

Kellogg's **Corn Fakes**

The social and economic costs of the removal of
micronutrients from Kellogg's cereals



The purpose of this report is to shed light on industry-specific issues related to food fortification. The information in this document has been obtained from sources believed reliable and in good faith but any potential interpretation of this report as making an allegation against a specific company or companies named would be misleading and incorrect. The authors accept no liability whatsoever for any direct or consequential loss arising from the use of this document or its contents. The economic analysis was carried out by Just Economics, with the executive summary, conclusions and recommendations written by the Changing Markets Foundation. This report was published in November 2019 by the Changing Markets Foundation and Just Economics.

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Glossary and abbreviations

Biomarkers:	<i>A naturally occurring molecule, gene or characteristic by which a particular pathological or physiological process, disease, etc. can be identified.</i>	NTD:	<i>Neural tube defects: birth defects of the brain, spine or spinal cord that happen in the first month of pregnancy, often before a woman even knows that she is pregnant. The two most common are spina bifida and anencephaly.</i>
Discount rate:	<i>The practice – standard in economic assessments – of discounting future benefits because they are of less value to the present generation, and to therefore express them in terms of their value today.</i>	Osteoporosis:	<i>A bone disease that occurs when the body loses too much bone, makes too little bone or both. As a result, bones become weak and may break from a fall – or, in serious cases, from sneezing or minor bumps.</i>
Folate:	<i>The generic term for both naturally occurring food folate and folic acid, the fully oxidised monoglutamate form of the vitamin used in dietary supplements and fortified foods. Folate is a B vitamin that is important for cell growth and metabolism.</i>	Price–cost margin:	<i>The difference between the price charged for a product and the cost of making it.</i>
Food fortification:	<i>The process of adding micronutrients (essential trace elements and vitamins) to food. It can be carried out by food manufacturers or by governments as a public health policy that aims to reduce the number of people with dietary deficiencies within a population.</i>	RTE:	<i>Ready-to-eat cereals: cold cereals that do not require warming or preparation, can be served straight from the packet and are most often mixed with milk.</i>
Food vehicles:	<i>A commonly consumed food that is used to deliver a particular nutrient or chemical substance to an individual or population, such as in food fortification.</i>	STPM:	<i>Social Time Preference Method: obtains a measure of society’s willingness to postpone private consumption now in order to consume later.</i>
ID:	<i>Iron deficiency</i>	Unit costs:	<i>The cost a company incurs to produce, store and sell one unit of a particular product. Include all fixed and variable costs involved in production.</i>
IDA:	<i>Iron-deficient anaemia</i>	WHO:	<i>World Health Organization</i>
LBW:	<i>Low birth weight</i>		
Macronutrients:	<i>Carbohydrates, fats and protein – the three basic components of every diet.</i>		
Malnutrition:	<i>A condition that results from eating a diet in which one or more nutrients are consumed either too much or too little, such that the diet causes health problems. It may involve calories, protein, carbohydrates, vitamins or minerals.</i>		
Marginal costs:	<i>The cost added by producing one additional unit of a product or service.</i>		
Micronutrients:	<i>Vitamins and minerals essential for energy production, vital biological processes, growth and development.</i>		



1. Executive summary

Poor-quality diets not only contribute to the rise in obesity and non-communicable diseases, such as cancer and diabetes, but also lead to micronutrient deficiencies – a lack of vitamins and minerals that can exacerbate, or even cause, health problems – from rickets, anaemia and mental health problems to hip fracture and cardiovascular disease. Food fortification – the addition of vitamins and minerals to commonly consumed foods – is an important tool in the fight against micronutrient malnutrition, which affects one-third of the world's population. Fortification is widely seen as an effective way to introduce important nutrients into people's diets. Breakfast cereals are one of the most commonly fortified foods, which has played a role in boosting populations' micronutrient intake.^{1 2}

This paper builds on a previous Changing Markets investigation, *Cereal Offender: is Kellogg's breaking its breakfast promises?*, which analysed Kellogg's breakfast cereal products sold in Mexico and exposed the cereal giant for reducing or removing two-thirds of essential micronutrients from their most popular cereal brands since 2013.³

Our findings in *Cereal Offender* called Kellogg's public commitments to tackling undernutrition and micronutrient deficiencies into question. The removal of nutrients makes little sense, given that iron and other mineral deficiencies remain a public health problem in Mexico. In response to our report, Kellogg's stated that its decisions are led by data and science;⁴ however, the company provided no details of the specific data related to the removal of micronutrients in its breakfast cereals in Mexico, and we have been unable to find any such evidence on its website or in its promotional materials.

The global breakfast cereal market is highly profitable. Kellogg's occupies nearly 30% of the total market share,⁵ and dominates the market in Mexico.⁶ While sales of breakfast cereal have fallen steadily in recent years in developed markets like the US and Europe as people seek healthier options or eat breakfast on the go,⁷ cereal sales worldwide are on the rise as a result of growing demand in emerging and developing markets.⁸ However, with a nearly 30% drop in share price over the past three years,⁹ Kellogg's has been under mounting pressure to put the company back on a path to growth.¹⁰ It is widely reported that the company considers developing markets as key to restoring its share price.¹¹

Building on our last report, this paper goes further to explore the economic implications of reducing the micro-nutrient content of breakfast cereals, focusing on what Kellogg’s may have saved through this practice – and at what cost to the Mexican economy. The economic analysis in this report, including calculations of the costs to society and the benefits to Kellogg’s, was carried out by Just Economics. The analysis focuses on five popular brands of Kellogg’s cereal sold in Mexico, and has been scoped to focus on three important micronutrients: iron, calcium and folic acid. For each micronutrient, the research takes some of the most significant potential negative impacts and costs them for Kellogg’s consumers, based on the risk of them developing health or cognitive problems as a result of poor nutrition. This is not an experimental study that directly measures the impacts of micronutrient removal; rather, it draws on findings from other studies to model where the costs are likely to arise, and for which consumers. The findings are therefore illustrative of the cost implications that might arise from Kellogg’s activities. The aim is to highlight the value and importance of food fortification, and the risks to society of apparent cost-saving measures by companies such as Kellogg’s.

Although the researchers encountered significant data gaps, these were circumvented by adopting a very narrow scope: the number of micronutrients considered and the costs included. This means we can be reasonably confident that the findings presented here are in the right order of magnitude, and that the savings Kellogg’s makes from removing micronutrients is dwarfed by the cost of this practice to Mexican society.

Our research reveals that Kellogg’s has made an estimated cost-saving of \$85 million over five years from cutting back on three key micronutrients in its most popular breakfast cereals. In contrast, the costs to society far outweigh any short-term benefits to Kellogg’s. **While Kellogg’s has saved money, the minimum cumulative social cost to Mexico of the removal of iron, calcium and folic acid from popular brands of Kellogg’s cereals is over \$250 million over five years. This means for every dollar Kellogg’s saves by defortifying cereals it destroys at least \$3 in value to Mexican society.**

While Kellogg’s is often criticised for price inflation,^{12 13} when the long-term consequences are taken into consideration, the price at the till pales in comparison to the real cost of eating their poorly fortified products daily. These savings are also tiny compared with its annual spend on advertising: \$752 million in 2018.¹⁴ Moreover, although Kellogg’s behaviour may align with its drive to increase growth, it appears to be unsuccessful. While recent results came in ahead of analysts’ expectations, over the long-term Kellogg’s revenues and earnings per share have declined year on year;¹⁵ suggesting that one-off cost savings to improve profit margins is a misguided strategy.

These findings demand answers, and clearly show that Kellogg’s approach is not working in the interests of its investors, consumers or wider society. Is the decision to reduce the micronutrient content a push for short-run cost savings? Is Kellogg’s putting profit over the long-term health of the Mexican population? Although the costs of malnutrition are not reflected on a company’s balance sheet, as a flawed long-term strategy Kellogg’s may be undermining its growth potential by damaging the health and productivity of its consumers. The findings presented in this report suggest not only a strong social, economic and moral case for changing course but also a business one. It is time for Kellogg’s to show its commitment to people over profit and stop breaking its breakfast promises.

2. Introduction

The global breakfast cereal market is highly profitable and highly concentrated. Four large players make up 84% of the market,¹⁶ of which Kellogg’s is the market leader, with a market share of 27% in 2015.¹⁷ In the late part of the 20th century, the ready-to-eat (RTE) cereal industry was the most profitable of all food industries, with profits averaging 17% of sales.¹⁸ However, as the industry entered the 21st century, demand in high-income countries began to contract; for example, between 2013 and 2018, cereal demand fell by almost 10% in the US.¹⁹ This was largely driven by changing habits, including consumers seeking out healthier breakfast options, but it was also driven by price. For example, between 1983 and 1993, breakfast cereal prices increased by 71% on average in the US, compared with a 37% increase across all foods.²⁰

Nonetheless, cereal sales are on the increase globally, as a result of growing demand in developing countries; they hit \$24.6 billion in 2018, up from \$23.2 billion in 2013.²¹ Asia-Pacific and Latin America, in particular, have begun to adopt developed-country food-consumption patterns; for example, breakfast cereal consumption grew in Brazil by 8–9% in the five years to 2003.²²

The RTE cereal industry is characterised by a high price–cost margin and large advertising-to-sales ratios.²³ Products that are losing favour in developed countries due to their high-salt or -sugar and low-fibre content are now being aggressively marketed in developing countries and emerging markets. As well as the promotion of developed-country food habits and lifestyles, there is evidence of strategies to insert RTE cereals into traditional diets; for example, as part of the Mexican traditional meal of cena (a light evening meal).²⁴ Other strategies to boost profits include masking higher prices through smaller packaging, and cutting back on issuing money-saving coupons.²⁵

With price rises exhausted, an alternative way of boosting profits is to reduce costs, thus increasing the (already high) price–cost ratio. Research by the Changing Markets Foundation has found evidence that the micronutrient content of Kellogg’s breakfast cereals in Mexico has been declining, and that they are now significantly poorer in terms of mineral and vitamin content than five years ago.²⁶ The expectation is that this will lead to a deterioration in children’s diets and contribute to an increase in iron, zinc and other key nutrient deficiencies, which are already high in Mexico. These findings sparked concern that this may be the thin end of the wedge for companies like Kellogg’s, which are under pressure to reduce costs, given that the costs of malnutrition are not reflected on their balance sheet.

