: To estimate the proportion and number of cancers occurring in Australia in 2010 attributable to parous women having breastfed for total durations of ≤12 months.

Methods: We estimated the population attributable fraction (PAF) of breast cancers (the only cancer site with convincing evidence of causal association) associated with women breastfeeding for ≤12 months in total, using standard formulae incorporating breastfeeding prevalence data, relative risks associated with breastfeeding and cancer incidence. We also estimated the proportion change in disease incidence (potential impact fraction [PIF]) that might have occurred under two hypothetical scenarios of women breastfeeding for longer durations.

Results: An estimated 235 (1.7%) breast cancer cases that occurred in Australian in 2010 could be attributed to women breastfeeding for total durations of ≤12 months. Assuming a hypothetical increase in breastfeeding, we estimated that the number of breast cancers prevented would range from 36 to 51 (prevented fraction = 0.3% to 0.4%).

Conclusions: More than 200 breast cancers were attributable to women breastfeeding for total durations of ≤12 months.

Implications: Policies to increase breastfeeding duration may help prevent breast cancers in the future.

Key words: population attributable fraction, cancer, risk factor, breast feeding, potential impact fraction

There are strong associations between a number of reproductive factors and hormone-related cancers such as breast, ovarian and endometrial cancer, but most of these factors (e.g. numbers of pregnancies, age at first birth) cannot pragmatically be modified for the purposes of cancer prevention. Breastfeeding has marked effects on maternal reproductive hormones, has been inversely linked to breast and ovarian cancer and, unlike many other reproductive exposures, can be promoted to women for its public health and individual benefits.

In the Second Expert Report on Food, Nutrition, Physical Activity and the Prevention of Cancer[1] and subsequent Continuous Update Project (CUP),[2] the World Cancer Research Fund/American Institute for Cancer Research (WCRF/AICR) concluded that there was convincing evidence that breastfeeding decreases risk of maternal pre- and post-menopausal breast cancer, but also concluded that the evidence for a causal association between breastfeeding and ovarian cancer[1,3] was only "limited-suggestive". This latter conclusion was based on their meta-analysis of three cohort studies[4-6] which showed a non-significant 10% reduction in risk for ever versus never breastfeeding (relative risk [RR] 0.90; 95% confidence interval [CI] 0.75–1.08).[3] However, results of another recently published meta-analysis of three cohort studies[5,7,8] (only one of which[5] was included in the WCRF review) suggested that each additional month of breastfeeding was associated with a significant 1.02% reduction in risk of ovarian cancer.[9]

There are several biologically plausible mechanisms by which breastfeeding might reduce risk of breast and ovarian cancers. Lactation causes differentiation of breast epithelial cells so they may be less susceptible to neoplastic transformation;[2] ductal epithelial cells also exfoliate during lactation potentially eliminating those with DNA-damage.[2] Furthermore, breastfeeding suppresses gonadotrophins, thereby lowering endogenous oestrogen and progesterone, and these hormones are thought to play an important role in the development of breast neoplasia.[2] For ovarian cancer, most data suggest that repeated exposure of the ovarian/fallopian tube epithelium (many ovarian cancers may actually arise from the fallopian tube) to the effects of recurrent ovulation and/or reproductive hormones have an important role in carcinogenesis. In suppressing gonadotrophins and ovulation, lactation should decrease exposure of the ovary/fallopian tube to most factors postulated to have a strong causative role in cancer development.[10]

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Our aim was to estimate the proportion of cancers attributable to little or no breastfeeding by parous women. Based on our *a priori* decision to limit our primary analyses to exposure-cancer relationships that either the WCRF or International Agency for Research on Cancer (IARC) had concluded were causal, in our primary analysis we estimated only the proportion of breast cancers diagnosed in 2010 that were attributable to little or no breastfeeding by women who had children. On the assumption that further studies will likely strengthen the evidence for a protective causal association between breastfeeding and ovarian cancer, we have undertaken a supplementary analysis to calculate PAF estimates for ovarian cancer.

Methods

The National Health and Medical Research Council Australian Dietary Guidelines recommend that individual babies be breastfed for at least the first year.[11] However, epidemiological studies of breastfeeding and cancer risk have mostly considered the effects of total duration of breastfeeding (i.e. the sum of the duration of all episodes of breastfeeding rather than the duration of individual episodes). The best prevalence data for Australian women that we could access were also expressed in terms of total duration and, in addition, grouped all women with total breastfeeding durations of greater than 12 months together. Therefore, for pragmatic reasons we have defined a theoretically optimal level of breastfeeding (in terms of cancer prevention) by a parous woman as a cumulative total duration of more than 12 months, irrespective of the number of children women had.

Relative risk estimates

For breast cancer, the WCRF/AICR (2007),[1] estimated a summary dose-response relative risk of 0.98 (95%CI 0.97-1.00) per five months of breastfeeding among parous women. This estimate was not updated in the 2010 report,[2] so we used this RR in our calculations. To obtain an estimate of risk per month of deficit in breastfeeding we assumed a log-linear relationship between exposure and risk:

Increase in log risk per 1 month deficit of breastfeeding (R_{bf}) = (ln(1/RR_5))/5

where RR_5 is the relative risk per 5 months of breastfeeding, giving an increase in log risk of $4.041e^{-3}$ per month deficit in breastfeeding.

Exposure prevalence estimates

The relative risks we used were for total duration of breastfeeding over a woman's lifetime, regardless of when in a woman's life breastfeeding may have occurred. We have only considered parous women in our estimates of the numbers of cases attributable to a lack of breastfeeding, because relative risks reported in the literature use parous women who have never breastfed as the reference group.

Data on the proportion of Australian women who have had children and breastfed, by the total duration of breastfeeding, were sourced from the 2001 National Health Survey (NHS) Confidentialised Unit Record Files (CURF).[12] These data were available only for women aged 19 to 64 years, so we have applied the prevalence of breastfeeding among the 60–64 year age group to the 65+ year age group. Breastfeeding prevalence was obtained for each 5-year age group across 14 categories of duration, ranging from the lowest category (never) to the highest category (more than 12 months), spanned by 12 ordinal categories rising in monthly increments (see Table 1).

Statistical analysis

The population attributable fraction (PAF) was calculated by age category using the following formula:[13]

$$PAF = \frac{\sum(p_x * ERR_x)}{1 + \sum(p_x * ERR_x)}$$

where p_x is the proportion of the population and ERR_x the excess RR in breastfeeding category x.

The excess relative risk (ERR) was calculated as:

$$ERR_x = \exp(R_{bf} \times BF_x) - 1$$

where R_{bf} is the increase in log risk for a deficit of 1 month of breastfeeding (using the formula described in Relative Risk estimates) and BF_x is the deficit in months of breastfeeding below 13 months in duration category x.

To estimate the number of cancers attributable to breastfeeding for durations of 12 months or less in a population of parous women, the incidence of breast cancer in 2010[14] was split into the estimated proportions occurring in parous and nulliparous women based on the average proportions of breast cancers in parous and nulliparous women across two prospective studies (1 Australia, 1 UK) and one pooled analysis of four prospective studies (US).[15-17] The proportional split (nulliparous/parous) was 14%/86%.

Supplementary analysis

We modelled the impact of breastfeeding for total durations of 12 months or less on ovarian cancer using the relative risk estimate of 0.95 (95%CI 0.90-0.99) per five months of breastfeeding (among parous women) from the meta-analysis by Luan and colleagues.[9] This equates to an increase in log risk for each one-month deficit of breastfeeding of 10.259e-3. The estimated proportional split of ovarian cancers occurring in nulliparous and parous women, based on two cohort studies and one pooled analysis, was 21%/79%.[5,18,19]

Potential impact of changing the prevalence of breastfeeding

While the NHMRC Australian Dietary Guidelines recommend breastfeeding infants

Table 1: Proportions (%) of parous women breast feeding for different total durations (months), Australia, 2001.

Age Group	Duration of breastfeeding (months)													
	Never	≤1	>1 to 2	>2 to 3	>3 to 4	>4 to 5	>5 to 6	>6 to 7	>7 to 8	>8 to 9	>9 to 10	>10 to 11	>11 to 12	>12
19-24 yrs	20.3	14.8	10.7	0.6	9.3	9.7	4.2	5.5	1.1	5.5	0.8	2.1	3.4	12.2
25-29 yrs	13.1	17.2	8.2	0.7	4.0	5.9	4.4	3.5	3.3	3.5	3.1	1.1	1.9	30.1
30-34 yrs	8.2	6.1	6.4	0.7	5.1	3.5	3.8	4.5	4.2	3.3	4.4	2.2	1.9	45.7
35-39 yrs	8.9	4.3	4.2	0.5	3.4	4.3	2.4	5.8	2.6	3.6	2.5	3.6	1.8	52.1
40-44 yrs	11.0	4.5	5.9	0.4	3.1	3.2	1.6	5.5	1.7	1.6	3.3	3.1	1.6	53.5
45-49 yrs	14.0	4.5	3.5	0.0	4.8	4.2	2.5	5.2	2.7	2.1	2.2	1.5	1.7	51.2
50-54 yrs	21.7	3.4	5.7	1.0	6.1	3.5	4.5	6.6	2.3	3.8	4.4	2.3	2.8	32.1
55-59 yrs	22.2	4.2	5.6	0.3	5.4	4.4	2.1	3.5	2.3	4.9	6.7	2.7	3.0	32.7
60-64 yrs	20.7	4.0	3.5	0.1	4.5	4.3	2.3	4.7	3.3	3.8	2.9	2.9	3.2	39.9

Source: 2001 National Health Survey, Expanded CURF, RADL. Findings based on use of Australian Bureau of Statistics CURF data12

for at least the first 12 months,[11] it may not be realistic to expect all mothers will be able to reach even a minimum total duration of 12 months across all pregnancies. We modelled the impact of more achievable prevalence changes among parous women:

1. If those who never breastfed instead fed for 1–3 months total duration; and those who reported ≤6 months of breastfeeding breastfed for a total of >6 months.
2. No new women initiated breastfeeding, however, those who reported ≤6 months increased their breastfeeding to a total of >6 months.

