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Published in:
Public Health Nutrition

DOI:
[10.1017/S1368980016001117](https://doi.org/10.1017/S1368980016001117)

Publication date:
2016

Document Version
Peer reviewed version

[Link to publication in Discovery Research Portal](#)

Citation for published version (APA):

Baker, P., Smith, J., Salmon, L., Friel, S., Kent, G., Iellamo, A., ... Renfrew, M. J. (2016). Global trends and patterns of commercial milk-based formula sales: is an unprecedented infant and young child feeding transition underway? *Public Health Nutrition*, 19(14), 2540-2550. DOI: 10.1017/S1368980016001117

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Global trends and patterns of commercial milk-based formula sales: is an unprecedented infant and young child feeding transition underway?

Abbreviated title: Rapid global growth in infant formula sales

Key words: infant and young child feeding, nutrition transition, formula, breast-milk substitutes

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Cite as: Baker P, Smith J, Salmon L, Friel S, Kent G, Iellamo A, Dadhich JP, Renfrew M (2016) Global trends and patterns of commercial milk-based formula sales: is an unprecedented infant and young child feeding transition underway? *Public Health Nutrition* (forthcoming)

Abstract

Objective: The marketing of infant/child milk-based formulas (MF) contributes to suboptimal breastfeeding and adversely affects child and maternal health outcomes globally. However, little is known about recent changes in MF markets. This study describes contemporary trends and patterns of MF sales at the global, regional and country levels.

Design: Descriptive statistics of trends and patterns in MF sales volume per infant/child for the years 2008-2013 and projections to 2018, using industry-sourced data.

Setting: 80 countries categorised by country income bracket, for developing countries by region, and in countries with largest infant/child populations.

Subjects: MF categories included total (for ages 0-36 months), infant (0-6 months), follow-up (7-12 months), toddler (13-36 months), and special (0-6 months).

Results: In 2008-2013 world total MF sales grew by 40.8% from 5.5 to 7.8kg per infant/child/year, a figure predicted to increase to 10.8kg by 2018. Growth was most rapid in East Asia particularly in China, Indonesia and Vietnam and was led by the infant and follow-up formula categories. Sales volume per infant/child was positively associated with country income level although with wide variability between countries.

Conclusions: A global infant and young child feeding (IYCF) transition towards diets higher in MF is underway and is expected to continue apace. The observed increase in MF sales raises serious concern for global child and maternal health, particularly in East Asia, and calls into question the efficacy of current regulatory regimes designed to protect and promote optimal IYCF. The observed changes have not been captured by existing IYCF monitoring systems.

Introduction

Breastfeeding is important for infant and young child health and development, and for maternal health, in both developed and developing country-settings.^(1; 2; 3) It is ranked as the single most effective intervention for the prevention of deaths in children under-five years of age.⁽⁴⁾ To achieve optimal growth, development and health the World Health Organization (WHO) recommends that infants should be exclusively breastfed for the first six months of life and thereafter receive nutritionally adequate and safe complementary foods while continuing breastfeeding for up to two years of age or beyond.^(5; 6) Although significant progress has been made in some countries, the global exclusive breastfeeding rate improved only marginally from 33% in 1995 to 37% in 2014.⁽⁷⁾ Every year an estimated 823,000 deaths, or 13.8% of total deaths, in children under-2 years of age would be prevented if breastfeeding were scaled-up to a near universal level in high-mortality low- and middle-income countries. For mothers, a universal level of breastfeeding in all countries would prevent an estimated 20,000 deaths from breast cancer annually.⁽⁸⁾ Suboptimal infant and young child feeding (IYCF) also incurs higher health systems expenditures through increased paediatric and maternal health care needs,^(9; 10; 11) and productivity-related economic losses of \$302 billion or 0.49% of world gross national income annually.⁽¹²⁾

The WHO/UNICEF *Global Strategy for Infant and Young Child Feeding* (GSIYCF) commits member countries to implement policies designed to protect, promote and support breastfeeding and to give full effect to the *International Code of Marketing of Breast-Milk Substitutes* and subsequent World Health Assembly resolutions (*The Code*).⁽¹³⁾ These commitments were reaffirmed in 2012, when member countries unanimously adopted the goal of increasing the global exclusive breastfeeding rate (<6 months) to at least 50% by 2025.⁽¹⁴⁾ Implementation and monitoring of *The Code* is further supported by the United Nations *Convention on the Rights of the Child* and its monitoring body, the Committee on the Rights of the Child. *The Code* is a response to long-standing concern that the commercial marketing of breast milk substitutes (BMS), including milk-based formulas (MF) and other foods represented to be suitable as partial or total replacements of breast milk, contributes significantly to suboptimal IYCF.⁽¹³⁾

Despite these high-level policy commitments, recent market reports indicate that a global MF ‘sales boom’ is underway.⁽¹⁵⁾ This sales boom applies to infant formula (for consumption by infants aged 0-6 months) but also to follow-up (7-12 months) and toddler (13-36 months)

formulas, which can displace ongoing breastfeeding if marketed and consumed inappropriately. Because products in these latter categories are often branded, packaged and labelled in ways that resemble infant formula, they can also be erroneously introduced in the first six months of life.^(16; 17; 18) The WHO has long maintained that these milks are unnecessary and unsuitable as BMS.⁽¹⁹⁾

Such reports are concerning given the well-established evidence that formula-fed children experience poorer health and developmental outcomes than breastfed children, with additional adverse implications for maternal health. Breast-milk is a personalised source of nutrition providing optimal levels of nutrients in volumes regulated by the mother-child feeding dyad, and an array of biological factors critical for normal immunological, gastrointestinal and neurological development.⁽⁸⁾ MF is an ultra-processed food,⁽²⁰⁾ defined as an industrial formulation of (typically) bovine milk powder, sugars, vegetable oils, vitamins and minerals, and other additives. Although an appropriate food when breastfeeding is contraindicated, MF is prone to microbial contamination (of the formula product, when mixed with contaminated water, or through unsterile feeding equipment), industrial contamination (e.g. the 2008 East Asia melamine poisoning crisis), and is implicated in infant malnutrition when practiced inappropriately (including under- and over-dilution and under- and over-feeding). Evidence on the health and developmental implications of MF come from studies comparing never and partially breast-fed vs. breastfed infants including significant increased risks of all-cause mortality, diarrhoea and pneumonia mortality,⁽²⁾ obesity and type-2 diabetes,⁽²¹⁾ otitis media,⁽²²⁾ malocclusion,⁽²³⁾ asthma,⁽²⁴⁾ and sudden infant death syndrome.⁽²⁵⁾ Non-breast fed children also demonstrate significantly lower intelligence quotient (IQ) scores, robust to adjustments for maternal IQ.⁽²⁶⁾ Formula-feeding affects maternal health primarily due to foregone protective effects of breastfeeding against ovarian cancer, breast cancer and type-2 diabetes.⁽¹⁾