To build on this research, and to further its campaign to stop Kellogg’s defortifying its breakfast cereals, the Changing Markets Foundation has commissioned Just Economics to explore the economic implications of reducing the micronutrient content of cereals. Our analysis shows that, while fortification has a cost to Kellogg’s, this is far less than the social and economic cost to its consumers and wider society of selling a nutritionally poorer-quality product – especially where nutritional deficiencies are widespread.

The remainder of this section discusses the research aims, methodology and caveats, and concludes with some wider context on food fortification. The report then goes on to summarise the main findings before setting out recommendations for how Kellogg’s and its shareholders, regulators and consumers can respond to these findings. The full workings for how the calculations were carried out are contained in the technical appendix.

2.1. Background and context

Micronutrients are vitamins and minerals that are essential for energy production, vital biological processes, growth and development. Cereals naturally contain many micronutrients, but these are largely removed in the process of preparing them for consumption in RTE cereals. Moreover, macronutrients either survive processing (such as carbohydrates) or are added to improve the flavour (such as sugar). To compensate for the unhealthy nature of the final processed product, manufacturers undertook voluntarily fortification of cereals with a range of micronutrients.²⁷ Due to the consistency in dietary patterns, breakfast cereals qualify as a suitable food vehicle for fortification and, as mentioned, have been found to play a role in boosting the micronutrient content of populations.^{28 29}

As with other RTE cereal, Kellogg’s has historically chosen to fortify its cereals in Mexico to improve their nutritional quality. However, the Changing Markets Foundation gathered evidence that suggests consistent and widespread reductions in the amounts of micronutrient content in their cereal since 2013 (see Table 2.1). As we can see, the amounts have decreased in every case except Vitamin D, with especially large decreases in vitamins C, B3 and B9.

This takes place in the context of strong epidemiolocal and economic evidence for food fortification, which is generally described as a highly socially beneficial public health intervention due to its efficacy in correcting or preventing nutrient deficiencies.³⁰ Over the past century, food fortification has been an effective tool for reducing the risk of nutrient deficiency diseases, such as beriberi, goiter, pellagra, rickets and neural tube defect.³¹

International agencies also back food fortification due to its cost effectiveness; for example, the Copenhagen Consensus^A ranked iron fortification as the third-best ‘world investment’ in 2008, meaning that economists agree this is one of the most cost-effective strategies to improve development outcomes worldwide. Malnutrition has direct economic impacts; affected adults earn up to one-fifth less over the life course,³² and well-nourished children are 33% more likely to escape poverty as adults.³³ Cumulatively, it is estimated that developing countries’ GDP is reduced by 2–3% per year because of undernutrition.³⁴ It has also been argued that there is a positive cost-benefit rationale for companies to fortify; the costs are low^B compared to fluctuations in the global prices of raw materials,³⁵ and companies are set to gain long term from improved diets and livelihoods, which will boost the incomes of future consumers. However, these are long-term gains that may be at odds with short-term profitability.

A A group of leading economists tasked with prioritising interventions to tackle world problems based on both impact and cost-benefit analyses. See: <https://www.copenhagenconsensus.com/>

B Although there were increases in the global price of folic acid at the beginning of the decade, these have returned to pre-2014 levels. See: <https://www.feednavigator.com/Article/2015/10/20/New-capacity-set-to-heighten-Chinese-folic-acid-price-slide>.

Table 2.1.Changes in micronutrient content between 2013 and 2019

Micronutrient	2013	2019	Percentage point change
Vitamin A	22%	10%	- 12%
Vitamin C	29%	0%	- 29%
Vitamin D	4%	29%	+ 25%
Vitamin E	10%	8%	- 2%
Vitamin B1 (Thiamin)	10%	8%	- 2%
Vitamin B2 (Riboflavin)	10%	8%	- 2%
Vitamin B6	10%	8%	- 2%
Vitamin B9 (Folate)	50%	14%	- 36%
Vitamin B12	44%	35%	-9%
Calcium	8.2%	5%	-3.2%
Iron	35%	20%	-15%
Zinc	13%	8%	-5%

Source: Product labels from five brands: Choco Krispis, Corn Flakes, Corn Flakes Special Edition, Special K, and Zucaritas

While fortification of staple foods has gained enormous global traction, there are issues with many aspects of implementation, most notably the regulatory monitoring.³⁶ Based on quality-assurance data from 20 national fortification programmes in 12 countries, Luthringer et al. estimate that fewer than half of the samples are adequately fortified against relevant national standards.³⁷ Although the study did not consider breakfast cereals, it demonstrates that there are wider issues of compliance with both mandatory and voluntary fortification standards, and that these are by no means limited to Kellogg’s.

2.2. Research scope and aims

The economic analysis in this report, including calculations of the costs to society and the benefits to Kellogg’s, was carried out by Just Economics. This analysis focuses on five of the most popular brands of cereal Kellogg’s sells in Mexico, as these are the ones for which comparable data are available. The cereals in question are:

- Choco Krispies
- Corn Flakes
- Corn Flakes Special Edition
- Special K
- Zucaritas (Frosties/Frosted Flakes)

The baseline year is 2013, when the tracking of micronutrient content began, and the comparison years are 2018/19.

Due to the myriad of health and development impacts of micronutrients, our analysis has been scoped to focus on three of the most vital:

- iron
- calcium
- folate (Vitamin B9)

For each micronutrient, we have taken some of the most important potential negative impacts of deficiency and costed them for Kellogg’s consumers, based on the risk that they will develop physical health, mental health or cognitive problems as a result of poor nutrition. Once the full cost of the micronutrient is calculated, we can estimate the contribution Kellogg’s could make in defraying these costs, were they to continue to fortify their cereals.

Our aim is to highlight - in dollars and cents - the value of food fortification, and the risks of chasing short-run savings at the expense of long-run social, economic and environmental value.

The study was scoped to focus solely on those in each age group who eat breakfast cereals, either frequently or exclusively. Data for this variable were drawn from market research by PROFECO.³⁸ It found that 50% of children consume cereal 3+ times per week, whereas 37% consume cereal every day. To ensure we remained conservative in our assumptions, we included only the sample of children who eat cereal every day (37%). However, as this will include hot cereals, porridge and so on, we further limited our sample to those who consume the ‘children’s cereals’ category of cereals (>50%).³⁹ Finally, Kellogg’s has the dominant share of children’s cereals in Mexico,⁴⁰and we again adjusted our samples to take account of this.

Throughout the analysis, we sought to adopt the most conservative assumptions at all times (see Box 1 for a discussion of assumptions and caveats). This was a difficult balance to strike. On the one hand, it is important to make visible the wide-ranging costs of micronutrient deficiencies, and how they are borne by different stakeholders. On the other, it is important to avoid overclaiming the costs to society and underclaiming the benefits to Kellogg’s, as this would undermine the powerful argument that underpins the analysis. The analysis presented here is a compromise between these two positions. Although costs are high relative to benefits, this reflects three factors:

- a) the efficiency with which a food vehicle like breakfast cereals can reach many people;
- b) the low-cost nature of the intervention; and
- c) the multiple impacts of micronutrient deficiencies during key stages of growth.

As discussed, this is consistent with findings from decades of cost-benefit analysis on food fortification.

The final step in conducting the analysis was to carry out sensitivity analysis to test the robustness of the findings. To do this, we systematically adjusted key variables to see whether the model was heavily dependent on any one variable, especially an estimate or imputed variable. However, due to the number of outcomes included - and the conservative nature of those assumptions - we found that the model was not overly sensitive to any one variable, and that the analysis likely underestimated the true cost of micronutrient removal from Kellogg’s cereal.

BOX 1: **Assumptions and caveats**

All economic analyses are underpinned by assumptions. The main assumptions informing our study, and our rationale for using them, are as follows:

1. We assume there are no adverse effects from fortification, and that safe upper limits are not breached by the inclusion of micronutrients in cereals. Given that fortification of cereals is widespread in highly developed economies with much lower rates of nutritional deficiency disease, we believe this is a reasonable assumption. Moreover, Kellogg’s stresses the importance of its products as sources of micronutrients, so we assume there is value in ongoing fortification.
2. For the purposes of the analysis, it was necessary to assume the benefits from micronutrient increases are linear (that is, they increase in proportion to changes in micronutrient content). We are aware that there may be threshold amounts required to bring consumers up to the biomarkers for adequate nutritional status, but it has not been possible to incorporate these into the study, due to a lack of data. It is important to note this is not an experimental study that directly measures the effects of the changes in micronutrient content; rather, it models an evidence-informed scenario, and the findings should be interpreted as illustrative of the problem we are highlighting.
3. Micronutrients are only valuable if the human body can absorb them. Absorption depends on the form in which the micronutrient is included in the cereal and whether factors inhibiting absorption are present in the diet. This is an important issue, but it is beyond the scope of this study. The assumption is, therefore, that the micronutrients are fully absorbable.
4. The analysis does not take account of the counterfactual; that is, what consumers would be eating if they were not eating breakfast cereal. However, the most appropriate analysis is the value of Kellogg’s cereals relative to the breakfast options they are displacing. For example, where breakfast cereal is displacing other fortified grains - and/or traditional nutritious breakfasts, such as eggs - this is clearly important, and increases the need to ensure those cereals are as nutritious as possible. Assuming growth in the Mexican market continues as forecast,⁴¹ and as traditional breakfasts are increasingly displaced, this becomes even more important.
5. There are clear sociodemographic differences in the prevalence rates of nutritional deficiencies.⁴² There is anecdotal evidence that more affluent consumers are more likely to eat cereals. However, we do not have the necessary disaggregated data on cereal consumption to include this variable in our analysis.
6. Several factors must also be held constant in this analysis. These include:
 - a. other food vehicles are not providing the micronutrient content to compensate for the reductions in cereals;
 - b. the optimal timing, volume of micronutrients required and fortification strategies are assumed to be right; and
 - c. the regulatory and policy context are not driving changes in micronutrient content
7. Finally, this study does not take account of the wider health consequences of the growth of highly processed foods, like RTE cereals, in developing countries and emerging economies.⁴³ This is especially an issue in countries, like Mexico, which are in the grip of an obesity crisis and where over half of all calories consumed now come from packaged foods and beverages.⁴⁴ A recent systematic review of studies on the relationship between body fat and RTE cereals found a positive association.⁴⁵ Nonetheless, as a result of fortification, RTE cereals can be an important source of micronutrients. Many of the studies that consider this relationship are funded by the food industry,⁴⁶ but independent research has also reflected this finding.⁴⁷ Our assumption, therefore, is that as cereals continue to be consumed, the micronutrient content will continue to matter, as will fortification as a means to combat deficiency disease.



