Nutrition

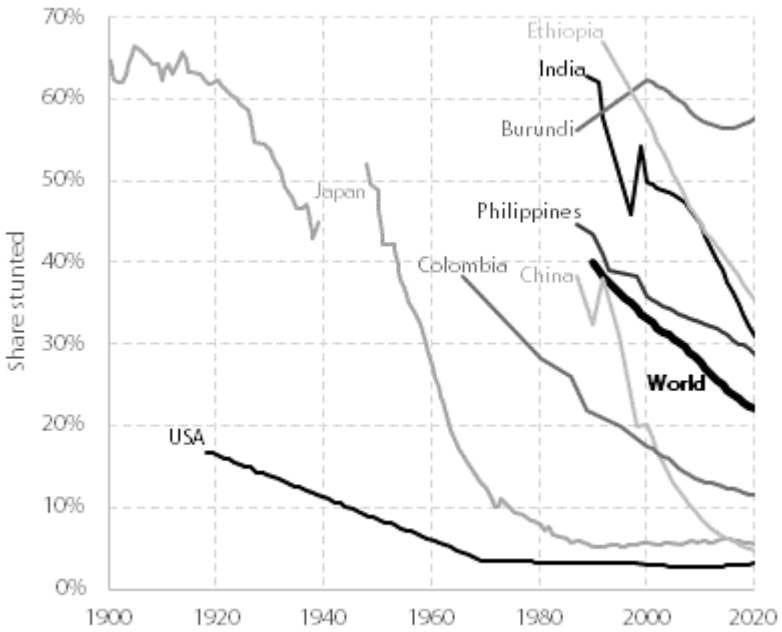
Although the share of the global population starving has dropped dramatically over the past century, nearly a quarter of the world's children still don't get the nutrition they need to flourish. In addition to making kids more prone to sickness and death, malnutrition can hamper cognitive and physical development. This not only saddles these children with long-term difficulties, but it also hurts societies by lowering people's productivity. Yet, there are a number of ways that policies can improve nutrition where it matters most, at low cost.

Malnutrition: Long-term harm to the most vulnerable

Feeding the world is incredibly important. The chapter on Agricultural R&D shows how we can make much more and cheaper food over the coming decades, especially for the most vulnerable people in the world. But clearly, policymakers can't rest there. We also need to ensure that there is better nutrition *in the present*.

The greatest nutritional challenge is long-term undernutrition in children. The most important impact happens within a child's first 1,000 days, from conception until the child is two years old. This is the critical window during which a sustained lack of nutrition has the greatest negative impact on the child's future physical and mental health.

Undernutrition is measured in terms of stunting, which means children are short for their age. Unlike being underweight, which mostly indicates short-term malnutrition, being shorter indicates that a child has been undernourished for a long time. The impacts are far more devastating than just being shorter than one's peers. Stunting means that a child is more likely to become sick and die from infections, in particular, pneumonia and diarrhea.



Sources: Data for Japan are interrupted by the Second World War. Most reliable data only begin around 1990. The global average has declined from 40% in 1990 to 22% in 2020. WHO, UNICEF, VOXDEV

Figure 10.1 Stunting of children under five years of age, from 1900 to 2020. Most reliable data only begin around 1990.

Stunted children also suffer from impaired behavioral development in early life. The lack of nutrition hampers brain cell growth—rather than the extensively branched neurons of better-fed children, stunted children's neurons will be shorter and show less branching. Stunted children are less likely to enroll in school and are more likely to enroll late. They tend to achieve lower grades and, in general, will score lower on tests of cognitive ability than non-stunted children. Because they learn less in school, they are less economically productive as adults and have lower lifetime incomes.

Happily, stunting has retreated over the past decades and afflicts a far smaller proportion of children than it once did, but it still causes tens of millions of additional stunted children in the poorer half of the world, as can be seen in Figure 10.1. Although there is relatively spotty data on stunting in the previous century, it's likely that it was mostly eradicated in the USA before 1900. It's rare in well-off countries today, and many developing countries have seen their rates fall from a very high level in even the last few decades.