To model the first scenario, we re-distributed women who never breastfed across to the '>1 to 2 months' and '>2 to 3 months' categories according to the actual distribution of women in these categories, and shifted the rest of the women who breastfed for up to six months to the '>6 to 7 months' category. In the second scenario, the proportion of women who never breastfed was not changed, while all the women who did breastfeed their children but did so for six months or less were shifted into the '>6 to 7 month' category. We then calculated the potential impact fraction (PIF) using the formula from Morgenstern and Bursic:[20]

$$PIF = \frac{\sum_{x=1}^{n} p_x RR_x - \sum_{x=1}^{n} p^*_x RR_x}{\sum_{x=1}^{n} p_x RR_x}$$

where p_x is the proportion of the population in category x, RR_x is the RR for that category and p^*_x is the population in category x after re-distribution of women who breastfed for less than six months according to the alternative scenarios described above.

We then calculated the number of breast cancer cases that would have occurred in Australia in 2010 assuming that the alternative scenarios of breastfeeding duration had prevailed. The PIF is then the proportional difference between the observed number of breast cancers and the number expected under the alternative prevalence scenarios.

Table 2: Population attributable fraction (PAF) and estimated number of cancers diagnosed in Australia in 2010 attributable to breast feeding for a total duration of 12 months or less.

		Breast Cancer (C50)[a]	
Age Group	PAF	Est. cases in parous women	Excess
Females			
19-24 yrs	3.1	6	0
25-29 yrs	2.5	58	1
30-34 yrs	1.6	164	3
35-39 yrs	1.4	431	6
40-44 yrs	1.5	789	12
45-49 yrs	1.6	1,343	22
50-54 yrs	2.2	1,566	35
55-59 yrs	2.2	1,578	34
65+ yrs	2.0	6,250	122
Total		12,185	235
PAF_{aw}	1.9[b]		
	1.7[c]		

Abbreviations: Est. cases in parous women = estimated number of observed breast cancers in parous women in 2010; Excess = excess cancers in 2010 attributable to breast feeding for a total duration of 12 months or less; PAF = population attributable fraction (expressed as a percentage); PAFaw = age-weighted population attributable fraction (expressed as a percentage).

a: International Classification of Diseases Code (ICD-10).

b: % of breast cancers estimated in parous Australian women 19+ years in 2010.

c: % of all breast cancers diagnosed in Australian women 19+ years in 2010.

Results

The proportion of parous women who breastfed for a total duration of more than 12 months was lowest for the youngest age category (19–24 years) at 12%, increased to around 50% for the age groups 25–49 years, but then declined sharply in the older age categories (50–64 years). More than 20% of parous women in these older age categories never breastfed their children (Table 1).

An estimated 235 breast cancer cases diagnosed in parous Australian women aged 19 years and over in 2010 (1.7% of all breast cancers) could be attributed to breastfeeding for a total of 12 months or less (Table 2). This corresponds to 0.5% of all cancer cases in women (aged 19+ years), excluding basal cell carcinoma and squamous cell carcinoma of the skin.

Supplementary analysis

If the association between a deficit in breastfeeding duration and ovarian cancer is causal, then we estimated that 51 ovarian cancers (3.9% of all ovarian cancers) would be attributable to breastfeeding for 12 months or less among parous women aged 19+ years.

Potential impact of changing the prevalence of breastfeeding

Altering the distribution of breastfeeding durations in Australian parous women had minimal impact on estimated breast cancer incidence. Under alternative scenario one (all parous women who had never breastfed instead breastfed for 1–3 months, and all women who breastfed for six months or less, breastfed for >6 to 7 months), we estimated there would have been 51 fewer breast cancers diagnosed in 2010 (PIF 0.4%); 22% of the breast cancers attributable to lack of breastfeeding would not have occurred.

Under scenario two (women who never breastfed did not change, but those who breastfed for six months or less instead breastfed for >6 to 7 months) we estimated there would have been 36 fewer breast cancers (PIF 0.3%); i.e. 15% of the breast cancers attributable to lack of breastfeeding would not have occurred.

Discussion

We estimated that 235 of the breast cancer cases occurring in parous Australian women (aged ≥19 years) in 2010 (1.7% of all breast cancers) could be attributed to breastfeeding for a total of 12 months or less. We also estimated that 51 (3.9%) ovarian cancers could be attributed to no or limited breastfeeding, although it is less clear whether the breastfeeding–ovarian cancer association is causal and these results should be interpreted in that light.

UK study estimates of 3.1% and 18% of breast and ovarian cancer respectively being attributable to less than six months of breastfeeding per child are both higher than the PAFs we have estimated.[21] For breast cancer, the difference has arisen because the proportion of women who breastfed in the UK was somewhat lower than in Australia. In the UK in 2000 only 69% of women had initiated breastfeeding at the birth of a child;[21] whereas, the equivalent figure was 83% in Australia in 2001.[22] The larger difference for ovarian cancer is mostly due to the use of different relative risk estimates. The higher estimate used in the UK study was from one cohort study (RR reduction per month of breastfeeding = 2%)[7] whereas we used a substantially lower relative risk estimate from a more recent meta-analysis (RR reduction per month of breastfeeding = 1.02%).[9] While there have been several other studies (from France,[23] China[24] and California[25]) that have calculated PAFs for breast cancer in relation to limited or no breastfeeding, the methodological approach taken in those papers was very different to ours, making direct comparisons inappropriate.

Our analysis had a number of limitations. The longest duration category of breastfeeding in the available prevalence data was 'greater than 12 months'. We therefore had to assume

that only total durations of breastfeeding of 12 months or less over a woman's lifetime were associated with cancer development. Given that this equates to only six months of breastfeeding per child (if women have, on average, two children) and the evidence suggests that risk continues to decrease with increasing durations of breastfeeding, the proportion of cases potentially prevented by increasing breastfeeding beyond a total of 12 months is likely to be even greater. Furthermore, the effects of lactation on maternal physiology vary considerably with the duration and intensity of individual episodes of breastfeeding as well as a woman's age at the time of breastfeeding, and so it is likely that effects on breast cancer risk also vary according to these factors; our PAF calculations cannot account for this. However, we have used the most reliable information available and further refinement of our estimates will require future new studies to adequately investigate these issues.

Notwithstanding the limitations, our results suggest that increasing the proportion of women who breastfeed their babies for longer durations might have a small but measurable impact on the number of women who develop cancer. Available data indicate that breastfeeding initiation rates are relatively high in Australia and may be increasing over time. Between 2005 and 2011, the proportion of children aged 0–3 years having ever received breast milk increased from 88% to 92%.[26,27] However, the results of the 2010 Australian National Infant Feeding Survey show that only 47% of infants were still predominantly breastfed at three months of age, reducing to 21% being predominantly breastfed at five months of age.[28] The relatively low prevalence of longer durations of breastfeeding indicates there is still potential to further lower rates of breast cancer, and possibly ovarian cancer. Public health policies and campaigns aimed at boosting breastfeeding duration should emphasise the cancer-preventing benefits of breastfeeding along with the other maternal and infant benefits, and these may help prevent breast and perhaps ovarian cancers in Australian women in the future.

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Cost Analysis of Maternal Disease Associated With Suboptimal Breastfeeding

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OBJECTIVE: To estimate the U.S. maternal health burden from current breastfeeding rates both in terms of premature death as well as economic costs.

METHODS: Using literature on associations between lactation and maternal health, we modeled the health outcomes and costs expected for a U.S. cohort of 15-year-old females followed to age 70 years. In 2002, this cohort included 1.88 million individuals. Using Monte Carlo simulations, we compared the outcomes expected if 90% of mothers were able to breastfeed for at least 1 year after each birth with outcomes under the current 1-year breastfeeding rate of 23%. We modeled cases of breast cancer, premenopausal ovarian cancer, hypertension, type 2 diabetes mellitus, and myocardial infarction considering direct costs, indirect costs, and cost of premature death (before age 70 years) expressed in 2011 dollars.

RESULTS: If observed associations between breastfeeding duration and maternal health are causal, we estimate that current breastfeeding rates result in 4,981 excess cases of breast cancer, 53,847 cases of hypertension, and 13,946 cases of myocardial infarction compared with a cohort of 1.88 million U.S. women who optimally breastfed. Using a 3% discount rate, suboptimal breastfeeding incurs a total of $17.4 billion in cost to society resulting from premature death (95% confidence interval [CI] $4.38–24.68 billion), $733.7 million in direct costs (95% CI $612.9–859.7 million), and $126.1 million indirect morbidity costs (95% CI $99.00–153.22 million). We found a nonsignificant difference in number of deaths before age 70 years under current breastfeeding rates (4,396 additional premature deaths, 95% CI –810–7,918).

CONCLUSIONS: Suboptimal breastfeeding may increase U.S. maternal morbidity and health care costs. Thus, investigating whether the observed associations between suboptimal breastfeeding and adverse maternal health outcomes are causal should be a research priority.

