

National survey of infant feeding bottles in Germany: Their characteristics and marketing claims

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Abstract

Bottles and teats are ubiquitously used for feeding infants and young children. Yet there are limited empirical studies on the scope of infant feeding bottles, their attributes, or their marketing claims. We report the first comprehensive survey on infant feeding bottles and teats in Germany. We aimed to explore the extent of bottles and teats available in Germany, describe their physical attributes and analyze their marketing claims. A cross-sectional survey of German bottle and teat manufacturer websites was conducted between June and November 2022. Product attributes are presented with descriptive statistics and photographs. Marketing claims are summarized in a descriptive content analysis. We identified 41 brands encompassing 447 unique products (226 bottles, 221 teats). The majority of bottles were plastic (147, 65%) or glass (64, 28%), and the majority of teats were silicone (188, 85%). Most brands (38, 93%) promoted products using one or more inappropriate marketing claims, including equivalency to breastfeeding (29, 73%), idealization through technical or medical descriptions (23, 58%), claims on disease prevention (31, 78%), references to naturalness (29, 73%), infant autonomy (10, 25%), and endorsements from parents (10, 25%) or health professionals (11, 28%). The majority of bottles and teats available in Germany appear to be marketed inappropriately and hold the potential to undermine public health recommendations on infant and young child feeding. Therefore, we recommend Germany strengthens legislation on the marketing of bottles and teats in accordance with the International Code of Marketing of Breastmilk Substitutes.

KEYWORDS

bottlefeeding, bottles, breastfeeding, commercial, commercial determinants of health, infant formula, International Code of Marketing of Breastmilk substitutes, marketing, teats

1 | INTRODUCTION

Bottlefeeding is a very common mode of feeding among formula-fed infants, mixed-fed infants and breastfed infants whose mothers pump their milk. In Germany, by 6 months of age, 43% of infants are

formula-fed and 38% are mixed-fed (Theurich et al., 2019). The practices of formula-feeding and expressed breastmilk feeding together create a rise in demand for and use of infant feeding bottles. The global infant feeding bottle market had an estimated value of \$3.46 billion in 2022 and is expected to grow with a

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compound annual growth rate of 5.7%, reaching a value of \$5.42 billion by 2030 (Grand View Research, 2022). In Europe, the infant feeding bottle market is growing similarly, at an expected compound annual growth rate of 5.4% between 2022 and 2029 (Data Bridge Market Research, 2022).

The World Health Assembly (WHA) adopted the International Code of Marketing of Breastmilk Substitutes (the Code) in 1981 (World Health Organization & UNICEF, 1981), which has been updated and elaborated upon by many subsequent WHA Resolutions. The Code is a set of recommendations to eliminate inappropriate marketing of infant formula, bottles and teats, complementary foods and toddler milks, including the prohibition of advertising to the public or promotion within health care systems, through the provision of free samples to parents, health care workers, health facilities or sponsorship of health professionals or scientific meetings (World Health Organization & UNICEF, 1981). It states that 'there should be no advertising or other form of promotion to the general public. This would include any advertising through mass media outlets such as television, magazines, billboards, websites, or social media (World Health Organization, 2017)'.

Globally, 78 countries that have adopted aspects of the International Code into their legislation also include aspects around the marketing of bottles and teats. Compared to other countries, Germany has one of the weakest legislations governing the marketing of bottles and teats, with very few provisions of the code adopted into law (World Health Organization, 2018). The last legal measure in Germany was put into place in 2016 (World Health Organization, 2022). Legislation governing the marketing of breastmilk substitutes in Germany only covers products marketed for infants under 12 months of age (hence excluding 'toddler milks' marketed for young children). There are also no provisions governing the marketing of complementary foods, bottles or teats. Additionally, there is no entity in Germany defined as responsible for monitoring or enforcement of compliance or for defining sanctions for violations of the Code, and legislation does not yet exist to ensure such an entity is independent, transparent and free from commercial influence (World Health Organization, 2022). According to German law, manufacturers are allowed to distribute informational and educational materials, refer to proprietary products, and use pictures and text that idealize infant formula (World Health Organization, 2022). Advertising to the general public as well as direct contact with mothers is permitted in Germany.

In terms of contact with health care facilities, there are no provisions in place in Germany to prohibit using health facilities for the promotion of infant formula, including the display of products, posters, materials from industry or hosting of industry events and use of personnel provided by or paid for by industry (World Health Organization, 2022). It is permitted for the industry to give gifts and incentives to health workers and health care systems, including financial or material inducements, research grants and scholarships, provision of free or low-cost products, donations of equipment and services, product samples and sponsorship of scientific meetings (World Health Organization, 2022).

Key messages

- There is limited research on infant feeding bottles and teats or their marketing claims.
- Most infant feeding bottle brands identified (38, 93%) promoted products using one or more inappropriate marketing claims.
- No national legislation currently exists to restrict misleading marketing claims on infant feeding bottles and teats.
- Large bottle volumes, teats designed for feeding complementary foods and nonstandardized language for teat flow rates may promote overfeeding, overweight and obesity.
- Bottles and teats should be made of safe materials, be designed for easy cleaning, meet specified European standards and reference the European safety standard.

In the absence of these important regulations in Germany, marketing practices of bottles and teats may be undermining public health messaging and recommended infant and young child feeding practices. These include optimal breastfeeding, safe formula feeding and age-appropriate complementary feeding practices (Alcaire et al., 2021). Therefore, it is important to describe the scope and characteristics of current bottles and teats sold on the German market. In this survey, we aim to describe the diversity of infant feeding bottles and teats available for purchase in Germany, describe their physical attributes and analyze their marketing claims.

2 | METHODS

We used *Amazon.de* and *Google.de* to identify the brands of baby bottles and teats available for purchase in Germany between June and November 2022. For the initial search, we used the search term 'Babyflasche' (baby bottle). From there, we identified the respective websites of baby bottle and teat brands. A master list of baby bottle and teat brands with their website and contact information was compiled, including websites of all major drugstores in Germany selling bottles and teats (Appendix S1).

Once the master list was compiled, we searched all manufacturer and drugstore websites comprehensively for bottles and teats, by scrolling through all products marketed for feeding infants. For brands selling bottles on their own websites, we extracted the data directly. For brands that were sold only by drugstores without separate websites, we extracted the data directly from drugstore websites. If bottles and teats were sold on Amazon Germany, but did not have a manufacturer website, we extracted data from product photos or labels available from *Amazon.de*. Where we identified bottles or teats on multiple websites, we removed all duplicate products.

