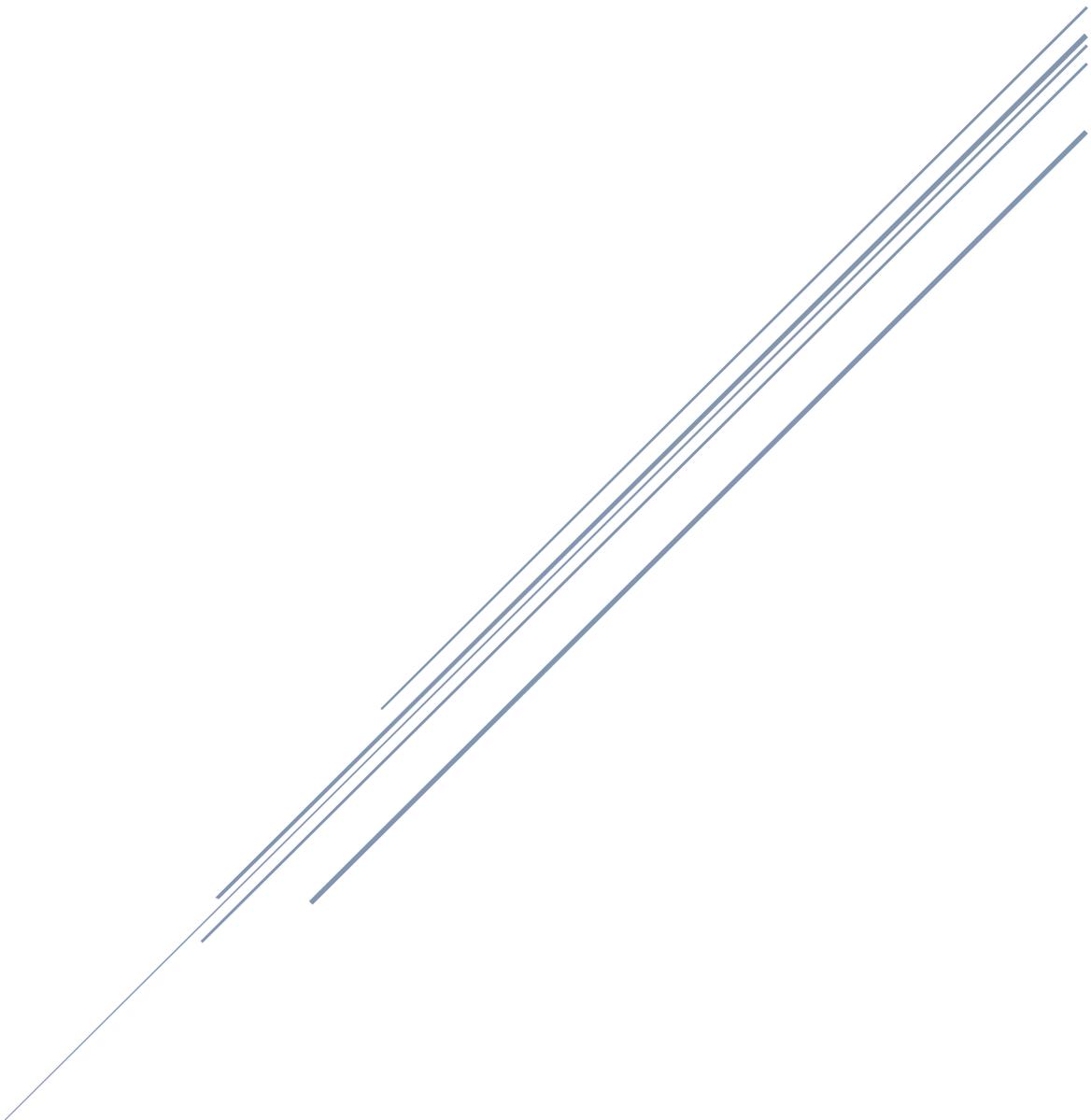


Digital marketing of breastmilk substitutes: a systematic scoping review

Submitted to the World Health Organization, 13 August 2021



The George Institute
for Global Health Australia

Publishing Notes

The following report was prepared by The George Institute for Global Health. The George Institute is a leading independent global medical research institute established and headquartered in Sydney. It has major centres in China, India and the United Kingdom, and an international network of experts and collaborators. Our mission is to improve the health of millions of people worldwide by using innovative approaches to prevent and treat the world's biggest killers: non-communicable diseases (NCDs) and injury.

Our work aims to generate effective, evidence-based and affordable solutions to the world's biggest health challenges. We research the chronic and critical conditions that cause the greatest loss of life and quality of life, and the most substantial economic burden, particularly in resource-poor settings.

Our food policy team works in Australia and overseas to reduce death and disease caused by diets high in salt, harmful fats, added sugars and excess energy. The team conducts multi-disciplinary research with a focus on generating outputs that will help government and industry deliver a healthier food environment for all.

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Executive Summary

Worldwide, too few children are breastfed. Commercial promotion of breast-milk substitutes is one factor undermining breastfeeding practices globally.

The International Code of Marketing of Breast-milk Substitutes was adopted by the World Health Assembly in 1981 to protect and promote appropriate infant and young child feeding. It calls for prohibition of all forms of direct-to-consumer promotion of breast milk substitutes by manufacturers and distributors and specifies appropriate practices in relation to public education about infant feeding. Several subsequent resolutions have been issued to update and clarify the Code, including World Health Assembly Resolution 54.2, which expressed concern over the use of “new modern communication methods, including electronic means” to promote products within the scope of the Code, and called on governments to strengthen mechanisms to ensure compliance in all forms of media.

In 2021, the World Health Organization commissioned The George Institute for Global Health to conduct a systematic scoping review describing existing literature on the scope and impact of digital marketing for promotion of breastmilk substitutes. This work will inform a report to the World Health Assembly in 2022.

We conducted systematic searches of academic and grey literature, including case reports from marketers themselves. Results from these searches highlight that breastmilk-substitutes are being marketed in a strategic and integrated fashion across a wide range of digital channels including social media platforms like Facebook and Instagram, manufacturer owned websites and online retailers, blogs, mobile apps and digital streaming services. Exposure to digital marketing of breastmilk substitutes is common, as self-reported by women and seen in examples of videos with millions of views, and posts with thousands of ‘likes’ and ‘shares’.

The strategies used by manufacturers to market in a digital context include well-known but prohibited tactics translated from traditional media, including posting imagery and/or wording that idealizes use of breastmilk substitutes, and offering coupons, samples, and discounts at online retail sites. The digital context also offers new opportunities for marketers that present novel challenges for promoting, protecting and supporting breastfeeding. These include widespread mining of consumer data to facilitate highly-targeted cross-device marketing to specific segments of the market, new avenues such as apps to directly contact parents in real time, and establishing financial relationships with parents to promote products to their peers on blogs and social media.

Available studies suggest that this marketing has a negative impact on intention to breastfeed, and a negative impact on breastfeeding initiation. The academic evidence is supplemented with manufacturers’ reports on the benefits of digital marketing for increasing intention to use, recruiting new users, and ultimately increasing sales from their products.

Addressing this will require strengthened action to implement, monitor and enforce the Code internationally, and through national legislation. Beyond the Code, additional policy avenues in the digital context include targeting the advertising policies of social media platforms, and exploring the application of data privacy regulation. As consumers and parents spend an increasing proportion of their lives online, renewed action to ensure that regulation keeps up with constantly evolving and increasingly sophisticated digital marketing tactics will be critical to protect public health worldwide.

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Background

Despite significant efforts to improve breastfeeding practices and achieve the WHO Global Nutrition Target for breastfeeding, too few children are breastfed as recommended (WHO and UNICEF, 2003). Worldwide, around 44% of infants under 6 months of age were exclusively breastfed during the period 2015-2020 (World Health Organization, 2020). Commercial promotion of breast-milk substitutes (BMS) undermines efforts to improve breastfeeding practices globally (Piwoz, Huffman, & L., 2015).

In 1981, the 34th session of the World Health Assembly (WHA) adopted the International Code of Marketing of Breast-milk Substitutes (the Code) as a minimum requirement to protect and promote appropriate infant and young child feeding (World Health Organization, 1981). The aim of the Code is “to contribute to the provision of safe and adequate nutrition for infants, by the protection and promotion of breastfeeding, and by ensuring the proper use of BMS, when these are necessary, on the basis of adequate information and through appropriate marketing and distribution” (World Health Organization, 1981). The Code also calls upon governments to introduce domestic legislation to regulate the marketing of BMS. In a subsequent resolution in 2001, the WHA expressed concern over the use of “new modern communication methods, including electronic means” to promote products within the scope of the Code, and called on governments to strengthen mechanisms to ensure compliance in all forms of media (World Health Assembly, 2001).

While progress has been made in implementing the Code (WHO and UNICEF, 2018, 2020), challenges persist to effectively do so. As of April 2020, 136 (70%) of 194 WHO Member States had enacted legal measures with provisions to implement the Code. Of these, 25 countries had measures substantially aligned, and a further 42 countries had measures moderately aligned with the Code. In most countries, monitoring and enforcement of regulation remained weak (WHO and UNICEF, 2020).

The value of the global milk formula market is expected to surpass USD 98 billion by 2025 (Global Market Insights, 2019). Marketing practices increasingly reach beyond traditional settings such as retail outlets and mass media. Use of digital platforms by manufacturers and distributors for marketing their products is accelerating (Changing Markets Foundation, 2017a; Save the Children, 2018). Digital marketing practices that were not yet conceived when the Code was written are now used regularly to reach young women and their families with messages that undermine breastfeeding (Piwoz et al., 2015).

In 2020, the seventy-third WHA requested the WHO to review current evidence and prepare a comprehensive report to understand the scope and impact of digital marketing strategies for promotion of BMS to the Seventy-fifth WHA in 2022 (World Health Assembly, 2020). The aim of this review is to systematically describe existing literature on the scope and impact of digital marketing for promotion of BMS to inform that report.