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Major medical authorities recommend exclusive breastfeeding for a child's first 6 months of life, with continued breastfeeding after the introduction of complementary foods through at least the child's first year of life.[1,2] However, in the United States, although 75% of mother–neonate dyads initiate breastfeeding, only 23% breastfeed for 1 year or more.[3] Not breastfeeding is associated with an increased risk of adverse health outcomes for infants and children. Previous research has shown the adverse health effects associated with suboptimal breastfeeding cost the United States $14.2 billion annually (2011 dollars) in pediatric disease, including the costs of 911 child deaths.[4]

Breastfeeding is also associated with maternal health outcomes.[5] Shorter duration of lactation is associated with increased maternal breast cancer,[6] ovarian cancer,[7,8] hypertension,[9–11] type 2 diabetes mellitus,[9,12] and myocardial infarction (MI).[9,13] We estimate the burden of maternal disease that might be averted if more mothers

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were able to adhere to infant feeding recommendations, assuming a causal association between breastfeeding and maternal health.

MATERIALS AND METHODS

Based on prior research (Table 1), we simulated the health and health care costs for a cohort of 100,000 women who were aged 15 years in 2002. We modeled the cumulative life experience for this cohort through age 70 years. Each year, each simulated woman had a possibility of giving birth, after which she had a possibility of breastfeeding her child for 0–18 months; each year, each simulated woman also had a probability of developing one of the five health conditions of interest or of dying (Fig. 1).

We examined two sets of simulations with the suboptimal arm reflecting current levels of breastfeeding and the other reflecting optimal levels. We defined optimal levels as breastfeeding for at least 1 year after each birth, consistent with medical recommendations.[1,2] Current breastfeeding rates were taken from final monthly data from the National Immunization Survey (see Appendix 1, available online at http://links.lww.com/AOG/A398). The difference in outcomes for the two simulations represents the burden of suboptimal breastfeeding if observed associations between lactation and maternal health outcomes are causal. Assuming steady-state conditions, the discounted costs incurred by the cohort of women of a given age summed over their lifetime are equivalent to the cost incurred by women of all ages during the course of 1 year. Interventions to improve breastfeeding rates would occur around the time of pregnancy, whereas the costs of maternal health effects are

Table 1. Associations Between Lactation and Maternal Health Conditions Informing Model

Condition	Source	Measure of Association	Effect on Maternal Risk of Condition	Measure of Lactation	Maximum Duration of Lactation With Effect on Condition in Model
Breast cancer	Collaborative Group, 2002[6]	Relative risk	4.3% (2.9–5.8%)	Per year lifetime	4 y lifetime
Premenopausal ovarian cancer	Table 2, Danforth et al, 2007[7]	Relative risk	0.66 (0.46–0.96)	18 or more mo lifetime	18 mo lifetime
			0.82 (0.54–1.24)	12–17 mo lifetime	
			0.76 (0.52–1.11)	7–11 mo lifetime	
			0.96 (0.76–1.21)	1–6 mo lifetime	
			1.0 (referent)	Never	
Type 2 diabetes mellitus	Table 5, Stuebe et al, 2005[12]	Hazard ratio	0.53 (0.40–0.70)	More than 23 mo lifetime	24 mo lifetime; risk reduction lasts 15 y after the woman's last birth
			0.76 (0.59–0.98)	From 11 to 23 mo	
			0.76 (0.58–0.99)	More than 6 to 11 mo lifetime	
			0.78 (0.57–1.06)	From 3 to 6 mo lifetime	
			1.03 (0.80–1.35)	Any lactation from 0 to 3 mo lifetime	
			1.0 (referent)	Never	
Hypertension	Table 3, Stuebe et al, 2011[18]	Hazard ratio	1.0 (referent)	12 or more mo per birth	12 mo per birth for up to four births
			1.07 (0.99–1.17)	9 to less than 12 mo per birth	
			1.09 (1.02–1.18)	6 to less than 9 mo per birth	
			1.19 (1.11–1.28)	More than 3 to less than 6 mo per birth	
			1.21 (1.12–1.30)	More than 0 to 3 mo per birth	
			1.22 (1.13–1.32)	Never	
MI	Table 3, Stuebe et al, 2009[13]	Hazard Ratio	0.66 (0.49–0.89)	More than 23 mo	24 mo lifetime risk reduction lasts 30 y after the woman's last birth
			0.89 (0.71–1.1)	More than 11 to 23 mo	
			0.96 (0.76–1.21)	More than 6 to 11 mo	
			0.98 (0.8–1.21)	More than 3 to 6 mo	
			0.94 (0.79–1.12)	More than 0 to 3 mo	
			1.0 (referent)	Never	

MI, myocardial infarction.

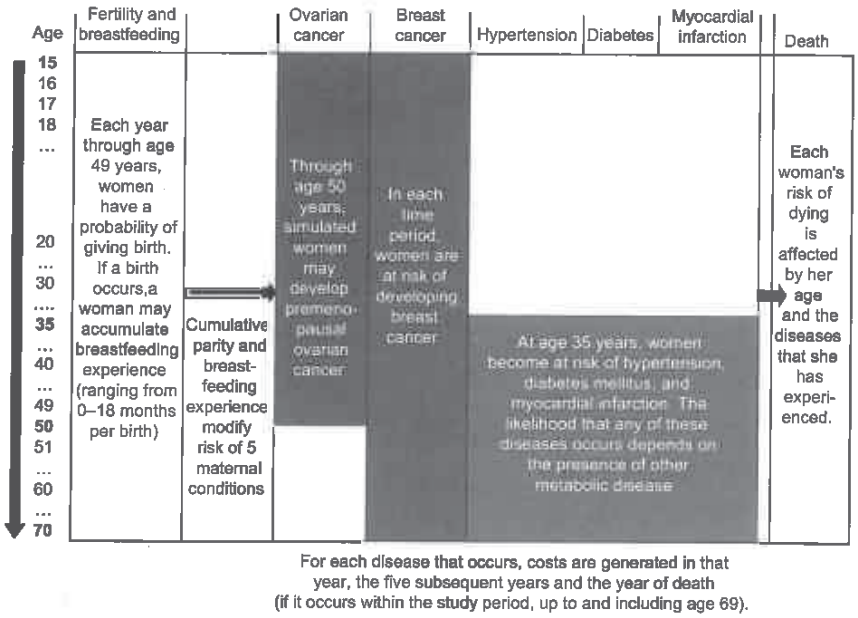

Fig. 1. Tracking the life experiences of a virtual woman in our model. Bold numbers indicate landmark ages.

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experienced in later life. The mean of the distribution of age at first birth in the United States is 25 years. Accordingly, we discounted all costs by the number of years difference between the age at which the cost is incurred and age 25 years.[14]

The first set of simulations describes maternal health outcomes with current rates of breastfeeding. This model simulates women from age 15 years through age 70 years using breastfeeding rates from the 2008 birth cohort from the Centers for Disease Control and Prevention.[15] Because the Centers for Disease Control and Prevention does not collect breastfeeding data beyond age 18 months, the maximum duration modeled in our analysis was 18 months for each birth. We used data from the National Center for Health Statistics to model birth rates and capped parity at six.[16]

A second simulation modeled the experiences of 100,000 hypothetical women who optimally breastfed. Given that some women cannot breastfeed, we assumed that 10% of simulated women would not breastfeed under optimal conditions. Of the remaining 90% of women, all were assumed to breastfeed at least 12 months, but the exact amount each woman breastfed ranged from 12 to 18 months and was determined using a formula that specified that 40% of women who breastfed (36% of all women) breastfeed for 18 months, whereas the remaining 54% of simulated women were randomly assigned across 12 months through 17 months.

To arrive at projected disease rates, deaths, and associated costs for the U.S. female population aged 15 years in 2002 (1.883 million[17]), we multiplied all results by a factor of 18.83. Because associations between breastfeeding and maternal health manifest over time, future costs were discounted at 3%. All simulations were performed in Java.

Because all relationships between lactation and health outcomes described in the literature are estimates, projections of future health outcomes must reflect that uncertainty. We therefore performed each simulation 2,000 times, drawing key parameters at random from triangular distributions covering the range of estimates available in the literature associating breastfeeding with maternal health outcomes, centered on the point estimate provided in the literature and a distribution width of four standard errors. Each simulation produced a data set that reflected a different combination of key estimates. We analyzed variability in our key outcomes across these data sets; these analyses represent a form of probabilistic sensitivity analyses.

We assumed that breastfeeding rates were correlated between pregnancies based on several sources of observational data[18,19] and used data from the Infant Feeding Practices Study II to model breastfeeding duration in a subsequent pregnancy contingent on duration of breastfeeding for the prior birth.[19]

Our analyses focused on five conditions that have been consistently associated with breastfeeding in observational studies that adjusted for parity as well as known or suspected confounders such as diet, physical activity, oral contraceptive use (in the case of cancer and hypertension),[6,7,18] and socioeconomic status (Table 1). For the purposes of our model, we assumed that these multivariate-adjusted associations reflect a causal relationship between breastfeeding and

maternal health. As women aged, their risk of experiencing each of the conditions depended on their breastfeeding experience to that point.

Associations between lifetime duration of lactation and invasive breast cancer (premenopausal or postmenopausal) were drawn from a meta-analysis of 47 epidemiologic studies.[6]

Lactation has been associated with reduced risk of ovarian cancer, and particularly premenopausal ovarian cancer.[7,8,20] We therefore modeled an association between breastfeeding and ovarian cancer until age 51 years, the average age of menopause.[21] Lactation is associated with lower maternal risk of hypertension.[9,18] We used estimates of this relationship from the Nurse's Health Study II,[18] which were adjusted for multiple potentially confounding covariates.

In multiple studies, lactation is associated with reduced maternal risk of type 2 diabetes mellitus.[12,22] Several studies have found differences in diabetes prevalence among postmenopausal women.[22,23] However, the only study to measure incident disease found that the association between breastfeeding and incident type 2 diabetes mellitus disappeared after 15 years after a woman's last birth.[12] Thus, we limited the effect of lactation on type 2 diabetes mellitus accordingly.