In China, the prevalence of stunting has nearly disappeared over a few decades. In Ethiopia, India, the Philippines, and Colombia, it has fallen markedly, whereas in countries like Burundi, it remains largely unchanged and stubbornly high. Globally, we have seen an almost halving in stunting over the past three decades, from 40% in 1990 to 22% in 2020.

Childhood stunting is, in the words of one assessment, "the best overall indicator of children's well-being." In this chapter, we will look at ways to increase nutrition, reduce stunting, and dramatically improve children's well-being.

Failing by more than 100 million children

The Sustainable Development Goal concerning malnutrition is nothing if not ambitious. SDG 2.2 promises to:

> By 2030, end all forms of malnutrition, including achieving, by 2025, the internationally agreed targets on stunting and wasting in children under five years of age, and address the nutritional needs of adolescent girls, pregnant and lactating women and older persons.

The Agricultural R&D chapter shows how the world will miss the whole second SDG by nearly a century. But let us here just focus on the target of stunting.

The world is definitely not on track to achieve an "end" to stunting anytime soon. As with other targets, "end" has been reinterpreted to be more achievable. Specifically, it sets the actual target as a 50% reduction in the number of stunted children from 2012 to 2030.

Although this is far less ambitious than a 100% reduction in malnutrition, we still aren't on track to hit that revised goal. As is evident in Figure 10.2, the world will miss the 50% reduction target from 174 million stunted children in 2012 to some 36 million children.[i]

Source: The trend for 2020–30 using the average reduction per year seen in the previous decade (2011–20), the goals set by the 2025 target (40% reduction from 2012 number), and the reinterpreted SDG2 target for 2030 (50% reduction from 2012 number). Of course, the actual SDG2 target still suggests the number of stunted children in 2030 should be (near) zero.

Figure 10.2 Global number of stunted children 1990–2020, trend from previous decade to 2030, and the path to the goals set for 2025 and 2030.

Yet there is a chance to correct our course. Over the last decade, there have been significant research breakthroughs in improving maternal and child nutrition, with large-scale effectiveness studies, innovations, and improved nutritional products. The paper for this chapter outlines three policies that have real potential to improve children's dietary intake in their first 1,000 days and thereby prevent serious long-term harm.

Supplements during pregnancy: Nutrition in the womb

Many women's diets lack micronutrients—the vitamins and minerals a body needs in very small quantities. This is a problem pregnancy can exacerbate when women often become nutrient-deficient as their bodies provide nutrition to their babies. Because the vital 1,000-day window for a child's nutrition begins at conception, making sure pregnant women have better diets can help both mother and child. There are more than 90 million births each year in low- and lower-middle-income countries. Providing mothers with vitamins and minerals could do immense good.

Most governments around the world already follow the WHO recommendation to provide pregnant women with iron and folic acid supplementation, reaching some 36 million pregnant women every year in low- and lower-middle-income countries.

Switching these women to a pill that includes many more micronutrients would only take a little training in these countries' healthcare sectors and add just a small cost to the government and essentially no extra cost to mothers.

Lacking calcium raises the risk of adverse pregnancy outcomes. Calcium supplements lower the odds of the mother developing hypertensive disorders that are associated with a sizable number of maternal deaths and considerable risk of early birth and low birth weight, which reduce the child's cognitive development and, in adulthood, long-term productivity. Calcium supplementation is a bit trickier than micronutrients because it requires two large pills, and they are more expensive. But it's still a relatively affordable and simple intervention. Because the costs and impacts are different, the two sets of pills are assessed separately.

Multi-micronutrient pills are already mass-produced and easy to supply. They contain 13 vitamins and minerals beyond iron and folic acid, including vitamins A, B1, B2, B6, B12, D, and E, plus zinc, copper, iodine, and selenium. They are so cheap that the additional cost per mother is just $1.55 for 180 pills covering the last two trimesters of the pregnancy. For 36 million women in a year, the cost comes to $56 million annually, as Table 10.1 shows. The additional training and education costs add another $1.12 per pregnant woman or $40 million for all.