2.1 | Inclusion and exclusion criteria

To be included, all products had to be available for purchase in Germany. We only included manufacturers with websites available in German or English languages.

Bottles and teats marketed for infants and young children under 36 months of age were included since this is the age range specified in the International Code of Marketing of Breastmilk Substitutes (World Health Organization & United Nations Children's Fund, 2017; Theurich, 2020). We extracted the recommended age range directly from the text or photos of labels on manufacturer or drugstore websites.

We included bottles and teats marketed for feeding breastmilk, infant formula or other liquids. The WHO NetCode toolkit also defines bottles to include 'feeding bottles attached to breast pumps and other types of vessels for feeding of infants comprising of a container and a teat' (World Health Organization, 2017). Therefore, storage containers for human milk advertised for infant feeding or advertised to fit 'standard available teats' were included.

Feeding devices with silicone teats or straws marketed as 'learning cups', or 'training cups', were excluded. Accordingly, we excluded teats with nontraditional shapes and sizes for older infants and children (e.g., hard sippy teats, hard plastic straws and plastic flip-top caps). If identical bottles were sold in various colours, they were considered to be the same product and were therefore only recorded once. Teats with a 'Y-shape' perforation marketed for feeding 'milk porridges' were included. We excluded bottles and teats marketed for infants and children with special needs (e.g., cleft lip and palate) or prematurity.

2.2 | Data extraction

For data extraction, an extraction sheet was created in Microsoft Excel with an a priori list of information to extract, including brand name, product description (product name, recommended age in months, bottle volume in mL, teat flow rate), bottle, teat or combination (categorical), breastfeeding claims, health claims, endorsements, composite materials and hyperlinks to product websites. Information was extracted by one of two (M. A. T., F. S.) researchers, recorded in Microsoft Excel and cross-checked by another researcher (M. A. T., M. Z.). Researchers extracted claims from the manufacturer's websites directly. Where the data could not be extracted directly from the manufacturer's website text (e.g., the recommended minimum age for use), we searched for photos of the front and back of the product label. Where available, we extracted data from photos of product labels. Manufacturers were contacted by email for any missing information identified and, in some cases, provided electronic product catalogues.

2.3 | Data analysis

'Marketing claims' were defined as any written statement or comparison made to advertise the benefits, characteristics or performance of a bottle

or teat. Extracted marketing claims were reviewed independently by two researchers (M. A. T., M. Z.). A content analysis of marketing claims was then conducted using an inductive analysis approach of the raw data. This was performed through discussion, and seven main categories of marketing claims were created.

Subsequently, each researcher coded extracted marketing claims into one of seven categories. Disagreements on the categorization of claims were resolved through discussion. Marketing claims in German were first translated by 'Google Translate'. Translations were then cross-checked by a native English and native German speaker. The results of the survey were summarized using tables, photographs and descriptive statistics.

2.4 | Photographs

Based on their characteristics (volume, composite materials and design), we chose a purposive selection of bottles and teats to photograph to demonstrate the wide variety of bottles and teats available on the German market. We then chose a purposive selection of teats to photograph based on their composite materials, design (shape) and marketing claims.

We used various purposive sampling techniques to guide which bottles to photograph depending on which of the characteristics we wanted to examine. Overall, we aimed to examine bottle volumes, the widths of bottlenecks, bottle composite materials including thermodynamic materials, overall shapes, bottle exteriors (grips) and designs of bottles with 'anti-colic' claims.

To demonstrate variation in bottle volume and neck width, we used maximum variation sampling (heterogeneous sampling) to capture the widest range possible. To demonstrate bottle shapes, thermodynamic materials and bottles marketed as 'anti-colic', we used extreme (deviant) case sampling. We did this to illuminate any unusual bottle shapes or outliers and chose bottles that were more extreme in nature to ensure maximum variation.

3 | RESULTS

We identified 41 bottle and teat brands for inclusion. A comprehensive list of brands surveyed is listed in Appendix S1. Figure 1 shows the cumulative number of unique bottles and teats by brand name.

3.1 | Infant feeding bottles

A total of 226 bottles were identified. Bottle volumes varied greatly (range 60–360 mL; average 205 mL \pm SD: 78 mL, median: 240 mL). The majority of bottles were made of plastic (polyethylene, $n = 147$, 65%), borosilicate glass (64, 28%) or stainless steel (15, 7%). Bottles were marketed in various colours (range: 1–4 colours). Some were printed with patterns including polka dots, triangles or rain drops or included symbols and cartoon graphics, such as animals, hearts, stars,