Data exist relating breastfeeding duration to coronary heart disease in general[9,24] and to MI in particular.[13] We used estimates of the association between lifetime lactation and incident MI from the Nurses' Health Study.[13] In accordance with this study, we limited the effect of lactation on MI to 30 years after a woman's last birth.

To account for potential overlap among hypertension, diabetes, and MI, we modeled transitions over time between comorbid disease states using a first-order Markov process. We calculated these transition probabilities using data from the longitudinal National Health and Nutrition Evaluation Survey, which assessed a cohort of women in 1987 and the same women again in 1992.[25] Several limitations of these data affect our model: 1) because this national survey lacks data on women before age 35 years, women in our model could not develop hypertension, type 2 diabetes mellitus, or MI before age 35 years; 2) because longitudinal survey data were only available for a 5-year interval, we assumed that transition probabilities were stable within the 5-year intervals and converted these probabilities from 5-year to 1-year intervals; 3) because the survey data were too few to provide stable estimates by year of age, we used transition probabilities for women in three age groups: aged 50 years and younger, 51–65 years, and 65 years and older.

Nulliparity and age at first birth predict breast cancer risk; we estimated the effect of these factors using the Breast Cancer Risk Assessment Tool.[26] For women younger than 35 years, we used data from Surveillance Epidemiology and End Results.[27] To model the relationship between parity and premenopausal ovarian cancer, we estimated from the literature that nulliparous women had twice the odds (95% confidence interval [CI] 1.4–3.3) of ovarian cancer compared with parous women.[28] To estimate associations between nulliparity and metabolic disease risk, we used data showing that nulliparous women have body mass indices[29] and body composition[30] similar to parous women who have breastfed at least 6 months. We therefore assigned nulliparous women the same risk of metabolic disease as women who breastfed for 6 or more months. Available data on type 2 diabetes mellitus, parity, and breastfeeding support this assumption.[23] Given the widespread use of effective contraception in the United States,[31] we assumed that duration of lactation did not affect likelihood of future birth.

To estimate mortality rates for women who developed breast or ovarian cancer, we used data from the yearly survival data from Surveillance Epidemiology and End Results.[27] We used age-specific mortality rates to account for the fact that premenopausal women tend to have less aggressive ovarian cancer and lower mortality rates.[28] For type 2 diabetes mellitus, hypertension, and MI, we used mortality rates from the National Health and Nutrition Examination Survey, although the 1992 survey data reflected all-cause deaths of the women assessed in 1987 and thus reflected the combination of all health conditions a woman had in 1987. All models assumed steady-state rates of disease and mortality.

We defined "premature death" as death at age 69 years or younger, because the median lifespan of a 20-year-old woman in the United States is 81.2 years.[32] We chose this age as a conservative measure of premature death, which reflects a loss of over 10 years from the average life expectancy of a woman in the United States. Simulated women could die from any cause; however, differences attributable to changes in rates of lactation reflect only mortality related to the five illnesses we model.

Published cost data were converted into 2011 dollars using the rate of medical inflation for direct costs and general inflation for indirect costs,[33] because medical inflation outpaces general inflation. Where no dollar year was specified in a source, we assumed the year before publication. We assumed that breastfeeding does not influence the costs of childbearing and discounted future costs by 3% per year, the social discount

rate, to the year when our hypothetical women were aged 25 years, the mean age of U.S. women at first birth.[14] We performed sensitivity analyses with discount rates of 0% and 5%. We subsequently briefly discuss the source and magnitude of each cost estimate; details are in Appendix 2, available online at http://links.lww.com/AOG/A399.

We calculated each death's cost using the value of a statistical life taken from the standard model using a revealed preference model to prevent a premature death (Table 2).[34] This measure is commonly used by government agencies and policymakers.[35,36] Although the Environmental Protection Agency's 2003 value of a statistical life at any age was $8.15 million,[35] other research has shown that the value of a statistical life varies over a lifetime with the highest value for those aged 35–44 years ($12.9 million)[34] and the lowest value for those over age 62 years ($2.81 million).[34,37,38] Although some authors include the cost of lost productivity resulting from premature death in the indirect costs, we did not count mortality-related costs in our estimates of indirect costs.

We estimated direct health costs and the indirect costs of morbidity and premature mortality. For cancers, we partitioned direct costs into those for the year of diagnosis, each year after the year of diagnosis, and the year before death from that cancer. To obtain indirect costs for breast and ovarian cancer, we applied the ratio from the National Institutes of Health of indirect to direct costs of cancer of 0.229.[39]

We used National Cancer Institute data on the direct costs of invasive breast cancer, which ranged from $23,863 for year of diagnosis in women aged 65 years or older to $97,490 for the final year of life in women younger than 65 years[40] (see Appendix 3, available online at http://links.lww.com/AOG/A400). We used cost data from the National Cancer Institute on the direct costs of premenopausal ovarian cancer, which range from $102,147 for the year of diagnosis to $8,578 for years after the year of diagnosis and $154,658 for the final year of life.[40] All deaths resulting from premenopausal ovarian cancer were assumed to occur before age 65 years.

Table 2. Value of a Statistical Life by Age

Age (y)	Value in 2011 Dollars
18–24	$4,130,120
25–34	$11,802,210
35–44	$12,873,950
45–54	$10,416,790
55–62	$4,835,900
Older than 62	$2,810,050

Data from Aldy J, Viscusi W. Age differences in the value of statistical life: revealed preference evidence. Review of Environmental Economics and Policy 2007;1:241–60 and converted into 2011 dollars. There is a paucity of data for value of a statistical life beyond age 62 y. We developed a conservative estimate based on extrapolating Figure 6 in Aldy J, Viscusi W. Age variations in workers' value of statistical life. Cambridge (MA): National Bureau of Economic Research; 2003.

We considered the cost of hypertension alone plus the cost of hypertension as a risk factor for other cardiovascular disease,[41] subtracting out that portion resulting from coronary heart disease.[42,43] We used a direct annual cost of $998 and indirect annual morbidity cost of $98.

Microvascular disease resulting from diabetes (nephropathy, neuropathy, and retinopathy) accounts for 48% of total diabetes costs.[44] We used $3,557 for annual microvascular direct costs and $893 for microvascular indirect morbidity costs. We excluded costs for macrovascular disease to ensure that we did not double count the costs of MI.

Direct medical costs for acute MI are $13,426[42] with indirect morbidity costs of $1,506. After MI, annual ongoing costs for coronary heart disease vary between $1,599[41] and $5,782.[43] Yearly indirect cost estimates vary from $434[41] to $648.[43] To be conservative, we used the lowest cost estimates for subsequent coronary heart disease.

We used Stata 11 to analyze the 4,000 data sets generated by the simulations. We estimated the variability of differences in the population prevalence of maternal cancers, type 2 diabetes mellitus, hypertension, MI, and premature mortality when women breastfed at current compared with optimal rates and the proportion of current disease burden that this change would reflect. We also calculated the range of differences in direct and indirect costs. To avoid double-counting, the latter include lost wages resulting from morbidity only. The CIs reported in Table 3 represent the 2.5th and 97.5th percentiles for the distribution of the outcome of interest across the 2,000 data sets simulated under each rate of lactation. The disease-specific cost differences shown in Table 4 were calculated using the cost estimates provided in Appendix 2 (http://links.lww.com/AOG/A399).

The study was exempt from the Cambridge Health Alliance institutional review board because it does not involve human subjects.

RESULTS

Comparisons of estimated rates of maternal illness under current rates of breastfeeding and under optimal breastfeeding conditions are shown in Table 3. We found significant reductions in three maternal conditions (MI, hypertension, and breast cancer) could be

Table 3. Lifetime Incidence of Maternal Conditions at Current and Optimal Breastfeeding Lactation Rates, Monte Carlo Simulation Model

	Current Rates of Lactation, Cases/1,000 Women	Optimal Lactation, Cases/1,000 Women	Mean Difference With Change From Current to Optimal Lactation, Cases/1,000 Women (95% CI)	Excess Annual Cases of U.S. Maternal Disease Resulting From Suboptimal Lactation* (95% CI)
Breast cancer	61.0	58.3	2.6 (2.1–3.2)	4,981 (3,992–6,044)
Premenopausal ovarian cancer	0.581	0.566	0.02 (−0.01 to 0.05)	28.7 (−19 to 94)
Hypertension	515.7	487.1	28.6 (23.3–34.3)	53,847 (43,836–64,596)
Type 2 diabetes mellitus	67.3	65.0	2.4 (−0.42 to 4.3)	4,482 (−791 to 8,022)
MI	86.8	79.4	7.4 (3.4–11.2)	13,946 (6,318–21,090)
Death before age 70 y	66.1	63.8	2.3 (−0.4 to 4.2)	4,396 (−810 to 7,918)

CI, confidence interval; MI, myocardial infarction.
* Assuming 1.883 million 15-year-old U.S. women per year (data from U.S. Census, 2005).[17]

achieved with changes in population rates of breastfeeding. If observed associations between lactation and maternal health are causal, our model found that optimal breastfeeding would prevent 8.5% (95% CI 3.9–12.7%) of maternal MI, 5.5% (95% CI 4.6–6.6%) of maternal hypertension, and 4.3% (95% CI 3.5–5.3%) of the breast cancers expected under current rates of lactation. This would represent savings in

Table 4. Potential Cost Burden at Current Breastfeeding Rates, in 2011 Million Dollars, by Discount Rate