Research objectives

The specific objectives are to:

- Understand what is known about the scope of digital marketing strategies for promotion of BMS and their alignment with the International Code of Marketing of BMS and subsequent relevant WHA resolutions;
- Understand what is known about the impact of digital marketing for promotion of BMS on
 - knowledge, attitudes, perceptions and beliefs (what people think)
 - intentions (what people think they will do)
 - behaviours (what people have done, e.g. uptake and use of BMS).

Methodology

Protocol and registration

The protocol of the study was registered a priori in the Open Science Framework Registry (<https://osf.io/5ftxp/>) and is reported here in accordance with the PRISMA-ScR reporting guideline (Appendix 1).

Eligibility criteria

Studies that met the following criteria were included:

- **Population & Exposure**
Studies on scope and impact of any type of digital marketing for promoting breastmilk substitutes were included. For the purposes of the review, the term “breast-milk substitute” referred to “any milks (or products that could be used to replace milk, such as fortified soy milk), in either liquid or powdered form, that are specifically marketed for feeding infants and young children up to the age of 3 years, including follow-up formula and growing-up milks”(10). For purposes of this review, if a study included marketing of products which are concurrently targeted towards children up to the age of 3 and beyond, they were included. However, if a study is focussed on milks for children specifically above 3 years they were excluded. Studies on substitutes for milk in general were not within the scope of the review.

We defined marketing as “the activity, set of institutions, and processes for creating, communicating, delivering, and exchanging offerings that have value for customers, clients, partners, and society at large” as defined by the American Marketing Association (11). We further defined digital marketing as any form of marketing that uses a digital channel or platform to create and exchange value with a target audience i.e. for marketing. An inclusive definition of digital channels and platforms, including but not limited to the following was taken. This included:

- social media (e.g. Facebook, Twitter, Instagram, Tik-tok, Wei-bo, Pinterest, Snapchat, YouTube)
- search engines (e.g. search engine optimisation or paid advertising on search engines)
- display advertising (e.g. putting banners on other people’s blogs/websites)
- digital broadcasts (e.g. digital radio, podcasts, webinars, video blogs)

- internal websites (e.g. website content owned by the company)
- streaming services or over the top media (e.g. Netflix, Amazon prime, online series)
- direct digital channels (e.g. targeted surveys, SMS, e-mail)
- mobile apps

No attempt was made to define digital marketing 'strategy'. Given the potential breadth of this term, any relevant strategy or tactic discussed in the returned literature on digital marketing of BMS was documented and grouped iteratively.

If a study was on a broader marketing strategy that explicitly contained a digital marketing component (as defined above), we included it provided the effect of digital marketing has been reported separately. However, studies which were on broad marketing strategies which did not specify any digital marketing component specifically or which do not present data on digital marketing in a segregated manner were excluded. Studies on the effects of regulations on digital marketing for the promotion of BMS were included.

- **Comparators:**

Studies were included irrespective of whether there is a defined comparator group used in analyses.

- **Outcomes:**

Studies reporting any of the following outcomes were included:

- Content, frequency, type of digital channel/platform, type of marketing strategy/tactic
- Exposure to digital marketing for BMS
- Knowledge, attitudes, beliefs and perceptions about BMS
- Intention to use BMS
- Behaviours among the specified population groups:
 - uptake/initiation of BMS use
 - frequency and/or intensity/quantity of consumption of BMS use
 - continuation or maintenance of BMS use
 - stopping exclusive breastfeeding
 - continuation of breastfeeding
 - stopping breastfeeding

- **Study Design:**

Primary studies with the following study designs were included:

- Intervention study designs:
 - randomised controlled trials, cluster-randomised trials, quasi-randomised trials
 - non-randomised controlled trials
 - controlled before and after studies
 - interrupted time series (with multiple time points before and after an intervention)
- Observational study designs:
 - cohort studies
 - cross-sectional studies or surveys
 - case-control

- Qualitative studies which have collected as well as analysed data in a qualitative fashion
- Mixed-methods studies
- Policy analysis
- Content analysis, irrespective of study design

Case reports on digital BMS marketing campaigns found through database and grey literature searches were also included (also see differences in protocol and full review).

- **Setting:**

There was no restriction on setting.

- **Other restrictions:**

Studies published from 01 January 2000 onwards were included to capture the time period during which digital medium became popular. There was no restriction, based on language or status of peer-review.

Information sources

Electronic database search

We searched PubMed, MEDLINE, EMBASE, CINAHL (EBSCO), APA PsycINFO, Cochrane Central Register of Controlled Trials, and the World Advertising Research Centre (WARC) database. The search strategies for all databases are presented in Appendix 2.

Other methods for searching

The reference lists of studies that met eligibility criteria were retrieved by electronic search and were manually screened to identify additional studies.

Websites of the following organisations working to protect and promote full implementation of the Code were hand-searched to identify additional non-peer-reviewed research which meet eligibility criteria:

- Save the Children Fund
- Global Breastfeeding Collective (WHO)
- World Breast Feeding Trends Initiative
- Baby Milk Action (IBFAN) and IBFAN International Code Documentation Centre
- Helen Keller International
- Changing Markets Foundation
- World Alliance for Breastfeeding Action
- Midwives Information & Resource Service
- International Confederation of Midwives (ICM)
- UNICEF

Screening

In the first phase, at least two authors (JZ and MH) independently screened each study retrieved based on titles and/or abstracts and marked each record as “exclude” or “include”.

Disagreements at this phase were resolved by discussion, with a third author (AJ) acting as arbiter. The first phase of screening was conducted in a cloud-based platform (Rayyan - <https://www.rayyan.ai/>) that allows simultaneous screening by multiple people without creating multiple datasets.

In the next phase of screening, full texts of all studies marked as “include” by consensus in the previous phase were obtained and reviewed independently by two authors (MH and JZ) for consideration for inclusion based on the eligibility criteria. Disagreements, if any, were resolved by discussion with a third author (AJ) acting as an arbiter.

Data management & analysis

At least two authors (JZ and GM) independently extracted data as per a pre-designed data extraction form. Disagreements were resolved by consensus between two authors. Authors of studies were not contacted for additional data and only data reported in published literature was included.

As there are no globally accepted typographies of digital marketing strategies available, a self-adaptive narrative synthesis approach with thematic analysis (Nowell, Norris, White, & Moules, 2017) was used to categorize results by the following characteristics:

- Geographic region (geographic as classified WHO regions)
- Type of digital marketing platform/channel
- Type of digital marketing strategy(s) used

We could not explore differences in outcomes between sub-groups initially planned because of paucity of studies (<10 studies for each group). This included the following groups.

- Types of target group (working mothers, pregnant mothers, new mothers (with children <6 months age), fathers)
- Differences between population groups (e.g. ethnicity, indigenous status, socio-economic status)

In the absence of ability to conduct specific sub-group analyses, we present findings by specific groups where mentioned in narrative form.

Differences between protocol and full review

We included case reports from the WARC database to collect relevant evidence not captured otherwise in peer-reviewed literature. We dealt with and synthesised case reports separately to other academic and grey literature publications, owing to lack of methodological information presented in these documents and differences in outcomes which limit their comparability. We included synthesised information on the impact of digital marketing on BMS manufacturer sales and profits from case reports following a post hoc decision taken in consideration of the potential utility of the information in supplementing available evidence on the impact of marketing on the previously specified populations.

Ethics

Ethics was not required as this systematic review did not involve any living participant and is a review of existing published research.

Results

The study selection process is summarised in Figure 1.

Publications

In total we included 29 primary publications, of which 22 were research papers (20 papers and 1 published abstract) and 7 were independently published reports.

Overall this included 11 content analysis studies, 6 mixed methods studies, 5 cross-sectional studies, 4 policy analysis studies, and 3 cohort studies.

Publications covered marketing activities in 33 specific countries. The following countries were covered in more than one study: United States of America (n=10), Indonesia (n=4), China (n=4), Thailand (n=4), Australia (n=4), United Kingdom (n=4), Vietnam (n=3), India (n=3), Hong Kong (n=3), Myanmar (n=2), New Zealand (n=2), Philippines (n=2), Brazil (n=2), and South Africa (n=2). Given the cross-border nature of digital marketing, five studies did not specify geographical coverage.

Case reports

We identified 22 relevant unique case reports about specific digital marketing campaigns for BMS in the WARC database. We also identified 1 additional case report from Facebook for Business in the references of included publications.

Our 23 case reports involved 9 companies: Nestlé, FrieslandCampina, Fonterra, Abbott, Wyeth, Danone, Illuma, Yili, and Mead Johnson. Two thirds of the case reports were published since 2017.

They covered marketing activities in 9 countries, of which seven were in Asia, and two were in the Americas: China (n=5), Vietnam (n=4), Singapore (n=4), Malaysia (n=2), Indonesia (n=2), Philippines (n=1), India (n=1), Mexico (n=1), United States of America (n=1). There were two further case reports that covered the Hong Kong SAR (China) (n=2).

