

The Impact of High Temperatures on Child Anthropometric Outcomes Worldwide

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Introduction

Climate change



Rising temperatures



Changes in precipitation patterns



Rising sea levels



Ocean acidifications



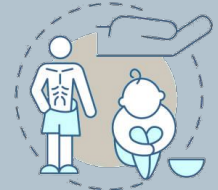
Shifts in the timing seasons

IMPACTS
ON



Food security
Care
Sanitation
Socioeconomic
conditions

IMPACTS
ON



Nutritional
health
impacts

Introduction



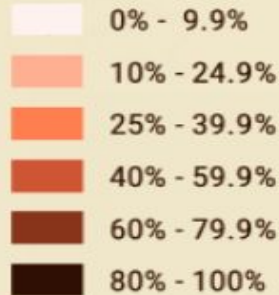
Food and Agriculture
Organization of the
United Nations

FAO FOOD INSECURITY MAP

Prevalence of Moderate or Severe Food Insecurity 2019-2021
SDG Indicator 2.1.2



Percent of the total population



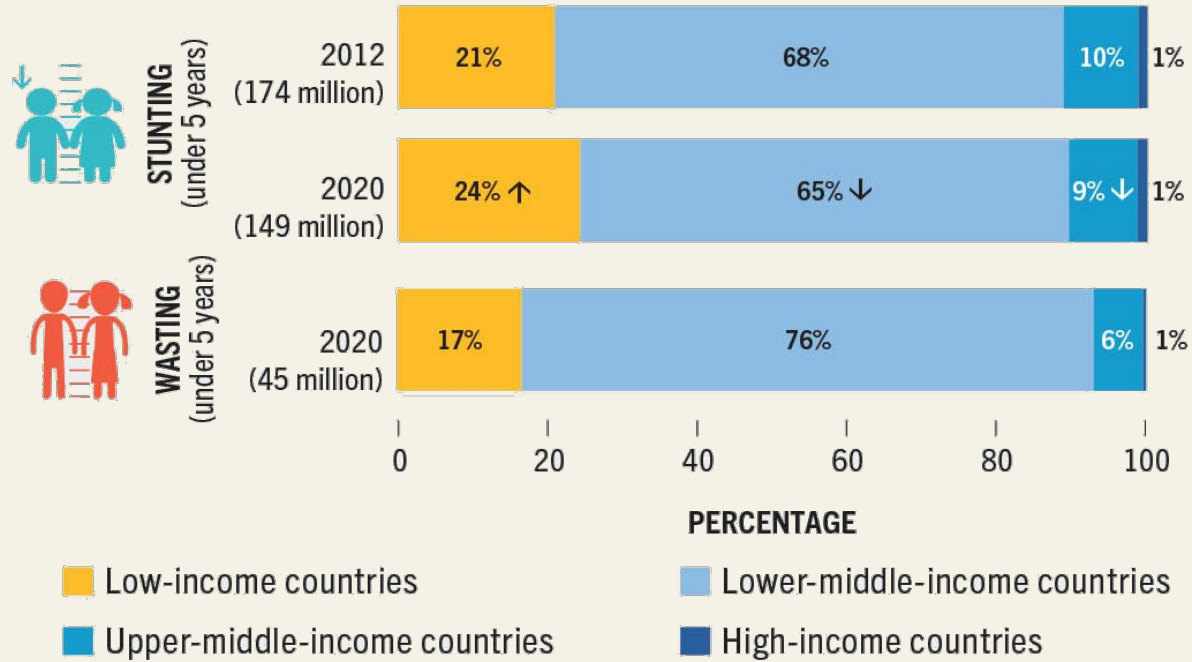
Data not available or not country validated

Source: FAO, IFAD, UNICEF, WFP and WHO, 2022. *The State of Food Security and Nutrition in the World 2022. Repurposing food and agricultural policies to make healthy diets more affordable*. Data are available on FAOSTAT (<https://www.fao.org/faostat/en/#data/FIS>).

The boundaries and names shown and the designations used on these maps do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers and boundaries. Dashed lines on maps represent approximate border lines for which there may not yet be full agreement.

Final boundary between the Republic of Sudan and the Republic of South Sudan has not yet been determined. Dotted line represents approximately the Line of Control in Jammu and Kashmir agreed upon by India and Pakistan. The final status of Jammu and Kashmir has not yet been agreed upon by the parties.