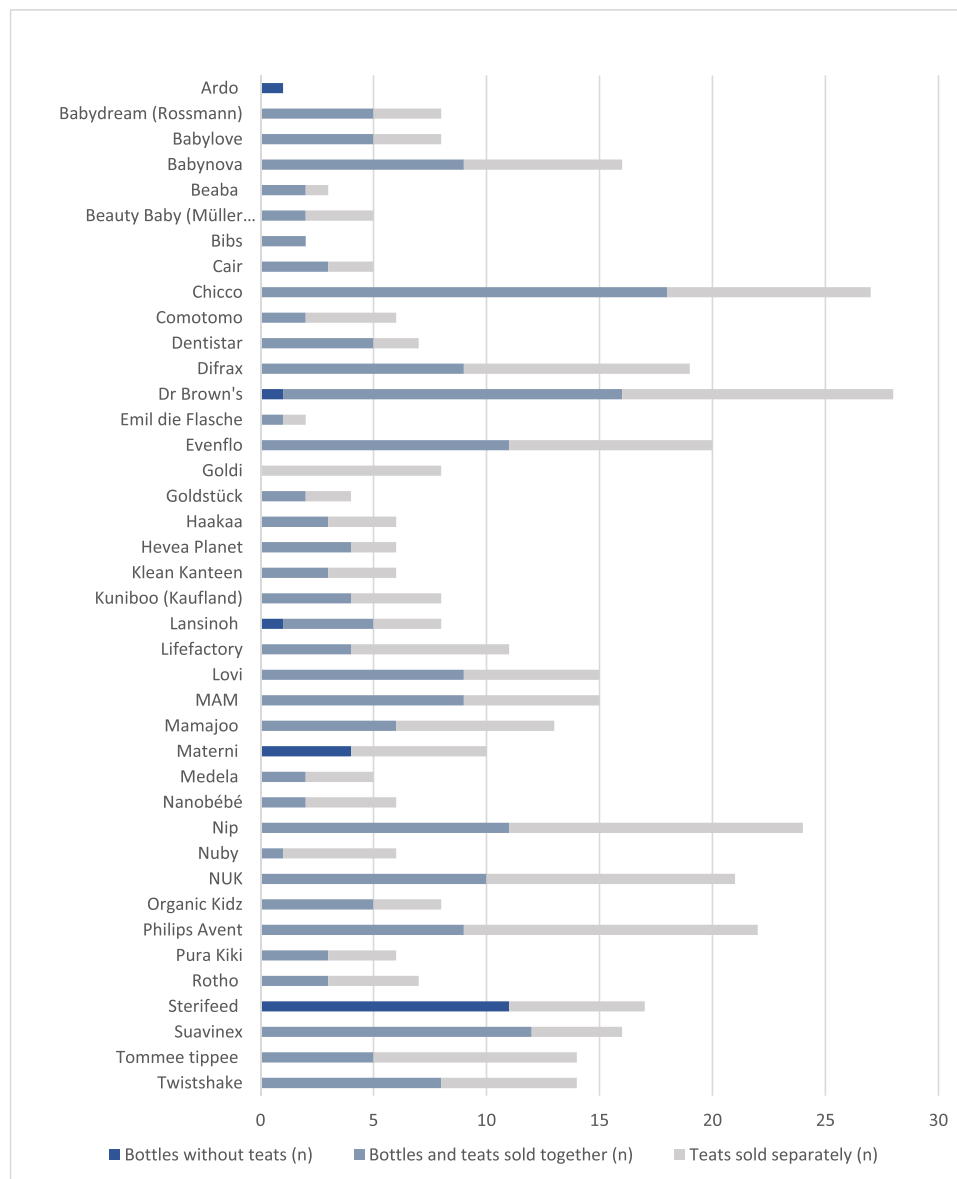


FIGURE 1 Number of bottles and teats marketed online in Germany by brand.

boats, cars, rockets or rainbows. Cartoons and imaginative figures were commonly printed on feeding bottles. Photographs of a purposive sample of bottles are depicted in Figure 2.

3.2 | Teats

A total of 221 teats were identified. Data on the composite materials of teats was available for 212 (96%) of the products surveyed. The majority of teats were made exclusively from silicone (188, 85%) or latex (24,11%). Two brands selling medical-grade bottles and teats described teats as being made from a 'food grade polymer' or 'elastomer' without further description. Only one teat consisted of multiple materials: silicone, polypropylene and an undescribed thermoplastic elastomer. Photographs of a purposive sample of teats are depicted in Figure 3.

Teats were advertised with various milk flow rates (e.g., slow, medium, high or for complementary foods) which are comparable to one another within a set of products from the same brand. Across brands, 28 unique designations for milk flow rates were identified (see Appendix S2).

3.3 | Marketing claims

In a content analysis, seven types of marketing claims were identified. Most brands (38, 93%) promoted products using one more inappropriate marketing claims. Twenty-three brands (56%) use four or more types (median: 4) of inappropriate marketing claims. These included claims on the equivalency to breastfeeding (29, 73%), claims on disease prevention (31, 78%) or references to naturalness (29, 73%). Other brands idealized bottlefeeding through technical or

scientific descriptions (23, 58%), promoted bottlefeeding for infant autonomy (10, 25%), or used parental (10, 25%) or health professional (11, 28%) endorsements. Table 1 presents descriptions of the marketing claim categories and examples of the wording used in claims.

4 | DISCUSSION

To our knowledge, no other scientific works have reported the scope and characteristics of bottles and teats available in the market in Germany. This online survey covered all major brands, including

brands sold by major drugstores in Germany. We assumed that the presence of bottles and teats has increased online (especially during and following COVID-19 pandemic conditions) and that in Germany, the majority of bottles and teats are either ordered from online marketplaces or purchased from major drugstores. We assumed that the scope of bottles and teats marketed exclusively offline in Germany is negligible. We, therefore, believe that our survey includes the majority of infant feeding bottles sold in the country.

We identified two other studies surveying infant feeding bottles or their marketing claims, including a 2014 survey from Australia on 91 bottles from 28 brands (Gibble et al., 2017) and a study of 197




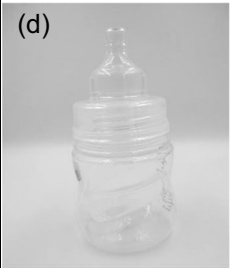
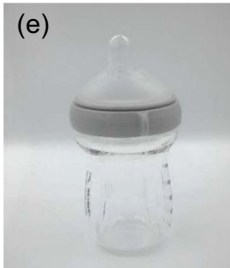




Characteristics	Photos of infant feeding bottles		
Varying bottle volumes (60, 250 and 360ml, and bottle neck diameters (wide and narrow)	(a) 	(b) 	(c) 
Differing bottle materials (Polyethylene, Borosilicate glass, or stainless steel) with silicone teats	(d) 	(e) 	(f) 
Unique bottle shapes	(g) 	(h) 	(i) 

FIGURE 2 Purposive sample of infant feeding bottles with specified characteristics. (a) 60 mL polypropylene bottle with silicone teat and wide bottle neck, marketed for 0–6 months of age. (b) 250 mL polypropylene bottle with latex teat and standard bottle neck, marketed starting from 6 months of age. (c) 360 mL polypropylene bottle with silicone teat with a wide bottle neck, marketed starting from 6 months of age. (d) 150 mL polypropylene bottle with silicone teat, marketed from birth. (e) 90 mL borosilicate glass bottle with polypropylene ring, silicone teat and wide bottle neck, marketed for 0–6 months of age. (f) 250 mL stainless steel bottle with silicone teat, no recommended age range. (g) 240 mL polypropylene bottle with silicone teat, no recommended age range. (h) 250 mL polypropylene bottle with silicone teat, marketed from birth. (i) 150 mL polypropylene bottle with silicone teat, marketed from birth. (j) 250 mL polypropylene bottle with silicone teat, marketed from birth. (k) 240 mL polypropylene bottle with silicone teat, marketed from birth. (l) 113 mL silicone pouch with silicone teat, marketed from birth. (m) 150 mL polypropylene bottle with silicone teat, temperature control display, marketed from 0 to 6 months. (n) 260 mL polypropylene bottle with silicone teat, temperature control display, no recommended age range. (o) 150 mL glass and silicone bottle with silicone teat, with a heat sensor function, marketed from birth. (p) 240 mL polypropylene bottle with silicone teat, polypropylene grip, marketed from birth. (q) 120 mL borosilicate glass bottle with latex teat, rubber grip, marketed from 0 to 3 months of age. (r) 300 mL glass bottle with latex teat, and thermal mug with a padded cloth covering, marketed from 0 to 6 months.