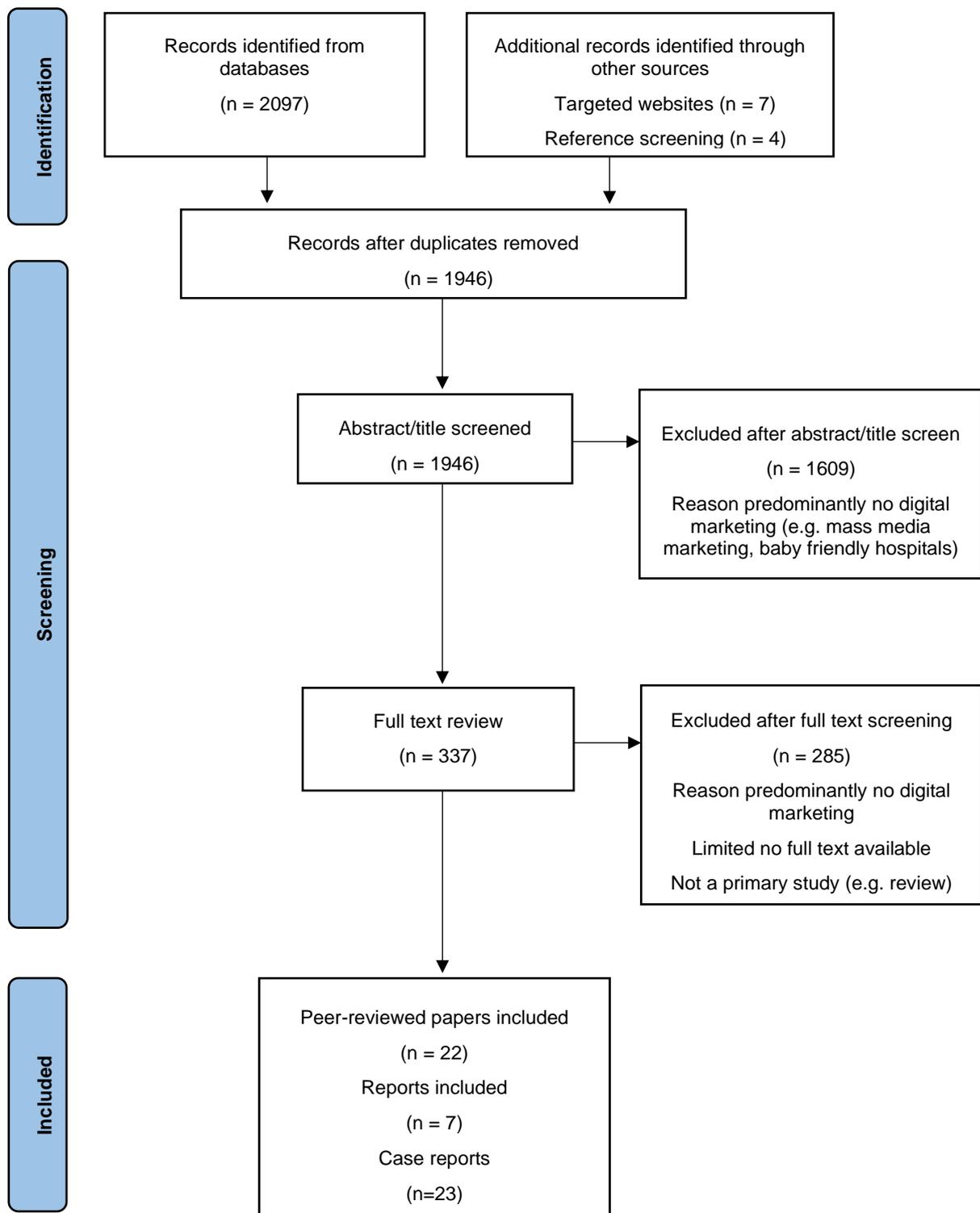


Figure 1. Flow chart of studies and case reports through the review process

Summary of included studies

The tables below provide separate summaries of publications (peer reviewed and grey literature) and case reports included.

Table 1. Summary of included publications (peer reviewed studies and independently published reports)

Author (Year of Publication)	WHO Region	Study Design	Study Setting	Study Category (Scope/Impact)	Study Population	Digital marketing channel or platform
Abrahams (2012)	Region of the Americas	Content analysis	USA	Scope	NA	Social media. (Facebook, MySpace, Twitter, Youtube, Google+), blogs, mobile applications, interactive websites
Bartolini et al (2009)	Region of the Americas	Cross-sectional study	Brazil	Scope	NA	Websites
Bass (2002)	European Region	Qualitative study	United Kingdom	Scope	NA	Manufacturer websites
Berry et al (2016)	Western Pacific Region	Content analysis	Australia	Scope	NA	Websites
Brewer (2020)	African Region, South East Asia Region	Policy analysis	Indonesia, India, Nigeria, Vietnam, Thailand	Scope	NA	Online retail
Changing Markets Foundation (2017)	World	Mixed-methods	World	Scope	NA	Social media, sponsored blogs, mobile applications, personalised emails
Ching et al (2021)	Region of the Americas, African Region, South-East Asian Region, Western Pacific Region	Mixed-methods study	Burkina Faso, Canada, China, India, Indonesia, Kenya, Laos, Malaysia, Myanmar, Pakistan, Singapore, The Philippines, United States, and Vietnam	Scope	NA	Social media (Facebook, Instagram), online shopping portal, partner-NGO website, online news portal, company website, public health website blog
Davis et al (2020)	Region of the Americas	Content analysis	United States of America	Scope	NA	Blogs
Department of Health Hong Kong (2013)	Western Pacific Region	Cross-sectional survey	Hong Kong	Scope/Impact	Mothers with singleton pregnancy; Cantonese speaking, lived in Hong Kong for >1 year prior to survey	Manufacturer websites, social media, online forums, electronic ads, email messages
Global Breastfeeding Collective (2020)	World	Policy analysis	World	Scope	NA	Social media (Facebook), sponsored blogs, vlogs, online magazines
Gunter et al (2013)	European Region	Content analysis	United Kingdom	Scope	NA	Manufacturer websites

Harris et al (2017)	Region of the Americas	Content analysis	United States of America	Scope	NA	Social media, sponsored blogs, manufacturer websites
Hastings et al (2020)	European Region, Region of the Americas, Western Pacific Region	Mixed-methods study	United Kingdom, Europe, North America, Australia, New Zealand	Scope	Industry experts and professionals with experience of marketing BMS	Mobile applications
Huang et al (2013)	Region of the Americas	Cohort study (national longitudinal study)	United States of America	Impact	Mothers aged 18 years or more; single births; neither mother nor infant had a health condition likely to affect feeding.	Internet
IBFAN (2018)	South-East Asian Region, Western Pacific Region	Policy analysis	China, India, Indonesia, Mongolia, Philippines, Korea, Sri Lanka, Thailand	Scope	NA	Manufacturer websites, retail websites
Jaichuen et al (2018)	South-East Asian Region	Cross-sectional study	Thailand	Scope	NA	Digital TV
Lozada-Tequeanes et al (2020)	Region of the Americas	Cross-sectional study	Mexico	Scope	NA	Social media (Twitter, Facebook, YouTube)
Mak (2016)	Western Pacific Region	Mixed-methods study	Hong Kong	Scope	Couples who had at least one child aged 3 years or younger	Blogs, social media (Facebook), parenting websites
Masin et al (2018)	World	Qualitative study	World	Scope	NA	Social media (Twitter, Facebook, Instagram), mobile messaging, sponsored blogs, mobile applications
Mejia et al (2016)	World	Content analysis	USA	Scope	NA	Social media (Facebook, Twitter), blogs
Newby et al (2015)	Western Pacific Region	Cohort study	Australia	Scope	Healthy women aged 18 years and over, first time mothers	Retailer websites, parenting websites
Pereira-Kotze et al (2020)	African Region	Policy analysis	South Africa	Scope	NA	Social media (Facebook, Instagram)
Prado et al (2020)	Region of the Americas	Cross-sectional study	Brazil	Scope	NA	Manufacturer websites
Senkal et al (2019)	European Region	Content analysis	Europe	Scope	NA	Social media (Facebook, Instagram, Twitter), blogs, mobile applications, interactive websites

Vinje et al (2017)	South-East Asian Region	Content analysis	Cambodia, Indonesia, Myanmar, Thailand and Vietnam	Scope	NA	Social media (Facebook posts or conversations)
Walker (2012)	World	Qualitative study	World	Scope	NA	Social media (Facebook, Twitter), mobile applications, websites
Wilking (2020)	Region of the Americas	Policy analysis	United States of America	Scope	NA	Social media, websites, influencers, digital display ads, banner ads, email messages, purchase reminders
Zhang et al (2013)	Region of the Americas	Cohort study (national longitudinal study)	United States of America	Impact	Healthy mothers with healthy term or near-term singleton infants	Websites
Zhao et al (2019)	Western Pacific Region	Content analysis	China	Scope	NA	Mobile applications

Table 2. Summary of included case reports

Manufacturer name and brand (Year)	Region	Country	Digital marketing channel/platform
Abbott Laboratories Philippines (2013)	Western Pacific Region	Philippines	Manufacturer website
Abbott Nutrition Malaysia (2019)	Western Pacific Region	Malaysia	Social media (Facebook)
Danone-Nutrition (2014)	Western Pacific Region	China	Internet
Danone-Nutrition (2017)	South-East Asian Region	Indonesia	Social media (YouTube, Facebook, Google+, InMobi)
Fonterra Brands Malaysia (2012)	Western Pacific Region	Malaysia	Social media, sponsored blogs, website
FrieslandCampina-Friso (2017)	Western Pacific Region	Vietnam	Mobile messaging (Zalo)
FrieslandCampina-Friso (2018)	South-East Asian Region	Indonesia	Social media (WhatsApp)
FrieslandCampina-Friso (2018)	Western Pacific Region	Vietnam	Social media (Facebook), e-commerce, online store
FrieslandCampina-Friso (2018)	Western Pacific Region	Vietnam	Social media (Facebook, Instagram, Zalo, Coc Coc, Bing, Google, GDN, Adtima), online store
FrieslandCampina-Friso Gold (2011)	Western Pacific Region	Vietnam	Social media (Facebook), parenting forums
Illuma Organic (2018)	Western Pacific Region	Hong Kong	Internet (Yahoo)
Mead Johnson (2018)	Region of the Americas	United States of America	Social media (Facebook, Instagram)
Nestlé (2016)	South-East Asian Region	India	Social media (YouTube)
Nestlé NAN OPTIPRO 3 (2018)	Western Pacific Region	Singapore	Social media (Facebook)

Nestlé-Excella Gold (2018)	Region of the Americas	Mexico	Music-streaming service (Spotify)
Nestlé-MOM & ME (2017)	Western Pacific Region	Singapore	Social media (Facebook)
Nestlé-NAN OPTIPRO 3 (2017)	Western Pacific Region	Singapore	Social media (Facebook)
Nestlé-NAN OPTIPRO Kid 4 (2017)	Western Pacific Region	Singapore	Social media (Facebook, Instagram)
Nestlé-Nestlac (2010)	Western Pacific Region	China	Online video channel
Nestlé-SuperNAN (2020)	Western Pacific Region	China	Internet
Wyeth (2017)	Western Pacific Region	China	Mobile applications
Wyeth Nutrition-Wyeth Gold (2014)	Western Pacific Region	Hong Kong	Mobile applications
Yili- Jinlinguan (2020)	Western Pacific Region	China	Artificial intelligence

Scope of digital marketing of BMS

We identified 29 publications (22 peer-reviewed studies and 7 grey literature reports) and 23 case reports that described the scope of digital marketing of BMS. Below we summarise data from these papers thematically by channels and platforms through which marketing is delivered and by strategy used. We also report available data on exposure or reach of this marketing activity.

