



RESEARCH SUMMARY

ENSO Impacts Child Undernutrition in the Global Tropics

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KEY TAKEAWAYS

1. The El Niño Southern Oscillation (ENSO) leads to changes in temperature and precipitation throughout the tropics, having widespread impacts on agriculture, economic production and social stability. To guide global public investments in food insecure areas, the study provides the first estimate of El Niño's impacts on child nutrition throughout the global tropics.
2. Using data tracking more than a million children spanning four decades and all developing country regions, the authors examine the children's weight in El Niño years compared to years where there was no El Niño as well as directly before and after the El Niño began. These data represent nearly 50 percent of children under five globally.
3. The authors find that warmer, drier El Niño conditions increase undernutrition in children across most of the tropics. In the small segment of areas where El Niño leads to increased precipitation, the opposite occurs. While the children's weight appears to recuperate, the shock on their nutrition at such a young age stunted their growth in later years.
4. In the case of the severe 2015 El Niño, nearly 6 million children were driven into undernutrition as a result. To put this into context, each 1-in-4 year El Niño event has an impact on children's nutrition that is at least 70 percent the size of the 1-in-100-year Covid-19 pandemic, and perhaps up to three times greater impact than Covid-19.
5. The number of children driven into undernutrition during the 2015 El Niño is equivalent to erasing one year of progress towards the international community's goal of eliminating undernutrition, with only 10 years remaining to meet that goal. To offset the impacts of the 2015 El Niño would require providing 134 million children with micronutrient supplements or 72 million with additional food in the food insecure region.
6. Despite increasing incomes and trade connectivity, El Niño has eroded and continues to hold back the developing world's progress in reducing hunger. But given the highly predictable nature of the events, institutions engaged in multi-year humanitarian efforts could easily incorporate El Niño into their planning to approach global hunger in a more proactive fashion.

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Introduction

The El Niño Southern Oscillation (ENSO) is the dominant source of global climate variability from year to year. Happening once every 4 to 7 years, during an El Niño, the temperatures at the surface of the equatorial Pacific Ocean increase. This localized change has a knock-on effect on the climate over nearly 30 percent of the land area in the world, sometimes very far away. These “teleconnections” cause higher temperatures throughout the tropics as well as shifts in precipitation patterns where some areas get drier than normal while others get wetter. The opposite happens during a La Niña, also once every 4 to 7 years, with the remaining years being ENSO-neutral and having no effect on the global climate.

The warmer El Niño has widespread impacts on agriculture, economic production and social stability throughout areas of the global tropics. El Niño has been linked to a rise in infectious diseases carried by insects and by water, as well as a decrease in crop yields that is especially troubling in the tropics where a large number of vulnerable food-insecure children already live.

There is some debate over whether climate change will increase the frequency and intensity of El Niño. Despite this debate, there is little doubt that as the world warms with climate change, and extreme changes to precipitation ensue, layering the effects of El Niño on top of these changes will create more impactful El Niños. For example, crop losses that occur in the tropics during El Niño years will be greater in the future under climate change. Additionally, studying episodes of hotter temperatures can be instructive as scientists seek to understand all of climate change’s impacts, including on hunger and nutrition.

One silver lining to El Niño is that it is predictable, with scientists able to forecast its arrival months in advance with increasing skill. This should allow policymakers, industries, and others the time to

prepare and adapt to these changes, unlike other extreme climate events such as heat waves, hurricanes and floods.

Research Design

Up until now, El Niño’s impact on food insecurity has generally focused on a single country or El Niño episode. To provide both a global and regional scope of the impacts to guide national and international public investments that could preempt El Niño, the study takes a more holistic approach. The researchers provide the first estimate of El Niño’s impacts on human nutrition throughout the global tropics. They look at the total influence of El Niño on all plausible factors that could contribute to food insecurity that are known to affect human nutrition—from agricultural productivity to infectious disease to conflict.