Although the reported MF sales boom could have important public health implications, it is not evidenced in current WHO/UNICEF monitoring systems for infant and young child feeding (IYCF). The existing MF-relevant indicator of ‘proportion of children 0-23 months of age who are fed with a bottle’ is voluntarily reported, coverage is low and longitudinal data patchy. To address the identified evidence gap this paper describes recent global trends and patterns in MF sales volumes using market sales data in countries categorised by income-level and in developing countries by region. Sales volumes in countries with the largest

infant/child populations are also reported. We conclude with a discussion of the potential factors driving global MF sales and observed variations between regions and countries.

Methods

Setting & subjects

The analysis included 80 countries for which data were available, categorised by World Bank income bracket: 15 lower-middle income countries (L-MICs), 26 upper-middle income countries (U-MICs) and 39 high-income countries (H-ICs), representing 280,220,000 infants/children aged 0-36 months in 2013 (Table 1).⁽²⁷⁾ To ascertain regional trends in MF sales in developing countries, where most of the recent MF market growth has been reported, L-MICs and U-MICs were also categorised by World Bank region (Table 2).

Table 1. Countries included in this analysis categorized by World Bank income bracket, and populations aged 0-36 months in 2013

Income bracket	GNI per capita (US\$)	Countries	Pop. aged 0-36 months
High-income	>12,745	Australia (AUS), Austria (AUT), Belgium (BEL), Canada (CAN), Chile (CHL), Croatia (HRV), Czech Republic (CZE), Denmark (DNK), Estonia (EST), Finland (FIN), France (FRA), Germany (DEU), Greece (GRC), Hong Kong (HKG), Ireland (IRL), Israel (ISR), Italy (ITA), Japan (JPN), Latvia (LVA), Lithuania (LTU), Netherlands (NLD), New Zealand (NZL), Norway (NOR), Poland (POL), Portugal (PRT), Russia (RUS), Saudi Arabia (SAU), Singapore (SGP), Slovakia (SVK), Slovenia (SVN), South Korea (KOR), Spain (ESP), Sweden (SWE), Switzerland (CHE), Taiwan (TWN), United Arab Emirates (ARE), United Kingdom (GBR), United States (USA), Uruguay (URY)	43,226,000
Upper-middle income	4,126 – 12,745	Algeria (DZA), Argentina (ARG), Azerbaijan (AZE), Belarus (BLR), Bosnia-Herzegovina (BIH), Brazil (BRA), Bulgaria (BGR), China (CHN), Colombia (COL), Costa Rica (CRI), Dominican Republic (DOM), Ecuador (ECU), Hungary (HUN), Iran (IRN), Kazakhstan (KAZ), Macedonia (MKD), Malaysia (MYS), Mexico (MEX), Peru (PER), Romania (ROU), Serbia (SRB), South Africa (ZAF), Thailand (THA), Tunisia (TUN), Turkey (TUR), Venezuela (VEN)	86,248,000
Lower-middle income	1,046 – 4,125	Bolivia (BOL), Cameroon (CMR), Egypt (EGY), Georgia (GEO), Guatemala (GTM), India (IND), Indonesia (IDN), Kenya* (KEN), Morocco (MAR), Nigeria (NGA), Pakistan (PAK), Philippines (PHL), Ukraine (UKR), Uzbekistan (UZB), Vietnam (VNM)	150,746,000
Total		80	280,220,000

Footnote: *low-income country.

Table 2. Lower-middle income and upper-middle income countries included in this analysis categorized by World Bank region, and populations aged 0-36 months in 2013

Region	Countries	Pop. aged 0-36 months
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Europe and Central Asia	Azerbaijan, Belarus, Bosnia-Herzegovina, Bulgaria, Georgia, Hungary, Kazakhstan, Macedonia, Romania, Serbia, Ukraine, Uzbekistan	6,932,000
East Asia	China, Indonesia, Malaysia, Philippines, Thailand, Vietnam	68,634,000
South Asia	India, Pakistan	89,586,000
Latin America	Argentina, Bolivia, Brazil, Colombia, Costa Rica, Dominican Republic, Ecuador, Guatemala, Mexico, Peru, Venezuela	27,273,000
Middle East and North Africa	Algeria, Iran, Egypt, Tunisia, Turkey, Morocco,	17,497,000
Sub-Saharan Africa	Cameroon, Kenya*, Nigeria, South Africa	27,072,000
Total		236,994,000

Footnote: *low-income country.

Data sources and measures

Data from food balance sheets (food supply), household expenditure surveys, and food consumption surveys are commonly used to monitor population-level diets.⁽²⁸⁾ However, we were unable to obtain adequate national-level, globally-comparable, longitudinal data for MF from these sources. Instead, similar to other analyses of global food and beverage markets, we adopted country-level retail sales volume per capita as a proxy measure of consumption.^(29; 30; 31) Data were extracted from country reports sourced from the Euromonitor Passport Global Market Information database (GMID), for the years 2008-2013 with projections to 2018.⁽³²⁾ Euromonitor collects these data from trade associations, industry bodies, business press, company financial reports, and official government statistics. The data are validated through consultation with people working within industry. Projections are calculated by establishing a historic market trend and then factoring in possible future market changes (e.g. likelihood of recession or government regulation).⁽³²⁾

To control for country population size differences and growth rates, volumes were converted to kg per infant/child, matched to the target age groups of the respective MF product categories defined by Euromonitor. These categories included: total MF (aggregates all product categories; for consumption by infants and children aged between 0-36 months), infant formula (IF; 0-6 months), follow-up formula (FUF; 7-12 months), toddler formula (TF; 13-36 months), and special formula (SF, sold for infants with dietary conditions and includes soy-based and lactose-free varieties; calculated for infants aged 0-6 months).⁽³²⁾ Infant/child population estimates corresponding to these categories were sourced from the Euromonitor GMID as derived from official UN and national statistics. Data were unavailable for FUF in the USA and TF in Japan making the total MF sales figures in these markets an underestimate.