Throughout the text in each section, we report findings first from peer-reviewed literature and independent reports, then from case reports acknowledging the differences in these two sources of evidence.

Digital channels and platforms

We found evidence that BMS are being marketed in a strategic and integrated fashion across a wide range of digital channels and platforms.

Social media

A total of 15 publications reported evidence that BMS companies use social media to promote formula brands and products (Abrahams, 2012; Changing Markets Foundation, 2017a; Ching et al., 2021; Department of Health Hong Kong SAR Government, 2013; Global Breastfeeding Collective, 2020; Harris et al., 2017; Lozada-Tequeanes et al., 2020; Mak, 2015; Masin, 2018; Mejia, Nixon, Seklir, & Dorfman, 2017; Pereira-Kotze, Doherty, & Swart, 2020; Senkal & Yildiz, 2019; Vinje et al., 2017; Walker, 2012; Wilking, 2020). The majority of publications involved media audits or content analysis (e.g. quantitative analysis of social media accounts and/or descriptive analysis of specific case study advertisements), some mixed this with qualitative interviews with social media users, or policy analysis of content against the provisions of the Code.

The publications covered a wide range of social media channels and platforms including: Facebook (n=12), Twitter (n=6), Instagram (n=5) and YouTube (n=5) and Pinterest (n=1), WhatsApp (n=1).

Studies that involved media audits by BMS manufacturer provided evidence that most brands have an established presence across multiple social media channels to maximise reach and reinforce promotional messages as part of a broader marketing strategy for their brand(s) (Abrahams, 2012; Ching et al., 2021; Harris et al., 2017; Mejia et al., 2017; Senkal & Yildiz, 2019; Wilking, 2020).

Social media platforms offer marketers novel and targeted opportunities for product promotion and connection with customers that extend beyond the possibilities created by traditional media. For example, the 12 publications that reported use of Facebook highlighted how this platform can be used to market in multiple ways: to share manufacturer-generated content on their own product pages (e.g. videos and posts), as well as providing a forum for users to post comments, questions and testimonials. Use of the 'like' and 'share' features allow users to share content easily with their peers that spreads company messages. One independent report highlighted Facebook's own role in harvesting user's data and selling this on to facilitate further targeted advertising, including by third parties on the Facebook platform (Wilking, 2020) (see further in 'Strategies' section below).

Six studies reported that BMS manufacturers were using Twitter, for example to communicate information about BMS products beyond standard customer service engagement and in the realm of marketing, for example to provide notification about photo contests, discounts and giveaways (Abrahams, 2012; Masin, 2018; Walker, 2012). Tweets also aligned BMS with new parents' hopes, dreams and concerns for their children (Mejia et al., 2017).

Five studies highlighted that brands had their own dedicated YouTube channels (Abrahams, 2012; Changing Markets Foundation, 2017a; Harris et al., 2017; Lozada-Tequeanes et al., 2020; Wilking, 2020). They used these, for example, to share advertisements and post videos about the difficulties of breastfeeding and the potential benefits of their products (Abrahams, 2012).

Studies that looked at Instagram (Ching et al., 2021; Masin, 2018; Pereira-Kotze et al., 2020; Senkal & Yildiz, 2019; Wilking, 2020), highlighted, for example how the imagery posted on that channel could be used to idealise the use of BMS (Senkal & Yildiz, 2019), or show pictures of infants less than 6 months old.

Beyond the published academic literature, evidence from 13 case reports highlighted BMS manufacturers' effective use of social media as a component of digital marketing strategies. Facebook was widely used, for example in Singapore, Nestlé posted an online web series of emotional short films ("Nestlé: NAN OPTIPRO Kid 4: Celebrate Christmas 2016," 2017) ("Nestlé NAN OPTIPRO 3: Nurture Your Child," 2017) and also used Facebook to develop a Baby Club Program ("Nestlé: MOM & ME – A taste of pregnancy," 2017); in Vietnam FrieslandCampina used Facebook forums to engage mothers in conversation ("Friso Gold: To grow is to let go," 2011). In Malaysia, Abbott launched an unbranded Facebook page to speak to mothers who sought word-of-mouth testimonials from a wider media network ("Abbott Mommy Scoop," 2018). There were examples that highlighted the integration of multiple social media channels, for example in Indonesia, Danone carried out a huge (20%) price reduction campaign on YouTube, Facebook, Google and InMobi ("Nutrilon Footfall

Measurement," 2017); in Vietnam, Friso posted ads on Facebook, Instagram, Zalo, Coc Coc, Bing, Google, GDN, Adtima ("Friso: So you think you can grow Vietnam," 2018). In the United States, Mead Johnson placed targeted ads in likely customer's Facebook News Feed or Instagram feed depending on which platform was most likely to drive the best campaign results at the lowest possible cost at any given time. The ads contained direct purchase links to Amazon.com (Facebook for Business, 2018).

Mobile applications

Seven publications reported on how BMS was marketed through use of free mobile applications to expecting and new parents (Abrahams, 2012; Changing Markets Foundation, 2017a; Hastings, Angus, Eadie, & Hunt, 2020; Masin, 2018; Senkal & Yildiz, 2019; Walker, 2012; Zhao, Li, & Freeman, 2019). The mobile applications served various functions including recording infant feeding and sleeping trends, access to duration graphs, feeding advice (including calling feeding experts live), tools for developing pregnancy to-do lists, and showing users how to receive a formula gift bag at the hospital. There were also apps which helped calculate ovulation dates and/or provided weekly updates on foetal/infant development for expectant/new mothers. There were features in apps which allowed mothers to communicate, make friends, and share digital journal entries (see further in 'Strategies' section below).

One paper provided a content analysis of advertisements for BMS on Chinese parenting apps (Zhao et al., 2019). It analysed 353 BMS advertisements from 31 companies, covering 44 brands, and 79 brand variants. All advertisements led to electronic shops, and nearly half used special price promotions for all brand variants. Many brands used images of a natural pasture as an emotional linkage strategy. Five brand variants had a celebrity endorsement, 25 made a product quality claim, and only 14 variants made a direct advertisement disclosure.

Among the case reports, we found four reported examples of how mobile applications were used to reach parents. In Hong Kong, Wyeth created an app called 'See the World At Home' to teach children about the world. In two months it had over 20,000 downloads and grew Wyeth's new user base by 65% ("Wyeth Gold: See the world at home.," 2014). In China, Wyeth developed a mobile application to track consumption of formula, and to pair with its device that prepared formula using capsules similar to coffee. The multi-component campaign grew new users by 246% in one year ("BabyNes for It Moms," 2017). In Vietnam, FrieslandCampina-Friso partnered with a messaging app Zalo cross-reference consumer data in order to reach new users through the messaging service. Friso's Zalo account gained 18k followers and \$250k USD was generated from new users ("FrieslandCampina Vietnam: Because we care," 2017). In Indonesia, FrieslandCampina-Friso used WhatsApp to support its 'new user acquisition strategy', focusing on the most efficient and cost-effective approach to recruit new users for its toddler milk products. To convince mothers to buy the product, it offered free samples via Facebook newsfeed advertisements and automatically followed these up with real-time conversations on the Whats-App messaging app. This approach to follow-up gained 67% more new users compared to the previous year where only SMS was used, at 50% lower costs ("Friso Indonesia: So You Think You Can Grow," 2018).

Blogs

We found 9 publications that reported on use of sponsored blogs to market BMS (Abrahams, 2012; Changing Markets Foundation, 2017a; Davis, Knol, Crowe-White, Turner, & McKinley,

2020; Global Breastfeeding Collective, 2020; Harris et al., 2017; Mak, 2015; Masin, 2018; Mejia et al., 2017; Senkal & Yildiz, 2019).

One report included content analysis of 719 unique blog posts mentioning products of six BMS manufacturers in 2015. Some of these blogs did not appear to result from compensation, for example 'use/like/discuss' posts which contain mentions of a brand that the blogger uses and/or likes but without mention of sponsorship. Other blogs did appear to be directly sponsored by brands, and commonly linked to retail websites with related coupons or other discounts. Blogs could be integrated as part of a broader digital media strategy, for example, one that linked viral videos with sponsored blogs and Facebook posts that invited women to join the "Sisterhood of Motherhood" and share their own pictures and stories (Harris et al., 2017).

One paper provided a content analysis of 59 blogs that advertised and sold recipe kits for homemade BMS (Davis et al., 2020). Among reviewed blogs, 33.9% did not provide a disclaimer that breastmilk is the preferred option, 25.4% recommended consulting a healthcare provider before use, and 76.3% and 20.3% either advertised or sold ingredients or recipe kits respectively. Credentials of bloggers varied, with only 7 bloggers identifying as nutritionists.

Among the case reports in the WARC database, we found one reported example of using sponsored blogs within a broader marketing strategy. In Malaysia, Fonterra made a website with information that allowed women to calculate the added sugar in toddler milks to raise awareness of its own 'no added sugar' brand. It invited influencers to a conference to present research findings on added sugars, and then conference attendees shared their takeaways through traditional and digital media, including 350 blog posts ("Anmum Essential: Mothers Against Secret Sugars," 2012).

Websites

Twelve publications reported that BMS marketing appeared on manufacturer, retailer or parenting websites (Abrahams, 2012; Bartolini et al., 2009; Bass, 2002; Berry & Gribble, 2017; Changing Markets Foundation, 2017a; Gunter, Dickinson, Matthews, & Cole, 2013; Harris et al., 2017; International Baby Food Action Network (IBFAN), 2018; Lozada-Tequeanes et al., 2020; Newby, Brodribb, Ware, & Davies, 2015; Prado & Rinaldi, 2020; Wilking, 2020).