	At 0% Discount Rate (95% CI)	At 3% Discount Rate (95% CI)	At 5% Discount Rate (95% CI)
Disease-specific costs			
Breast cancer			
Direct cost	$253.43 ($199.49–312.34)	$104.77 ($82.62–129.11)	$61.43 ($48.32–76.20)
Indirect cost	$58.03 ($45.71–71.51)	$23.99 ($18.92–29.56)	$14.07 ($11.08–17.45)
Premenopausal ovarian cancer			
Direct cost	$5.31 ($5.00–18.36)	$3.04($2.73–10.67)	$2.18 ($2.10–7.93)
Indirect cost	$1.22 (−$1.14 to $4.21)	$0.70 (−$62 to $2.44)	$0.50 (−$0.48 to $1.81)
Hypertension			
Direct cost	$823.59 ($670.65–984.18)	$336.15 ($274.32–400.87)	$194.68 ($158.47–232.09)
Indirect cost	$80.87 ($65.84–96.70)	$33.01 ($26.94–39.37)	$19.12 ($15.57–22.79)
Type 2 diabetes mellitus			
Direct cost	$276.02 (−$5.48 to $478.00)	$113.08 ($1.12–196.96)	$65.26 ($1.56–114.04)
Indirect cost	$66.97 (−$1.33 to $115.97)	$27.43 ($0.28–47.80)	$15.83 ($0.38–27.66)
MI			
Direct cost	$430.30 ($220.08–629.70)	$176.69 ($90.74–257.71)	$102.18 ($52.68–148.50)
Indirect cost	$104.91 ($56.49–150.41)	$40.99 ($21.88–58.82)	$22.92 ($12.22–32.84)
All-cause costs			
Total direct cost	$1,788.65 ($1,495.14–2,091.49)	$733.72 ($612.64–859.67)	$425.72 ($354.43–499.37)
Total indirect cost	$312.00 ($243.96–378.56)	$126.12 ($99.00–153.22)	$72.44 ($856.78–87.97)
Premature death (all cause)	$42,461.14 ($17,243.56–58,547.80)	$17,405.60 ($4,375.09–24,676.64)	$9,986.41 ($1,22.31–14,505.70)
Total	$44,561.79 ($19,021.46–60,942.50)	$18,265.44 ($5,136.52–25,625.45)	$10,484.58 ($1,636.08–15,052.66)

CI, confidence interval; MI, myocardial infarction.

direct medical costs of $733.72 (95% CI $612.94–859.67) million and indirect medical costs of $126.12 (95% CI $99.00–153.22) million using a discount rate of 3%. The potential cost savings with optimal lactation under other discount rates are shown in Table 4.

Premature deaths that might be prevented by changes in rates of lactation are estimated to be 4,396 (95% CI −810 to 7,918). At a 3% discount rate, the cost to society of these premature deaths totals $17.41 (95% CI $4.38–24.68) billion. When alternative discount rates are considered, these society costs are shown in Table 4.

DISCUSSION

Our Monte Carlo simulations indicate that if observed associations between lactation and maternal health are causal, optimal breastfeeding[1,2] could significantly reduce rates of breast cancer, hypertension, and MI for U.S. women. Our model found that approximately 4,000 premature maternal deaths could be prevented by optimal breastfeeding, although CIs for this estimate crossed zero. Of note, our point estimate for premature death exceeds the annual number of U.S. deaths from cervical cancer (3,909), asthma (3,361), or influenza (3,055).[45] If a randomized control trial were to demonstrate similar effects to those reported in the observational literature, the "number needed to treat" with optimal breastfeeding to prevent a case of maternal hypertension would be 35, to prevent a maternal MI would be 135, and to prevent a case of breast cancer would be 385.

Previous work has shown that suboptimal breastfeeding is associated with annual pediatric costs of $14.2 billion[4] (or $3,430 per live birth). Our current work builds on these pediatric costs by estimating that the United States annually incurs an additional $18.3 billion in potentially preventable maternal health costs, attributable largely to the high value placed on life lost before the age of 70 years. However, the CIs around this estimate are wide with a lower bound of $5.1 billion.

Of note, our models may underestimate the true maternal costs of suboptimal breastfeeding; we modeled the effects of lactation on only five maternal health conditions despite data linking lactation with other maternal health outcomes.[46] In addition, women in our model could not develop type 2 diabetes mellitus, hypertension, or MI before age 35 years, although these conditions are becoming increasingly prevalent among young adults.[47] Although some studies have found an association between lactation and rates of postmenopausal diabetes[22,23] and cardiovascular disease,[10] we conservatively limited the duration of lactation's effect on both diabetes and MI. Limitations in the underlying studies prevent us from modeling the effect of extended lactation on some maternal conditions (eg, ovarian cancer). Finally, all cost inputs were purposely conservative. It is worth noting that the largest cost–effect in our simulation involves the association between hypertension and breastfeeding. Our source data on this relationship[18] considers the potential effect of unobserved confounding and argues that such confounding is unlikely to explain the adjusted association between breastfeeding and hypertension.

Because of the uncertainty in the underlying research literature, our estimates have broad CIs. The variability in our model results reflects the imprecision of the studies that underlie our model. Although the CIs cross zero for incidence of type 2 diabetes mellitus, premenopausal ovarian cancer, and premature deaths, the associated costs are statistically significant because of the nonlinear nature of these relationships. Key cost figures are sensitive to the choice of discount rates because many health outcomes are observed far into the future; however, under a range of discount rates, our models indicate that investment in policies to support lactation could produce significant cost savings.

Our models assume casual relationships between lactation and maternal health outcomes. Although the observational studies that underlie our models all adjusted for multiple confounders, including known risk factors for the disease outcomes of interest, risk factors for early breastfeeding cessation such as preterm birth, preeclampsia, and obesity are also risk factors for metabolic disease in later life. Our use of observational data reflects the existing literature on lactation and maternal health; apart from a single randomized trial examining the effect of exclusive lactation duration on maternal weight loss,[48] there are no published studies of maternal health outcomes in randomized trials of breastfeeding.

Future studies should capture and report each month of lactation rather than grouping duration responses into multimonth ranges or bins, because finer grained data would strengthen models of breastfeeding's effect on health outcomes. In addition, studies are needed on the effects of lactation on the disease course of women who develop each of the conditions we considered. Data are also needed on the costs of infant feeding. Because we were unable to find adequate data on the time costs of preparing and feeding an infant formula compared with breastfeeding, these costs are not considered in our models. However, we recognize that infant feeding practices have quantifiable time costs in terms of both maternal employment and income. More broadly, updated longitudinal studies of

the natural history of hypertension, diabetes, and cardiovascular disease are needed, because the data from the National Health and Nutrition Examination Survey that we used in our model are somewhat dated.

In conclusion, our models suggest that if associations between lactation and maternal health outcomes are causal, suboptimal breastfeeding currently results in substantial morbidity, mortality, and health costs for U.S. women. The magnitude of these costs warrants definitive study of whether lactation plays a causal role in determining maternal health and should inform national policies and programs to enable more women to reach their personal breastfeeding goals.

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Potential economic impacts from improving breastfeeding rates in the UK

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ABSTRACT

Rationale Studies suggest that increased breastfeeding rates can provide substantial financial savings, but the scale of such savings in the UK is not known.

Objective To calculate potential cost savings attributable to increases in breastfeeding rates from the National Health Service perspective.

Design and settings Cost savings focussed on where evidence of health benefit is strongest: reductions in gastrointestinal and lower respiratory tract infections, acute otitis media in infants, necrotising enterocolitis in preterm babies and breast cancer (BC) in women. Savings were estimated using a seven-step framework in which an incidence-based disease model determined the number of cases that could have been avoided if breastfeeding rates were increased. Point estimates of cost savings were subject to a deterministic sensitivity analysis.

Results Treating the four acute diseases in children costs the UK at least £89 million annually. The 2009–2010 value of lifetime costs of treating maternal BC is estimated at £959 million. Supporting mothers who are exclusively breast feeding at 1 week to continue breast feeding until 4 months can be expected to reduce the incidence of three childhood infectious diseases and save at least £11 million annually. Doubling the proportion of mothers currently breast feeding for 7–18 months in their lifetime is likely to reduce the incidence of maternal BC and save at least £31 million at 2009–2010 value.

Conclusions The economic impact of low breastfeeding rates is substantial. Investing in services that support women who want to breast feed for longer is potentially cost saving.

What is already known on this topic

- Low rates of breast feeding are associated with increased mortality and morbidity among infants and mothers.
- In the UK and many other high-income countries, breastfeeding rates are low.
- Previous studies reported from countries similar to the UK indicate that increasing breastfeeding rates reduces healthcare costs by improving mother and child health.

What this study adds

- Use of breast milk substitutes is associated with a raised risk of four childhood illnesses and maternal breast cancer; breast feeding reduces the related National Health Services treatment costs.
- Supporting mothers who are exclusively breast feeding 1 week after the birth to continue breast feeding until 4 months could save at least £11 million annually, by reducing three childhood illnesses.
- Doubling the proportion of mothers breast feeding for 7–18 months of their lifetime could save £31 million at present value, by reducing maternal breast cancer and increasing both quantity and quality of life.