3. Findings

In this section, we provide an overview of the findings from this analysis. We begin with a cost summary for each micronutrient before presenting the aggregated costs. We then provide an estimate of the savings to Kellogg's of removing these micronutrients, before comparing the dollar value destroyed for each dollar saved.

3.1. Findings on the costs of calcium

Osteoporosis is the index disease for calcium deficiency, but it is by no means the only disease associated with calcium imbalance.⁴⁸ It has also been linked to rickets, dental problems,⁴⁹ cancers,⁵⁰ cataracts,⁵¹ diabetes⁵² and depression.⁵³ Osteoporosis and fragility fractures generally present a high disease burden to societies; they have high economic costs and increase the risk of depression and anxiety.⁵⁴ They are also on the increase, both in terms of cost and prevalence – especially in countries like Mexico, which are undergoing rapid demographic transition due to increased life expectancy.⁵⁵

Our analysis has been scoped to solely consider the risk of hip fracture due to calcium deficiency. Hip fracture is a major consequence of osteoporosis and one of the most problematic of all fragility fractures. Although it would be possible to extend to a wider number of fractures and other conditions, our narrow scope ensures we are adhering to the most conservative set of assumptions, and reduces the risk that we are overclaiming the costs of micronutrient deficiency.

Due to the importance of calcium during adolescence, and the high levels of deficiency within that age group in Mexico, we have focused solely on children that were 12 years of age in 2018. This group has been exposed to less nutritionally

dense Kellogg’s cereals since the age of seven, and, in the coming years, will continue to consume fewer micronutrients than would have been the case at baseline. In total, there were 1.17 million males and 1.11 million females in this cohort in Mexico.⁵⁶ Males and females have been modelled separately, due to differential fracture risks for the sexes, and adjusted for the proportion that consume Kellogg’s children’s cereals (as described above). Again, to ensure our assumptions are conservative, we have estimated that just 10% of the risk of hip fracture results from insufficient calcium in the diet.⁵⁷ Our estimate of the number of children at risk of hip fracture later in life due to reduced calcium intake is therefore 1,998.

Estimates of the costs of hip fracture are derived from Clark et al.⁵⁸ and uprated to 2018 prices (\$7,155) based on the annual rate of inflation.⁵⁹ **The collective lifetime costs of hip fracture in children as a result of reduced fortification are estimated to be in excess of \$700,000 for children aged 12 who consume Kellogg’s cereals in the children’s category every day.** We would expect this cost to be incurred annually as successive cohorts of children reach adolescence.

3.2. Findings on the costs of iron

Iron deficiency (ID) is the most common micronutrient deficiency in the world, and an estimated 20–25% of infants worldwide have iron-deficiency anaemia.⁶⁰ ID has been linked to diminished cognitive skills, worse school performance and lower IQ,⁶¹ lower productivity,⁶² mental ill-health,⁶³ behavioural problems,⁶⁴ reduced physical activity,⁶⁵ excessive alcohol use and risky sexual behaviour in adolescence,⁶⁶ risk of infection,⁶⁷ poor pregnancy outcomes and maternal mortality.⁶⁸

There are three critical periods for ID: early neonatal, toddlerhood and adolescence, all of which are periods of intense growth and development.⁶⁹ Importantly, it is only for the adolescent group that treatment with iron can (sometimes but not always) reverse cognitive symptoms, whereas prolonged ID in under-5s can lead to long-term and potentially permanent cognitive and behavioural impairments.⁷⁰ As with calcium, we have taken one cohort of children: those aged 2 in 2018. In total, there were over 2.2 million children in this cohort in 2018 in Mexico.⁷¹ This group are recent consumers of cereals, and will be consuming fewer micronutrients via this food vehicle throughout this important growth stage. We considered three social outcomes in this analysis: cognitive loss, behavioural problems and depression.

For productivity, we have adapted a formula developed by Horton and Ross to calculate the per-capita costs of this loss of income over the life course.⁷² Horton and Ross estimate the wage penalty at 2.5%.⁷³ Rather than using per-capita GDP, we have made a more conservative adjustment by using the Mexican minimum wage in 2019 (\$5.10 per day).⁷⁴ This gives us an annual per-capita cost of anaemia of \$33 per year. This figure only takes into account the economic costs to individuals (and whatever taxes would be transferred to the state), and is therefore a narrow assumption. This cost is applied to the proportion of children who are at risk of anaemia linked to ID, and who fall into our consumer group described above – a total of 26,105 children.

It has been estimated that prolonged anaemia in childhood increases the risk of developing behavioural problems in adolescence by 13%.⁷⁵ This would suggest that over 3,000 two-year-olds who consume cereal every day and suffer from iron-deficient anaemia are at risk of developing behavioural problems. In a Brazilian study, Murray et al. found that behavioural problems in childhood increase the risk ratio that young people would engage in crime as adults (RR= 1.5).⁷⁶ This figure, along with the crime victimisation rate for Mexico (18.3%),⁷⁷ enables us to estimate an overall increase in risk of crime of 9% (n=318). The material costs to victims of crime in Mexico is \$757 per victim,⁷⁸ or \$1,343 in today’s prices.

Several studies have found depression to be a symptom of ID.⁷⁹⁸⁰ Using an estimate of the risk of developing a depressive disorder from iron-deficient anaemia (RR= 2.34),⁸¹ and the national prevalence of depression in Mexico (4.5%)⁸² enables us to arrive at an estimate of the overall increase in risk of depression from anaemia: 1.6% (n=442). Arredondo et al. have calculated the costs of case managing depression for Mexico (\$224),⁸³ which we have uprated to 2018 prices (\$407).

Taking account of the proportional impact of the removal of Kellogg’s micronutrients, we arrive at a lifetime cost estimate of these three outcomes. For cognitive loss, behavioural problems and depression, these are \$9.6 million, \$2 million and \$1.5 million respectively, leading to a total annual loss from iron-deficient anaemia of \$13 million for children aged two.

3.3. Findings on the costs of folate

Of the micronutrients considered as part of this study, folate has seen the largest decrease in Kellogg’s cereals, with falls of up to 70% in bestselling brands like Corn Flakes and a 36% point decrease on average. Yet the efficacy of fortification with folic acid to prevent neural tube defects (NTD) has been proven, and its role in other birth defects is the subject of ongoing research.⁸⁴ As well as birth defects, lack of folate has been linked to low birth weight (LBW),⁸⁵ which is in turn associated with various chronic diseases later in life,⁸⁶ as well as higher hospital costs at birth.⁸⁷ Folate does not only matter in pregnancy, however; deficiency in early years is similar to ID, and linked to later developmental problems.

In this study, we have focused on two key groups: toddlers (aged 2) and pregnant women. Folate is the only micronutrient for which we include an adult cohort. Although breakfast cereals are largely marketed and sold to children, we know adults are also significant consumers of RTE cereals. For example, we know from market data that >40% of the cereals sold in Mexico that fall within the ‘breakfast cereals’ category are not classed as ‘children’s cereals’,⁸⁸ suggesting they are also marketed to, and consumed by, adults.



For toddlers and young children, a major risk of folate deficiency is anaemia. A study of the determinants of anaemia in Mexico has found that 2% of anaemia cases were linked to folate deficiency.⁸⁹ We have used this figure to estimate the number of cases to take forward in our model (n=1,044). As with iron, the assumption is that there are the same impacts on cognitive loss, behavioural problems and mental health (see above and technical appendix).

For newborn babies, who benefit from their mother’s consumption of folic acid during pregnancy, we have derived our estimate from the number of live births in 2018. This has been multiplied by our estimate for the proportion of women of childbearing age who eat cereal (14.7%).⁹⁰ We assume that 21% of mothers have insufficient folate during pregnancy.⁹¹ There are two negative potential outcomes included: an increased risk of NTDs and LBW. The risk of LBW in 2009 in Mexico was 8.5%.⁹² We assume a 6% reduction in the rate of LBW,⁹³ resulting in 36 fewer cases of LBW per year. For NTDs, fortification reduces the risks from 3.5% to 1.47%, or a difference of about 2%.⁹⁴ If we assume our cohort could benefit to a similar level, this would result in 142 fewer cases of NTDs in Mexico.

The costs of folate-deficient anaemia are assumed to be the same as those for iron-deficient anaemia. Two additional costs have been added: the hospital costs of LBW (\$9,500, a mid-range estimate for Mexico)⁹⁵ and NTDs (\$1,574).⁹⁶

The lifetime costs of folate-deficient anaemia and problems at birth are over \$1.1 million and \$0.5 million respectively, or a total of \$2.92 million annually. As with the other micronutrients, we would expect these to be incurred annually for live births or children reaching the age of two. These analyses do not double count; the outcomes considered for each are discreet. Finally, the conditions considered here are just a few of the many negative health and social consequences of folate deficiency.

3.4. Summarising the costs

To estimate lifetime costs, all figures are projected into the future, depending on the micronutrient and the outcomes (see technical appendix for more details). Two factors influence future costs: inflation and the discount rate. The former has averaged 5.6% in Mexico in the ten years to 2010, ranging from 2.7% to 6%, and is estimated to average 3.13% to 2024.⁹⁷ For the latter, we have chosen to use a Social Time Preference Method (STPM), which measures the preference for giving up consumption in favour of savings, and which the World Bank recommends for social investment decision-making.⁹⁸ For Mexico, Lopez recommends using an STPM of 3.3% for projects with social or environmental public-sector investments,⁹⁹ which is appropriate for future health benefits. The future cost is therefore discounted by the STPM less the inflation rate (0.015%) from the baseline in 2018 prices. The final step in the calculations is to adjust the figures for the proportion of micronutrient recommended daily allowance (RDA) the cohort is losing out on (the amount of micronutrient lost as a share of the difference between their micronutrient intake and their RDA).

We estimate that the minimum cumulative social cost of Kellogg’s removing three micronutrients from its cereals is \$16.8 million per annum. This means that, if this rate of fortification stays constant (at 2019 levels of fortification) between now and 2024, the five-year cost relative to restoring the nutrient levels will be over \$250 million.

3.5. Summary of benefits to Kellogg’s

Data on the costs to Kellogg’s of fortifying its cereals are not publicly available. Indeed, although fortification costs are often included in cost-benefit analyses, these tend not to consider breakfast cereals and are therefore not directly applicable to this study. As we could not consult any publicly available data on costs, we utilised contacts in the food-fortification industry to derive estimates.