Two papers reported how manufacturer websites created opportunities for live engagement, such as user-generated photos and comments, access to live feeding advice and tools to notify friends about products (Abrahams, 2012; Wilking, 2020). These same papers also noted that manufacturer websites provided educational content and infant feeding advice in contravention to provisions of the Code (Abrahams, 2012; Wilking, 2020) (see further 'Strategies' section below). In the United Kingdom, a content analysis of websites of major manufacturers found that in 2009, all websites of five major manufacturers contained formula product information that could be considered promotional in nature, but by 2012 this was true of only two sites (Gunter et al., 2013).

In Asia, a report by IBFAN focused on online manufacturer and online retail websites highlighted case studies of how these featured incentives to purchase BMS products, such as cashback offers, iPhone giveaways, free shipping, online discounts, free samples, coupons and branded gifts (International Baby Food Action Network (IBFAN), 2018). A

content analysis of webpages advertising 25 unique infant formula products in Australia found every advertisement contained at least one health claim, 18 also contained at least one nutrition content claim, and 3 pages referenced the nutritional content of human milk. All of these claims appeared in spite of national regulation prohibiting them (Berry & Gribble, 2017). Another paper reported that in Mexico nearly all 27 websites of six major BMS manufacturers included an invitation to make contact (directly or indirectly) with the company (email, chat, contest), and 32% of sites included sales promotions (Lozada-Tequeanes et al., 2020).

The report by Harris analysed BMS advertising on third-party websites and found the 11 brands in their analysis averaged 60.8 million ads viewed per month. The third-party websites with the most advertising for BMS were Amazon.com, facebook.com and Walmart.com (Harris et al., 2017).

Among the WARC case reports, four reported examples of effective use of websites by BMS manufacturers. Illuma created an online information hub on Yahoo! to promote its featured organic milk formula which successfully cultivated an audience of 42,000 ("Illuma Organic: The Green Parents' Data Farm," 2018). In Malaysia, Abbott Nutrition's e-commerce store for nutritional products including BMS became the bestselling storefront in its category on Lazada (the top e-commerce platform in Southeast Asia) by the end of 2017 ("Abbott Mommy Scoop," 2018); Danone and Friso also provided online stores/e-commerce for their customers in China and Vietnam respectively which increased sales and engagement ("Friso: Winning over Vietnamese Moms with a unique proposition," 2019; "Nutralon: Capture every 7 days of Chinese mom," 2014).

Search engines

We found no academic publications that reported on the use of search engine functionality.

Among the WARC case reports we found one report of strategic use of search engine optimisation as part of a broader marketing strategy. In the Philippines, growing-up milk Gain School Advance launched a multi-component strategy that was designed to creatively reach their target consumers while also complying with the Philippines' Milk Code restrictions on advertising. The campaign targeted high-socioeconomic 'Tiger mothers' with material to support their children's learning that included print workbooks, on-ground activations in pre-schools and a new interactive website (www.thebiggestgainer.org) for kids. The branded website was search-optimised, 'letting it not only be top of mind but top of search' ("Gain: The biggest GAINer Caravan - Winning the approval of Asian tiger mothers," 2013).

Digital broadcast

We found only one publication investigating the role of digital broadcasts (e.g. digital radio, podcasts, webinars, video blogs) for BMS marketing. The content analysis of 504 hours of digital television in Thailand found that baby and toddler milk formula were the most common products advertised on this medium (Jaichuen et al., 2018).

Among the WARC case reports, we found one example of Nestlé launching audio stories via digital audio streaming service Spotify to promote their Excella Gold product in Mexico ("Nestlé: Excella Gold Short Audio-Musical Stories in Spotify," 2018). The company produced 12 short audio stories and created a branded profile on Spotify. The campaign was targeted to parents, and the audio stories were purportedly designed specifically to develop

babies' movement, communication skills and creativity. There were two components to the campaign: audio advertisements and sponsored sessions. The audio advertisements were served between songs during active sessions, and invited users to Spotify playlists with short stories that had already been uploaded on users profiles. With the sponsored sessions, users were offered the opportunity to unlock 30 minutes of uninterrupted listening in exchange for watching the brand's video. During the first round of the campaign, more than 4.2 million impressions were delivered with a unique reach of almost 500k. Most users listened daily to around four stories.

We found one further example of Nestlé creating the 'first ever' parenting video channel on China's biggest online video platform youku.com. The campaign was seen as an important way to rebuild confidence after earlier melamine adulteration issues in milk powder in China. The channel featured experts and consumer videos on parenting. The channel was Nestlé branded, such that no other milk powder competitor could advertise. Each of the 36 episodes featured questions from mothers, which were answered by nutritionists and Nestlé experts with practical demonstrations. Topics went beyond BMS to things such as what to feed a feverish baby to good parent-toddler games. There were 13 million video views in 3 months and consumers left thousands of comments, 96% of which were positive ("Nestlé: NESLAC Experts talk," 2010).

We did not find any publications or case reports related to product placement or other marketing strategies within internet streaming services such as Netflix or Amazon Prime.

Direct digital channels

We did not find any studies or case reports specifically reporting on the use of direct digital channels (e.g. targeted surveys, SMS, e-mail).

Other

Among the WARC case reports, we found two examples of the use of Artificial Intelligence (AI) to enhance BMS marketing. In 2020, both Nestlé and Yili used AI technology as part of digital marketing efforts in China. Nestlé's SuperNAN brand drew upon consumer research that Chinese mothers were concerned about their babies' minor sensitivities and felt they were failing if their babies had allergies or health conditions. This insight was used together with AI technology through a smart device and big data from WeChat to identify and tailor 51 different 30 second video ads to seven specific audience segments and increase the brand's association with allergy prevention. For example, one group of mums received messages about environmental sensitivities, while another group received messages regarding skincare and allergies. The campaign garnered 450 million impressions, increased sales by 32% and unaided brand awareness rose by nine points ("SuperNAN: Super Relatable," 2020).

Yili partnered with a smart speaker manufacturer Xiaomi Mi to create an AI baby expert loaded with >1000 mum-and-baby-related questions and answers (Q&A) and promoted it via reality television show *Fantastic Baby* ("Jinlingguan: AI Baby Expert," 2020). The Q&A enabled parents to interact directly with the speaker and receive immediate answers in a hands-free way. 10,000 speakers were given as gifts when parents purchased more than a month's support of milk powder. Existing speaker owners were also given full access to the Q&A content. The case report states that the company used 'only factual answers-backed by

science and research' to 'ensure trust from parents.' To 'ensure all answers were neutral and credible, [Yili] neither promoted its products, nor claimed its product superiority'. However, the company ended each answer with 'answers provided by research experts at [Yili]', to ensure brand exposure.

We also found one report of the use of geo-targeting mothers. In Indonesia Danone generated online awareness of a 20% price reduction on its premium Nutrilon growing-up milk with ads on Facebook and Google that targeted mothers in a specific geographical area. It linked these to a feature that highlighted (offline) stores near the current location of users and redirected them to Google maps to guide them towards the store. This resulted in an 18% increase in sales ("Nutrilon Footfall Measurement," 2017).

Strategies

From the activities occurring across the digital platforms and channels outlined above, we identified the following key strategies being used to market BMS.

These strategies may be used by BMS manufacturers themselves, or by third parties such as online retailers. Some strategies replicate traditional marketing strategies in a digital environment (e.g. providing free samples), whereas others exploit new opportunities created by the digital context (e.g. collecting consumer data to segment the market and target advertising, utilising digital 'influencers').

Collecting consumer data to segment the market and facilitate targeted advertising

Three publications and multiple case reports highlighted how digital marketing, in particular social media, is being utilised by BMS companies to study consumer preferences and collect personal data which is then used to target them with digital marketing for BMS (Changing Markets Foundation, 2017a; Hastings et al., 2020; Wilking, 2020). This kind of data mining remains largely unregulated.

In a 2020 policy report on reducing digital marketing in the United States, Wilking reported the process by which this is done, drawing on a variety of online news pieces and work by the United States Federal Trade Commission on targeted advertising generally. The report found that it is virtually impossible to avoid data collection about pregnancy or infant caregiving. Consumer data is collected across multiple devices including smartphones, tablets, personal computers, smart televisions, smart watches and other wearables. Expectant parents and infant caregivers use these devices to access health information, connect with family and friends, and research and purchase baby products. Companies have made the user experience between these devices seamless, such that a social media post accounting a pregnancy, or online browsing for maternity clothing, or a search engine enquiry about pregnancy can trigger targeted advertising for baby products on all of a person's digital devices. This is known as 'cross-device tracking' (Wilking, 2020).

BMS manufacturers and retailers collect consumer data themselves, and may also purchase data and ad-targeting services from data brokers. Data brokers "collect, maintain, manipulate and share a wide variety of information about consumers without interacting with them directly" (United States Federal Trade Commission, cited in (Wilking, 2020)), meaning consumers are often not aware how much data they generate or how their data is used. Data brokers collect information from online and offline sources including public records. Wilking provides the following examples where families generate data:

- Posting a pregnancy or birth announcement on social media, or using a hashtag
- Creating an online baby registry specifying a due date
- Shopping for prenatal or newborn items online
- Registering for pregnancy or parenting websites or store loyalty programs
- Conducting internet searches for topics related to fertility, pregnancy, birth and infant feeding
- Shopping for maternity or infant items at brick and mortar store
- Communicating with friends and family on digital devices
- Accessing public services
- Giving birth resulting in the creation of a public birth certificate

Data brokers aggregate and segment consumer data into categories like “expectant” or “new baby”. Firms then contract with data brokers to use cookies and other tracking mechanisms to conduct targeted marketing (United States Federal Trade Commission, cited in (Wilking, 2020)). Parents may also identify themselves by publicly posting status updates e.g. disclosing a new baby as a ‘Life Event’ on Facebook , or using a hashtag like #28weekspregnant on Instagram that makes their posts searchable (Wilking, 2020).