Gross domestic product (GDP) per capita (in international dollars at purchasing power parity to allow for comparability between countries) was adopted as an approximate measure of consumer purchasing power with data extracted from the World Bank World Development Indicators database for the years 2008-2013.⁽²⁷⁾

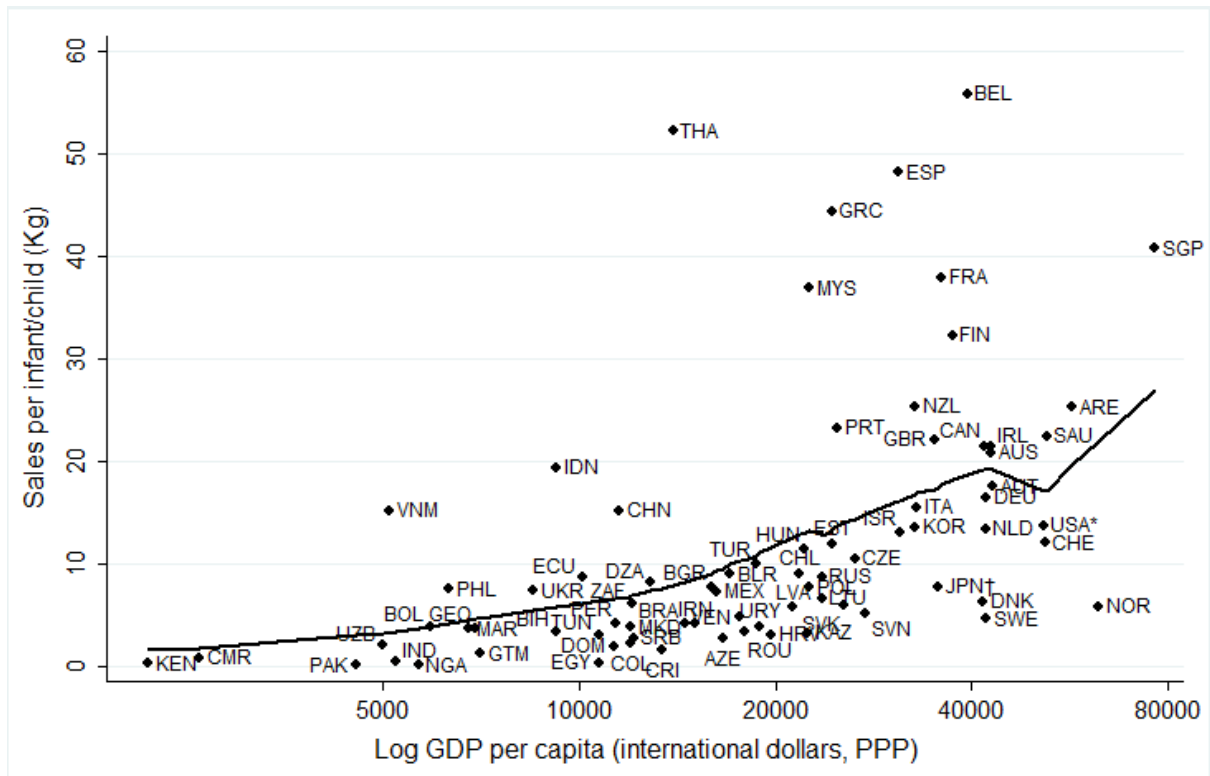
Data analysis

Country total MF sales volumes per infant/child in 2013 were plotted against GDP per capita (in international dollars at purchasing power parity for comparability between countries). Country compound annual growth rates (CAGR) for the 2008-2013 period were calculated and plotted against sales volumes in 2013 for the respective categories. Additionally, descriptive statistics were used to describe total MF and category sales volumes and five-year historical (2008-2013) and projected (2014-2018) growth rates, for each country income category, and for the five country markets with the largest infant/child population in each country income category. Sales in L-MICs and U-MICs were also analysed by region.

Results

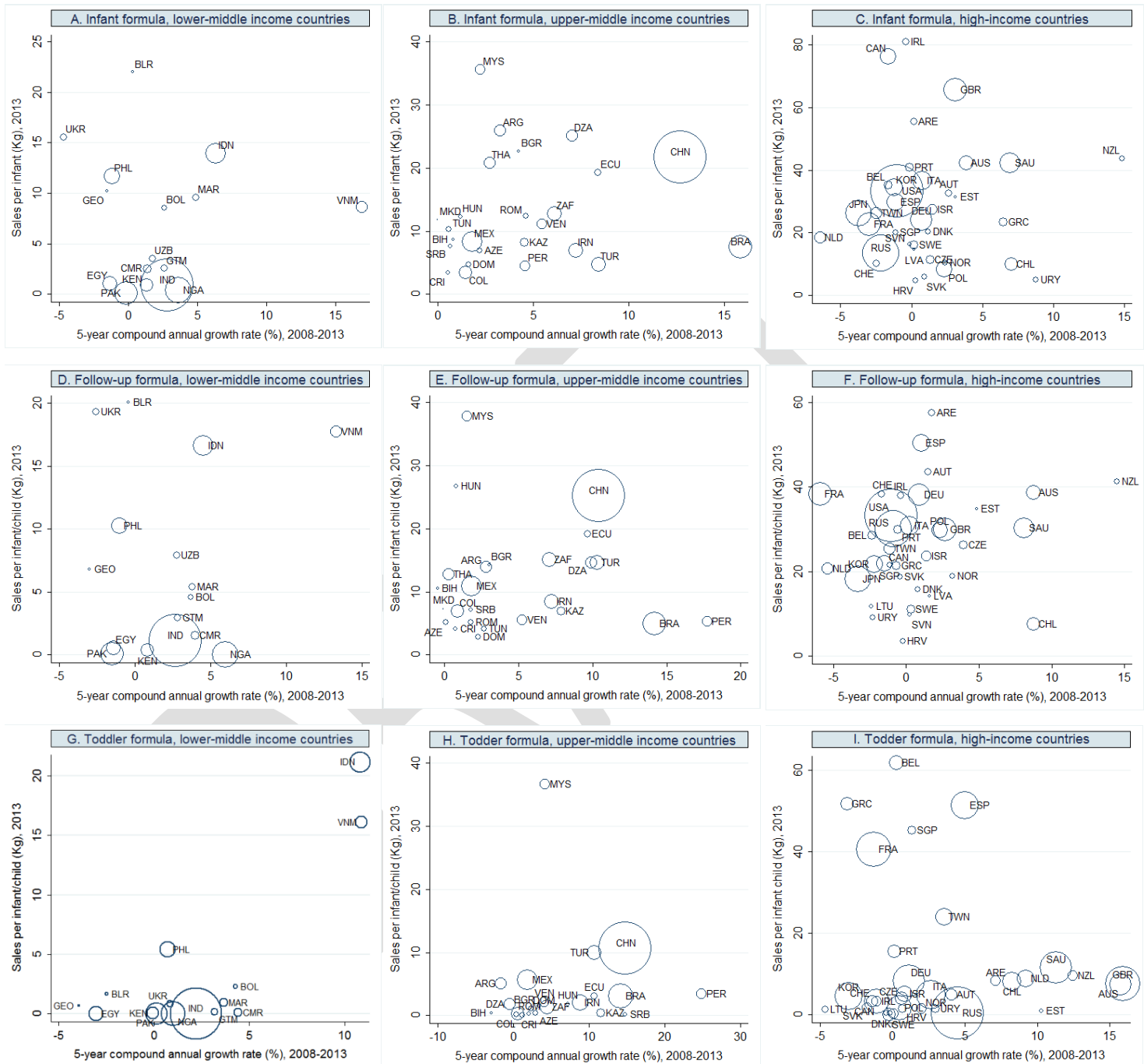
Figure 1 shows the relationship between total formula sales per infant/child and log GDP per capita in 2013. Figures 2a-i show the relationship between sales volume per infant/child in 2013 and the compound annual growth rate for sales volume per infant/child in the 2008-2013 period, for the infant, follow-up and toddler formula categories, in countries grouped by income. These demonstrate a positive association between sales volume and country income level, although with wide variability in sales volumes and growth rates between countries within each income category. For example, Indonesia and Vietnam had considerably higher sales volumes and growth rates in contrast to other LMICs such as Egypt, India and Pakistan. The United Kingdom, Australia, New Zealand and Saudi Arabia had considerably higher sales volumes and growth rates than most other HICs, particularly Scandinavian and Eastern European countries such as Denmark, Sweden and Croatia.