Using data that includes 1.3 million children under age five spanning four decades and all developing country regions—regions that contain nearly half the world’s under-5 population—the authors estimate the systematic effect of El Niño. Child weights and heights are calculated as weight-for-age and height-for-age using the World Health Organization (WHO) international standard. Most children in the tropics are well below the global average of weight-for-age. When they drop below the global 2.5th percentile, they are considered to be severely underweight.

The researchers examine the children’s weight in El Niño years compared to years where there was no El Niño, as well as directly before and after the El Niño began, while controlling for a multitude of local factors and trends in nutrition. Children’s weight measurements are extremely sensitive to these nutritional shocks due to their high caloric needs while growing, and provide a summary measure of contemporary household food security.

Figure 1 • Regions of the World where El Niño Changes Temperature and Precipitation Patterns

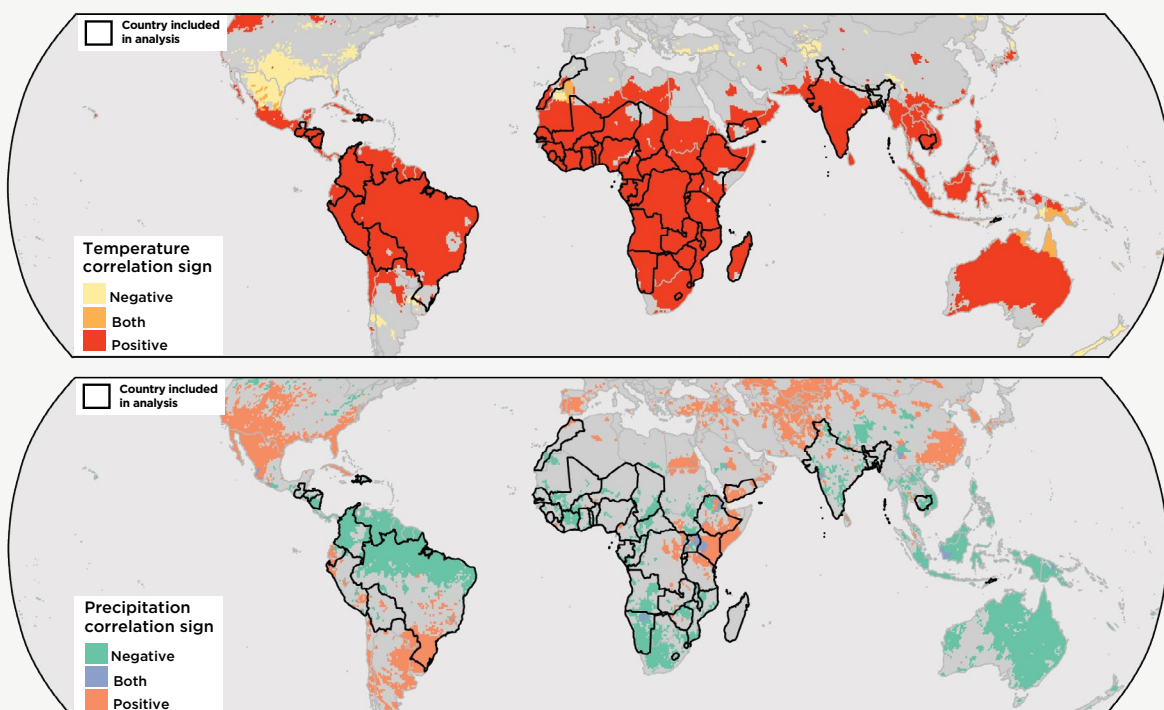
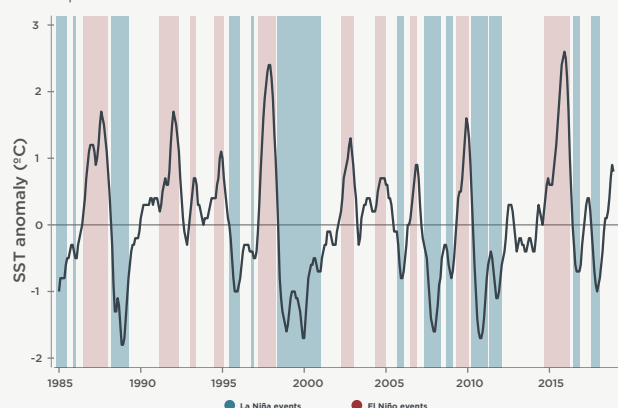