One publication by Hastings et al also reported on strategic use of data to segment and target markets. Drawing upon marketing and business literature and qualitative interviews of industry experts, the paper gives an example of common segmentation in western markets into ‘blue, yellow and red’ mothers linked to different focuses on ambition, happiness and safety. Target groups do not just get specific advertisements, but recommendations for specific brands each backed by a multifaceted marketing effort (Hastings et al., 2020).

One report by Changing Markets Foundation included material on the importance of ‘social listening’, which allows instant collection and analysis of personal data shared online to tweak a company’s online presence to increase reach, engagement and ultimately sales. Social listening provides a new set of tools “which use deeply effective emotional hooks to subtly steer women towards a brand and its products.” One new tool reported is emotions analytics (EA) which uses emotion recognition software to analyse facial expressions and listen to language and tone through social media. The report suggests that in the future EA may be used to market to consumers depending on their mood (Changing Markets Foundation, 2017a, 2017b).

Case reports from WARC also provided evidence of how BMS manufacturers use predictive analytics, artificial intelligence and machine learning to identify consumers who are most likely to purchase BMS products, thereby making their posts more effective. For example, the case report on Nestlé’s SuperNan campaign in China outlined above used social media data to segment the market, and combined this with AI to create 51 different 30 second video ads tailored to different market segments for mothers who were predominantly concerned about different allergies or sensitivities (“SuperNAN: Super Relatable,” 2020).

Initiating direct contact with mothers

Article 5 of the Code prohibits all promotion to the general public, including contact between manufacturers and pregnant women or mothers of infants, including helplines, direct mail and baby clubs. Despite these provisions, we found at least six publications and multiple case reports which reported examples of BMS manufacturers inviting or automatically or making direct contact with mothers in digital environments.

Four papers reported that BMS companies (and their marketing personnel) made direct contact with mothers through social media posts and online messaging boards (Abrahams, 2012; Lozada-Tequeanes et al., 2020; Pereira-Kotze et al., 2020; Senkal & Yildiz, 2019). In Mexico, nearly all 27 websites of six major BMS manufacturers included an invitation to make contact (directly or indirectly) with the company (email, chat)(Lozada-Tequeanes et al., 2020). In South Africa, which has implemented the Code in national legislation, Pereira-Kotze provided legal analysis of breaches of legislation, including direct contact with mothers through WhatsApp to join a conversation and win rewards and Facebook posts inviting mothers to a 'secret' club (Pereira-Kotze et al., 2020).

A report analysing compliance with the Code in five countries found that company contact with mothers was increasing across all five countries (Indonesia, Thailand, Nigeria, India and Vietnam) (Brewer, Andrzejewski, Vij, Crossley, & Kauer, 2020).

Case reports from the WARC database also provided evidence of direct contact as a successful tool to recruit new users. For example, in Indonesia, FrieslandCampina-Friso offered free samples via Facebook newsfeed advertisements and automatically followed these up with real-time conversations with mothers on the Whats-App messaging app to convert them as regular users ("Friso Indonesia: So You Think You Can Grow," 2018). Friso used similar strategies on the Zalo platform in Vietnam ("Friso: So you think you can grow Vietnam," 2018).

Establishing financial relationships between manufacturers and influencers

We found three publications and one case report that reported evidence that BMS companies provide financial or other incentives to expectant and new mothers to act as 'influencers' and blog and/or post positive reviews about their formula products. While Article 5 of the Code prohibits all advertising in any form, the involvement of individuals as primary promoters presents a scenario unlikely foreseen when the Code was drafted forty years ago.

The report by Harris et al analysed the content of 719 unique blog posts mentioning the products of six BMS manufacturers and found that companies commonly provided incentives to 'mom bloggers' to post about their brands. The majority of posts did not contain disclaimers to indicate that the post was sponsored, although links to other pages on the blog (e.g. 'about this blog') often revealed that the blogger received support from the brands (Harris et al., 2017). One paper exploring Code violations on social media across 46 accounts of nine BMS brands also reported that manufacturers were establishing a financial relationship between manufacturers and bloggers by providing incentives for mum "influencers" to create posts about their experiences with the brands (Senkal & Yildiz, 2019). The report by the Changing Markets Foundation provided an example of Danone Nutricia paying a team of mothers to act as community managers and answer questions of fellow mothers on Facebook (Changing Markets Foundation, 2017a).

Among the WARC case reports we found one reported example of using sponsored blogs within a broader marketing strategy. As part of its marketing of a 'no added sugar' toddler milk in Malaysia, Fonterra invited influencers to a conference to present research findings on added sugars, with attendees sharing their takeaways through traditional and digital media, including 350 blog posts ("Anmum Essential: Mothers Against Secret Sugars," 2012).

Providing educational material on infant and young child feeding

Article 4 of the Code regulates the provision of information and educational material about infant feeding, including prohibiting the provision of industry-prepared educational materials to the public. Despite this, we found at least three publications and two case reports that reported that BMS manufacturers were providing educational material on infant and young child feeding to the public on websites, blogs, mobile apps and social media.

On social media, brands frequently featured experts offering advice for parents on healthy eating, sleeping, and breastfeeding. One paper reported Code violations on two major BMS company websites providing manufacturer-created educational materials with live access to feeding or nutrition advice to the public through their websites without the disclaimer information mandated by Article 4 of the Code (Abrahams, 2012). One paper from South Africa reported apparent violations of national legislation implementing the Code via Facebook posts that provided educational information to the public on infant and young child feeding (Pereira-Kotze et al., 2020). Ching reported examples from during the COVID-19 pandemic where BMS companies hosted educational webinars on topics related to COVID-19 and infant and young child feeding (Ching et al., 2021).

Among the WARC case reports, clear examples of providing educational material included Yili's AI speaker loaded with Q&A on infant and young child feeding ("Jinlingguan: AI Baby Expert," 2020), and Nestlé's parenting video channel ("Nestlé: NESLAC Experts talk," 2010), both in China.

Offering coupons, discounts, free samples and gifts

Article 5 of the Code prohibits all promotion to the general public, including providing product samples directly and indirectly, and promotions at retailers including point-of-sale displays, coupons, premiums, and short-term price discounts (i.e. sales). Despite this, we found at least eight publications and one case report that provided evidence of these activities in a digital environment (Abrahams, 2012; Brewer, Vij, Crossley, & Kauer, 2020; Ching et al., 2021; Harris et al., 2017; International Baby Food Action Network (IBFAN), 2018; Masin, 2018; Walker, 2012; Wilking, 2020).

Content analysis of 11 BMS manufacturer social media accounts by Abrahams reported discounts and giveaways on multiple channels (Abrahams, 2012). The publication by Ching et al reported that companies were offering discount coupons linked to the hardship created by the global pandemic "in difficult times, count on Similac..."(Ching et al., 2021).

A report by IBFAN monitoring Code compliance by 11 countries in Asia focused specifically on breaches of the Code in online retail settings highlighting issues such as free shipping, advertising on shopping website storefronts, cashback offers and free iPhone giveaways (International Baby Food Action Network (IBFAN), 2018). A legal analysis of compliance with the Code in five countries found that in Thailand particularly there was significant non-compliance through online point-of-sale promotions (Brewer, Andrzejewski, et al., 2020).

The report by Wilking provides examples how the three major U.S. infant formula companies use their own webpages, social media accounts and online stores to offer coupons, free samples and branded gifts in the mail. It also highlights how women are encouraged to share valuable data such as birth dates in exchange for these 'gifts'. The data obtained is then used for further targeted marketing (Wilking, 2020).

In the WARC case reports, Danone carried out a huge (20%) price reduction campaign on YouTube, Facebook, Google and InMobi in Indonesia that also geotargeted mobile users such that when they saw advertisements highlighting the discount they would also be directed through Google Maps to the nearest retail store to purchase the discounted item ("Nutralon Footfall Measurement," 2017).

Use of health or nutrition claims and/or images and text that idealize formula feeding

Article 9 of the Code sets requirements for labelling, including requiring that BMS do not use nutrition or health claims and do not use images or text that idealize formula feeding.

Article 9 also requires that BMS labels must clearly state that breastfeeding is superior, use only with the advice of a health worker, and provide instructions and warnings about proper preparation. While physical 'labels' do not exist in a digital environment, it is clear that digital channels and platforms create opportunities to provide analogous information.

We found evidence in at least seven publications that BMS manufacturer websites, online-retailers and social media posts are not always meeting these requirements (Abrahams, 2012; Berry & Gribble, 2017; Harris et al., 2017; Lozada-Tequeanes et al., 2020; Prado & Rinaldi, 2020; Senkal & Yildiz, 2019; Silva, Oliveira, Boccolini, & Sally, 2020).

For example, three papers reported that BMS manufacturer websites used health and nutrition claims (Berry & Gribble, 2017; Lozada-Tequeanes et al., 2020; Senkal & Yildiz, 2019).

Analysis of websites and social media content in Mexico found that images that idealise the use of BMS were used by most companies (Lozada-Tequeanes et al., 2020). Abraham also noted the common practice of soliciting user-generated photos used by many BMS manufacturers on their social media accounts and through contests allowed manufacturers to effectively circumvent proscriptions on the use of images idealizing formula feeding (Abrahams, 2012).

Four studies reported that the main non-compliance on BMS company websites was the absence of satisfactory warning statements or disclaimers required by national legislation to give effect to the Code (Davis et al., 2020; Harris et al., 2017; Prado & Rinaldi, 2020; Silva et al., 2020). One study reported improvements in compliance related to including these warnings between 2009 and 2012 on manufacturer websites in the United Kingdom (Gunter et al., 2013).

Exploiting uncertainty created by the COVID-19 pandemic

One study focussed specifically on the use of digital marketing for BMS during COVID-19, (Ching et al., 2021). Some tactics used specifically during the pandemic included emphasising immunity and resilience (and associating this with BMS use), riding on public health authorities to gain legitimacy, and appealing to public sentiment on solidarity and hope. BMS companies also endorsed breastfeeding but at the same time created uncertainty around breastfeeding risks during the pandemic. BMS companies gave discount coupons for "difficult times" and also sponsored educational webinars on topics related to COVID-19 and infant and young child feeding.