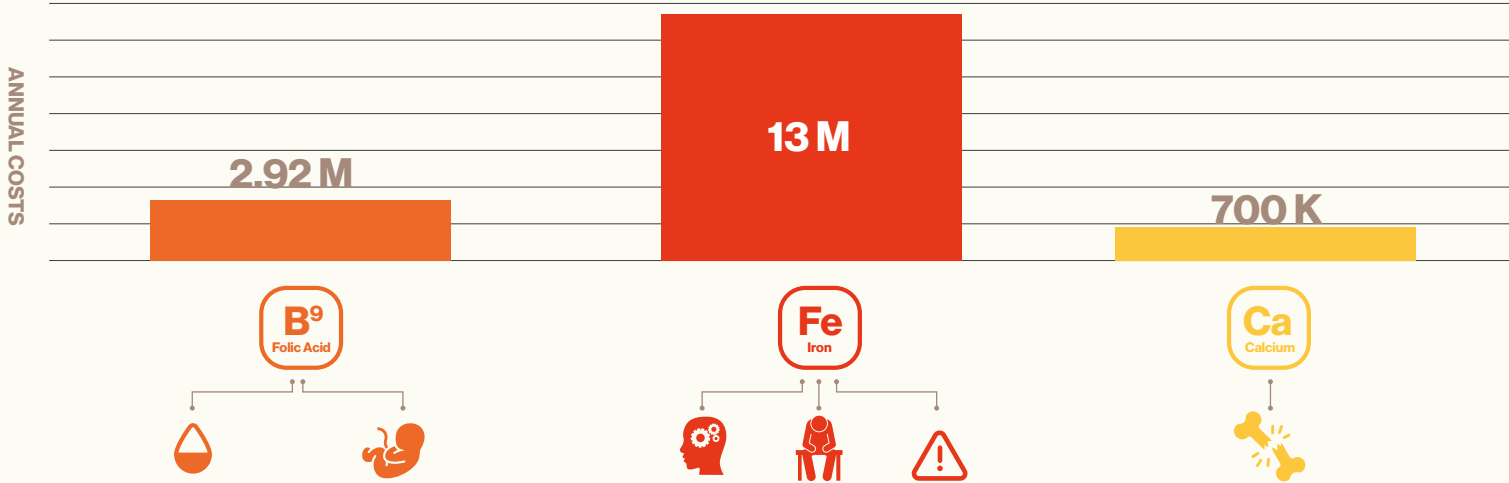
To calculate the savings to Kellogg’s, therefore, we first estimated the volume of micronutrients the company has avoided using in its products annually. To do this, we compared the volume of micronutrients in each kilogram of Kellogg’s cereal (see Table 3.1).

Table 3.1. Change in the micronutrient content of Kellogg’s cereals between 2013 and 2019.

Micronutrient	2013	2019	% change	RDA	RDD (mgs)	Change (mgs)
Vitamin A	22%	10%	12%	600	0.0006	0.000072
Vitamin C	29%	0%	29%	90	0.00009	0.0000261
Vitamin D	4%	29%	-25%	20	0.00002	-0.000005
Vitamin E	10%	8%	2%	16	0.016	0.00032
Vitamin B1	10%	8%	2%	1.3	0.0013	0.000026
Vitamin B2	10%	8%	2%	1.3	0.0013	0.000026
Vitamin B6	10%	8%	2%	1.6	0.0016	0.000032
Vitamin B12	44%	35%	9%	2.4	0.0000024	0.000000216
Vitamin B9	50%	14%	36%	400	0.0004	0.000144
Calcium	8.20%	5%	3.20%	1,300	1.3	0.0416
Iron	35%	20%	15%	18	0.018	0.0027
Zinc	5%	5%	5%	11	0.011	0.00055

The industry sources who provided our cost estimates cannot be referenced due to the commercial sensitivity of the information provided. Although micronutrient costs vary, like any commodity, we accessed data from three different sources and chose to employ the largest cost estimates to reduce the risk of undervaluing the benefits to Kellogg’s. Applying these cost estimates to the volume of micronutrient removed, we estimate that the savings for these three micronutrients is almost \$17 million per year.

The exact saving to Kellogg’s is unknown, and may well be higher – not least as these figures do not attempt to account for the costs of production, transportation or quality control, market fluctuations or potential discounts. However (as shown in the next section), even if these were considered, they are likely to be negligible compared to the costs to Mexican society of their removal.



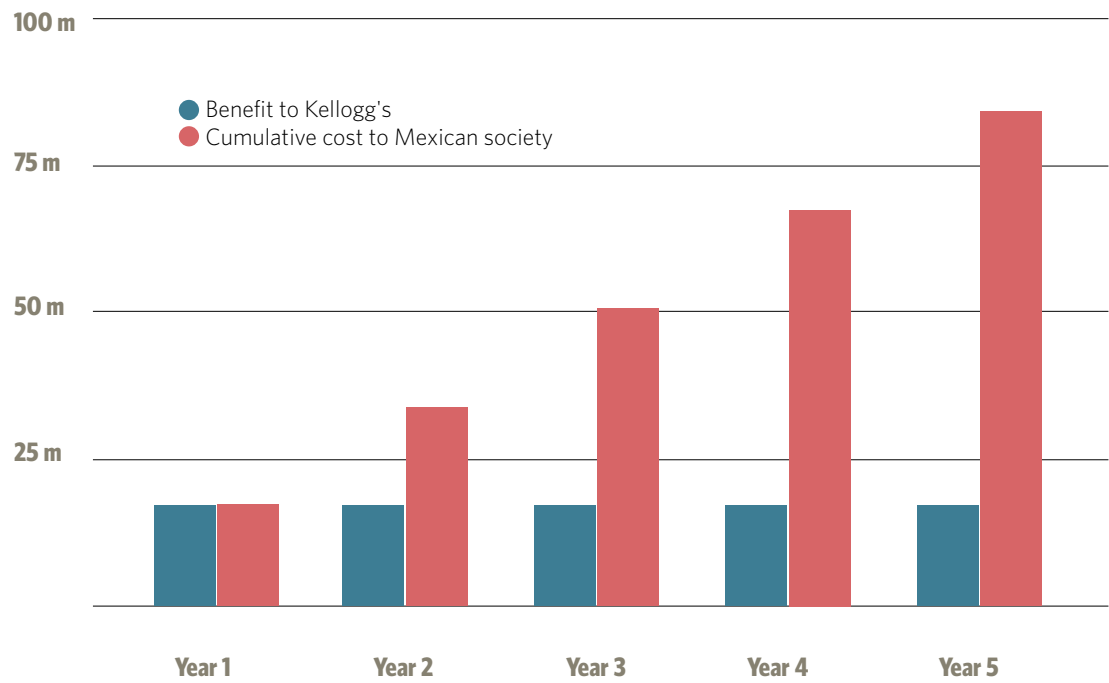
3.6. Comparison of costs and benefits

A simple comparison of the costs and benefits shows that, in one year alone, the costs to society far outweigh the short-term cost benefits to Kellogg’s, irrespective of the estimate used.

Cumulatively, over a five-year period, Kellogg’s is saving almost \$85 million based on these estimates. However, this compares to a cumulative social cost of over \$250 million. **As such, for every \$1 Kellogg’s saves, it destroys almost \$3 in value to Mexican society.** Even if the savings to Kellogg’s were twice those set out here, the costs would still outweigh the benefits (\$1: \$1.5). These calculations are set out in Table 3.2.

Table 3.2. Comparison of costs to society vs benefits to Kellogg’s

	2018	2019	2020	2021	2022	Total
	2018	2019	2020	2021	2022	Total
Cost to society	16,859,370	16,859,370	16,859,370	16,859,370	16,859,370	
Benefit to Kellogg’s	16,982,082	16,982,082	16,982,082	16,982,082	16,982,082	84,910,412
Cumulative cost to society	16,859,370.41	33,718,740.83	50,578,111.24	67,437,481.65	84,296,852.07	252,890,556



Over a five-year period, for every \$1 Kellogg's saves by de-fortifying cereals, it destroys at least \$3 in value to Mexican society.

4. Conclusions and recommendations

4.1. Conclusions

Kellogg’s, the world’s cereal giant, is failing to deliver on its nutritional promises to families and children. Rather than ‘nourishing families so they can flourish and thrive’,¹⁰⁰ in Mexico it is estimated that Kellogg’s has made a cost-saving of almost \$17 million per year from systematically cutting back micronutrients in its most popular breakfast cereals. This means a saving for Kellogg’s of \$85 million over five years.

The costs to society, however, far outweigh any short-term benefits to Kellogg’s. This report highlights that the minimum cumulative social cost to Mexico of removing iron, calcium and folic acid from popular Kellogg’s cereals brands is over \$16 million per year. However, the five-year cost to society will be over \$250 million – and these costs are projected to grow annually as more consumers enter the market. For a country in the grips of a malnutrition crisis – and that recently committed to increasing its health budget by \$2.2 billion USD to address a healthcare shortfall¹⁰¹ – it is unacceptable for Kellogg’s to be adding to this burden.

Kellogg’s states that ‘a critical part of running a good business is also doing good for society’.¹⁰² Yet, according to this research, the company is far from following its own principle. Over a five-year period, for every \$1 Kellogg’s saves by de-fortifying cereals, it destroys at least \$3 in value to Mexican society.

With a nearly 30% drop in share price over the past three years,¹⁰³ Kellogg’s management has been under mounting pressure to put the company back on a path to growth. Given declining profitability and sales,¹⁰⁴ Kellogg’s might be expected to extol the nutritional benefits of its fortified cereals to boost sales. However, it appears that a desire to increase the price–cost ratio has motivated Kellogg’s decision to reduce the micronutrients in its cereals. Although Kellogg’s argues its decisions are data- and science-led,¹⁰⁵ the company has provided no details of this science, and micronutrient deficiencies in Mexico remain problematic – providing little justification from a public health or science-based perspective.

The decision to prioritise saving money over improving the health of children and families who eat their cereals not only exposes Kelloggs’ skewed priorities but also reveals a lack of long-term business strategy. The approach may boost

the company’s financial reputation in the short term, but by removing essential nutrients the company is eroding a key reason to buy its cereals in the future – and betraying the trust of Mexican consumers. If Kelloggs’ decision to reduce the micronutrients in its cereals is indeed driven by a desire to return to growth, this comes at a high cost to its consumers and wider Mexican society, as this research highlights.

These findings are also a warning sign – one that may represent the thin end of the wedge– for other food companies that, like Kellogg’s, are under pressure to reduce their costs, given that the costs of malnutrition are not reflected on the company balance sheet. If Kellogg’s has flown under the radar for five years while undermining the health of Mexican citizens, how many other markets and brands might be doing the same?