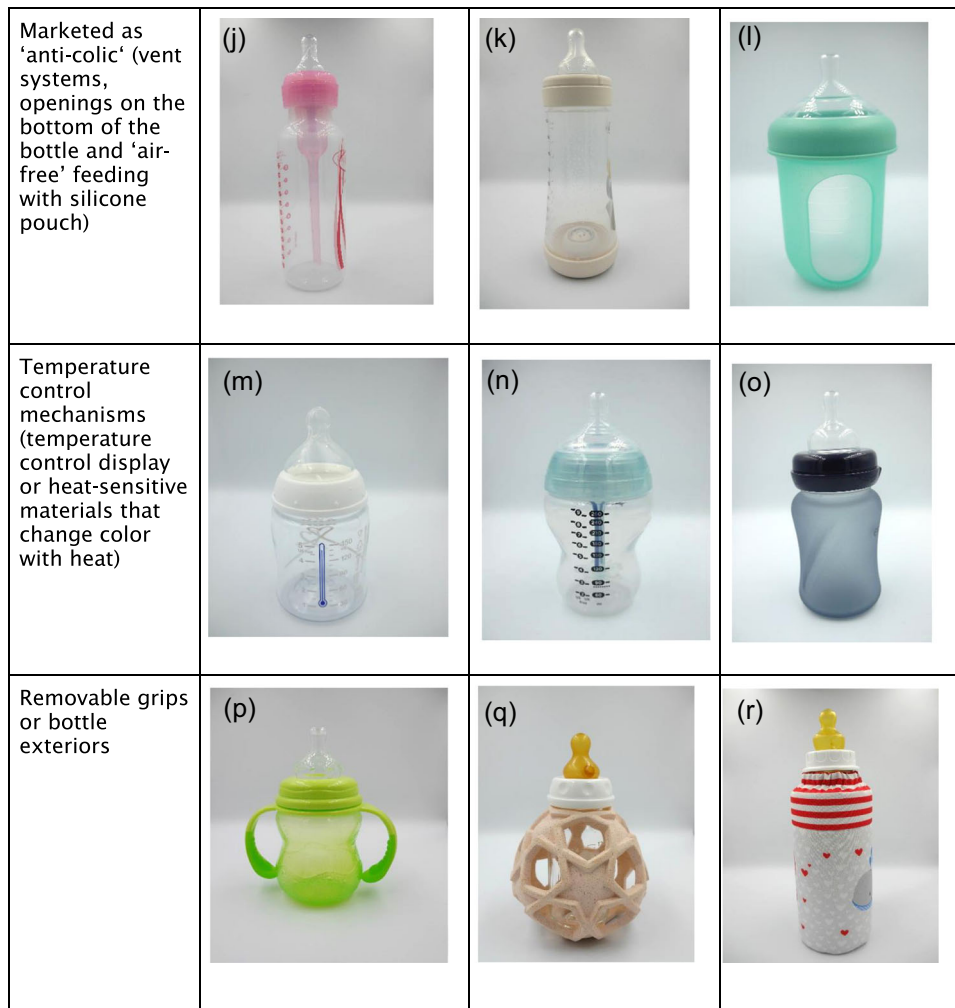


FIGURE 2 (Continued)

feeding bottles and 77 teats sold in retail outlets in Uruguay (Alcaire et al., 2021). Compared to these surveys, our survey identified 41 brands comprising 226 bottles and 221 teats, a substantially larger sample. We cannot conclude if the differences in the number of bottles and teats identified in Germany compared to the studies from Australia and Uruguay are due to variations in sales between world regions, year of study or sampling technique (in-person vs. online marketplaces), or a combination of reasons. (Table 2).

4.1 | Implications of bottle characteristics for infant health

The physical characteristics of infant feeding bottles have serious implications for child health. For this reason, they are currently governed by the European safety standard for infant and child drinking equipment (EN 14350:2020+A1:2023). This standard is published by the European Committee for Standardization and specifies safety requirements relating to the materials, construction,

performance, packaging, and product information for feeding bottles intended for infants and children aged from birth to 48 months of age. It was given the status of a national standard in February 2024, so conflicting national standards had to be withdrawn by August 2024. In our survey, only 19 bottles stated on their website text that their product 'fulfills the requirement of the European Norm EN 14350' or 'conforms to EU standards'. However, we found that some products were linked to 'instructions for use' where this information was listed in small print.

4.1.1 | Bottle materials and food safety

In this survey, we found that 65% of bottles available in the market were made of plastic. Information about the prevalence of plastic feeding bottles on the German market is important for determining exposure to existing endocrine-disrupting environmental contaminants like bisphenols, as well as any new or emerging contaminants. Epidemiological studies tracking global bisphenol A (BPA) concentrations in human urine have shown an overall decrease in bisphenols in child populations from

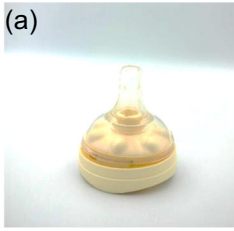
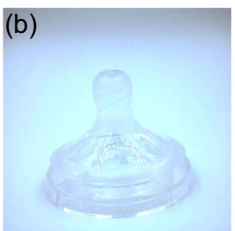
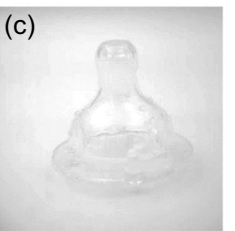
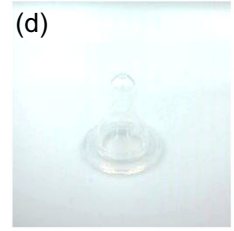
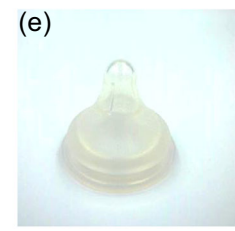
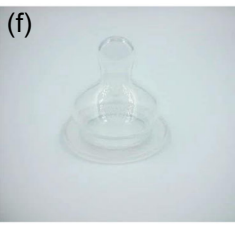