Exposure and reach

Exposure to digital marketing of BMS is common. We found three publications that reported some measure of pregnant women or mothers' exposure to digital marketing of BMS, and at

least seven case reports where BMS manufacturers reported a measure of how many people had been reached by their marketing activities.

Exposure of pregnant women and mothers to digital marketing of BMS

In Australia, a survey of 277 women in their first pregnancy reported that 73% used the internet to access information about breastfeeding (including government websites), and 52% of respondents used the internet to access information on formula feeding (Newby et al., 2015).

In Hong Kong, a government published survey of 500 mothers explored experiences and views on formula milk advertising and promotion. Of respondents, 56.8% of participants reported always having encountered formula milk advertising on the internet (less than television and radio (84.5%), but more than print media (52.8%) and point of sale (46.7%)) (Department of Health Hong Kong SAR Government, 2013).

In the same survey, social media and other online forums were ranked sixth from eight sources of health information and materials used by mothers to obtain information on breastfeeding and infant and young child feeding (Department of Health Hong Kong SAR Government, 2013). When asked to score informational materials on breastfeeding and infant and young child feeding produced by various organizations, materials of formula milk companies scored highest in attractiveness and accessibility, but lowest in credibility (Department of Health Hong Kong SAR Government, 2013).

Analysis by the Global Breastfeeding Collective found that in Ecuador, 18% of new mothers participated in industry-sponsored social groups and activities that were mostly digital. In Thailand, 83% of mothers reported seeing at least one BMS promotion in the past six months, over one quarter on social media or the internet (Global Breastfeeding Collective, 2020).

Reach of marketing activities

At least seven case reports provided figures on the reach of marketing.

Nestlé's parenting video channel online received 13 million views in 3 months in China, and thousands of comments, 96% of which were positive ("Nestlé: NESLAC Experts talk," 2010). In India, another Nestlé campaign targeting urban mothers who want to breastfeed generated 5.5 million views on YouTube ("Nestlé: Now Everyone Can Breastfeed a Child," 2016). The report by Harris provided an example of a YouTube video that had gone viral (>20million views) as part of a broader marketing campaign (Harris et al., 2017).

In China, Yili's AI speaker with Q&A material on infant and young child nutrition was used by 60% of the 10,000 speaker owners who received the speaker during a promotion. These users initiated 55 million Q&A sessions ("Jinlingguan: AI Baby Expert," 2020). In Mexico, Nestlé's use of Spotify stories reached 500k users and created 4.2 million impressions ("Nestlé: Excella Gold Short Audio-Musical Stories in Spotify," 2018).

In the smaller market of Singapore, Nestlé-NAN OPTIPRO 3 posted short campaign films with influencers talking about their parenting experiment on Facebook, which resulted in over 200k views in 2017 ("Nestlé NAN OPTIPRO 3: Nurture Your Child," 2017). In the following year, their Mother's Day video achieved almost 100k views, over 400 shares and 100 comments, with engagement rates reaching 11% ("Nestlé NAN Optipro 3: When the parents meet the experts," 2018). During two weeks near Christmas, Nestlé also launched videos

that incorporated Christmas carols with brand information on Facebook and Instagram, resulting in over 300k views in Singapore ("Nestlé: NAN OPTIPRO Kid 4: Celebrate Christmas 2016," 2017).

Some case reports included data on new engagement from marketing efforts. Friso Gold gained more than 10k active fans and >17k likes by engaging mothers in conversations on Facebook in Vietnam ("Friso: Winning over Vietnamese Moms with a unique proposition," 2019). Abbott garnered 60k followers on Facebook via its Abbott Mommy Scoop page ("Abbott Mommy Scoop," 2018). Illuma organic successfully cultivated more than a 42k person audience through its information hub marketing organic formula via Yahoo! ("Illuma Organic: The Green Parents' Data Farm," 2018).

Impact of digital marketing of BMS

We identified only two publications that reported on the impact of digital marketing of BMS on at least one outcome of interest identified in the protocol. We describe these findings by outcome below.

To supplement this, we also included information from case reports from the perspective of BMS manufacturers of the impact on digital marketing on business outcomes.

Knowledge, attitudes, beliefs and perceptions about BMS

We did not identify any studies that reported on the impact of digital marketing of BMS on knowledge, attitudes, beliefs and perceptions about BMS.

Intention to use BMS

A longitudinal study of mothers in the United States (sample sizes 1384 to 2530) through babies' first year found that mothers' reported exposure to formula information on websites was associated with lower intention to breastfeed (Zhang, Carlton, & Fein, 2013).

In the same study, mothers' reported exposure to breastfeeding information from websites was related to higher odds of intended duration and intended initiation of breastfeeding (Zhang et al., 2013).

Behaviours among the specified population groups

A longitudinal study of mothers in the United States (sample sizes 1384 to 2530) through babies' first year in the found that mothers' reported exposure to formula information on websites was associated with lower breastfeeding initiation (Zhang et al., 2013).

In the same study, mothers' reported exposure to breastfeeding information from websites was related to higher odds of actual initiation and duration of breastfeeding (Zhang et al., 2013).

The authors found more significant associations between breastfeeding outcome measures and media exposure from websites than from other types of media (e.g. print and radio). They suggest this may be because women who are exposed to information on websites are actively seeking the information, as opposed to passively receiving it as may occur with broadcast or print media. They also suggested it is possible that websites are more effective at influencing mothers' feeding decisions (Zhang et al., 2013).

A further analysis of the same study included 1700 mothers who fed their babies formula at 1 month and evaluated the associations between formula marketing (digital and non-digital), reasons for choosing a formula brand, and switching of formula brands through the infant's first 9 months of life. It found that pre-natal exposure to direct-to-consumer marketing on the internet impacted women's switching of formula brands after 1 month – where women were exposed to advertising they switched from the brand used at the hospital more frequently for non-health reasons (Huang, Labiner-Wolfe, Huang, J. Choiniere, & Fein, 2013). The same association was not found with exposure to information from broadcast or print media. The authors suggest this may be because information on the internet may be encountered more often while actively seeking information.

Financial outcomes for BMS manufacturers

While not included in our original protocol, a number of case reports provided data from BMS companies on the benefits of BMS marketing to company sales or profits. Although the limited detail in these reports and the wide range of metrics reported make them difficult to systematically synthesise, they nevertheless provide supplementary evidence that digital marketing of BMS appears to be working as intended to deliver a return on investment to BMS companies.

Some case reports provided evidence that digital marketing represented better value for companies than traditional marketing techniques. Budgets were reported by 15/22 case reports, with the range of money spent starting as low as \$3500 USD reportedly spent by Nestlé to launch audio stories on music platform Spotify in Mexico ("Nestlé: Excella Gold Short Audio-Musical Stories in Spotify," 2018)) up to \$10m USD (spent by Danone on digital behaviour monitoring, tracking and social listening on both PC and mobile in China ("Nutrilon: Capture every 7 days of Chinese mom," 2014).

Some case reports highlighted savings compared to previous marketing techniques. For example, posting ads via Facebook, Instagram, Zalo, Bing, Google helped Friso to achieve a cost per new user 20% lower compared to the previous year in Vietnam ("Friso: So you think you can grow Vietnam," 2018). In Indonesia, following up with potential new users through automated methods on WhatsApp was more effective and 50% cheaper than previous campaigns using telephone ("Friso Indonesia: So You Think You Can Grow," 2018).

There were also numerous examples reported where digital marketing campaigns had attracted new users and associated profits. For example, Wyeth's BabyNes campaign in China using online, social media, editorial, in-store and events reportedly grew new users by 246% in one year ("BabyNes for It Moms," 2017). Friso used Zalo, Vietnam's messaging app, to map and reach users, generating \$250k from new users ("FrieslandCampina Vietnam: Because we care," 2017).

In China, AI technology drove more than \$2.2m in sales for Yili-Jinlingguan ("Jinlingguan: AI Baby Expert," 2020) and increased sales by 32% for Nestlé-SuperNan ("SuperNAN: Super Relatable," 2020) respectively. Wyeth's app to teach children about the world 'See the World at Home' increased sales by 30% ("Wyeth Gold: See the world at home.," 2014). In Indonesia, Nutrilon's campaign to geo-target and guide users on Google Maps to nearby shops increased sales by 18% ("Nutrilon Footfall Measurement," 2017).

Discussion

Summary of main results

This review has reported on various aspects of digital marketing of BMS and evidence of their impact on breastfeeding behaviours. The innovative nature of online marketing activity required us to use a mix of traditional and non-traditional sources of information to document the pathways through which marketing affects behaviour and the consequences of these practices.

From this review, we conclude digital marketing of BMS is occurring in a strategic and integrated fashion across a wide range of digital channels and platforms. Exposure to BMS marketing is common, as evidenced by women's own reports in academic studies and case report examples of videos, posts and blogs with millions of views and thousands of 'likes' and 'shares' online.

We found that the strategies used by manufacturers to market in a digital context include well-known but prohibited tactics adapted from traditional media including posting imagery and/or wording that idealizes formula feeding, omitting prescribed disclaimers or using prohibited health and nutrition claims in online content, and offering coupons, samples and discounts through online retail. In addition to these strategies, the digital context offers new opportunities to marketers that present novel challenges for promotion, protection and support of breastfeeding. These include widespread mining of consumer data to facilitate highly-targeted cross-device tracking and segmented marketing, avenues such as apps to directly contact parents in real time, and establishing financial relationships with parents to promote products to their peers on blogs and social media.

Available studies suggest that exposure to digital marketing of BMS is associated with lower intention to breastfeed and lower breastfeeding initiation. They also suggest this association is more significant from online content than traditional forms of media. Pre-natal exposure to direct-to-consumer marketing on the internet also made women more like to switch brands from that used at the hospital without a health reason. Supplementing this limited academic investigation of the relationship between exposure to digital marketing of BMS and infant and young child feeding practices, case reports from marketers themselves demonstrate the significant effect of marketing on parents' attitudes and behaviours. They also highlight the resulting financial benefits for industry.