Introduction



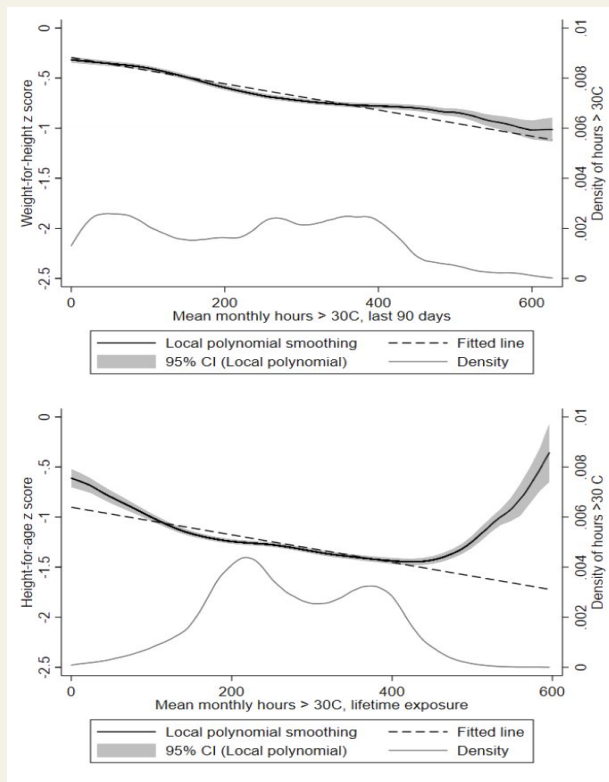
(FAO) The State of Food Security and Nutrition in the World 2022

Research question

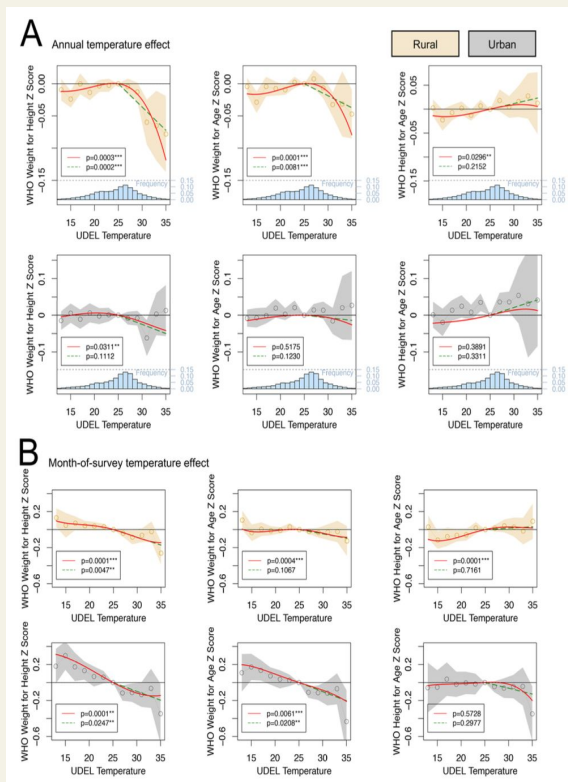
How do high temperatures impact the measurement outcomes of children aged 1 to 5 across different regions and continents worldwide?

Background

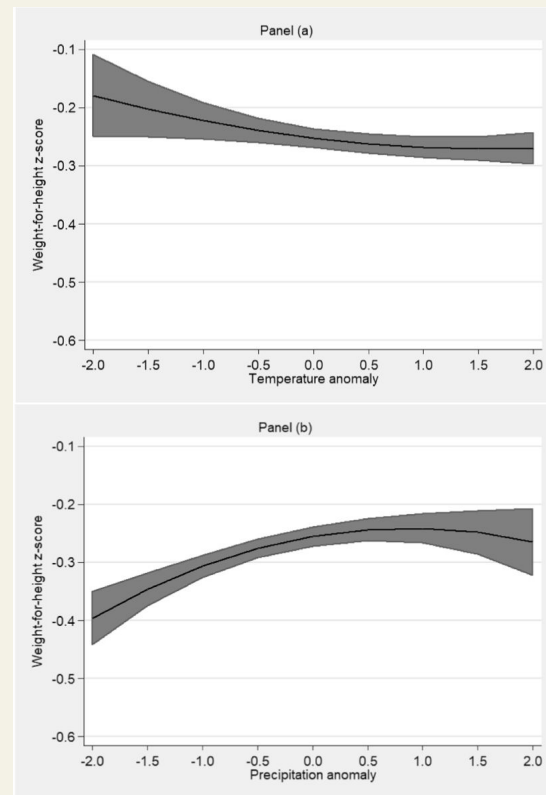
Blom et al(2019)



Baker and Anttila-Hughes (2020)



Thiede and Strube (2020)



Data Sources

DHS program Data

Child anthropometric data, household socioeconomic information, and type of residence, geo location (GPS).