INTRODUCTION

The prevalence of breast feeding (referred to, hereafter, as 'breastfeeding rates') from initiation to 6 months post birth, has been very low in many Western countries for years.[1] There is good quality evidence (see our systematic review[2]) showing the negative impact of using substitutes for breast feeding on five diseases in children and mothers; gastrointestinal (GI) infection, lower respiratory tract infection (LRTI) and acute otitis media (AOM) in infants; necrotising enterocolitis (NEC) in preterm babies and breast cancer (BC) in mothers. Other conditions including cognitive outcomes, early years obesity, Sudden Infant Death Syndrome and markers of longer-term cardiovascular disease have been associated with the use of substitutes for breast feeding, but the evidence available is not in a form appropriate for robust economic analysis.[2]

The economic impact of infant feeding is extensive and multifaceted.[3] Low rates of breast feeding impact on costs borne by the health service and families, through disease and its treatment as well as expenditure on breast milk substitutes. It has also been argued that women who breast feed make a substantive, direct and positive contribution to the national economy through their supply of breast milk.[4] Previous studies show that increasing breastfeeding rates could result in substantial cost savings per year, for example, US$3.37 billion (in 2007) in the USA (of which US$2.2 billion is direct medical costs and US$1.17 billion is indirect costs to include time missed from work and personal expenses excluding the cost of deaths),[5] $A9 million in Australia (in or before 1997)[6] and €50 million in The Netherlands (in or before 2007).[7] The above figures are not like-for-like comparisons due to variation in methods to estimate such

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savings. Nevertheless, the evidence from industrialised countries suggests that increasing breastfeeding rates could be a cost-saving policy. Interpreting these estimates in a UK context, nevertheless, requires consideration of British breastfeeding rates, treatment regimens and healthcare-seeking behaviour.

The number of women starting to breast feed in the UK has risen sharply over the past 20 years, from 62% in 1990 to 81% in 2010.[1] Despite this increase, rates of breast feeding duration and exclusivity have remained low (in 2010, 55% were breast feeding at 6 weeks, 23% exclusively (48% and 21%, respectively, in 2005[5])), and most women who start to breast feed stop before they would like to as a result of problems.[1 9] This has encouraged policy makers to set targets and offer financial support to UK health services to implement the Unicef UK Baby Friendly Initiative and other strategies.

The purpose of this paper is to calculate potential cost savings to the National Health Service (NHS) attributable to increases in breastfeeding rates in the UK through preventing the five diseases for which evidence of health benefit is strongest. It is expected that such information will be useful in planning, commissioning and policy decisions related to breastfeeding support services.

METHODS

The methods of this economic analysis have been described in detail elsewhere[2] and are summarised briefly below.

Identifying priority diseases

The five priority diseases—four acute diseases in infants and BC in women—were identified through an extensive systematic process that examined high-quality systematic reviews and large, high-quality UK studies.[2] Only reviews and studies that met quality criteria including adequate measures of exposure to breast feeding, formula feeding and weaning, and where data existed to allow economic analysis, were included.

Perspective

The perspective of the economic analysis is the NHS in the UK. We did not include any costs associated with not breast feeding that fall on individuals, households and/or any other sectors. Data on treatment costs and potential cost savings are presented in 2009–2010 prices.

Time horizon

For three acute conditions (GI, LRTI and AOM), analysis was limited to the first year of life, whereas maternal BC estimates took a lifetime perspective, and analysis of NEC focussed on the baby's stay in a neonatal unit. Where the time horizon was longer than a year (ie, maternal BC), a discount rate of 3.5% was used.[10]

Economic modelling

Building on methods employed in previous studies,[3 5 6] a seven-step framework was developed (see web appendix figure 1). First, a 'base case', reflecting current levels of breast feeding in the UK, and alternative policy scenarios for each priority outcome were defined and used to assess the impact of achieving potential policy targets. All alternative scenarios were based on breastfeeding rates in the UK. Noting that 90% of women in the UK who stop breast feeding before 6 weeks do so before they wish to,[8] we assumed that women who initiated breast feeding could breast feed for considerably longer than at present with appropriate care and support.[11] This facilitated the use of varied definitions of breast feeding and the time horizon over which costs and benefits would accrue. Table 1 shows these scenarios. For example, scenario A1 envisaged an increase in the exclusive breast feeding rate at 4 months from 7% (observed in 2005) to 21% (observed at 6 weeks in 2005). This assumes a policy in which mothers who are breast feeding at 6 weeks are given appropriate care and support enabling them to breast feed for at least 4 months.

Next, the reference population was selected as: children born in the year 2009 for child diseases and a cohort of 'first-time' (to be meaningful for future policy change) mothers in 2009. Then, the reference population was divided into two feeding groups for each policy scenario: breast fed/breast feeding and non-breast fed/breast feeding, using rates derived from the

Table 1 Policy scenarios developed to model costs and potential savings

	Definition of breast feeding and rate used (base case)*	Alternative policy scenarios modelled		
Gastrointestinal illnesses Lower Respiratory tract infections Acute otitis media	Scenario A0: current rate (base case) for '*exclusive*' breast feeding rate at *4 months* (7%)	Scenario A1: increase from 7% to 21% at 4 months, (21% refers to the rate currently observed at 6 weeks)	Scenario A2: increase from 7% to 45% at 4 months, 45% refers to the rate currently observed at 1 week	Scenario A3: increase from 7% to 65% at 4 months, 65% refers to the rate currently observed at birth
	Scenario B0: current rate (base case) for '*exclusive*' breast feeding rate at *6 months* (0.5%)	Scenario B1: increase from 0.5% to 7%, (7% refers to the rate currently observed at 4 months)		
	Scenario C0: current rate (base case) for '*any* breast feeding' rate at *6 months* (25%)	Scenario C1: increase from 25% to 48%, (48% refers to the rate currently observed at 6 weeks)		
Necrotising enterocolitis	Scenario D0: current rate (base case): Any breast milk feeding rate at discharge from neonatal unit neonatal units (35%)	Scenario D1: increase from 35% to a hypothetical 50%	Scenario D2: increase from 35% to a hypothetical 75%	Scenario D3: increase from 35% to a hypothetical 100%
Maternal breast cancer	Scenario E0: current rates (base case): 32% parous women never breast feeding, 36% breast feeding for ≤6 months, 16% breast feeding for 7–18 months, 16% breast feeding for 18+ months	Scenario E1: Increase rate of breast feeding for ≤6 months to 52%, 16% never, 52% ≤6 months, 16% 7–18 months, 16% 18+ months	Scenario E2: Increase rate of breast feeding for ≤18 months to 32%, 16% never, 36% ≤6 months 32%, 7–18 months, 16% 18+ months	Scenario E3: Increase rate of breast feeding for 18+ months to 32%, 16% never, 36% ≤6 months, 16% 7–18 months, 32% 18+ months

*Source for base case breastfeeding figures: A0-C0 (IFS 2005[5]); D0 (MOSAIC cohort[9]); E0 (Million Women Study[12]). Note that at the time of this study, 2010 IFS data[1] on breastfeeding rates were not available. Hence, the use of 2005 IFS data for A0-C0

Table 2 Key disease parameters and values used to model breastfeeding scenarios**

Outcome	Odds ratios in favour of breast feeding	Incidence	Unit costs (2009/2010 prices)
Gastrointestinal illnesses	Exclusive breast feeding. Hospitalisation: 0.39 (0.18–0.85)[20] GP visits: 0.28 (0.11–0.69)[21] Any breast feeding: Hospitalisation: 0.52 (0.30–0.87)[20] GP visits: 0.36 (0.18–0.74)[21]	Hospital admissions: 17.2/1000 live births* Primary care consultations: 4682/100 000 infants <1 year†	Hospital admissions‡: Baseline: £989 per admitted child Lower quartile: £586 Upper quartile: £1206 Primary care consultation[22]: Baseline: £36 per GP consultation Upper end cost: £53
Lower respiratory tract infection	Exclusive breast feeding: Hospitalisation: 0.70 (0.49–0.98)[20] GP visits: 0.69 (0.47–1.0)[23] Any breast feeding: Hospitalisation: 0.67 (0.52–0.88)[20] GP visits: 0.65 (0.43–0.96)[24]	Hospital admissions: 59.1/1000 live births* Primary care consultations: 23 433/100 000 infants <1 year†	Hospital admissions‡: Baseline: £1078 per admitted child Lower quartile: £749 Upper quartile: £1290 Primary care consultation[22]: Baseline: £36 per GP consultation Upper end cost: £53
Acute otitis media	Exclusive breast feeding: GP visits: 0.50 (0.37–0.70)[25] Any breast feeding: GP visits: 0.40 (0.21–0.76)[24]	Primary care consultations: 136/100 000 infants <1 year†	Primary care consultation[22]: Baseline: £36 per GP consultation Upper end cost: £53
NEC	Any breast milk: 0.19 (0.05–0.73)[26]	NEC cases[27]: 1/100 neonatal admissions Surgical NEC: 31% Medical NEC: 69% Average length of stay: 26.7 days§	Surgery‡: Baseline: £1450 per episode Lower quartile: £689 Upper quartile: £1802 Neonatal unit stay‡: Baseline: £618 per bed-day Lower quartile: £509 Upper quartile: £712
Maternal breast cancer	Ever breast feeding vs never breast feeding: 0.96 (0.92–0.99)[28] Breast feeding for <6 months vs never: 0.98 (0.95–1.01)[28] Breast feeding for 7–18 months vs never: 0.94 (0.91–0.97)[28] Breast feeding for 18+ months vs never: 0.89 (0.84–0.94)[28]	Breast cancer cases: Lifetime incidence of 12 500/100 000 population (ie, a lifetime risk of one in eight)¶	Breast cancer average: Baseline: £11 726 per case[29] Upper end cost: £16 260[30]

*Infant Feeding Profiles 2002/2003–2009/2010. Beta Test V.7 September 2011 from Department of Health.
†Data made available by the Royal College of GPs Research and Surveillance Weekly Returns Service for 2010.
‡Estimated by research team based on the NHS Reference Costs 2009–2010. Available at: http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_123459
§Hospital Episode Statistics 2009–2010: http://www.hesonline.nhs.uk/Ease/servlet/ContentServer?siteID=1937&categoryID=192
¶Breast cancer UK incidence statistics. Cancer Research UK: http://info.cancerresearchuk.org/cancerstats/types/breast/incidence/
**Details of each parameter value can be found in the Appendix to the main report, pp.86–113 available from http://www.unicef.org.uk/Documents/Baby_Friendly/Research/appendices_preventing_disease_saving_resources.pdf
NEC, necrotising enterocolitis; NHS, National Health Service; GP, general practitioner.