Figure 1. Total formula retail sales volumes (kg) per infant/child (aged 0-36 months) vs log GDP per capita (PPP, international dollars) in 2013, with fitted values



Footnotes: The fitted line on the graph represents a robust nonparametric locally weighted regression describing the smoothed relationship between the variables, generated using the Stata *lowess* algorithm (set to the default bandwidth of 0.8, N=79); see Table 1 for country abbreviations; data from Euromonitor Passport Global Market Information database; * volume for USA excludes follow-up formula; † volume for JPN excludes toddler formula; HKG was excluded as an outlier with 256.9 kg per infant/child; GDP = Gross Domestic Product per capita at purchasing power parity (PPP) and international dollars to allow for comparability between countries.

Figures 2a-i. Formula sales volumes (kg) per infant/child in 2013 vs. five-year compound annual growth rates (%) for 2008-2013, for countries grouped by income category, with weighted markers representing infant/child population sizes



Footnotes: See Table 1 for country abbreviations; data from Euromonitor Passport Global Market Information database; population estimates are for infants/children aged 0-6 months for infant formula, 7-12 months for follow-up formula, and 13-36 months for toddler formula; Figure 1c excludes JPN and outliers not shown are HKG (269.3 kg, 14.3%) and FIN (114.8 kg, -0.8%); Figure 1f outliers not shown are HKG (100.5 kg, 4.9%) and FIN (72.3 kg, -0.6%); Figure 1g excludes UZB; Figure 1e excludes MKD and outlier not shown is THA (68.8 kg, 6.3%); Figure 1i excludes JPN and USA and outliers not shown are HKG (298.7 kg, 10.7%) and FIN (1.3 kg, 33.0%).

Table 3 describes MF product category sales volumes in 2013, and historic and projected five-year growth rates in the country income categories and in countries with largest infant/child populations. Figure 3 demonstrates MF category sales trends for the country income categories. Between 2008 and 2013 the total world MF sales volume grew by 40.8% from 5.5 to 7.8 kg per infant/child/year, a rate greatly exceeding GDP growth over the same period. Between 2014 and 2018 this figure is projected to increase by 30.4% to 10.8 kg with growth led by the infant and follow-up categories. The toddler category demonstrated the strongest growth in the 2008-2013 period, however infant and follow-up formula were more significant in terms of absolute volume growth. The infant and follow-up categories are predicted to account for most of world volume growth in 2014-2018.