This paper does not take into account the wider health consequences of increased consumption of highly processed foods like RTE breakfast cereals. This is a particular issue in countries like Mexico, where the prevalence of obesity is at crisis point – 35% among children and 70% among adults.¹⁰⁶ A major cause of this is excessive consumption of sugary food and drink¹⁰⁷ – including RTE cereals, which nutritionists recommend be considered ‘discretionary’ foods rather than part of a regular balanced diet.¹⁰⁸ The macronutrient profiles of Kellogg’s breakfast cereals already lead many to question their nutritional value and wider health costs to society. The Access to Nutrition Index found that only 24% of Kellogg’s products were rated ‘healthy’ in 2018.¹⁰⁹ This paper provides additional analysis that the company’s trend of removing micronutrients further reduces its cereals’ nutritional value while also – as we demonstrate – adding to the societal cost.

From a business perspective, the two interrelated health problems of micronutrient deficiency and obesity pose an immense challenge to food companies like Kellogg’s, which view emerging and developing markets as their primary source of new growth in the coming years. As Kellogg’s moves further into these markets – and as its cereals displace nutritious traditional diets – nutritional quality will become more important, as will its responsibility as a corporate citizen generally. The nutritional quality of foods is also likely to become a more pressing issue, set against the backdrop of climate change and the predicted deterioration of essential vitamins and minerals in staple crops.¹¹⁰

In line with ideas such as ‘shared value’,^c Kellogg’s has a stake in the prosperity of societies within which it is licensed to operate. This stake includes the economic development of those countries, the wages of consumers who buy the company’s products and the productivity of workers it employs (who in turn are consumers). If the decision to reduce the micronutrient content in cereals is determined by short-run cost savings, this study highlights the false economy of such a decision, given Kelloggs’ shared objective with its stakeholders and the interconnected nature of corporations, workers and consumers in today’s economy. It is time for Kellogg’s to show its commitment to people over profit, and stop breaking its breakfast promises.

C The idea that the competitiveness of a company and the health of the communities around it are mutually dependent.

4.2. Recommendations

Kellogg’s

- Publish the research and/or specific regulatory requirements that informed the company’s decision to remove micronutrients from RTE breakfast cereal in Mexico.
- Immediately re-fortify cereal products in Mexico, to ensure the products contain essential micronutrients that people in Mexico both lack and are paying for in the price premium they are charged.
- Commission an independent global review of fortification practices, for breakfast cereals and all other products, in light of the strong findings on the negative impacts of removing essential micronutrients, and to align with Kelloggs’ policies and public commitments on tackling micronutrient deficiencies.

Investors

- Ask Kellogg’s to explain why it is has removed important vitamins and minerals from its cereals, despite micronutrient deficiencies remaining a serious health problem.
- Take a ‘social return on investment’ approach to plans for future growth of Kellogg’s. This will mean moving away from a view of developing and emerging markets as solely sources of growth and of fortification as solely a cost centre.
- Engage with the wider health and social context within which Kellogg’s operates, and grasp opportunities that are presented to improve health, livelihoods and development outcomes. In the long run, the social, economic and environmental value of such an approach would dwarf any short-run profits and create a more sustainable source of growth.

Regulators

- Introduce robust standards for breakfast cereal fortification, and ensure manufacturers are rigorously monitored.
- Prohibit the use of health claims for food where these claims cannot be proven.
- Publish RDAs for Mexico, disaggregated by age, gender and (potentially) region.
- Commission independent research on breakfast cereal fortification in Mexico.
- Develop guidelines on appropriate consumption of RTE breakfast cereals (that is, as discretionary foods) to reduce their impact on the Mexican diet – and, in turn, the obesity crisis.

Consumers

- Stop buying Kellogg’s breakfast cereals until the company can prove it is taking nutrition issues seriously.
- Seek out government or independent advice on sources of micronutrients, and nutrition more generally. This is especially important for children and adolescents, who are in critical growth phases of their lives.
- Reduce consumption of ultra-processed foods, and diversify diets to include more fruit and vegetables to ensure proper intake of vitamins and minerals.
-

NGOs

- Stop funding and partnership agreements with Kellogg's, especially if the NGO has a mandate to improve nutritional outcomes, or if the funding undermines impartiality.
- Stop receiving research funding from Kellogg's, especially for universities or health-education centres, where such funding risks impartiality.
- Hold Kellogg's to account for its nutritional policies and public commitments on improving nutrition.

5. Technical appendix

5.1. Focus on calcium

Osteoporosis and related fragility fractures are growing public health concerns worldwide. In 2013, osteoporosis was estimated to cost the EU €37 billion annually, and these costs were set to rise by 25% by 2025 as a result of demographic changes.¹¹¹ These changes are even more dramatic in countries like Mexico, which are undergoing rapid demographic transition due to increased life expectancy.¹¹² Hip fractures, which are on the increase, have high economic costs¹¹³ and increase the risk of depression and anxiety. Indeed, they have been reported to have a greater impact on patient quality of life than breast and prostate cancers.¹¹⁴ In one study, women aged 75+ said they would prefer death to a bad hip fracture resulting in nursing-home placement.¹¹⁵ Fractures are also linked to increase the risk of mortality; the majority of excess deaths occur within the first six months of a fracture.¹¹⁶

Bone mineral is laid down throughout childhood; the most rapid increase occurs during puberty, and peak bone mass (PBM) is achieved in early adulthood. The development of maximal bone mass during growth is a major cause of osteoporosis, and anything that impedes it will affect later risk of fracture.¹¹⁷ During growth, and especially adolescence, calcium is accumulated in the skeleton until it reaches a period of equilibrium, beyond which it starts to deplete (from around age 50).¹¹⁸ Genetic factors partly influence bone-mass accumulation; so, too, do lifestyle factors, including exercise, Vitamin D intake and calcium. Repeated studies have demonstrated the relationship between calcium intake in childhood and adolescence and bone mass in later life.¹¹⁹

Although it is the 'index disease' for calcium, osteoporosis is by no means the only disease associated with calcium imbalance.¹²⁰ It has also been linked to rickets, dental problems,¹²¹ cancers,¹²² cataracts,¹²³ diabetes¹²⁴ and depression.¹²⁵ Dietary calcium has also been found to decrease lead absorption, and may play a role in reducing the risk for lead poisoning in children.¹²⁶ The causal relationships between these variables are more difficult to establish, which make them unsuitable for inclusion in an economic analysis. Nonetheless, it demonstrates the wide range of risks from calcium deficiency, and more research is needed into the calcium's role beyond bone health.¹²⁷

The case for fortification

A recent systematic review of calcium intake internationally found widespread deficiencies.¹²⁸ The only region in world where calcium consumption approaches the recommended levels of 1,000 mg per day is Northern Europe. Mexico is no exception to this. Data from the Mexican National Institute of Public Health finds that over half of children in Mexico aged over 5 had inadequate calcium, with the figure rising to over 80% in teens.¹²⁹ Data are insufficient to compare



changes in diets over time, but some academics argue that changes in consumption patterns, such as replacing milk with sodas and soft drinks, could be increasing the prevalence of osteoporosis.¹³⁰ This is especially problematic for girls in late childhood and adolescence – women are more prone to osteoporosis, and bone growth during adolescence requires higher levels of calcium intake.

However, there are a limited number of dietary sources of calcium outside of dairy products.¹³¹ In addition, it is difficult to achieve changes in diets at the national level by, for example, convincing people to consume more dairy.¹³² Several authors have identified calcium fortification of food staples as a supportive mechanism for meeting calcium requirements.^{133 134}

Research shows that fortification can work to reduce risks of osteoporosis. In a cohort study in China, girls who consumed fortified soymilk experienced significant increases in bone mass compared to a control group.¹³⁵ In Mexico, children who consumed cereal and milk daily had a higher intake of micronutrients at breakfast and throughout the day than those who did not, which the authors assumed was a result of fortification.¹³⁶

However, for fortification to work most effectively, it needs to be included in a food staple that forms part of regular dietary patterns, be consumed by key target groups and be absorbable. Breakfast cereals meet many of these criteria. They are also consumed by both sexes and throughout childhood and adolescence, which are the key time periods for developing bone mass. They therefore constitute a good food vehicle for fortification.

Scoping the study

For calcium, we focus on one well-documented outcome of calcium deficiency in childhood and adolescence: hip fracture. As discussed above, this is only one of many potential negative impacts. Hip fracture has been selected because there is a robust epidemiological research base, which means it lends itself to incorporation into an economic model. Although it would be possible to extend to a wider number of fractures and other conditions, our focus on only one subset of these ensures the estimates are conservative, and that true costs are likely to be higher. The baseline year for this study is 2013, when the testing of breakfast cereals commenced and when micronutrient levels were higher than in subsequent years.

Due to the importance of calcium during adolescence, and the high levels of deficiency within that cohort in Mexico, we have focused solely on children who were 12 years of age in 2018. This group has been exposed to less nutritionally dense Kellogg’s cereals since the age of seven, and will continue, in the coming years, to consume fewer micronutrients than would have been the case at baseline. In total, there were 1.17 million males and 1.11 million females in this cohort.¹³⁷ Males and females have been modelled separately due to differential fracture risks for the sexes. See Table 5.1 for a breakdown of the sample.

Table 5.1. Scoping study to Kellogg’s consumers: calcium

Gender	Population	Consume cereal every day (37%)	Consume Kellogg’s cereals (49.4%)	Consume ‘children’s cereal’ (54%)
Male (12)	1,171,147	433,324.39	231,829	55,601601
Female (12)	1,118,167	413,721.79	221,341	53,086086

Risk of hip fracture

Drawing on data collected by Clark et al.,¹³⁸ the International Osteoporosis Foundation reports that the lifetime risk of having a hip fracture at 50 years of age was 8.5% in Mexican women and 3.8% in Mexican men. These data were drawn from incidents reported between 2000 and 2006. Due to the demographic changes described above, the lifetime risk for our cohort will be higher.¹³⁹ Carlos et al. have projected the lifetime risks to 2050, which they estimate at 12% and

6% for women and men respectively.¹⁴⁰ These are but a subset of all fragility fractures and osteoporosis; the latter risk was estimated as 32% and 8% respectively in 2010.¹⁴¹

Several factors determine whether someone will develop musculoskeletal problems in later life. It is estimated that genetics contributes 60–80% and lifestyle factors the remaining 20–40%.¹⁴² Consumption of adequate amounts of calcium and Vitamin D during the development of PBM, along with physical exercise, are the main lifestyle determinants.¹⁴³ To ensure our assumptions are conservative, we have estimated that just 10% of the risk of hip fracture is a result of insufficient calcium in the diet. This mean 6,373 boys and 13,610 girls who now consume Kellogg’s cereals every day are at risk of developing hip fracture due to insufficient calcium in their diets (see Table 5.2). It is these young people for whom the reduction of micronutrients is potentially so costly. In the next section, we estimate what these costs are likely to be.