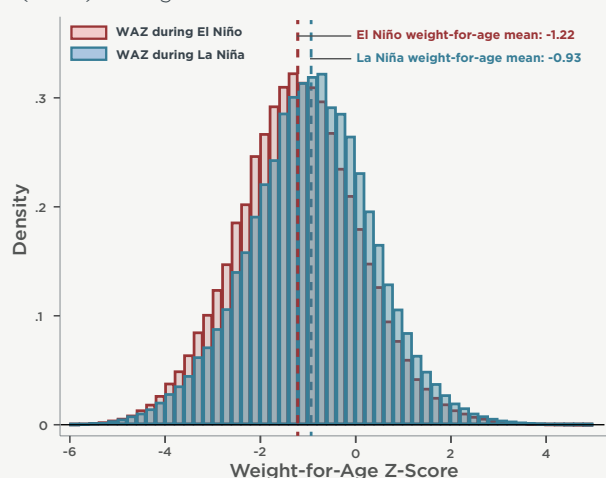
Figure 2 • Variation of Tropical Pacific Sea Surface Temperature and ENSO Events



Findings

A 1° Celsius temperature increase in the tropical Pacific caused by El Niño leads to a 2.7 percent decrease (0.03σ decrease) in the average child's weight for their age. Children living in the tropics typically have a lower weight for their age than those living in non-tropical regions. While the cooler temperatures of La Niña improve their average weight slightly, those children are still close to 1 standard deviation away from the average child, globally. The average child during El Niño years weighs in at 1.22 units lower than the global average. The WHO categorizes those children who are 2 standard deviations below the norm as severely underweight, which is a known risk for child mortality and other illnesses. A significant portion—an average of 20.4 percent of children in each country in the data—weigh in at or below that 2-unit threshold. A 1° Celsius increase in tropical Pacific temperature leads to a 2.9 percent increase in the number of children in this dangerous category. The same dynamic is shown for other outcomes reflecting nutrition, including weight-for-height and body mass index (BMI). The dataset used in the paper represents approximately 311 million children under the age of five. This means that even small effects represent changes to millions of children.

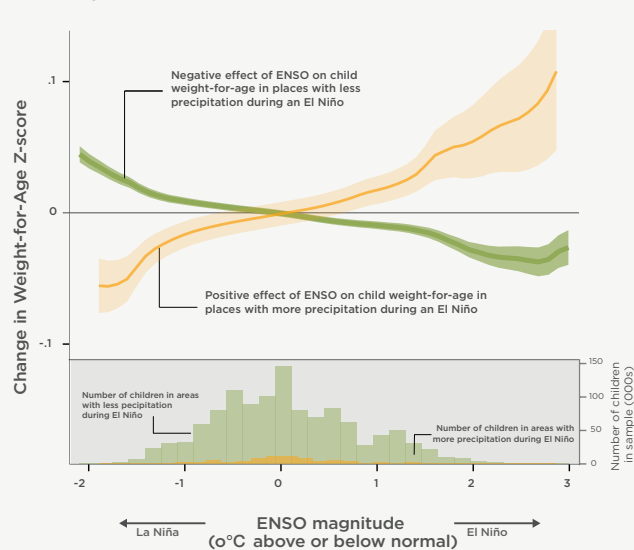
Figure 3 • Distribution of Weight-for-Age Z Scores (WAZ) During Years Classified as El Niño and La Niña



During the 2015 El Niño, 5.9 million children dropped into the most severe and dangerous category of undernutrition. During the 2015 El Niño, one of the most severe on record, the number of children at or below the WHO threshold jumped by nearly 6 percent from the norm in the region—corresponding to an additional 5.9 million children being driven into underweight status. To put that into context, the 2015 El Niño had an impact on child wasting at least 70 percent as large as the impact of the Covid-19 pandemic, and perhaps even three times greater impact than Covid-19⁴. This is especially striking because, in contrast to the 1-in-100 year pandemic, an El Niño occurs once about every 4 years, and it is possible to predict.