The three main health benefits of multi-micronutrient supplements are that they reduce the risks of stillbirths, of mothers giving birth too early, and of having a child with low birth weight. The paper estimates that giving 36 million pregnant women these pills will prevent 47,000 stillbirths. For the purposes of the BCR, this has a value of $108 million.[1]

It's also extremely beneficial to prevent early births and children being born underweight, as both these can set a child on a path of lower cognitive development, with an average loss of 5 IQ points and worse education results. This, in turn, means the child will grow up to earn lower wages and be less productive. The paper estimates the reduction in lifetime income from a 5 IQ point loss to be 10% for both early births and infants with low birth weight. For an average child in a low- or lower-middle-income country, this income loss, discounted back to the present, is worth almost $2,200.

Multi-micronutrient supplements will prevent 5% or 228,000 children from being born too early. Using the average $2,200 income loss, this results in a total wage benefit of $491 million for those kids when they grow up. It would also avoid 21% of all infants being born with low birthweights, helping 1.4 million children grow up to reclaim higher productivity, which has a value of $3 billion.

In total, as Table 10.1 outlines, the benefits are vastly larger than the costs, with $38 of benefits for each dollar spent.

[1] Controversially, stillbirths (dying before or during delivery) are typically not counted as deaths in cost-benefit analysis; instead, stillbirths are counted as costs for the mother as funeral costs and additional time off work for recovery and grieving, etc. The common reason is typically given that if the unborn, dead child was counted as the death of a full individual, this would make it hard to avoid counting miscarriages (deaths of fetuses before viability) as full deaths as well, with these numbering 23 million globally each year. Needless to say, this is a highly charged issue for many, and if a higher valuation were attached, it would make the multi-micronutrient supplements an even better investment.

Table 10.1 Annual costs, benefits, and benefit-cost ratio for multi-micronutrient supplementation.

Costs		Million $
	Multi-micronutrient pill, additional cost	56
	Healthcare system, education, and training	40
	Total costs	97
Benefits		
	Stillbirths, 47,000 avoided	108
	Early births, lower productivity for 228,000 avoided	491
	Low birth weight, lower productivity for 1,4 million	3,030
	Total benefits	3,629
	Benefit-cost ratio	38

Note: Future benefits are discounted at 8%.

Source: Costs are for 36 million pregnant women in low- and lower-middle-income countries that each year already take vitamin A and folic acid pills (of a total of 90 million annual pregnancies). The individual costs are described in more detail in the text.

The costs and benefits of calcium follow the same general outline as those of micronutrients. The tablets are quite large, and since two are needed every day for the last 20 weeks of pregnancy, the cost is much more sizeable at $6.84 per pregnancy, or $248 million in total, as seen in Table 10.2. The program cost is already included with the multi-micronutrient pill.

Table 10.2 Costs, benefits, and benefit-cost ratio for calcium supplementation with maternal mortality.

Costs		Million $
	Calcium pill, additional cost	248
	Total additional costs	248
Benefits		
	Stillbirths, 81,000 avoided	186
	Early births and lower productivity for 693,000 avoided	1,613
	Low birth weight and lower productivity for 423,000 avoided	958
	Eclampsia and pre-eclampsia avoid 8,470 maternal deaths	1,817
	Total benefits	4,601
	Benefit-cost ratio	19

Note: Future benefits are discounted at 8%.

Source: Costs are for 36 million pregnant women in low- and lower-middle-income countries (of a total of 90 million annual pregnancies). The individual costs are described in more detail in the text.

Calcium supplementation reduces the number of stillbirths by much more, and it avoids almost as many losses in IQ from early births and low birth weight, although the distribution over outcomes is different. Crucially, calcium also likely reduces pre-eclampsia and eclampsia, which are rare but serious conditions where high blood pressure results in seizures during pregnancy or during birth. This means that calcium supplements can prevent 8,470 maternal deaths each year, valued at $1.8 billion.