University of Delaware's gridded station-based

This dataset consists of Terrestrial Air Temperature: Monthly Time Series from 1900 to 2018

World Bank Data Bank

Data on regions, income groups, and GDP per capita for each country

Methods

Standard fixed-effects ordinary least squares regressions model of temperature on child anthropometric outcomes.

$$A_{i,r,c,m,y} = \varphi T_{i,m} + \gamma X_i + \alpha M_i + \omega_{c,y} + \mu_m + \sigma_r + \epsilon_{i,r} (1)$$

$$A_{i,r,c,m,y} = \varphi T_{i,m} + \omega_{c,y} + \mu_m + \sigma_r + \epsilon_{i,r} (2)$$

A → Anthropometric measurements of child.

T → Temperature in the month of interview.

γ → Child controls such as age in months, rural residence, gender, birth order

α → Maternal controls such as age, marital status, the total number of children, and education level

Fixed effects

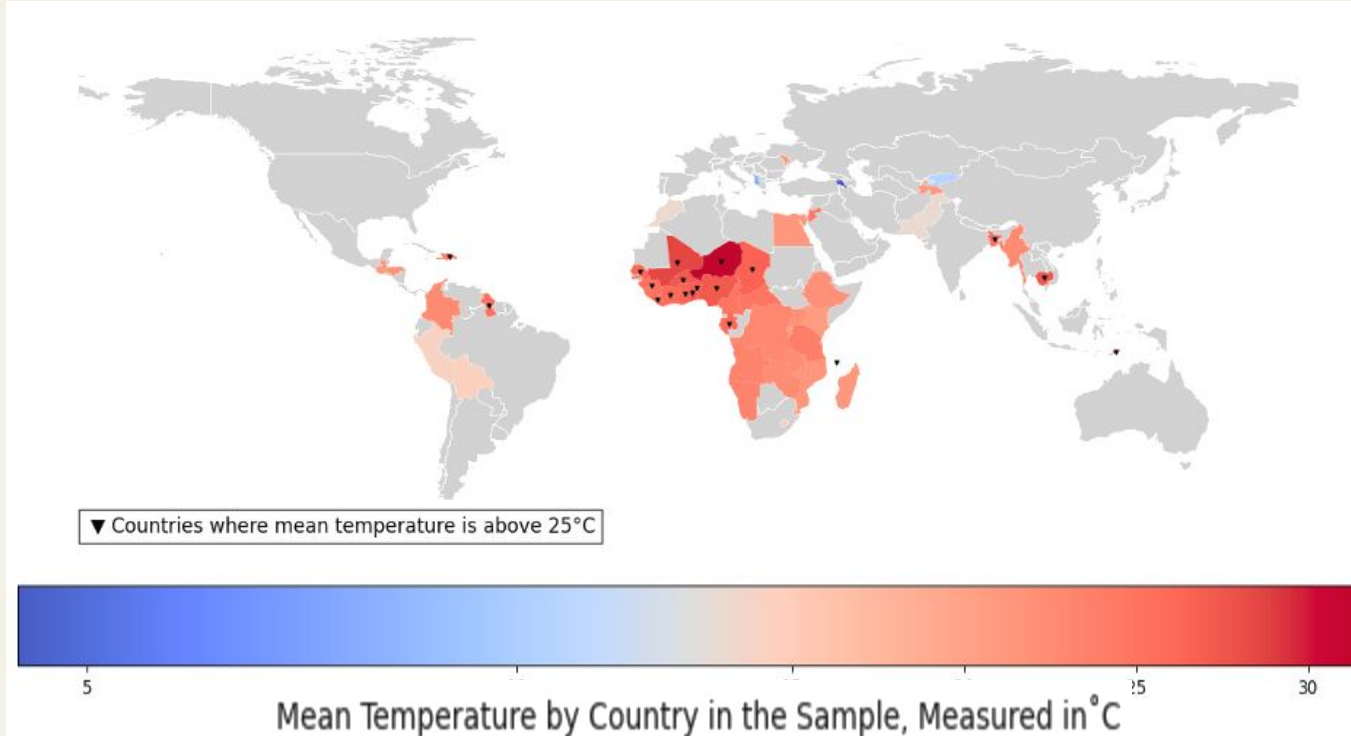
ω → Year of the interview

σ → Country indicator

μ → Month of the interview, for arbitrary seasonal effects