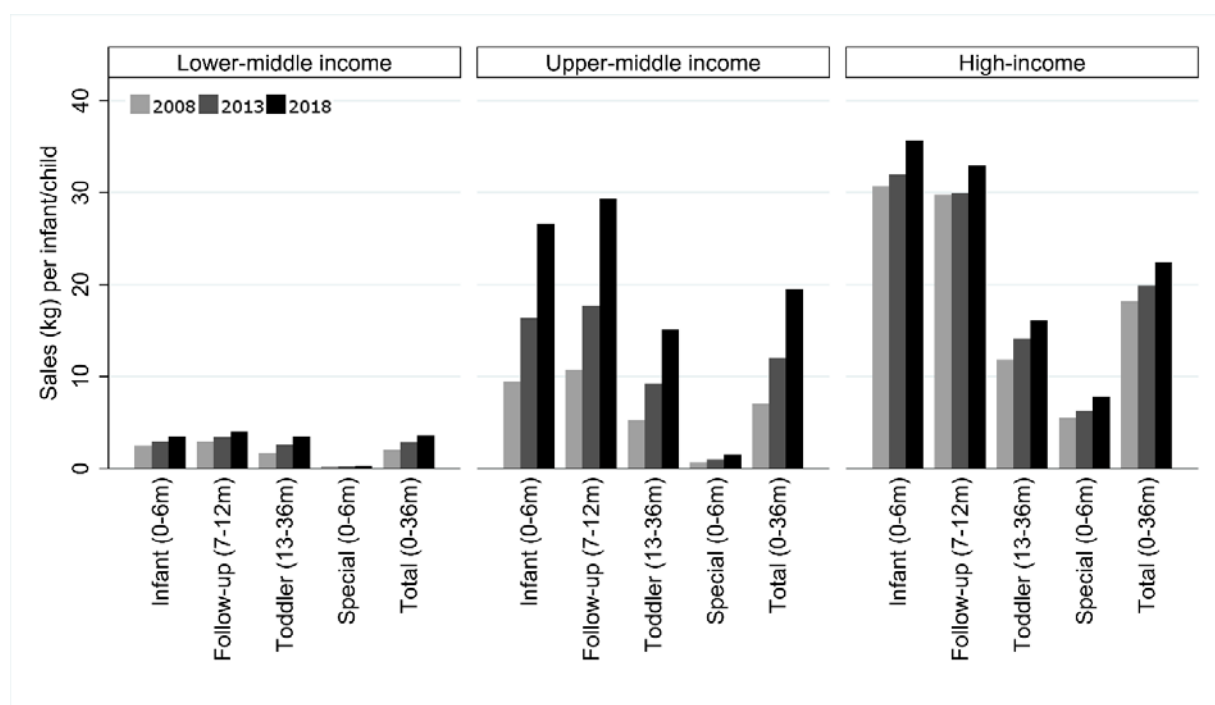
Much of the recent growth was explained by U-MICs, where total MF sales volume per infant/child grew by 71.7% in 2008-2013, led by China, Brazil, Peru and Turkey. Growth was also strong in L-MICs led by Indonesia and Vietnam, although with some exceptions (e.g. Indonesia) absolute sales volumes were comparatively low; whereas 19.9 kg per infant/child of total MF was sold in H-ICs in 2013, this figure was only 2.8 kg in L-MICs. Although total MF sales grew in HICs, many of the largest markets, namely France, Japan, Korea, USA and Russia, underwent negative growth in the infant and follow-up categories. However, many HICs demonstrated strong growth in toddler formula. Hong Kong was an outlier with a total MF volume of 256.9 kg in 2013, and growth of 83.5% over the 2008-2013 period, likely resulting from sales for informal export into neighbouring China. Some HICs, for example New Zealand, Australia, Ireland and France are significant dairy producers and high volumes in these countries may also partly reflect sales for informal export.

Table 3. Formula category sales volumes (kg) per infant/child with five-year actual and projected growth rates (%), for country income brackets and largest country markets by infant/child population size, 2013

Markets	Infant (0-6m)	Follow-up (7-12m)	Toddler (13-36m)	Special (0-6m)	Total (0-36m)	Total Δ 2008-13 (%)	Total Δ 2014-18 (%)	Δ GDP 2008-13 (%)
H-IC	32.0	30.0*	14.1†	6.3	19.9‡	10.5	9.9	-4.2
USA	45.4	-	5.0	16.4	-	-	-	1.9
Russia	13.6	30.1	0.4	3.6	8.7	-4.8	14.3	4.1
Japan	26.3	18.2	-	2.6	-	-	-	2.1
UK	65.7	29.9	7.7	5.7	22.0	31.3	13.0	-2.1
France	22.8	38.4	40.6	4.2	37.9	-13.2	-7.4	-0.9
U-MIC	16.3	17.7	9.2	1.0	12.0	71.7	47.3	8.7 §
China	21.7	25.3	10.7	0.2	15.2	106.0	60.0	49.1
Brazil	7.5	4.9	3.1	0.3	4.2	132.5	28.2	9.1
Mexico	8.3	10.9	5.6	2.0	7.2	11.4	9.1	2.9
Iran	7.0	8.4	2.0	1.4	4.1	53.6	46.8	3.2
Turkey	4.7	14.7	10.0	0.3	10.0	80.2	41.8	12.8
L-MIC	2.9	3.4	2.5	0.2	2.8	38.8	21.6	14.5
India	0.9	1.2	0.0	0.0	0.4	16.2	7.8	31.6
Nigeria	0.4	0.0	0.0	0.0	0.1	24.0	19.9	15.8
Pakistan	0.1	0.1	0.0	0.0	0.0	-2.6	1.9	6.4
Indonesia	13.9	16.6	21.2	0.5	19.3	69.4	30.6	24.7
Philippines	11.7	10.3	5.4	1.1	7.5	-0.1	4.8	18.7
World	10.6	11.1*	6.0†	1.2	7.8‡	40.8	30.4	-0.9
Δ 2008-13 (%)	32.9	31.2	53.3	21.7	40.8	-	-	-
Δ 2014-18 (%)	27.3	29.9	33.0	23.6	30.4	-	-	-

Footnotes: Δ = change; H-IC = High-income countries; U-MIC = Upper-middle income countries; L-MIC = Lower-middle income countries; GDP = gross domestic product per capita (at purchasing power parity (PPP) and constant 2011 international dollars to allow for comparability between countries); * = excludes USA; † = excludes JPN; ‡ = excludes toddler formula in JPN and follow-up formula in the USA; § = excludes ARG; data from Euromonitor Passport Global Market Information database.

Figure 3. Formula category sales volumes (kg) per infant/child by country income groups, 2008-2013 with projections to 2018