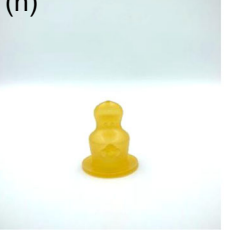
Characteristics	Photos of infant feeding bottle teats		
Teats marketed with 'anti-colic' valves (A, B, C)			
Teats with narrow (D) and wide (E, F) diameters			
Teats with Y-shape opening marketed for complementary foods (G), and latex teats (H)			

FIGURE 3 Purposive sample of infant feeding bottle teats with specified characteristics. (a) Silicone, polypropylene and thermoplastic elastomer teat, marketed for feeding breastmilk only, no recommended age range. (b) Silicone teat, wide neck, with 'anti-colic' valve; marketed from birth. (c) Silicone teat, with 'anti-colic' valve, marketed from birth. (d) Silicone teat, narrow neck, marketed from birth. (e) Silicone teat with 'anti-colic' valve, no recommended age range. (f) Silicone teat with 'anti-colic' valve and wide neck, marketed from birth. (g) Silicone teat with 'anti-colic' valve, wide neck and Y-shaped opening marketed for complementary foods from 6 months of age. (h) Latex teat with 'anti-colic' valve, no recommended age range.

2011, likely due to the wide-reaching prohibition of BPA in infant feeding bottles in many countries since 2009 (Huang et al., 2018). This decreasing trend in BPA exposure has also been demonstrated in pediatric populations in Germany (Tschersich et al., 2021). Nevertheless, bisphenol A is still being identified in the urine of young children in Germany and therefore researchers recommend continuing epidemiological monitoring of environmental sources of phenols (Tschersich et al., 2021). A toxicology study of the urine of 47 German infants in Bavaria in 2011 found that free BPA was observed above the limit of quantification in only 3 of 91 (3%) urine samples, but infants fed with baby bottles had approximately twofold higher total BPA levels compared to non-bottle-fed infants (Völkel et al., 2011).

A recent study from Zhang et al. (2023) investigated infant exposure to microplastics from infant feeding bottles and found that in formula-fed infants, the microplastic exposure from plastic feeding bottles is 6.8 times higher than from infant formula powder alone. Microplastics shed from infant feeding bottles have been shown to increase inflammation in human intestinal cells (Xu et al., 2023).

4.1.2 | Bottle design and food safety

The cleaning and sterilization of infant feeding bottles have very important implications for the hygienic preparation of infant formula and the safe storage and feeding of human milk. Therefore, bottle design and composite materials are important attributes to consider when choosing a feeding bottle. Due to the need for routine cleaning and sterilization, bottles should have designs that are relatively simple to disassemble and clean. However, this survey identified bottles with designs (including extreme curvature, shapes, and narrow 'anti-colic' venting systems) that would prove difficult to clean.

Bottle composite materials are also important to consider with regard to cleaning and sterilization practices. It has been shown that the shedding of microplastics and BPA from infant feeding bottles increases during the preparation of bottles for feeding, for example, through shaking, sterilization of plastic feeding bottles with boiling water, dishwashing, brushing and microwave heating (Brede et al., 2003; Ehlert et al., 2008; Xu et al., 2023). Since this knowledge

TABLE 1 Description of the types of marketing claims with examples.

Type of marketing claim and description	Number of brands using this type (n, %)	Examples
<i>Equivalency to breastfeeding:</i> References to breastfeeding, mother's skin, breasts or nipples, and claims implying equivalency or superiority to breastfeeding	29 (71%)	<ul style="list-style-type: none"> • References to teats as 'nipples' • 'Physiologically mimics the mammary glands during nursing' • 'teat is modelled after mother's breast' • 'the extra-soft and flexible silicone adapts to the palate so that the baby can retain its natural sucking behaviour learned at the breast. This makes it easy to switch from breast to bottle and back to breast' • 'especially developed for breast-fed babies' • 'Safe for breastfeeding (does not disturb the sucking reflex)' • 'Skin soft silicone' • 'Unique bottle shape—just like mother's breast during breastfeeding' • 'Designed to be close to mother's breast'
<i>Mechanics of bottlefeeding:</i> Idealization of bottlefeeding through technical descriptions of the mechanisms of bottlefeeding	23 (56%)	<ul style="list-style-type: none"> • 'Anatomically formed' • 'Orthodontic' • 'Enables proper sucking-swallowing-breathing coordination. Provides proper mouth and tongue muscle work. Enables proper suckling rhythm' • 'It extends and contracts with the child's sucking action. Mobilizes the oral cavity muscles to properly work'
<i>Disease prevention:</i> Claims that bottles or teats improve infant health or well-being through reduction of colic, possetting, burping, flatulence, etc.	31 (76%)	<ul style="list-style-type: none"> • 'Reduces the risk of colic, spit-up, and ear infections' • 'Aids in digestion' • 'Anti-colic' • 'Medical grade silicone nipple protects against latex allergens' • 'Developed with an anti-colic vent to prevent stomach pain in babies' • 'Integrated 1-piece venting system to help reduce the potential for colic, reflux, gas, and fussiness'
<i>Naturalness:</i> Claims which refer to 'nature' or 'naturalness' of infant feeding bottles	29 (72%)	<ul style="list-style-type: none"> • 'Especially natural drinking feeling' • 'Natural drinking experience' • 'For a familiar drinking feeling' • 'Teat supports your baby in their natural drinking behaviour' • 'A natural feeding experience'
<i>Infant autonomy:</i> Claims that bottle-feeding promotes infant autonomy	10 (24%)	<ul style="list-style-type: none"> • 'Easiest for babies who hold the bottle on their own' • 'Child can regulate the flow themselves' • 'The perfect choice to teach your baby independence' • 'Especially easy to hold for tiny hands' • 'Ergonomic design: fits well into the hands of parents and infants'
<i>Claims by parents:</i> Surveys of parents, claims on infant acceptance of feeding bottles	10 (24%)	<ul style="list-style-type: none"> • 'Quick acceptance by babies' • '84% of moms who used our anti-colic bottles agreed they reduced their baby's colic symptoms. Based on 2021 study of 524 parents' • '94% of babies accepted our teat'
<i>Endorsement by health professionals:</i> Surveys of health professionals or endorsements by health professionals, health professional associations, or research institutes	11 (27%)	<ul style="list-style-type: none"> • 'Teats approved by the Spanish Society of Pediatric Dentistry' • 'Recommended by 98% of 100 midwives' • 'For breastfed babies, recommended by midwives and paediatricians' • '88% of doctors confirm that the sucking rhythm of the breastfed baby is maintained' • 'Supporting the WHO breastfeeding recommendations' • 'Products are developed from the beginning in collaboration with research institutes like the ICMRS, paediatricians, experts in child development, dentists, and midwives'

Abbreviation: WHO, World Health Organization.