Infant Feeding Survey for child outcomes[8] and estimates of lifetime breastfeeding duration derived for BC.[12] The differential disease incidence was obtained using the formula: x=s/(br+1−b), where x=disease incidence in a non-breastfeeding group, s=overall incidence of the disease in question, b=current breastfeeding rate; r=risk ratio in favour of breast feeding, and xr=incidence of the condition in a breastfeeding group.[5] The risk ratios (or ORs where risk ratios were not available) were abstracted (or calculated) from the primary source, using the most appropriate definition of infant feeding for that particular disease (eg, the time-dependent nature of the exposure and the disease) and were adjusted for confounders including sociocultural factors. The values of these ratios are given in table 2.

The estimated incidence of care episodes was then multiplied by the unit cost of a care episode (eg, hospitalisation). For maternal BC, a cohort of 100 000 women was followed-up over their lifetime, using a simple three-state Markov process (cancer, no cancer, death), to estimate treatment costs. The relevant care episodes and unit costs used in the model are provided in table 2.

Total treatment costs for primary and secondary care were estimated using the relevant UK population for each priority outcome (eg, 788 486 infants in the case of GI) and savings compared with the 'base case' calculated. In the case of BC, the incremental benefit that combines a value of £20 000 per quality-adjusted life year (QALY) gained with treatment costs was estimated. Lifetime costs and QALYs were discounted prior to averaging. Life years were adjusted by a utility value of 0.71.[13] Findings present the potential savings to the NHS that might result from increased rates of breast feeding.

Finally, deterministic sensitivity analyses assessed the impact of uncertainties in key parameters on the predicted cost savings; disease incidence, ORs, unit costs of treating a care episode or disease, discount rate and utility values. Values of parameters were changed one at a time, using the ranges set out in table 2, to identify the impact on costs and potential savings. Life-years were adjusted by a utility value of 0.80 and 0.67[13] in the sensitivity analysis.

RESULTS

Current treatment costs

The NHS cost of treating three childhood diseases (GI, LRTI, AOM) was calculated as £75.5 million per year; the cost of treating NEC in preterm babies was calculated as £13.5 million per year and the lifetime costs of treating BC in parous women was calculated as £960 million at present value (table 3).

Potential cost savings

Increasing the proportion of women breast feeding exclusively for 4 months (7%) to 21% (Policy A1) would reduce hospital cost associated with GI by approximately £1.2 million per annum. Increasing the rate further to 45% (Policy A2) or 65% (Policy A3), would save £3.2 million or £5 m per annum, respectively. The inclusion of primary care costs would provide total potential savings associated with this condition of £1.34–£5.54 million per annum.

Around £2 million per year could be saved in LRTI hospitalisation costs and £0.3 million per annum in general practitioner consultation costs by increasing the exclusive breast feeding rate at 4 months (7%) to 21% (Policy A1) (table 3). Potential cost savings from avoiding the need to treat AOM in primary care is estimated to be between £0.28 and £1.16 million, depending on whether the exclusive breast feeding rates at 6 months increases from the current 7% to 21% (Policy A1) or 65% (Policy A3).

£2.3 million per year could be saved if the proportion of babies fed any breast milk (mother's own or donor milk) until discharge from neonatal units were to increase from 35% to 50% (table 3). These figures suggest that the cost of each

Table 3 Estimated *total* costs of treating five identified diseases and potential savings/benefits associated with increased breastfeeding rates in the UK (£, million, 2009–2010 prices)

	Gastrointestinal			Lower respiratory tract infection			Acute otitis media		Necrotising enterocolitis (NEC)	Maternal breast cancer (BC)		
	H	p Values	*Total*	H	p Values	*Total*	p Values	*Total- acute diseases*	Treatment costs	Treatment costs	Value health gains*	*Total*
Current treatment costs	13.42	1.33	14.75	50.25	6.65	56.90	3.85	75.5	13.54	959.50	NA	959.50
Savings with												
Policy A1	1.20	0.14	1.34	2.16	0.30	2.45	0.28	4.08				
Policy A2	**3.25**	**0.38**	**3.63**	**5.85**	**0.80**	**6.65**	**0.76**	**11.04**				
Policy A3	4.96	0.58	5.54	8.93	1.22	10.25	1.18	16.95				
Policy B9	0.56	0.07	0.63	1.00	0.14	1.14	0.13	1.9				
Policy C1	1.68	0.23	1.91	4.16	0.59	4.75	0.62	7.28				
Policy D1									2.30			
Policy D2									**5.12**			
Policy D3									9.95			
Policy E1										15.34	7.42	22.76
Policy E2										**21.17**	**10.25**	**31.42**
Policy E3										27.80	13.46	41.26
Total savings from mid-level policy scenario (Policy A2)—acute diseases										11.04		
Total savings from mid-level policy scenario (Policy D2)—NEC										5.12		
Total savings from mid-level policy scenario (Policy E2)—BC (without value of health gains)										21.17		
Total benefits from mid-level policy scenario (Policy E2)—BC (with value of health gains)										31.42		

The italics face is used to differentiate table 3 from table 4. One provides 'total', the other provides 'average' figures. The bold face **highlight** policies that are recommended as realistic targets in the discussion section
*Monetary value of health (QALY) gains @ £20 000/QALY
NA, Not applicable
H, hospitalisation costs, P, primary care costs

Table 4 Estimated *average* costs per individual of treating identified diseases and potential cost savings associated with increased breastfeeding rates in the UK (£, 2009–2010 prices)

	Gastrointestinal illnesses*	Lower respiratory tract infection*	Acute otitis media*	Necrotising enterocolitis†	Maternal breast cancer‡
Current treatment costs	17.02	75.52	4.88	171.13	3057.51
Savings with:					
Policy A1	0.92	3.12	0.35		
Policy A2	2.49	8.48	0.96		
Policy A3	3.81	12.94	1.47		
Policy B1	0.43	1.45	0.16		
Policy C1	1.52	6.05	0.79		
Policy D1				29.02	
Policy D2				77.39	
Policy D3				125.75	
Policy E1					48.88
Policy E2					67.46
Policy E3					88.59

*Cost per infant
†Cost per neonatal admission
‡Cost per primiparous woman

neonatal unit admission could be reduced, on average, by at least £30.

Over £15 million, for a total of 313 817 first-time mothers (the annual cohort in 2009), could be saved in treatment costs for BC over their lifetime, if half the women who currently do not breast feed were enabled to breast feed for up to 6 months during their lifetime (table 3). If the proportion of those 'never breast feeding' was halved, and 32% of women were enabled to breast feed for a lifetime total of 7–18 months, the net present value of predicted savings from BC would be over £21 million over the lifetime of 313 817 first-time mothers.

QALY gain

A total of 371 QALYs would also be gained from the reduction in incidence of BC across the lifetime of 313 817 first-time mothers, if half the number of those not breast feeding currently were supported to breast feed for up to 6 months in their lifetime. Given a willingness to pay £20 000 per QALY as recommended by the National Institute for Health and Care Excellence, the net present value of these gains, when combined with savings from treatment costs, are £23 million, £31 million and £41 million, respectively, for the three policy scenarios.

Average cost savings

For comparative purposes, these results are also presented as average costs in table 4. For example, GI in the UK costs the NHS a total of £17 per infant per year, but potential savings if exclusive breast feeding increased from 7% to 21% at 4 months could be £0.92 per infant per year. The potential savings from NEC could be £77 per neonatal admission per year if the current rate of breast milk feeding in the neonatal units were to increase to 75% at discharge.

Sensitivity analysis

Table 5 presents results from the sensitivity analysis showing sensitivity. The results were most sensitive to the value of ORs used. For example, the lowest estimate of GI-related cost savings under policy scenario A1 (£0.34 million) was the result of using a higher value of OR than the baseline OR (hence less effective). The use of the lower value of the OR (rather than the baseline OR) yielded the highest estimate of GI-related savings under policy scenario A1 (£1.78 million).

DISCUSSION

Main findings

Supporting mothers who are exclusively breast feeding at 1 week to continue breast feeding until 4 months could save at least £11 million per year by reducing the incidence of three acute infections in children. Additionally, increasing the current rate of breast milk feeding in the neonatal units from 35% to 75% could save £6.12 million per year in treatment costs by reducing the incidence of NEC. If the proportion of mothers currently breast feeding for 7–18 months in their lifetime were to double, a net present value of £21 million savings could be realised by reducing the incidence of BC over the lifetime of each annual cohort of first-time mothers (plus a further £10

Table 5 Selected results from the sensitivity analyses for policies A1, D1 and E1 (£, million, 2009–2010 prices)

	Gastrointestinal illnesses	Lower respiratory tract infection	Acute otitis media	Necrotising enterocolitis	Maternal breast cancer
Mean estimate	1.20	2.16	0.28	2.30	22.8
Lowest estimate	0.34	0.44	0.17	0.61	6.00
Highest estimate	1.78	4.50	0.35	2.90	40.0

Cost savings figures are for low-level policy scenario (ie, A1s—E1s) and include only hospitalisation costs for gastrointestinal, lower respiratory tract illnesses and acute otitis media and treatment costs for necrotising enterocolitis and maternal breast cancer. This sensitivity analysis relates to estimates provided in table 3.

million value attributed to QALY gains). These equated to £14 per infant in the first year of life, £77 per neonatal admission and £100 per first-time mother, respectively.