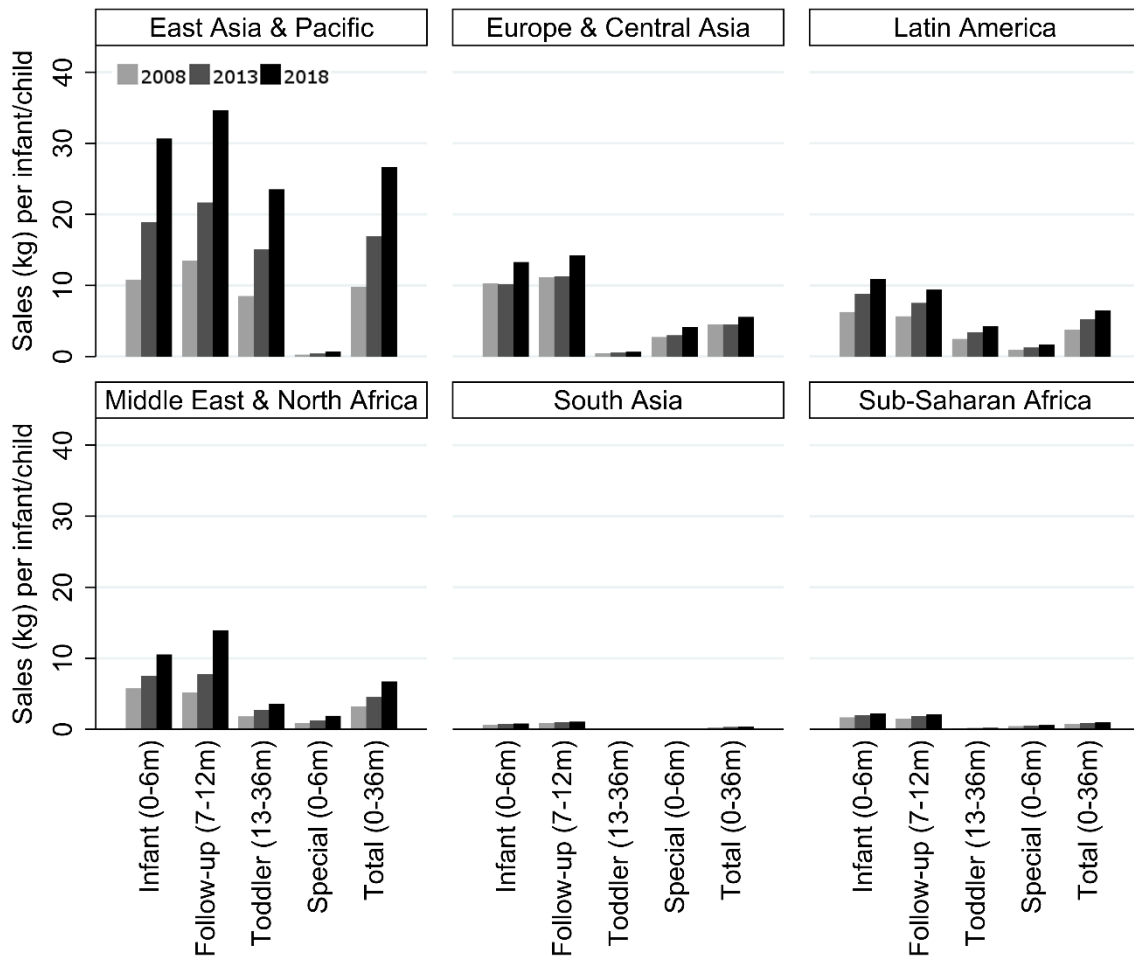


Footnotes: Data from Euromonitor Passport Global Market Information database; estimates for high-income countries excludes toddler formula in JPN and follow-up formula in the USA; countries grouped by World Bank country lending categories.

Figure 4 shows MF category sales trends in U-MICs and L-MICs by region. Volume growth in all regions has been led by the infant and follow-up formula categories. Follow-up formula sales volumes exceeded infant formula volumes in all regions except Latin America and Sub-Saharan Africa. The rate and scale of change in East Asia & Pacific exceeded that of all other regions; in 2008-2013 total MF sales there grew by 72.8% from 9.8 kg to 16.9 kg per infant/child. In 2014-2018 this figure is projected to increase by 57.7% to 26.6 kg. Four countries, China, Indonesia, Thailand and Vietnam explained much of the regional growth, with total MF sales growing by 106.0%, 69.4%, 40.0% and 96.9% respectively in 2008-2013. China has undergone the most significant change in formula sales over the 2008-2013 period because of its relatively high category sales volumes and growth rates, but also because of its large infant/child population size. The Philippines is the only country in this region where the market contracted. The Middle East & North Africa region also demonstrated strong volume growth led by Iran and Turkey with total MF growth rates of 53.6% and 80.2% respectively in 2008-2013. The Latin America region demonstrated some heterogeneity; while total MF sales in Brazil and Peru grew by 132.5% and 159.7% respectively over the 2008-2013 period, for Mexico this figure was just 11.4%. In Sub-Saharan Africa the small level of observed

growth was led by South Africa with 37.0% total MF growth in 2008-2013. Among all regions, sales volumes and growth rates were lowest in South Asia with negligible total MF volume growth in India and negative growth in Pakistan.

Figure 4. Formula category sales volumes (kg) per infant/child in L-MICs and U-MICs by region, 2008-2013, with projections to 2018



Footnotes: Data from Euromonitor Passport Global Market Information database; includes data for L-MICs and U-MICs only (i.e. excludes HICs) grouped by World Bank region.

Discussion

In contrast to stable trends in global exclusive breastfeeding measures,⁽⁷⁾ the total world MF sales volume grew by 40.8% from 5.5 kg to 7.8 kg per infant/child in the 2008-2013 period. This figure is predicted to increase to 10.8 kg by 2018. Volume growth has been led by the infant (0-6m) and follow-up (7-12m) formula categories. This indicates that a population-level IYCF transition towards diets higher in MF is not only well underway, but is expected to continue, and in some regions and countries continue apace. Volume growth has occurred most rapidly in the middle-income countries of East and South-East Asia: China, Indonesia, Malaysia, Thailand, and Vietnam. UNICEF recently called attention to the ‘alarming’ decline in breastfeeding rates in this region.⁽³³⁾ As home to the world’s second largest infant/child population (~41 million aged 0-36 months in 2013) the most significant absolute changes in IYCF have been in China.

An IYCF transition is not a new phenomenon. For example, a 1982 WHO meta-analysis demonstrated eight stages of change in breastfeeding prevalence and duration with increasing increments of income and urbanization.⁽³⁴⁾ Historical analyses demonstrate a decline in breastfeeding rates in several countries, reaching a historic low in the 1950s-60s alongside the increasing hospitalisation and medicalization of births and more intensive MF marketing.^(35; 36; 37) What appears to be novel is that the contemporary IYCF transition is likely to be characterised by rapid growth in MF sales and ultimately consumption, and that this is potentially unprecedented in terms of the rate and scale of change. Why now? Why especially in East and South-East Asia? The results must be understood against a backdrop of contemporary transformations to economic, social, and political systems that are driving changes in the demand and supply of processed foods globally.