Results

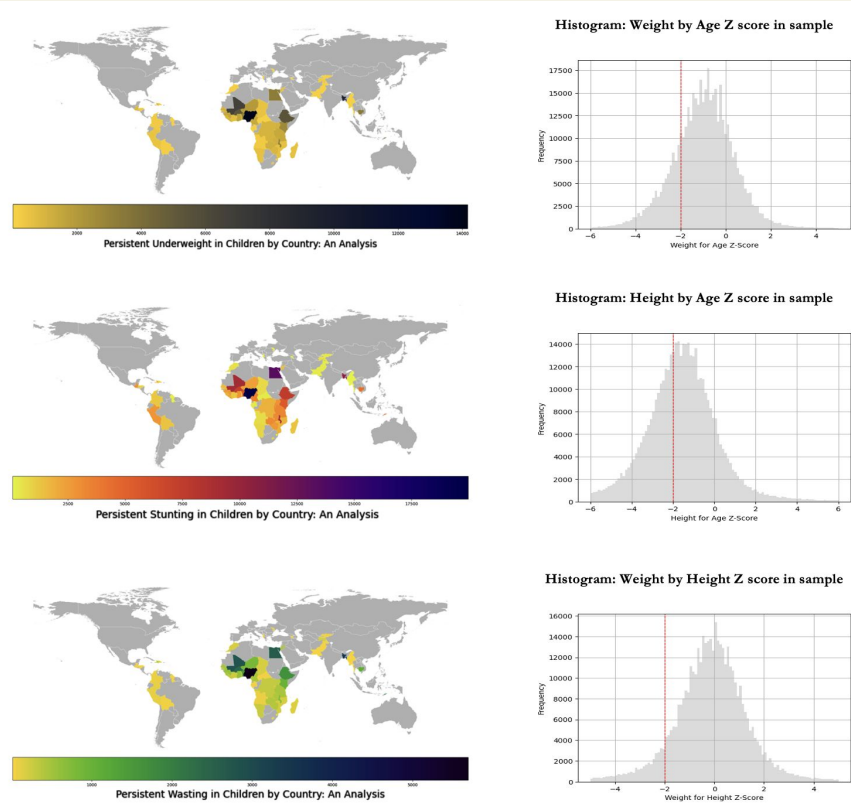
Summary Temperature



Countries	54 countries
Min temperature	-4.19 °C
Max temperature	31.48 °C

Results

Summary Anthropometrics



Underweight

21%

Stunting

38.3%

Wasting

8.3%

Results

Temperature Effects on anthropometric outcomes on children

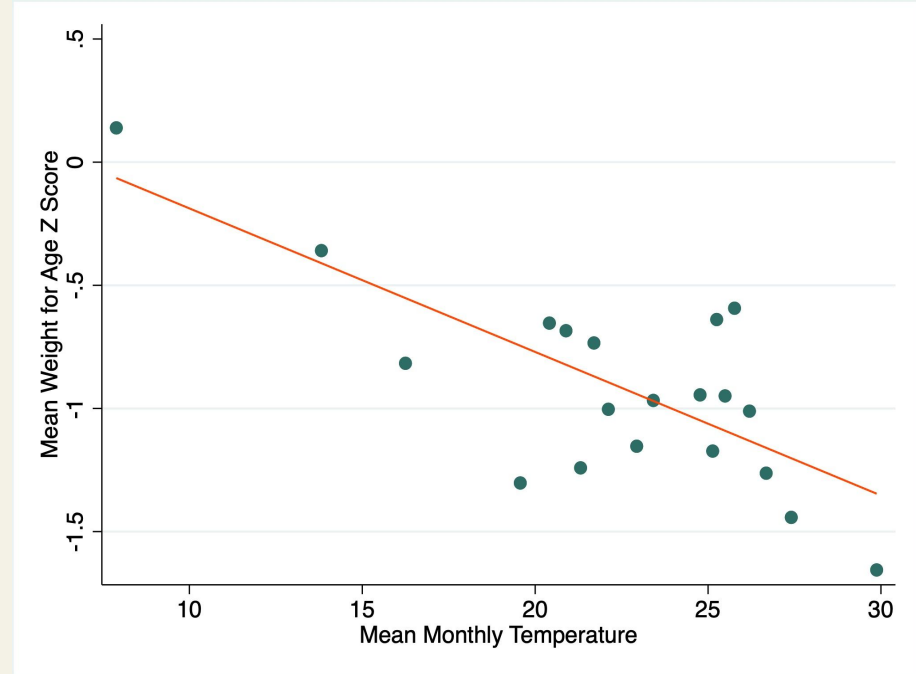
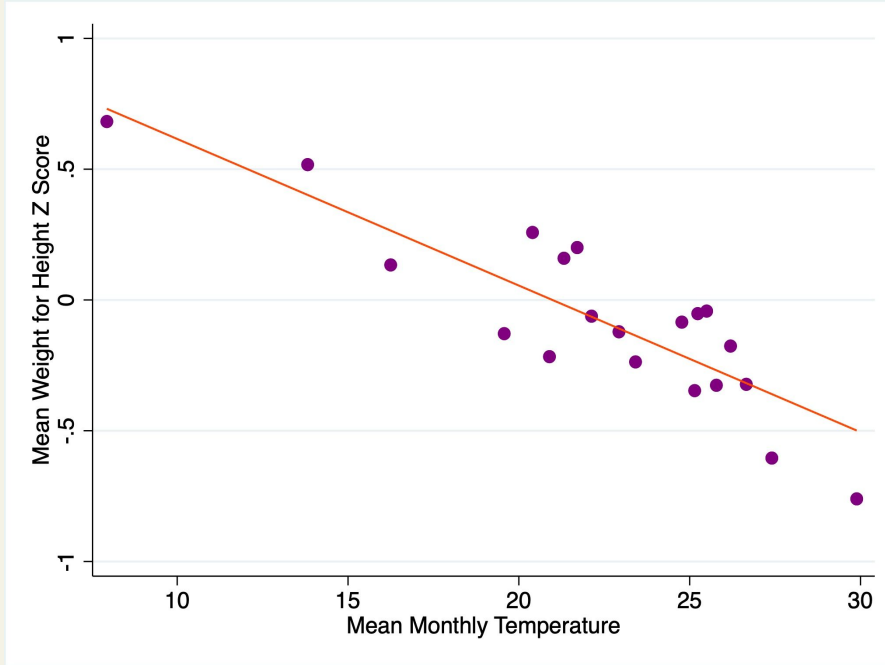
	1	2	3	4	5	6	7	8
VARIABLES	WAZ	WAZ	HAZ	HAZ	WHZ	WHZ	BMI	BMI
Monthly Temperature	-0.0500***	-0.0176***	-0.0185***	0.00377	-0.0525***	-0.0260***	-0.0497***	-0.0263***
	-0.00436	-0.00349	-0.005	-0.00389	-0.00323	-0.00288	-0.00313	-0.00284
Constant	0.197*	-0.551***	-1.102***	-1.617***	1.095***	0.481***	1.220***	0.680***
	-0.107	-0.079	-0.126	-0.0894	-0.0823	-0.0658	-0.0802	-0.0651
Observations	433,113	433,113	424,177	424,177	421,161	421,161	420,104	420,104
R-squared	0.039	0.167	0.004	0.093	0.041	0.109	0.036	0.09
Year FE	No	Yes	No	Yes	No	Yes	No	Yes