TABLE 2 Types of marketing claims by brand.

	Equivalency to breastfeeding	Mechanics of bottlefeeding	Disease prevention	Naturalness	Infant autonomy	Recommended by parents	Endorsement by health professionals
Ardo	-	-	-	-	-	-	-
Babydream	-	X	X	X	-	X	-
Babylove	-	X	X	X	-	-	-
Babynova	X	X	X	X	X	-	-
Beaba	X	-	-	-	X	-	-
Beauty baby	-	X	X	X	-	X	-
Boon Nursh	X	X	X	X	-	-	-
Bibs	-	-	X	-	-	-	-
Cair	-	-	-	-	-	-	-
Chicco	X	X	X	X	-	X	-
Comotomo	X	-	X	X	-	X	-
Difrax	X	-	X	X	X	-	X
Dentistar	X	-	X	X	X	X	-
Dr Browns	X	X	X	X	-	X	X
Evenflo	X	X	X	X	-	-	X
Emil	-	X	X	-	-	-	-
Goldi	-	-	X	X	-	-	-
Golstück	-	X	X	-	-	-	-
Haakaa	X	X	X	X	X	-	-
Hevea Planet	-	X	-	X	-	-	-
Klean Kanteen	X	-	-	-	-	-	-
Kuniboo	-	X	X	-	-	-	-
Lansinoh	X	X	X	X	-	X	X
Lifefactory	X	-	-	X	-	-	-
Lovi	X	X	X	-	-	-	X
MAM	X	X	X	X	X	X	X
Mamajoo	X	-	X	X	-	-	-
Materni	-	-	-	-	-	-	-
Medela	X	X	-	X	-	-	X
Nanobebe	X	-	X	X	X	-	-
Nip	X	X	X	X	-	-	-
NUK	X	X	X	X	X	X	X
Nuby	X	-	X	-	X	-	-
Organic Kidz	X	X	X	X	-	-	-
Philipps Avent	X	-	X	X	-	-	X
Pura Kiki	X	-	X	X	-	-	-
Rotho	X	X	X	X	-	-	X
Sterifeed	X	X	-	X	-	-	-

(Continues)

TABLE 2 (Continued)

	Equivalency to breastfeeding	Mechanics of bottlefeeding	Disease prevention	Naturalness	Infant autonomy	Recommended by parents	Endorsement by health professionals
Suavinex	X	X	-	-	X	-	X
Tommee Tippee	X	-	X	X	-	X	-
Twistshake	X	-	X	X	-	-	-

is also increasing amongst the general public, there is an anticipated increase in the availability and purchase of glass feeding bottles and feeding bottles from other materials (Data Bridge Market Research, 2022). In this survey, we identified 64 bottles made of borosilicate glass and 15 bottles made of stainless steel on the German market.

4.1.3 | Bottle volumes and infant feeding practices

Other physical attributes of bottles and teats may be undermining current health and nutrition recommendations for infants and young children. These include bottle volumes which are too large, teats with arbitrarily described flow rates and teats designed for feeding complementary foods, which may increase the risk of overfeeding. This survey demonstrated an average infant bottle volume of 205 ± 78 mL (mean \pm SD; median: 240 mL) on the German market. This finding is important because studies indicate that larger bottle volumes may lead to overfeeding. A study of 865 exclusively formula-fed infants at 2 months of age investigated infants fed with larger bottles (≥ 170 mL) compared to smaller bottles (< 170 mL). The study found that infants fed with larger bottles drank on average 114 mL more infant formula per day ($p = 0.03$) (Wood et al., 2016). These findings have implications for the risk of infant overfeeding and the development of childhood overweight and obesity.

A 2014 survey from Australia included 91 bottles from 28 brands and found that 19 bottles (22%) had at least one measured marking outside the accepted tolerance range given by EN 14350 (Gribble et al., 2017). This survey did not examine bottle marker accuracies. However, since inaccurate volume markers have implications for under- and overdilution of infant formula and serious implications for child nutrition and health, this is also an important area for future investigation within the German infant feeding bottle market.

4.1.4 | Teat design and infant feeding practices

A systematic review looking at infant formula feeding practices associated with weight gain found that overfeeding infant formula, as well as the addition of complementary cereals into feeding bottles, may contribute to excess weight gain (Appleton et al., 2018). Most infant feeding guidelines also do not recommend feeding infants cereals through a feeding bottle, due to the risk of choking (Appleton et al., 2018). Despite this, our survey identified 16 teats (from nine different brands)

that were designed for feeding complementary foods (using a so-called 'y-cut' design) or otherwise recommended feeding complementary food porridges with teats in their instructions or messaging. This finding coincides with other studies on bottle- and teat-like devices designed and inappropriately marketed for feeding complementary foods (Theurich, 2018a, 2018b, 2020), despite public health recommendations in Germany discouraging this practice (Koletzko et al., 2019).

Another important implication for overfeeding includes teat flow rates. Our study identified 28 unique designations to describe milk flow rates. Heterogeneous and arbitrary descriptions for milk flow rates (e.g., 'variable flow', 'uni' or 'mini') complicate analyses or comparisons across brands. Furthermore, it is uncertain how well the company designation for milk flow rates reflects the actual milk flow rate. In a study on milk flow rates of 375 teats sold in the United States, milk flow rates varied widely from 0.86 to 37.61 mL/min, and milk flow rates printed on the packaging did not accurately reflect these rates (Pados et al., 2019). It is unknown how accurate the advertised milk flow rates are for teats sold in Germany, however, standardization of the terminology for milk flow rates seems warranted.