A theory of ‘nutrition transition’ can be adapted to propose that with increasing income growth, urbanization, and female labour-force participation (i.e. factors generally associated with economic development) infant/child populations shift to higher levels of MF consumption.^(38; 39; 40) The results support this theory, demonstrating a positive though variable association between MF sales and country income level with the most rapid changes observed in East Asian middle-income countries with high rates of GDP growth. However, sales growth has significantly out-paced GDP growth suggesting that income change only partly explains the reported results. East Asia also has some of the highest rates of rural-urban migration globally with China and Vietnam expected to urbanize most rapidly in coming decades.⁽⁴¹⁾ As with other processed foods, this urbanisation is likely to increase population-

level accessibility to MF. The large-scale global increase in effective demand for MF may also be explained by the contemporary ‘feminization’ of East Asia’s manufacturing workforce, particularly in the region’s export processing and special economic zones where women can comprise between 70-90% of the workforce.⁽⁴²⁾ In the absence of supportive working conditions (e.g. adequate maternity leave, paid lactation breaks, flexible working hours, and nursing facilities), formula feeding can be less time intensive and more convenient than breastfeeding for working mothers as other carers can feed the infant.^(43; 44)

A theory of ‘dietary dependency’ can be adapted to propose that with global market integration the traditional IYCF systems of developing countries (i.e. predominantly breastfeeding and home-prepared complementary foods) are displaced by, and thus increasingly dependent on, the imports, investments and marketing practices of transnational milk formula corporations (TMFCs).⁽²⁹⁾ This is particularly relevant to IYCF because the biology of breastfeeding means that the form of dependency is extreme when short-term lactation capacity is lost at an individual level (i.e. mammary involution due to bottle-feeding) and when cultural norms are changed (i.e. a shift from ‘breastfeeding’ to ‘formula-feeding’ culture) at the population level. Commercial marketing and promotion facilitates this dependency by normalising formula as an appropriate food for all infants rather than as a specialised food for those unable to breastfeed.^(45; 46; 47) Dependency can impair infant and young child food security when there are disruptions to formula supply, accessibility (including affordability) and capacity to utilize.⁽⁴⁸⁾ Four TMFCs together controlled 55% of the global MF market value in 2013: Nestle, Danone, Mead Johnson and Abbot Laboratories.⁽¹⁵⁾ There are strong incentives for these companies to expand transnationally. MF is highly lucrative with reported net profit margins of 10-20%. The global total MF sales value was US\$44.8 billion in 2014, projected to reach US\$70.6 billion by 2019. In 2014, the Chinese MF market alone was worth US\$17.8 billion.⁽¹²⁾ With stagnating growth in more heavily regulated high-income markets, developing Asian countries are seen as new growth opportunities given their rising income levels, young and growing populations, and openness to foreign investment.⁽⁴⁹⁾ Additionally, TMFCs often donate large quantities of MF to countries in post-disaster situations, potentially undermining breastfeeding in this context. This is most pertinent for the Asia-Pacific region, the world’s most disaster-prone.⁽⁵⁰⁾

Approximately 10% of MF sales is spent on marketing and promotion.⁽⁵¹⁾ Extrapolating this to the reported global sales value we estimate a global MF marketing expenditure of US\$4.48 billion in 2014. MF is marketed directly to consumers through online and print advertising,

and indirectly through health systems, sponsorship of professional organizations, and lobbying of policy-makers.⁽¹²⁾ Such marketing can powerfully influence social norms about IYCF through *inter alia* portraying MF as a symbol of modernity, as comparable or superior to breast-milk and formula feeding as extensively practiced.⁽⁴⁶⁾ Strong evidence implicates MF marketing during the perinatal period, especially the distribution of free or low-cost samples and maternity discharge packs to health care workers and mothers, with reduced rates of breastfeeding initiation, duration and exclusivity.⁽¹²⁾ This underpins the requirement of the Baby Friendly Hospitals Initiative (BFHI) that hospitals are free of intrusive efforts to market breastmilk substitutes.⁽³⁷⁾ Evidence demonstrates that the BFHI has had a significant positive effect on exclusive breastfeeding rates at national and global levels. However, the most recent monitoring data indicates that just 27.5% (representing 21,328 hospitals) of all maternities worldwide had ever been designated as baby friendly, representing 8.5% of those in industrialised countries and 31% in less developed countries.⁽⁵²⁾

The strong growth in the follow-up formula and toddler formula categories observed in this analysis is concerning. Since 1986 the WHO has maintained that follow-up formula is both unnecessary and unsuitable as a breast-milk substitute from 6-months of age onwards. Further, existing formulations can result in excessive protein intake and inadequate intakes of essential fatty acids, vitamins and minerals.⁽¹⁹⁾ Sales growth in these categories may reflect a market segmentation strategy whereby TMFCs are exploiting the erroneous perception that breastfeeding applies to the first six months only, and not to continued breastfeeding.⁽⁵³⁾ The branding, packaging and labelling of follow-up formula and toddler formula products frequently resembles and is commonly mistaken for infant formula.^(16; 18; 45) This can circumvent MF regulations focused exclusively on the 0-6 month age-bracket and may be exacerbated when IYCF policies and programmes emphasise exclusive breastfeeding only, and not ongoing breastfeeding.⁽⁵⁴⁾

The variability in the observed GDP-sales relationship demonstrates that an IYCF transition is not an inevitable consequence of economic growth. Several middle-income and high-income countries have achieved comparatively low sales levels. Government decisions concerning the regulation of MF markets, as well as those concerning breastfeeding protection, promotion, and support are likely to be important determinants of country-level differences. For example, one analysis found a significant positive association between indicators of country-level implementation of the GSIYCF and trends in exclusive breastfeeding and breastfeeding duration over a 20-year period.⁽⁵⁵⁾ Further research is

required to ascertain associations between these same measures and global MF sales patterns. Nonetheless, we now explore some of the most important policy and regulatory factors likely to be shaping MF markets.

Weak and inadequately implemented MF marketing regulation is likely to be a key explanatory factor in the observed differences in between-country sales. Violations of the WHO/UNICEF *International Code of Marketing of Breast-milk Substitutes* and subsequent resolutions (*The Code*) by formula companies are common in both developed and developing countries.^(56; 57; 58) *The Code* is not legally binding under international law (adopted under Article 23 of the WHO constitution), nor is it enforceable under domestic law unless adopted into national legislation.⁽⁵⁶⁾ According to the latest WHO monitoring report only 37 (19%) out of 199 reporting countries had adopted all of the recommendations into law, just 69 (35%) had fully prohibited the advertising of BMS, and 45 (23%) had a functioning implementation and monitoring system.⁽⁵⁶⁾ In those with active monitoring systems many are under-resourced and do not impose legal sanctions against industry violators.⁽⁵⁸⁾ Internet marketing channels, including social media, are new sources of non-compliance.⁽⁵⁹⁾ In China, undoubtedly the engine of the contemporary global MF sales boom, many provisions of *The Code* were adopted into legislation in 1995. However the legislative scope is outdated and applies to the 0-4 month age category only, implementation and enforcement has been reported as weak and poorly coordinated, and *Code* violations appear to be common and widespread.^(12; 57; 60) In contrast, regulatory responses appear to have constrained formula markets in several countries. For example, sales volumes and growth in India is negligible and is at least partly explained by that Government's full adoption of *The Code* into legislation with a scope of 0-24 months of age.^(45; 56) Another country with comparatively low levels of MF sales is Brazil where *The Code* is fully adopted into legislation covering 0-36 months of age, is rigorously monitored, and has been regularly strengthened in response to violations (although sales are now beginning to grow rapidly).^(12; 56)