Table 5.2. Estimates of hip fracture risk

Consume cereal every day	Consume Kellogg’s flakes	At risk of hip fracture	Number that could be improved by increased calcium
433,324.39	55,601	5,373	308
413,721.79	53,086	13,610	659

Costs of hip fractures

Carlos et al. estimate that the annual healthcare cost of osteoporosis, osteopenia and associated fragility factures was \$411 million in 2010, that these costs would be 19.2% higher in 2015 and that, by 2020, they will have increased by 41.7%.¹⁴⁴ These increases are caused by the combined factors of increased cost and life expectancy. In our study, we focused solely on hip fractures, as there is good-quality cost data available – including some indirect costs, such as cost to individuals. Hip fractures are one of the more expensive type of fragility fractures, but they only make up one-fifth of all fragility fractures,¹⁴⁵ which again ensures a conservative scope for our calculations.

Clark et al. modelled the costs of hip fractures from 2009–2050 using variable inflation rates and discount rates (see Table 5.3).¹⁴⁶ Costs are expressed in unit costs, as marginal costs are not available. Although the marginal costs will be lower, the unit costs are more likely to be appropriate, given that only the medical costs of hip fracture and, as discussed above, the costs to individuals (which can include mortality) are likely to be substantial.

Table 5.3. Future unit costs of hip fracture using variable inflation and discount rates

Year	i=0%	i=3%	i=5%	i=0%	i=3%	i=5%
2009	5,026	5,026	5,026	5,026	5,026	5,026
2020	5,026	3,631	2,939	5,026	6,957	8,596
2050	5,026	1,496	680	5,026	16,887	37,152

Source: Clark et al. (2010)

In our study, we took the baseline figure from 2009 (\$5,026) and uprated it to 2018 prices (\$7,155) based on the annual rate of inflation.¹⁴⁷ This figure is then projected to 2057 – the year in which our cohort will reach the age of 50, at which point their risk of fractures will increase dramatically. Unlike some of the other micronutrients, the costs of calcium deficiency are usually not experienced in the short term, as the risks regarding insufficient bone mass generally occur in later life.

Two factors influence future costs. The first is inflation, which has averaged 5.6% in Mexico in the ten years to

2010, ranging from 2.7–6%.¹⁴⁸ However, it is standard practice in economic assessments to discount future benefits to account for these being of less value to the present generation, and to therefore express them in terms of their value today. We have chosen to use an STPM, which measures the preference for giving up consumption in favour of savings.¹⁴⁹ For Mexico, Lopez recommends using an STPM of 3.3% (2008) for projects with social or environmental public-sector investments, which is appropriate for future health benefits. The IMF estimates that the inflation rate to 2024 for Mexico is 3.15%. The future cost is therefore discounted by the social discount rate less the inflation rate (0.015%) from the baseline in 2018 prices. This deflates the 2057 cost to \$5,183.

The original figure provided by Clark et al. is based solely on direct medical costs;¹⁵⁰ it does not include indirect costs, such as loss of productivity or the pain and suffering patients experience. It has also been estimated that half of health expenditure in Mexico is patients’ out-of-pocket payments, which gives a sense of how much higher the figure might be. Moreover, hip fracture mortality is 12–20%, and most survivors never regain their pre-fracture level of physical function. Hip fractures also lead to permanent admission to a nursing home in approximately 20% of patients.¹⁵¹ There is also evidence that more than half of the country’s annual health spending is out of pocket, but our model does not include any of these costs.¹⁵²

Attributing the costs to Kellogg’s reduction in calcium

For our sample of cereals, calcium has been reduced in three of the five, with one staying the same and one increasing (see Table 5.4).

Table 5.4. Change in calcium RDA, 2013–19

Brand	RDA 2013 (%)	RDA 2019 (%)	Change
Choco Krispies	15%	15%	0
Corn Flakes	10%	0%	-10
Corn Flakes special edition	10%	0%	-10
Special K	0%	10%	+10
Zucaritas	6%	0%	-6

If we assume the calcium RDAs are representative of Kellogg’s cereals, we can extrapolate for the full range. What we find is the average RDA decreases from 8.5% in 2013 to 5% in 2019 – a change of 3.2%. For children at risk of hip fracture and for whom dietary changes can have an impact, this is a loss of 3.2% of their daily calcium. Research has found an average intake of 656 mg in calcium-deficient children in Mexico.¹⁵³ If we compare this with the RDA for Mexico of 1,300 mg,¹⁵⁴ we find a daily gap of 644 mg. A further decrease of 3.2% is the equivalent to 45 mg of calcium daily. Although this may seem like a small amount, it is in fact 7% of the calcium-deficiency gap. This means 7% of the costs of future hip fractures could be defrayed. We then multiply this by the number of children who could be effectively targeted through fortification. The results can be found in Table 5.5.

Table 5.5. Costs of future hip fractures attributable to Kellogg’s

Gender	No. that could be improved by increased calcium	Cost of hip fracture (discounted to 2057)	Proportion of costs attributable to Kellogg’s	Total costs
Male	637	\$5,167	\$361	\$230,084
Female	1,361	\$5,167	\$361	\$491,380
Total				\$721,465

As we can see, the lifetime costs of hip fracture in children as a result of reduced fortification are estimated to be in excess of \$700,000 for children who consume Kellogg’s cereal every day. We would expect this cost to be incurred annually as each cohort of children reaches adolescence. As we have stressed throughout the analysis, hip fracture is but one of many negative health consequences from calcium deficiency. Our analysis is also based solely on health service costs, and does not take account of wider social and economic impacts, which include an increased risk of mortality. It therefore underestimates the costs of reducing the calcium content of Kellogg’s cereals.

5.2. Focus on iron

ID is the most common micronutrient deficiency in the world, and an estimated 20–25% of infants worldwide have iron-deficiency anaemia.¹⁵⁵ Iron is present in all body cells and is fundamental for basic physiological processes, such as haemoglobin production and enzyme function.¹⁵⁶ There are three critical periods for ID: early neonatal, toddlerhood and adolescence, all of which are periods of intense growth and development.¹⁵⁷ ID has been linked to diminished cognitive skills, worse school performance and lower IQ,¹⁵⁸ lower productivity,¹⁵⁹ mental ill-health,¹⁶⁰ behavioural problems,¹⁶¹ reduced physical activity,¹⁶² excessive alcohol use and risky sexual behaviour in adolescence,¹⁶³ risk of infection,¹⁶⁴ poor pregnancy outcomes and maternal mortality.¹⁶⁵ One study found that children aged 6–23 months who regularly consumed iron supplements grew 1.2 cm more than children who did not consume the supplement regularly.¹⁶⁶

Importantly, it is only for the adolescent group that treatment with iron can (sometimes but not always) reverse cognitive symptoms, whereas prolonged ID in under-5s can lead to long-term and potentially permanent cognitive and behavioural impairments.¹⁶⁷ Nonetheless, most studies show that children do respond to iron treatment, and tend to have improved long-term outcomes as a result. Pollitt concluded that iron therapy lasting at least two months resulted in major improvement in IQ,¹⁶⁸ and Horton and Ross present a range of studies they believe provide ‘conclusive evidence for a causal link between ID and developmental delays that can be corrected by iron therapy’.¹⁶⁹

The case for fortification

Fortification programmes have been found to be an effective way of reducing ID and anaemia. They have also been found to be cost effective due to the profound economic and social consequences for countries where ID is prevalent. In Venezuela, flour and maize fortification has been found to more than halve the prevalence of ID, and reduce anaemia by 9%, for an annual per-capita cost of \$0.12.¹⁷⁰ Another study found that iron fortification is three times as cost effective as supplementation, costing \$4 vs. \$13/Disability Asjusted Life Years saved.¹⁷¹ Similarly, Levin et al. estimate a ratio of 84:1 for iron-fortification interventions and 28:1 for iron supplementation.¹⁷² According to the World Bank, no other technology offers ‘as large an opportunity to improve lives ... at such a low cost and in such a short time’.¹⁷³ In response to these data, the Pan American Health Organisation argues that fortifying staple foods with iron can provide a source of iron for vulnerable groups across the lifespan. Research from Latin American – including Mexico – has found that fortified complementary foods are widely accepted and consumed, and have contributed to improving social and health outcomes.¹⁷⁴

Scoping the study

As discussed, iron is important for three discreet groups of consumers: infants, toddlers and adolescents. For the purposes of this study, we focused solely on the costs of ID to toddlers; infants are not generally consumers of mainstream RTE breakfast cereals, and outcomes for adolescents – while significant – are not as large or irreversible as for young children. As with the other micronutrients, we have taken one cohort of children: those aged two in 2018. This has not been split

by gender, as differences in prevalence rates tend not to be found for this age group.¹⁷⁵ In total, there were over 2.2 million children in this cohort in 2018.¹⁷⁶ Members of this group are recent consumers of cereals and will be consuming fewer micronutrients via this food vehicle throughout this important growth stage. Again, the baseline year for the study is 2013. Table 5.6 shows the breakdown of the number of consumers included.