Strengths and weaknesses

This is the first study to quantify, nationally, the burden of illness associated with the low breastfeeding rates in the UK and potential gains to the NHS (from reduced illness, saved costs and increased quality of life) achievable through increased breast feeding. We made assumptions about a realistic increase in breastfeeding rates, but consider these achievable given that 80% of Norwegian mothers,[14] 68% of Swedish mothers[15] and 60% of Australian mothers[16] breast feed at 6 months. In fact, the target rates we have applied to estimate cost savings are lower than those seen in other European countries. While a number of alternative scenarios are presented for evaluation, the mid-level scenarios (Policies A2, D2 and E2) could serve as realistic policy targets for interventions.

Comparison with other studies

Our study adds to the global empirical database on the scale of potential cost savings achievable through increasing breastfeeding rates. In Italy, the difference in treatment costs between 'fully' breast fed (exclusively or predominantly for 3 months) and 'partially' breast fed (complementary feeding or no breast feeding) children was estimated at €160 per infant per year.[17] Increasing the exclusive breastfeeding rate at 6 months to 90% was estimated to save US$3.37 billion per year in treatment costs in the USA[5] and, assuming a 100% breastfeeding rate, €250 per newborn per year in the Netherlands.[7] Achieving an exclusive breastfeeding rate of 80% at 3 months was estimated to save SA$9 million per year.[6]

By contrast, our estimates were based upon relatively small increments in the prevalence of breast feeding. We took account of rates achieved in other European countries[14 15] as well as the encouraging trends observed in the UK over the past 25 years.[1 18] Greater economic gains would be made were rates to increase further. Focussing purely on the five diseases associated with the strongest evidence base increases the robustness of results, but also indicates that the calculated savings may be underestimates.

Implications

It is very important to note that achieving the savings we describe does not depend upon persuading more women to breast feed after the birth. Rather it envisages that those women who have chosen to breast feed will receive better early support through investment in proactive, accessible, high-quality services. This is very important because national statistics indicate that 80% of women who stop breast feeding in the early weeks would have liked to have breast fed for longer.[1] Our study should reassure policymakers, service planners and commissioners that a rapid return on investment is realistic and feasible, supported by cost savings that can be realised in the first year of infants' lives.

Future research

High-quality evaluations of the effectiveness and cost effectiveness of interventions that support women to breast feed longer are now needed. Our findings can contribute to these studies through robust estimates of both robust short-term and long-term effects.

CONCLUSION

Increasing the current breastfeeding rates is likely to generate substantial cost savings to the NHS in the UK; the actual amounts saved will depend on the extent of the increase and the effectiveness of interventions. While the cost of these interventions must be considered, the potential savings indicate that substantial further investment has a strong economic case.

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Potential economic impacts from improving breastfeeding rates in the UK

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Notes

The Power of the First Hour:
BREASTFEEDING SAVES LIVES

Company Briefings: Nestlé & Danone

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Nestlé & Danone: **STOP** RISKING CHILDREN'S HEALTH

Nestlé: The Longest Boycott in History

Nestlé is the world's largest food company and accounts for 23% of the global baby nutrition food sector. It has distribution networks in 140 countries and is one of the world's most recognised brands.

After reports of aggressive marketing practices by Nestlé were uncovered in the 1970s, a Nestle boycott was organised in 1977, which is still in force today – the world's longest running continuous boycott of a company.

Of all the breast milk substitute manufacturers, Nestle has some of the most developed internal policies on monitoring the WHO code on breast milk substitutes with sophisticated internal monitoring and progressive policies compared to its competition. However, in recent monitoring reports Nestle was still associated with too many examples of violations reported by groups monitoring the code, and we believe they can improve their compliance with the code.

Recent reported Code Violations

Potentially misleading branding can have serious effects on children's health in poor countries. In 2008 this was highlighted by the British Medical Journal which published an article in response to reported cases of malnutrition in Laos amongst infants who had been fed coffee creamer. According to the article, the product used in those cases was reported to be Nestlé's Bear Brand coffee creamer, which at the time carried a logo of a cartoon baby bear being held by its mother in what appears to be the breastfeeding position. The largest ingredient in the creamer was sugar.

The journal conducted a survey examining what it called the 'misperceptions and misuse' of the Bear Brand coffee creamer among paediatricians and consumers in 84 villages across the country. The survey found that 18% of parents had fed the creamer to their children and 39% thought it was good for infants. The study concluded that the labelling and logo put children's health at risk. Nestlé has since amended the logo to show a mother bear holding a glass.

In 2012 a Nestle factory in India was raided by the India Food and Drug Administration after reports of inappropriate labelling (specifically placing a bottle on the packaging instructions and were accused by government officials of 'clever marketing techniques that needed to be checked' to be in compliance with Indian law[1]. India has some of the most comprehensive and strict labelling laws in the world, the application of which Nestlé has challenged in court[2] – a case that has dragged on from 1994 until now[3].

Recent research by Save the Children suggests that representatives of Nestlé are also still active in hospitals and health centres, speaking directly to mothers and Health workers. Save the Children's research in China found that 40% of mothers interviewed said that they had been contacted directly by baby food companies' representatives (including, in a number of cases, by Nestlé); Seventy-nine

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[1] http://www.indianexpress.com/news/haryana-goes-after-nestle-baby-food/983986 accessed on 31/1/2013. Nestlé claims that its depiction of the bottle was to explain preparation only and that it is now revising its infant formula labels.

[2] Nestle claims it was in compliance with one of two conflicting laws at the relevant time and is not challenging the law

[3] http://www.foodnavigator-asia.com/Policy/Nestle-in-the-dock-for-17-year-old-complaint-on-flouting-infant-formula-labelling-laws accessed on 31/1/2013

per cent of these mothers said the representatives had recommended their companies' products or given them free samples.

A nationally representative survey commissioned by Save the Children in Pakistan in 2012[4] shows that one in ten health professionals surveyed said that their health facility had received free samples of breast-milk substitutes, teats or bottles in the previous six months; half of the free samples were said to be of infant formula. Among all those respondents who said they had received a sample, 68% said that the sample had been manufactured by Nestlé[5].

Danone: A new violator on the block?

Danone is the second largest baby food manufacturer in the world, accounting for 14% of global business. It operates in 150 countries with the majority of its revenue from European sales, however emerging markets in Asia accounted for 40% of Danone's revenue in 2011.

A well-known brand in Europe, Danone's formula marketing practices have not been scrutinised to the same degree as Nestlé, although the company have said they will be publishing new global policies in the next few weeks. However, Danone has been found to have made misleading advertising claims in the past about its products. In 2010, the European Food Standards Agency ruled that Danone did not have sufficient evidence to justify a claim that the '*Immunofortis*' ingredient in its baby formula products strengthened an infant's immune system;[i] subsequently Danone said that the name *Immunofortis* would no longer be used on products manufactured after the end of 2012, but the shield logo will still be used.

Recent reported Code Violations

In 2007 Danone acquired Sari Husada[ii], a BMS company in Indonesia which has been cultivating relationships with midwives in Indonesia for several years through its "Srikandi" programmes.[iii] These programmes aim to build brand loyalty and trust among health workers, including midwives. Evidence published by IBFAN in 2010 and seen by Save the Children suggests that the Srikandi scheme provided midwives with incentives of money and foreign travel in return for selling formula.[iv] The evidence suggests that Srikandi midwives were given monthly criteria including providing details of infants delivered and buying a certain amount of formula and that midwives could get financial rewards, invitations to scientific seminars and tourism trips, depending on how long they remained in the scheme. Some of the free trips on offer were said to be a pilgrimage to Mecca.[v] Danone has since stated that this programme has been discontinued.

However Danone has since launched a new Srikandi Academy in 2011. The stated aim of the project is to "help junior midwives establish practices in rural areas".[vi] But a business case for the project presented in January 2012 suggests that this may not be the only aim. It states that "Health Care Professionals (midwives especially) are of course key endorsers / brand ambassadors for our products!"[vii] Targeting of health workers is against the code.

There have also been reports of Danone representatives contacting mothers and health workers directly in China. A survey we conducted found that 40% of mothers interviewed said that they had been contacted directly by baby food companies' representatives. Seventy-nine per cent of these mothers said the representatives had recommended their companies' products or given them free

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[4] Save the Children, Breastfeeding and Code Violation Survey (Pakistan), October 2012

[5] Violation of Article 7.3, which states that no samples of infant formula or other products listed in the Code should be provided to healthworkers except for professional evaluation or research.

samples. The brand mentioned most frequently by mothers who said they had been contacted directly by baby food companies' representatives was Dumex (**Danone**).

Danone is a member of several industry lobbying associations that seek to influence laws, legislation and influence public perceptions around their products. While industry undeniably has a role to play in deciding policies, in our view these associations are not always fully and publicly transparent.. The Asia Pacific Infant and Young Child Nutrition Association (APIYCNA) of which Danone is a member, has hired a global PR firm to lobby the World Health Organisation.[viii] Danone is also a member of the Hong Kong Infant and Young Child Nutrition Association (HKIYCNA)[ix] which has placed newspaper ads in support of the marketing of formula and commissioned a survey of mothers that showed a lack of support for the Hong Kong Code on breast milk substitutes[x].

This is a known problem. The WHO 2002 Civil Society Initiative report said that there were "insufficient safeguards" on conflict of interest and "a lack of systematically accumulated knowledge about the sponsors and the interest groups behind individual NGOs".[xi]

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[iv] IBFAN BTR 2010

[v] A violation of Article 7.3 of the Code. Breaking the Rules, Stretching the Rules 2010. Companies' marketing behaviour is measured against the *International Code of Marketing of Breastmilk Substitutes and WHA resolutions. Danone Company profile & Code violations*

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