Strengths and limitations of the review

We used a robust and transparent search strategy to identify relevant studies of interest. We searched multiple databases and used supplementary methods to identify further research. We captured evidence from a wide range of digital media channels and platforms. However, the temporal and transient nature of some social media channels (e.g. Tik-Tok and Snapchat) make them difficult to monitor, suggesting the scope of digital marketing activities may be even wider than currently reported.

We did not hand-search websites in non-English languages. We do not believe this is likely to significantly impact findings on the scope of digital marketing, however additional evidence on impact might have been missed.

Our decision to add WARC case reports enabled development of a more comprehensive picture on the topic in the words of marketers themselves. We dealt with and synthesised

case reports separately to make the methodological distinction clear. While the WARC database is global and purports to have the world's largest collection of advertising effectiveness case studies, the majority (18/23) of results returned relate to WHO's Western Pacific Region (18/23). Potential explanations for this could include an actual focus by manufacturers on advertising in these markets (for example, see rapid growth in sales volumes in East and South East Asia described by Baker et al (Baker et al., 2021), limited regulatory restrictions on BMS marketing in these jurisdictions, and/or a disproportionate use of WARC by advertisers in this region.

Implications for research and practice

Addressing the widespread and harmful nature of digital marketing of BMS will require strengthened action to implement, monitor and enforce the Code at a global level, and through national legislation. It may also require development or extension of policy guidance and regulation in new areas.

Many of the strategies used in a digital context are arguably already prohibited under the Code. These include provision of information and educational materials on infant feeding (Article 4) and all forms of promotion to the public (Article 5). As online retail continues to grow, it could also be argued that requirements akin to Article 9 for labelling on pack be applied to ensure consumers have equivalent information provided at the point of online sale. Where countries have implemented domestic legislation implementing these provisions of the Code, monitoring of digital environments may support increased enforcement and appropriate sanctions.

These may be relatively straightforward to apply to activities of national corporations online, but more challenging to enforce against cross-border marketing to which citizens are exposed in a global online marketplace. Supplementing the Code and government-led legislation, one avenue may be to seek agreement with platforms such as Facebook, Instagram, YouTube and Google to include restrictions on BMS marketing in their internal marketing policies. Precedent exists here with existing restrictions on pornography and some other harmful commodities. In the United Kingdom, Google recently included restrictions on marketing High Fat Sugar Salt (HFSS) foods to minors in an update to its 'Other restricted businesses policy' (Google Advertising Policies, 2020). Platforms could also make it easier for users to opt-out of parenting ads on their platforms.

In addition to addressing these more well-worn strategies, the digital context has provided new opportunities for marketers that remain largely unregulated. Further work is needed, for example, to address the risks created by widespread mining of consumer data. Data collection makes targeted digital marketing possible, and as noted in the report by Wilking, it is inextricably linked with consumer privacy. In some jurisdictions, further research may suggest opportunities provided by privacy legislation or other policies that protect consumers from the collection of their information (Wilking, 2020). Beyond data mining, regulatory innovation is also needed to address practices such as BMS manufacturers offering financial or other incentives to parents to act as 'influencers' for their products. Like data mining, these practices are not unique to the BMS industry and lessons may be drawn from further research on efforts to address this practice in other areas.

As consumers and parents spend an increasing proportion of their lives online, renewed action to ensure that regulation keeps up with constantly evolving and increasingly sophisticated digital marketing tactics will be critical to protect public health worldwide.

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Appendix 1 PRISMA Checklist

Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews (PRISMA-ScR) Checklist

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
TITLE			
Title	1	Identify the report as a scoping review.	Click here to enter text.
ABSTRACT			
Structured summary	2	Provide a structured summary that includes (as applicable): background, objectives, eligibility criteria, sources of evidence, charting methods, results, and conclusions that relate to the review questions and objectives.	Click here to enter text.
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of what is already known. Explain why the review questions/objectives lend themselves to a scoping review approach.	Click here to enter text.
Objectives	4	Provide an explicit statement of the questions and objectives being addressed with reference to their key elements (e.g., population or participants, concepts, and context) or other relevant key elements used to conceptualize the review questions and/or objectives.	Click here to enter text.
METHODS			
Protocol and registration	5	Indicate whether a review protocol exists; state if and where it can be accessed (e.g., a Web address); and if available, provide registration information, including the registration number.	Click here to enter text.
Eligibility criteria	6	Specify characteristics of the sources of evidence used as eligibility criteria (e.g., years considered, language, and publication status), and provide a rationale.	Click here to enter text.
Information sources*	7	Describe all information sources in the search (e.g., databases with dates of coverage and contact with authors to identify additional sources), as well as the date the most recent search was executed.	Click here to enter text.
Search	8	Present the full electronic search strategy for at least 1 database, including any limits used, such that it could be repeated.	Click here to enter text.
Selection of sources of evidence†	9	State the process for selecting sources of evidence (i.e., screening and eligibility) included in the scoping review.	Click here to enter text.
Data charting process‡	10	Describe the methods of charting data from the included sources of evidence (e.g., calibrated forms or forms that have been tested by the team before their use, and whether data charting was done independently or in duplicate) and any processes for obtaining and confirming data from investigators.	Click here to enter text.
Data items	11	List and define all variables for which data were sought and any assumptions and simplifications made.	Click here to enter text.

SECTION	ITEM	PRISMA-ScR CHECKLIST ITEM	REPORTED ON PAGE #
Critical appraisal of individual sources of evidence§	12	If done, provide a rationale for conducting a critical appraisal of included sources of evidence; describe the methods used and how this information was used in any data synthesis (if appropriate).	Click here to enter text.
Synthesis of results	13	Describe the methods of handling and summarizing the data that were charted.	Click here to enter text.
RESULTS			
Selection of sources of evidence	14	Give numbers of sources of evidence screened, assessed for eligibility, and included in the review, with reasons for exclusions at each stage, ideally using a flow diagram.	Click here to enter text.
Characteristics of sources of evidence	15	For each source of evidence, present characteristics for which data were charted and provide the citations.	Click here to enter text.
Critical appraisal within sources of evidence	16	If done, present data on critical appraisal of included sources of evidence (see item 12).	Click here to enter text.
Results of individual sources of evidence	17	For each included source of evidence, present the relevant data that were charted that relate to the review questions and objectives.	Click here to enter text.
Synthesis of results	18	Summarize and/or present the charting results as they relate to the review questions and objectives.	Click here to enter text.
DISCUSSION			
Summary of evidence	19	Summarize the main results (including an overview of concepts, themes, and types of evidence available), link to the review questions and objectives, and consider the relevance to key groups.	Click here to enter text.
Limitations	20	Discuss the limitations of the scoping review process.	Click here to enter text.
Conclusions	21	Provide a general interpretation of the results with respect to the review questions and objectives, as well as potential implications and/or next steps.	Click here to enter text.
FUNDING			
Funding	22	Describe sources of funding for the included sources of evidence, as well as sources of funding for the scoping review. Describe the role of the funders of the scoping review.	Click here to enter text.

JB1 = Joanna Briggs Institute; PRISMA-ScR = Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews.

* Where *sources of evidence* (see second footnote) are compiled from, such as bibliographic databases, social media platforms, and Web sites.

† A more inclusive/heterogeneous term used to account for the different types of evidence or data sources (e.g., quantitative and/or qualitative research, expert opinion, and policy documents) that may be eligible in a scoping review as opposed to only studies. This is not to be confused with *information sources* (see first footnote).

‡ The frameworks by Arksey and O'Malley (6) and Levac and colleagues (7) and the JBI guidance (4, 5) refer to the process of data extraction in a scoping review as data charting.

§ The process of systematically examining research evidence to assess its validity, results, and relevance before using it to inform a decision. This term is used for items 12 and 19 instead of "risk of bias" (which is more applicable to systematic reviews of interventions) to include and acknowledge the various sources of evidence that may be used in a scoping review (e.g., quantitative and/or qualitative research, expert opinion, and policy document).

Appendix 2 Search Strategy

The following search strategy was used for PubMed, MEDLINE, EMBASE, CINAHL (EBSCO), APA PsycINFO and the Cochrane Central Register of Controlled Trials.

CONCEPT	SEARCH STRATEGY (TESTED =)
1. Breast milk substitute	"Infant Formula"[Mesh] OR "Bottle Feeding"[Mesh] OR "Milk Substitutes"[Mesh] OR (("breast milk" OR "breast-milk") AND "substitute*") OR ("infant formula*" OR "baby formula" OR "formula-fed" OR "formula milk" OR "baby milk" OR "first milk" OR "baby formula" OR "artificial milk" OR "milk supplement" OR "supplemental feeding" OR "formula-supplement" OR "Breast milk substitute" OR "formula-feed" OR "formula feeding" OR "infant formula" OR "infant milk" OR "infant formula milk" OR "follow-on formula" OR "follow up formula" OR "transition formula" OR "toddler formula" OR "growing-up formula" OR "bottle feeding" OR "bottlefed")
2. Digital Marketing	"Marketing"[Mesh] OR "Social Marketing"[Mesh] OR "Direct-to-Consumer Advertising"[Mesh] OR "Internet"[Mesh] OR "Internet Use"[Mesh] OR "Internet-Based Intervention"[Mesh] OR "Electronic Mail"[Mesh] OR "internet" OR "website" OR "search engine" OR "SEO" e-mail OR "electronic mail" coupon OR console OR "online gam*" OR online OR internet OR digital OR "social media" OR "social network" OR "new media" OR advergam* OR Twitter OR tweet OR Instagram OR Weibo OR Wei-bo OR Youtube OR tiktok OR tik-tok OR facebook OR netflix OR "amazon prime" OR "over-the-top" OR streaming OR OTT OR blog* or influencer* OR SMS or "short messaging service" OR "podcast" OR "app*" OR "online communit*"
Concepts add	Concept 1 AND 2

We used a different strategy to locate WARC case reports given its different search functionality and use of key words. We searched the WARC category of 'baby food' for any item containing the words 'formula' OR 'milk' AND 'digital'. We screened 80 preliminary results to include 25 relevant case reports about 22 marketing campaigns for BMS that had at least some digital component.