Table 5.6. Scoping study to Kellogg’s consumers: iron

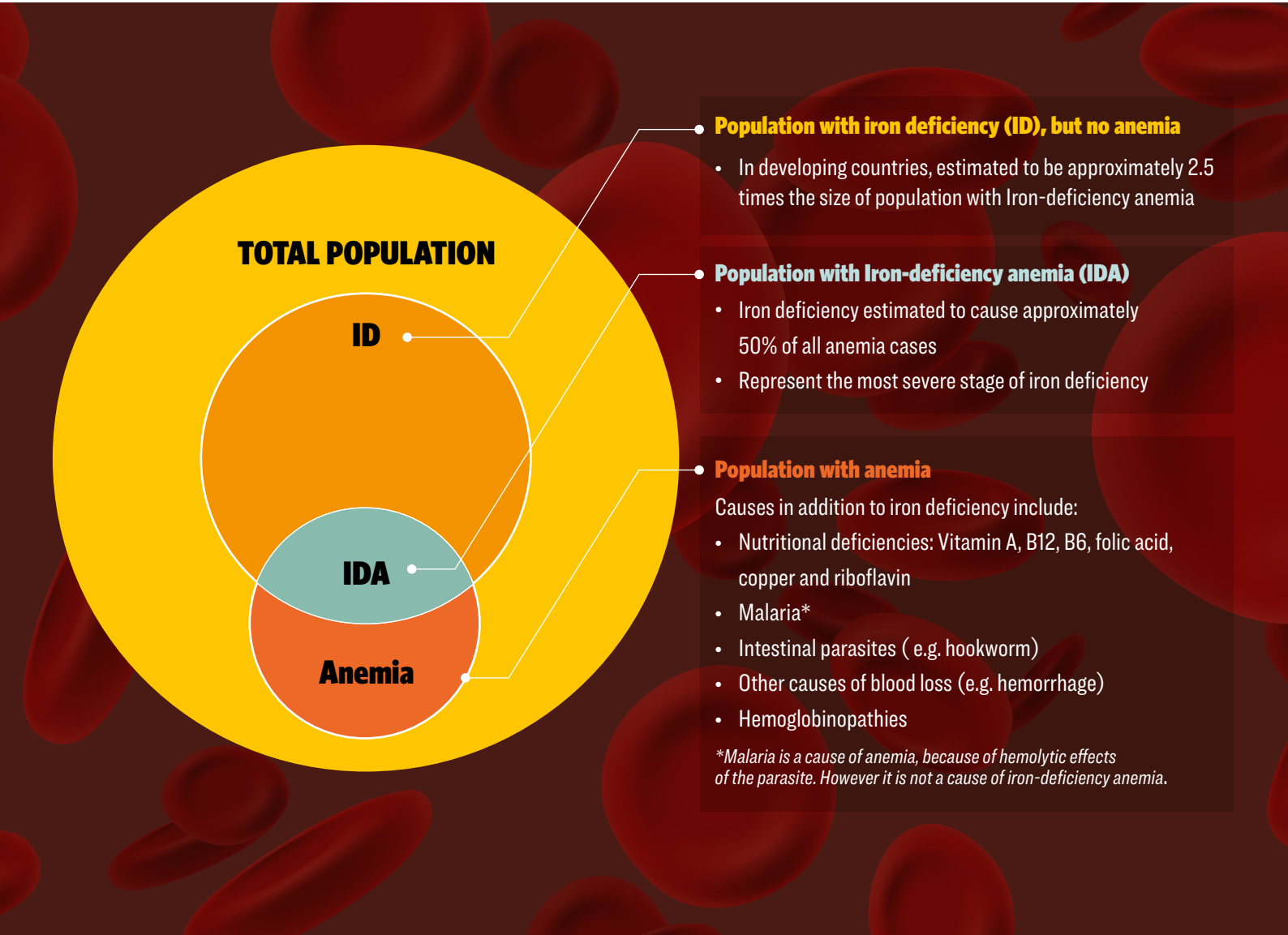
Gender	Population	Consume cereal every day (37%)	Consume Kellogg’s cereals (49.9%)	Consume ‘children’s cereal’ (54%)
All (2)	2,284,717	266,170	111,791	59,986

Risk of iron-deficient anaemia (IDA)

A lack of sufficient iron in the body can lead to IDA. There are other types of anaemia, such as the type caused by folate deficiency (see below), but IDA is the most common. It is important to distinguish between IDA and ID, with the former being more common than the latter. Figure 5.1 shows the relationship between ID, IDA and anaemia not related to ID.

Figure 5.1. Relationship between iron deficiency, iron-deficient anaemia and non-ID-related anaemia

Source: Adapted from Yip, 1989¹⁷⁷



Although IDA is more severe than ID, the latter still has profound potential negative impacts, especially in the early years. ID is widespread in Mexico; it is estimated that 52% of 1–4-year-olds, 46% of 5–11-year-olds and 79% of adolescent girls are iron deficient,¹⁷⁸ suggesting a significant public health concern. Our study focuses on two-year-olds, and we therefore used the prevalence rate of anaemia in preschool children (23.3%).¹⁷⁹ However, this anaemia prevalence is only partly as a result of ID; an estimated 50–60% of cases fall into this category, and we have conducted our modelling on the basis of the lower estimate of 50% (see Table 5.7).

Table 5.7. Example of calculations to identify at-risk population

At risk of anaemia	Consume cereal every day	Consume Kellogg’s children’s cereals	Proportion linked to ID
532,339	266,170	266,170	25,105

Costs of IDA

We have considered three social outcomes in this analysis: cognitive loss, behavioural problems and mental ill-health. As discussed, these are a small number of the total potential negative outcomes linked to ID. However, they are the ones with the strongest evidence base and sufficient studies of causal relationships, which can be incorporated into an economic model.

In terms of general cognitive performance, iron-deficient toddlers have been found to experience developmental delay¹⁸⁰ and have a lower IQ in adolescence, and the gap in cognitive function widens between them and iron-sufficient children as they age.¹⁸¹ Children who were formerly iron deficient demonstrate poorer mathematical and writing abilities, consistent with long-term alteration to hippocampal and higher-cortical functions.¹⁸² This has been linked to lower lifetime productivity, among other outcomes.¹⁸³ Horton and Ross estimate the long-term wage penalty associated with this cognitive loss as 2.5% of income.¹⁸⁴ This is a conservative estimate, given that losses from IDA have been estimated at 17% for workers engaged in heavy physical labour and 5% for moderately active workers.¹⁸⁵ In the same study, losses due to cognitive deficits for malnourished children were 4% for IDA.

Adapting a formula developed by Horton and Ross, we have calculated the per-capita costs of this loss of income over the life course.¹⁸⁶ Horton and Ross estimate the wage penalty at 2.5%.¹⁸⁷ Rather than use per-capita GDP, we have made a more conservative adjustment by using the minimum wage in 2019 (\$5.10 per day).¹⁸⁸ This give us an annual per-capita cost of anaemia of \$33 per year. This figure only takes account of the economic costs to individuals (and whatever taxes would be transferred to the state). However, these wage losses have implications for wider society through reduced productivity and GDP. In 2003, Horton and Ross estimated that Bangladesh alone loses 2% of its GDP to ID, and South Asia loses \$5 billion annually.¹⁸⁹ These wider losses are not included in our model.

ID is linked to several behavioural problems in children, including irritability, disruptive behaviour, attention deficit and lack of interest in their surroundings.¹⁹⁰ Although infancy may be the most important period for the development of conduct and behavioural norms, toddlers with IDA have been shown to be more hesitant and wary than those without, suggesting the preschool period has affective and behavioural effects similar to those reported for IDA in infancy.¹⁹¹ Based on research by Lozoff et al., we estimate a 13% increase in the risk of developing a behavioural problem in adolescence.¹⁹² This is based on the difference between childhood conduct problems among those with ID compared with those without. This would suggest that over 5,000 two-year-olds who consume cereal every day and suffer from IDA are at risk of developing behavioural problems.

The presence of behavioural problems increases the likelihood of criminal behaviour. For example, up to 80% of crime in the UK is committed by people who had behavioural problems as children and teenagers.¹⁹³ One cost implication of an increase in behavioural problems is therefore increased crime. In Mexico, the current rate of crime victimisation is 18.7%.¹⁹⁴ In a Brazilian study, Murray et al. found that behavioural problems in childhood significantly increased the likelihood that crime would be committed in adulthood.¹⁹⁵ Using the increased risk ratio (1.5) and applying it to the current crime rate suggests a 9.3% increase in the risk of crime being committed. Crime has many social, economic and psychological impacts; however, data on these are limited for Mexico. Here, we based the cost solely on the material costs of crime (\$575),¹⁹⁶ and uprated these to 2018 prices (\$1,343).

Several studies have found depression to be a symptom of ID,^{197 198} and iron stores are associated with depression in adults.^{199 200 201} Mothers with IDA have also been found to show an improvement in depressive symptoms with iron supplementation.²⁰² In our analysis, we use an estimate of the likelihood that a toddler who experiences anaemia throughout childhood will develop a depressive disorder as an adult (2.34).²⁰³ The national prevalence of depression in Mexico is 4.5%.²⁰⁴ Applying the increased odds ratio would therefore increase the risk of depression by 1.6%. Accordingly, we estimate that 717 individuals will develop depressive disorders as adults linked to their ID in childhood. Arredondo et al. have calculated the costs of case managing depression for Mexico.²⁰⁵ This cost (\$224) has been uprated to 2018 prices (\$407).

Projecting into the future

Costs are projected into the future on the same basis as calcium. For cognitive impacts, while we discount the costs from 2018 prices, we assume earnings will only begin at age 21. This is a conservative estimate, as many young people will begin working before then. We assume a full working life to retirement at age 65. For both behavioural problems and mental health, we assume a 20-year period of analysis, beginning at age 14. This reflects the fact that both mental health and behavioural problems begin to become problematic and socially costly around this time. However, we assume that either affected individuals will recover or the cost associated with their conditions will be minimised. We exclude any costs over the age of 34, which is also the peak age for engagement in criminal activity, and relevant for the behavioural outcome. The lifetime costs of these three outcomes – cognitive loss, behavioural problems and depression – are \$8.8 million, \$7.5 million and \$2 million respectively.

Attributing the costs to Kellogg's reduction in iron

Table 5.8. Change in iron RDA, 2013–19

Outcome	Proxy	Number affecting	Per-capita cost	Total
Choco Krispies	25%	20%	-5%	
Corn Flakes	40%	20%	-20%	
Corn Flakes special edition	40%	20%	-20%	
Special K	45%	20%	-25%	
Zucaritas	25%	20%	-5%	
Average	35%	20%	-15%	

We find that the average RDA decreases from 35% in 2013 to 20% in 2019 – a change of 15%. For children at risk of anaemia, this is a 42% reduction in their daily iron. Although we know the proportions of children in Mexico who lack iron and

develop anaemia, estimates of the iron intake among the deficient are not readily available. One study found an average intake of 4.5 mg.²⁰⁶ If we compare this with the RDA for Mexico of 7 mg for young children,²⁰⁷ we find a daily gap of 2.5 mg. The reduction between 2013 and 2019 equates to a reduction of 1.04 mg, or a 42% reduction in the iron required to meet their target. We have estimated an RDA of 7 mg of iron, which is in line with the IOM recommendation.²⁰⁸ The results of these calculations are presented in Table 5.9.