4.2 | Implications of bottle marketing claims for infant health

Our survey demonstrates that infant feeding bottles in Germany are marketed using various methods and claims which have specific target audiences, including health professionals, parents or infants and young children themselves. Claims targeting health professionals might include those using highly scientific descriptions or endorsements by health professional societies. Claims targeting parents might have statements or parental endorsements, like 'based on a 2021 study of 524 parents...94% of babies accepted our teat'. Bottle manufacturers may even market products to infants and children directly through designs of bottles or labels that are printed in various colours, patterns, and familiar cartoons and imaginative figures.

Manufacturers in this survey used various marketing claims to promote bottlefeeding to breastfeeding parents, idealized feeding by equating bottles and teats with breastfeeding, and used claims that bottles improve the feeding experience or otherwise improve child health, well-being, or development. We did not find any scientific literature to substantiate such claims. We discuss the potential health ramifications of each of the marketing claim types that were identified in our survey.

4.2.1 | Bottle- and breastfeeding equivalency, or compatibility

Claims which equate bottlefeeding with breastfeeding, which convey bottlefeeding as 'natural,' or which state bottlefeeding is easily compatible with breastfeeding are problematic. These types of claims may persuade parents to purchase and use feeding bottles under the pretence that their breastfed infant will be able to seamlessly combine breastfeeding and bottle-feeding. However, there is no indisputable evidence that bottlefeeding will not have an adverse impact on the ability of infants to breastfeed. Furthermore, there is no evidence that any particular type of bottle or teat makes it easier for infants to combine breast- and bottlefeeding. In fact, bottlefeeding may interfere with the ability of some infants to breastfeed.

4.2.2 | Bottlefeeding and oral health

Claims that idealize bottlefeeding through technical or scientific descriptions of the mechanisms of bottlefeeding are problematic. These claims may persuade health professionals to recommend parents with low health literacy to purchase or use a feeding bottle under the assumption that the bottle will promote improved coordination of swallowing, sucking, and breathing. Indeed, claims that bottle teats are 'orthodontic' are counter to evidence that shows that prolonged bottlefeeding causes overjet and dental misalignment, findings that have also been demonstrated in German cohorts (Robke, 2008). Furthermore, these claims may persuade parents to believe that feeding bottles are needed to promote healthy dental or oral development when this is untrue.

4.2.3 | Pathologizing normal infant behaviours

Perhaps the most concerning findings of this survey are the scientifically unfounded claims that bottlefeeding reduces the risk of colic, spit-up, stomach pain, reflux, gas, fussiness and ear infections. In this survey, the majority of bottles were marketed as 'anti-colic' (139, 62%). We find the marketing of bottles and teats as 'anti-colic' to be particularly deceptive and problematic. We found only a few published studies in Germany and the Netherlands comparing teats with varying flow rates and vents, commonly marketed as 'anti-colic' vents, to investigate such claims. Nevertheless, these studies were funded by the manufacturers of the teats themselves, posing conflicts of interest and casting doubt on the validity of the study findings (Kreitschmann et al., 2018; Lagarde et al., 2019). Similar to the marketing tactics used to market infant formula (The Lancet, 2023), manufacturers of bottles and teats in this survey portray common and developmentally appropriate infant behaviours such as crying, possetting, flatulence, unsettledness and irregular sleep patterns as pathological. These normal behaviours are often cited as reasons to introduce bottles and teats. On the other hand, in the case of infants with unexplained frequent, prolonged, or intensive crying due to medical reasons, the unethical marketing of products to

alleviate infant colic may indeed prolong timely evaluation or care by health professionals and cause additional confusion, burden and financial expense to parents.

4.3 | Limitations

This survey excluded bottles and teats marketed specifically for preterm infants and infants with special needs like cleft lip and palate. This is because these populations often require specialized feeding support and may use a variety of supplemental feeding devices (including nasogastric feeding tubes, syringes, supplemental nursing systems, gavage, cups, spoons or paladais) which fell outside the scope of this survey. We therefore call for more research on bottles, teats and other specialized infant feeding equipment that are specifically recommended for preterm, sick and other infants requiring specialized feeding support.

5 | CONCLUSION

Large bottle volumes, teats designed for feeding complementary foods and nonstandardized language for teat flow rates may promote overfeeding, overweight and obesity. Bottles and teats should be made of safe materials, be designed for easy cleaning, meet and reference current European safety standards for drinking equipment. Manufacturers of infant feeding bottles and teats sold in Germany are using inappropriate marketing practices. Therefore, we call for the introduction of effective legislation aligned with the International Code for Marketing of Breastmilk Substitutes to prevent such practices. Furthermore, we call for mechanisms that ensure ongoing effective monitoring and enforcement of penalization for unethical marketing practices.

AUTHOR CONTRIBUTIONS

Melissa A. Theurich and Monika Ziebart conceptualized the survey. Melissa A. Theurich, Monika Ziebart and Frances Strobl collected data. Melissa A. Theurich and Monika Ziebart conducted the content analysis. Melissa A. Theurich performed descriptive statistics. All authors read and approved the manuscript.

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CONFLICT OF INTEREST STATEMENT

The authors do not claim any financial arrangement with companies whose products are featured in the manuscript. Melissa A. Theurich previously received consultancy and travel reimbursement fees from the United Nations Children's Fund (UNICEF), the World Health Organization (WHO), the German Society for Paediatric and Adolescent Medicine (DGKJ), the Austrian Society for Paediatric and Adolescent Medicine

(ÖGKJ) and the Ludwig-Maximilians University of Munich (LMU). The remaining authors declare no conflict of interest.

DATA AVAILABILITY STATEMENT

Data described in the manuscript will be made available upon request pending approval by the corresponding author.