In total, the benefits—at $4.6 billion—are 19 times larger than the costs—at $248 million. Since both micronutrients and calcium supplementation are very effective, it is recommended that both should be implemented, delivering $24 back on the dollar (see Table 10.5).

Complementary Feeding Promotion: Ensuring infants get the food they need

Around the age of 6 months, an infant's need for energy and nutrients starts to exceed what a mother's breast milk can provide. At that point, parents need to begin giving the child additional food. This is referred to as the complementary feeding transition. This transition is difficult to manage because it entails gradually introducing a series of new foods to children in the right quantities and at the right frequency. Some parents may be unaware of the right foods to feed their children, while others might not know how frequently little children should be fed. And even if this is well understood, some families may not be able to afford these foods.

This chapter's paper evaluates two policies to promote complementary feeding in the 40 low- and lower middle-income-countries with the highest rates of stunting. Within each country, the research divides the population into the richest 40% of households and the poorest 60%.

Let us first look at the richest 40%. To be clear, most of these families are not rich by international standards; the 40% richest people in India, for instance, earn on average about $4,800 per year.[ii] That said, they do have the incomes needed to purchase the right diets for their children. What they lack is information and/or the ability to apply this information. Because children in these better-off households account for about 30% of all stunting or seven million children, targeting these families has the potential to reduce stunting at a very low cost.

Across the 40 low- and lower-middle-income countries, the richest 40% of households have 27.5 million children each year. Over the 18-month period between six months and two years (the end of the first 1,000 days), healthcare workers meet with the mother nine times and provide guidance to ensure better nutrition. The cost of the consultants, their travel time, and the value of the mother's time over 18 months for one child is $21.38. For the 27.5 million children born each year, the cost is $444 million for healthcare workers and $145 million for mothers, as indicated in Table 10.3.

Table 10.3 Annual costs, benefits, and benefit-cost ratio for Complementary Feeding Promotion.

Costs		Million $
	Healthcare workers	444
	Value of mothers' time	145
	Cost of incremental food consumption	289
	Total costs	878
Benefits		
	Avoided deaths	2,659
	Higher productivity	11,294
	Total benefits	13,953
	Benefit-cost ratio	16

Note: Future benefits are discounted at 8%.

With better information, the seven million children that would otherwise have become stunted will now get more and better food. This will have direct costs for the parents,

estimated at $289 million. But this will also have significant benefits for the seven million children in terms of fewer deaths and fewer stunted children.

In total, the improved feeding will avoid about 9,000 deaths, for a monetary benefit of $2.7 billion. Studies indicate that of the seven million better-fed children, two million will likely avoid stunting. This means that two million children will grow up with better-developed brains, learn more in school, and become more productive as adults. For the 59% that will enter the workforce, each will be able to earn much more over their lives. Discounted back to today, the value of higher productivity is equivalent to an additional $11.3 billion.

The BCR comes to 16, which makes promoting complementary feeding a phenomenal investment to help the world.

The researchers make similar calculations for children living in the poorest 60% of households. Here, children's needs might be greater, and caregivers might need additional consultations. Crucially, these households can't afford to buy better food for their infants, so they need additional cash transfers. This makes the costs go up when compared to the benefits, and therefore this intervention delivers a good but not phenomenal $7.5 in social benefits back on the dollar. Moreover, we can help the same target group better with another policy called SQ-LNS.

SQ-LNS: Transforming a child's life for $90

If we want to get food directly to children in the 6–23 months window, we might think about simply distributing different kinds of foods. But that is not as easy as it sounds. Distributing free staple foods is logistically challenging, with spoilage and corruption increasing costs. Moreover, children in this age range need access to proteins and micronutrients too, and the foods containing these are often more expensive and harder to transport. A relatively new solution is to provide a new food, a supplement called "Small-quantity lipid-based nutrient supplements" or SQ-LNS.