Table 5.9. Costs attributable to Kellogg's for those who consume cereal every day

Outcome	Proxy	Number affecting	Per-capita cost	Total	Lifetime cost	Attributable to Kellogg's
Cognitive loss	Lost productivity	26,105	\$21	\$541,464	\$22,915,811	\$9,624,640
	Behavioural problems	318	\$757	\$240,596	\$4,888,580	\$2,053,203
Mental health/ mood	Cost of treating per year	442	\$408	\$180,117	\$3,659,733.83	\$1,537,088

When we include costs for those who consume cereal less frequently, the lifetime costs associated with the change in micronutrient content is almost \$13.2 million. However, we would expect this cost to be incurred annually as each cohort of children reaches the age of two.

5.3. Focus on folate

The importance of folate sufficiency during pregnancy is well understood. The efficacy of folic-acid fortification in preventing NTD has been proven, and its role in other birth defects is the subject of ongoing research.²⁰⁹

As well as birth defects, folate has been linked to LBW. Folic-acid supplementation has been found to be associated with increased fetal growth, resulting in higher placental and birth weight and decreased risks of LBW²¹⁰ and lower associated costs at birth.²¹¹ Higher maternal folate status has been shown to be protective against other adverse birth outcomes, such as congenital heart defects and preterm birth.²¹² A recent study found that, despite fortification of food staples, 9–33% of women of childbearing age have intakes below the levels the World Health Organization (WHO) recommends. However, up to 12% of children may be consuming up to the safe upper limits, pointing to the need for enforcement and monitoring of mandatory requirements.²¹³ Furthermore, lower folate status in early pregnancy may impair fetal brain development and affect hyperactivity/inattention and peer problems in childhood.²¹⁴

Folate does not only matter in pregnancy, however; deficiency is linked to anaemia throughout the life course. The developmental risks are therefore similar to iron, as discussed above. Finally, there is some evidence of a link between folate deficiency and mental illness in adulthood.²¹⁵

The case for fortification

The findings from these studies have led to the establishment of national fortification programmes in some countries, and declines in rates have been observed in those countries. Folic-acid fortification is now mandated in 87 countries, although levels of fortification vary widely.²¹⁶ Evidence from the US, Canada, Costa Rica and Chile suggest that mandatory fortification policies in these countries have been associated with a reduction – of approximately 30–50% on average – in the incidence of spina bifida and anencephaly.²¹⁷ In Mexico, there was a 59% reduction in risk – from 3.5% in 1995–99 to 1.47% in 2001–06 – following mandatory fortification of wheat and corn.²¹⁸

Mandatory fortification programmes have been found to reduce the high costs associated with prevention programmes, such as education campaigns,²¹⁹ and to be more effective and egalitarian than supplementation. Research from the US, for example, found that its national fortification programme reduced the gap in folate deficiency between income and social groups.²²⁰

As well as the clear benefits of increasing populations’ folate intake, one of the reasons so many programmes have been initiated is their low cost. In the US, it is estimated to cost about 1 cent per person per year, or about \$1,000 per neural tube defect prevented.²²¹

Scoping the study

While folate intake matters throughout the life course, in this study we focused on two key groups: toddlers (aged two) and pregnant women. This is the only micronutrient for which we include an adult cohort. Although breakfast cereals are largely marketed and sold to children, we know adults are also significant consumers of RTE cereals. For example, we know from market data that 46% of the cereals sold in Mexico that fall within the ‘breakfast cereals’ category are not classed as ‘children’s cereals’, suggesting they are also marketed to and consumed by adults.²²²

As with the iron analysis, we have taken one cohort of children – those aged 2 in 2018. This has not been split by gender, as differences in prevalence rates tend not to be found for this age group.²²³ In total, there were over 2.2 million children in this cohort in 2018.²²⁴ Members of this group are recent consumers of cereals, and will be consuming fewer micronutrients via this food vehicle throughout this important growth stage. The baseline year for this study is 2013, when the testing of breakfast cereals commenced, and when micronutrient levels were higher than in subsequent years.

Table 5.10. Scoping study to Kellogg’s consumers: folate

Total	Consume cereal every day (37%)	Consume Kellogg’s cereals (49.9%)	Consume ‘children’s cereals’ (54%)
2,284,717	845,345	417,601	224,078

For newborn babies who benefit from mother’s consumption of folate during pregnancy, we have derived our estimate from the number of live births in 2018. This has been multiplied by our estimate for the proportion of women of child-bearing age who consume each cereal (14.7%).²²⁵ There is limited consumption data on cereal by age group; this estimate, although taken from the US, is the closest approximation we could find. We know Kellogg’s has a 42.9% market share for cereals that are not marketed to children in Mexico, and that 46% of all cereals sold fall into this cereal category. Of these, 24% are classed as ‘flakes’ (that is, not muesli or other adult cereals) – suggesting that, of the 14.7% who consume cereal, almost a quarter consume RTE cereals and over 40% of these are sold by Kellogg’s. See Table 5.11 for a breakdown of the numbers in question.

Table 5.11. Expectant mothers who consume Kellogg’s cereals

Total	Consume cereal every day (37%)	Consume Kellogg’s cereals (49.9%)	Consume ‘children’s cereals’ (54%)
2,200,000	323,400	138,738.6	33,274

Risk of anaemia and neo-natal complications

For toddlers and young children, a major risk of folate deficiency is anaemia. A study of the determinants of anaemia in Mexico has found that 2% of cases were linked to folate deficiency.²²⁶ We have used this figure to estimate the number of cases to take forward in the model (n=1,044; see Table 5.12). As with iron, the assumption is that there are the same impacts on cognitive loss, behavioural problems and mental health.

Table 5.12. Calculations to identify at-risk population

Consume Kellogg’s cereals	Consume ‘children cereals’	At risk of anaemia	Number linked to folate deficiency
417,601	224,078	52,210	1,044

For newborn children, we assume 21% of mothers have insufficient folate during pregnancy. This estimate comes from a study of deficiency rates in Mexico after the introduction of the wheat and corn fortification programme,²²⁷ which found that 9–33% of women were deficient (mean=21). We have included two potential negative outcomes: an increased risk of NTD and LBW. The risk of LBW in 2009 in Mexico was 8.5%.²²⁸ Evidence from Shaw et al. demonstrates a 6–9% reduction in LBW in women following a national fortification programme in the US.²²⁹ If we use the more conservative 6% estimate, the risk to women in Mexico would be reduced by 0.5%. This would result in 68 fewer cases of LBW per year. For NTDs, fortification has reduced the risks from 3.5% to 1.47% – a difference of about 2%.²³⁰ If we assume our cohort could benefit to a similar level, this would result in 274 fewer cases of NTDs in Mexico.

Costs of anaemia and neo-natal complications

For folate-deficient anaemia, the rationale for costs is the same as that for ID, and is not reproduced here. Future costs have been calculated on the same basis. The figures for folate are provided in Table 5.13.

Table 5.13. Costs for anaemia linked to folate deficiency

Outcome	Proxy	Number affected	Per-capita cost	Total	Lifetime cost
Cognitive loss	Lost productivity	1,044	\$21	\$21,659	\$916,632
Behavioural problems	Cost of crime	13	\$757	\$9,624	\$407,299
Mental health/mood	Cost of hospital treatment	18	\$400	\$7,067	\$143,595

For the newborn cohort, we used estimates of hospital costs alone for both LBW and NTDs. These are a small proportion of the overall costs, given the high risk of mortality from both conditions, risk to individuals of experiencing a disability from either, and risk to family members from caring for a child with that disability. Costs of NTDs are not available for Mexico, and data on healthcare costs are limited, as are health economics studies. Instead, we have used an estimate of healthcare costs for NTDs from Chile (\$1,200).²³¹ This figure was expressed in international dollars, converted to Mexican pesos, converted back to international dollars using PPP estimates (\$812) and then uprated to 2018 prices (\$1,573).

Profit et al. have estimated the cost of intensive care for children with LBW.²³² These range from \$3,000 for the least severe cases to \$11,400 for the most severe. We used the mid-range value, \$9,500, to estimate the hospital costs avoided. Unlike with the other outcomes, we have only assumed a one-off cost associated with illness, and, as a result have not projected ether into the future.

Table 5.14. Costs relating to low birth weight and neural tube defects

Outcome	Proxy	Number affected	Per-capita cost
Low birth weight	Hospital costs	36	\$9,500
Neural tube defects	Hospital costs	142	\$1,574

Attributing the costs to Kellogg’s reduction in folate

Of the micronutrients considered as part of this study, folate has seen the largest decrease, with drops of 70% in bestselling brands like Corn Flakes. On average, Kellogg’s brands have seen a 36% decrease (see Table 5.15).

Table 5.15. Change in folate RDA, 2013–19

Brand	RDA 2013 (%)	RDA 2019 (%)	Change (%)
Choco Krispies	25%	10%	-15%
Corn Flakes	70%	0%	-70%
Corn Flakes special edition	70%	25%	-45%
Special K	34%	10%	-24%
Zucaritas	50%	25%	-25%
Average	50%	14%	-36%

The reduction in folate in Kellogg’s cereals is so large (144 mg of folate, or 36% of the RDA) that it would mostly compensate for folate deficiencies among those who consume cereals. Estimating the folate intake for deficient populations is challenging. Two studies of adults have found estimates of 212 mg²³³ and 310 mg²³⁴ per day. If we assume the lowest estimate, then Kellogg’s contribution to reach RDA is 80% (that is, 144 mg as a share of 179 mg, which is the difference between the daily intake and the RDA). If we assume the higher estimate, it would enable consumers to reach 100% of their RDA. For the purposes of this study, we have gone with the lower estimate to be sufficiently cautious. We have also assumed this 80% rate for children, as no estimates of daily intake were available for the deficient group in this cohort.

The results of these calculations are presented in Table 5.16.

Table 5.16. Costs attributable to Kellogg’s: folate

Outcome	Proxy	Number affecting	Per-capita cost	Total	Lifetime cost	Attributable to Kellogg’s
Cognitive loss	Lost productivity	1,044	\$21	\$21,659	\$916,632	\$737,403
	Behavioural problems	13	\$757	\$9,624	\$407,299	\$327,660
Mental health/mood	Cost of treating per year	18	\$400	\$7,067	\$143,595	\$115,518
LBW	Hospital costs	36	\$9,500	\$338,553	\$338,553	\$338,553
NTDs	Hospital costs	142	\$1,574	\$223,259	\$223,259	\$223,259

As we can see, the lifetime costs of folate-deficient anaemia are \$1.18 million. We would expect this cost to be incurred annually as each cohort of children reaches the age of two. For the newborn group, the costs are over \$500,000, giving a total cost for both groups of \$2.9 million.

As we have stressed throughout the analysis, the conditions considered here are just a few of the many negative health and social consequences of folate deficiency. Our analysis was also based solely on a narrow number of stakeholders.

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