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REFERENCES

- Alcaire, F., Antúnez, L., Vidal, L., de León, C., Girona, A., Rodríguez, R., Giménez, A., Bove, I., & Ares, G. (2021). The idealisation of bottle feeding: Content analysis of feeding bottles and teats packages in Uruguay. *Public Health Nutrition*, 24(10), 3147–3155.
- Appleton, J., Russell, C. G., Laws, R., Fowler, C., Campbell, K., & Denney-Wilson, E. (2018). Infant formula feeding practices associated with rapid weight gain: A systematic review. *Maternal & child nutrition*, 14(3), 12602.
- Brede, C., Fjeldal, P., Skjevrak, I., & Herikstad, H. (2003). Increased migration levels of bisphenol A from polycarbonate baby bottles after dishwashing, boiling and brushing. *Food Additives and Contaminants*, 20(7), 684–689.
- Data Bridge Market Research. (2022). *Europe baby feeding bottle market—Industry trends and forecast to 2029*. Data Bridge Market Research.
- Ehler, K. A., Beumer, C. W. E., & Groot, M. C. E. (2008). Migration of bisphenol A into water from polycarbonate baby bottles during microwave heating. *Food Additives & Contaminants: Part A*, 25(7), 904–910.
- Grand View Research. (2022). *Baby bottle market size, share & trends analysis report by product (plastic, silicone, glass, stainless steel), by distribution channel (offline, online), by region, and segment forecasts, 2023–2030* (Report ID: GVR-2-68038-863-3). Grand View Research Inc.
- Gribble, K., Berry, N., Kerac, M., & Challinor, M. (2017). Volume marker inaccuracies: A cross-sectional survey of infant feeding bottles. *Maternal & Child Nutrition*, 13(3), e12388.
- Huang, R., Liu, Z., Yin, H., Dang, Z., Wu, P., Zhu, N., & Lin, Z. (2018). Bisphenol A concentrations in human urine, human intakes across six continents, and annual trends of average intakes in adult and child populations worldwide: A thorough literature review. *Science of the Total Environment*, 626, 971–981.
- Koletzko, B., Bührer, C., Ensenauer, R., Jochum, F., Kalhoff, H., Lawrenz, B., Körner, A., Mihatsch, W., Rudloff, S., & Zimmer, K. P. (2019). Complementary foods in baby food pouches: Position statement from the Nutrition Commission of the German Society for Pediatrics and Adolescent Medicine (DGKJ, e.V.). *Molecular and Cellular Pediatrics*, 6(1), 2.
- Kreitschmann, M., Epping, L. C., Hohoff, A., Sauerland, C., & Stamm, T. (2018). Sucking behaviour using feeding teats with and without an anticolic system: A randomized controlled clinical trial. *BMC Pediatrics*, 18(1), 115.
- Lagarde, M. L. J., van Alfen, N., de Groot, S. A. F., Geurts, A. C. H., & van den Engel-Hoek, L. (2019). Adaptive capacity of 2- to 5-month-old infants to the flow, shape, and flexibility of different teats during bottle feeding: A cross-sectional study. *BMC Pediatrics*, 19(1), 477.
- Pados, B. F., Park, J., & Dodrill, P. (2019). Know the flow: Milk flow rates from bottle nipples used in the hospital and after discharge. *Advances in Neonatal Care*, 19(1), 32–41.
- Robke, F. J. (2008). Effects of nursing bottle misuse on oral health. Prevalence of caries, tooth malalignments and malocclusions in North-German preschool children. *Journal of Orofacial Orthopedics*, 69(1), 5–19.
- The Lancet (2023). Unveiling the predatory tactics of the formula milk industry. *The Lancet*, 401(10375), 409.
- Theurich, M. A. (2018a). Perspective: Novel commercial packaging and devices for complementary feeding. *Advances in Nutrition*, 9(5), 581–589.
- Theurich, M. A. (2018b). World Health Assembly Resolution 69.9 calls for an end to unethical marketing of “Baby Foods”. *Journal of Human Lactation*, 34(2), 272–275.
- Theurich, M. A. (2020). Are modern complementary food packaging, devices and teats compatible with international guidance on complementary feeding? *Journal of Human Lactation*, 36(1), 29–33.
- Theurich, M. A., Davanzo, R., Busck-Rasmussen, M., Díaz-Gómez, N. M., Brennan, C., Kylberg, E., Bærug, A., McHugh, L., Weikert, C., Abraham, K., & Koletzko, B. (2019). Breastfeeding rates and programs in Europe: A survey of 11 national breastfeeding committees and representatives. *Journal of Pediatric Gastroenterology and Nutrition*, 68(3), 470–407.
- Tschersich, C., Murawski, A., Schwedler, G., Rucic, E., Moos, R. K., Kasper-Sonnenberg, M., Koch, H. M., Brüning, T., & Kolossa-Gehring, M. (2021). Bisphenol A and six other environmental phenols in urine of children and adolescents in Germany—Human biomonitoring results of the German Environmental Survey 2014–2017 (GerES V). *Science of the Total Environment*, 763, 144615.
- Völkel, W., Kiranoglu, M., & Fromme, H. (2011). Determination of free and total bisphenol A in urine of infants. *Environmental Research*, 111(1), 143–148.
- Wood, C. T., Skinner, A. C., Yin, H. S., Rothman, R. L., Sanders, L. M., Delamater, A., Ravanbakht, S. N., & Perrin, E. M. (2016). Association between bottle size and formula intake in 2-month-old infants. *Academic Pediatrics*, 16(3), 254–259.
- World Health Organization. (2017). *The International Code of Marketing of Breast-Milk Substitutes: frequently asked questions (2017 update)*. World Health Organization.
- World Health Organization. (2018). *Marketing of breast-milk substitutes: national implementation of the international code, status report 2018*. World Health Organization.
- World Health Organization. (2022). *Marketing of breast-milk substitutes: national implementation of the international code, status report 2022*. World Health Organization 2022.
- World Health Organization & UNICEF. (1981). *International Code of Marketing of Breast-Milk Substitutes*.
- World Health Organization & United Nations Children's Fund. (2017). *NetCode toolkit. Monitoring the marketing of breast-milk substitutes: Protocol for ongoing monitoring systems*.
- Xu, Z., Shen, J., Lin, L., Chen, J., Wang, L., Deng, X., Wu, X., Lin, Z., Zhang, Y., Yu, R., Xu, Z., Zhang, J., Zhang, Y., & Wang, C. (2023). Exposure to irregular microplastic shed from baby bottles activates the ROS/NLRP3/Caspase-1 signaling pathway, causing intestinal inflammation. *Environment International*, 181, 108296.
- Zhang, Q., Liu, L., Jiang, Y., Zhang, Y., Fan, Y., Rao, W., & Qian, X. (2023). Microplastics in infant milk powder. *Environmental Pollution*, 323, 121225.

SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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