SQ-LNS comes as a paste or spread that is individually packaged in robust sachets that are packed in sturdy cartons that can be distributed to parents. The paste makes them shelf-stable and easy to eat. Children can easily consume one small packet each day containing 20–50 grams and perhaps 110–270 kcals. This packet contains essential fatty acids and proteins targeted toward preventing malnutrition in vulnerable children. They are typically made from vegetable oil, peanut paste, milk powder, and sugar, with added vitamins and minerals, thus providing many of the micronutrients and fatty acids that are necessary for physical and brain development.

The paper on which this chapter is based estimates the benefits and costs of a program that rolls out SQ-LNS to the 40 low- and lower-middle-income countries with the highest rates of stunting prevalence. Within each country, the program focuses on the 60% lowest socio-economic or poorest families. This means that the solution reaches the most vulnerable groups in the most vulnerable countries, which is about 41 million children annually.

The cost of the SQ-LNS is $2.79 per child per month. The delivery costs are almost as much, at $2.23, leading to a total cost of $5 per child per month. This amounts to $90 per child over a duration of 18 months, or $3.7 billion per annual birth cohort of 41 million children, as shown in Table 10.4.

Extensive studies show that the benefits to young children from SQ-LNS include reduced stunting and reduced health risks, including a lower risk of dying. Providing SQ-LNS to 41 million children will avoid 155,000 child deaths at a total benefit of $45.7 billion. Getting SQ-LNS to all 41 million children across 18 months would avoid stunting for more than 1.5 million children. This means they would go on to develop more, study more, and become more productive in their adult lives. The resulting higher productivity reflected in higher wages would be worth, on average, $5,875 per child, discounted back to today. Assuming the same labor force participation rate as today at 59%, this results in total productivity benefits worth over $5.4 billion.

Table 10.3 Annual costs, benefits, and benefit-cost ratio for SQ-LNS.

Costs		Million $
	SQ-LNS sachets for 41.3 million children	2,072
	Distribution of sachets	1,655
	Total costs	3,727
Benefits		
	1.55 million fewer stunted children; 59% get jobs with higher productivity	5,355
	155,514 fewer deaths among children	45,727
	Total benefits	51,082
	Benefit-cost ratio	14

Note: Future benefits are discounted at 8%.

In total, getting concentrated food packages (SQ-LNS) to children would have significant costs at almost $4 billion annually, but the benefits would be almost 14 times the cost, making it not quite phenomenal, but still a very, very good investment.

Feeding children better

We have promised to tackle malnutrition and stunting, but we're failing. This chapter highlights a number of phenomenal policies where a few resources can make a huge difference. We can make sure pregnant women get multiple micronutrients and calcium supplements, which will make children develop better and have more productive lives, delivering $24 back on each dollar spent (Table 10.5).

Table 10.5 Annual benefits and costs in million dollars of nutrition interventions.

	Benefit	**Cost**	**BCR**
Multiple micronutrients and calcium for pregnant women	8,229	344	24
Complementary feeding promotion, 6–23 months, richest 40%, no cash	13,953	878	16
Total	22,182	1,222	18

We should also focus our attention on complementary feeding promotion for the 41 million children from 6–23 months. Helping the parents feed their children better saves lives and makes two million children grow up to be less stunted, better educated, and ultimately more productive, delivering $16 back on the dollar.

These are some of the most effective ways to help avoid the scourge of malnutrition and embrace the opportunities for millions of more healthy and productive lives.

The data and texts in this manuscript are not finalized. Intended use is for finding references, links and sources for the finalized text of the book Best Things First.

The academic paper is entitled "Investing in nutrition—A global best investment case." It is authored by

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[i] This is outlined in https://www.who.int/news/item/06-05-2021-the-unicef-who-wb-joint-child-malnutrition-estimates-group-released-new-data-for-2021, p. 25, and is discussed further in https://www.who.int/publications/i/item/WHO-NMH-NHD-17.9.

[ii] https://data.worldbank.org/indicator/SI.DST.05TH.20?locations=IN, income share for top 40% is 56.5%, so 56.5%/40%=1.4