The impacts of El Niño are reversed in areas that experience high precipitation during the El Niño, suggesting a link to the role of El Niño on agriculture. El Niño is generally characterized by drier conditions (green shading), leading to a decrease in weight as an El Niño's temperature increases (green line). However, a small portion of the sample, 6.4 percent (orange shading), experienced wetter conditions. In those locations that experienced more rain (orange line), the children's weight increased. The role of precipitation may indicate the importance of agriculture in mediating the impacts of El Niño on nutrition.

Figure 4 • Association of ENSO and Child Nutrition Differs in Areas with More or Less Precipitation During El Niño

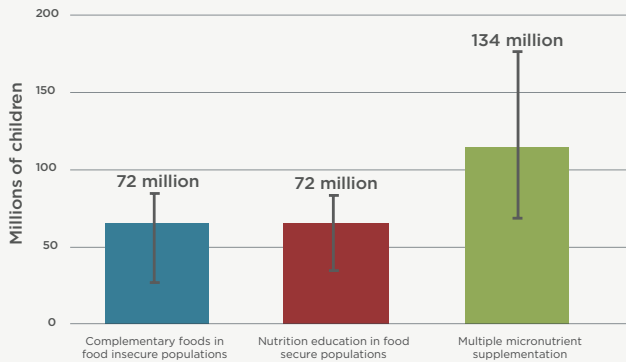


While a child's weight improves after El Niño passes, the height of younger children is reduced and they are shown to be stunted years later, indicating the persistent impacts of El Niño. El Niño has no persistent effect on a child's weight-for-age. So while being severely underweight is a risk to health and a major risk factor in child mortality, weight can recover once nutrition returns to adequate levels. However, the same children who were underweight at a young age saw their overall height stunted years after the negative shocks from El Niño, consistent with height being slower to respond to health shocks than weight and with the first 2 years of life being the riskiest period for interruptions to growth.

⁴ FAO, IFAD, UNICEF, WFP and WHO. 2021. The State of Food Security and Nutrition in the World 2021. Transforming food systems for food security, improved nutrition and affordable healthy diets for all. Rome, FAO. <https://doi.org/10.4060/cb4474en>

Offsetting the impacts of the 2015 El Niño would require providing 134 million children with micronutrients supplements or 72 million with additional food. Public health programs help children who are underweight or malnourished in a variety of ways. Three of the most studied and effective are providing food insecure children with food, nutritional education, and providing micronutrient supplements. The study shows that to offset the effects of the 2015 El Niño would require that about 134 million children receive micronutrient supplements or 72 million receive complementary foods or nutritional education.

Figure 5 • Scale of 2015 El Niño effects in terms of Public Health Interventions



Policy Impacts

The international community has set the target of eliminating all forms of malnutrition worldwide by 2030 as part of the Sustainable Development Goals (SDG) agenda and is making efforts to establish metrics, monitor, and implement policies to achieve this goal. Developing countries deemed to be making insufficient progress are being pressured to do more. During 2015–2018, 34 percent of the children in the study's sample countries were underweight, implying that to decrease hunger enough to meet the international communities' goals the percentage of underweight children would have to decrease by 2.6 percentage points each year until 2030. The 2015 El Niño erased that progress by one year, and future El Niños will similarly set back progress on achieving these goals.

El Niño is a natural occurrence eroding the developing world's progress in reducing hunger. Given that El Niño's impact on childhood nutrition remains the same across decades, despite increasing incomes and trade connectivity, this may signal that it is difficult for countries to adapt on their own despite the predictability of the challenge. Governments and agencies already engaged in multi-year humanitarian planning and budgeting should incorporate El Niño into their planning to approach global hunger in a more proactive fashion.

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