Maternity protection regulations determine the compatibility of IYCF choices with formal maternal employment. In the context of absent or ineffective regulation the choice of whether to formula-feed or breastfeed is not a true choice. For many, formula-feeding is the only choice if the alternative is the loss of employment and income. Indeed, it is more common for new mothers to stay employed and use breastmilk substitutes rather than leave work or school in order to breastfeed.⁽¹²⁾ This not only discriminates against the combined economic and reproductive rights of women but also against the rights of the child to adequate nutrition.

The *Maternity Protection Convention* of the International Labour Organization protects against maternity discrimination and provides for adequate paid maternity leave (minimum of 14 but preferably 18 weeks at two-thirds of earnings), the right to continue breastfeeding on return to work, paid nursing breaks, and access to appropriate and hygienic nursing facilities. Yet the most recent monitoring report found that most countries in Asia (81%), the Middle East (92%), and Latin America (79%) fail to meet the minimum leave and earnings standards. Just 31% have legislated the mandatory provision of nursing facilities. Subsequently, 830 million (68%) of working women worldwide do not have adequate maternity protection of which 80% live in Africa and Asia. Just 330 million (28.4%) are legally entitled to receive cash payments in the event of childbirth.⁽⁶¹⁾

Free trade agreements, which have been extensive in East Asia in recent decades, reduce barriers to the movement of investments, production capacity, raw materials, and final products across borders.⁽⁴⁹⁾ These processes enable TMFCs to more easily expand their operations through the establishment of transnational networks of affiliate firms and highly coordinated global supply chains.⁽⁶²⁾ Contemporary large-scale increases in dairy production for export in many countries, particularly New Zealand, have provided TMFCs with a ready supply of milk powder, the primary ingredient used in formula production.^(53; 62) The liberalization of trade in retail services has also spurred the ‘supermarketisation’ of developing countries since the late 1990s, creating new MF distribution channels. In this context, government regulators face the paradoxical challenge of balancing the investments and thus opportunities for economic development TMFCs provide and the public health implications of those investments. This is especially the case when companies such as Nestle and Danone are among the largest operating in developing countries, and when government agencies have only limited capacity to weigh the public health implications.⁽⁴⁹⁾

In some countries conflicts in government policy objectives exist. For example, more than half of MF purchases in the US are by the Government through its *Special Supplemental Nutrition Program for Women, Infants, and Children*.⁽⁶³⁾ In China, MF consumption is promoted by government subsidies with the aim of developing the domestic industry including the development of new formula products.⁽⁵¹⁾ The MF industry also generates large tax revenues, creating an incentive to maintain or encourage market growth. This is especially likely when the significant economic value of reproductive services, including breastfeeding, is excluded from national accounting systems.⁽⁵¹⁾ In East Asia’s so-called ‘productivist welfare states’ we hypothesise that MF may be viewed by policy-makers as

instrumental to female labour-force participation and therefore to economic development, although this requires further investigation.⁽⁶⁴⁾

There are several limitations of this analysis. The market data used captures sales volume only, an imperfect measure of consumption because it does not capture BMS products distributed through informal food systems, nor for wastage (i.e. the proportion of MF sold but not consumed). Sales volumes may not accurately reflect domestic consumption in some markets due to high sales for informal export. For example, in Hong Kong total MF was 256.9 kg per infant/child in 2013 reflecting cross-border purchases by mainland Chinese consumers. High sales volumes in several high-income countries (e.g. New Zealand) also partly reflects informal cross-border trade. As described elsewhere, Euromonitor Passport is not a scholarly database and the data have similar limitations to official government trade and economic statistics.⁽²⁹⁾ The data has not been validated from a nutritional standpoint through, for example, comparisons with household expenditure or food consumption surveys. However these data have several merits: it's abundance, that it is not subject to recall bias (i.e. in contrast with survey data), and that it has been consistently reported across countries and time using standardised measures.⁽²⁹⁾ Lack of comparable longitudinal data prevented analysis of the relationship between MF consumption and breastfeeding prevalence and duration. Thus there is an implicit assumption in this analysis that MF displaces breastmilk in infant and young child diets, rather than reflecting the potential substitution of MF for other BMS such as animal milks. Finally, we have not reported within-country MF sales patterns although a 'social transition' inverse to breastfeeding is likely, with formula-feeding initially most prevalent among high-income groups and then in low-income groups over the course of a country's economic and social development.⁽³⁴⁾

Conclusions

A global population-level IYCF transition towards diets higher in milk-based formulas, especially infant and follow-up formulas consumed in the first year of life, is well underway, is expected to continue, and in some regions and countries continue apace. While the concept of such a transition is not new, the observed rapidity in growth and volumes per infant/child is unprecedented. This transition is most evident in the middle-income countries of East Asia, particularly China, Indonesia, Malaysia, Thailand and Vietnam. Because of the large infant/child population in this region, regulatory decisions there concerning IYCF are likely to have an important impact on global infant, child and maternal health over coming decades.

The results also raise serious concern that the rapid changes observed are not being captured in a timely manner by existing international IYCF monitoring systems. Important questions must also be raised about the efficacy of existing policy and regulatory regimes intended to protect the health of children and mothers and to prevent unethical formula marketing. As described elsewhere greater political priority, strengthened governance mechanisms and strategic actions for IYCF are urgently needed.^(47; 53; 54; 58) New institutions established by WHO / UNICEF including the Global Breastfeeding Advocacy Initiative and the Network for Global Monitoring and Support for Implementation of the International Code (NetCode) may provide important platforms for coordinating global action.⁽⁴⁷⁾ This analysis affirms a need for renewed efforts towards the implementation, monitoring and enforcement of *The Code*, including stronger accountability mechanisms for governments and industry.

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