Month FE	No	Yes	No	Yes	No	Yes	No	Yes
Country FE	No	Yes	No	Yes	No	Yes	No	Yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Results

Average Monthly Temperature Effects on Anthropometric Outcomes, collapsed by country



Results

Temperature Effects on Anthropometric Outcomes in Children: Comparison of Models with child controls and Fixed Effects.

MODELS		9	10	11	12	13	14
VARIABLES		WAZ	WHZ	BMI	WAZ	WHZ	BMI
Child controls	Monthly Temperature	-0.0166*** (0.00310)	-0.0258*** (0.00281)	-0.0263*** (0.00282)	-0.0147*** (0.00281)	-0.0251*** (0.00269)	-0.0259*** (0.00275)
	Rural	-0.318*** (0.0171)	-0.0738*** (0.0147)	-0.0148 (0.0151)	-0.209*** (0.0152)	-0.0339** (0.0148)	0.00772 (0.0154)
	Age in months	-0.00345*** (0.000443)	0.00683*** (0.000649)	0.00366*** (0.000661)	-0.00591*** (0.000413)	0.00567*** (0.000669)	0.00298*** (0.000695)
	Male	-0.0625*** (0.00940)	-0.00852 (0.0107)	0.0587*** (0.0106)	-0.0635*** (0.00933)	-0.00847 (0.0106)	0.0589*** (0.0106)
	Birth order	-0.0206*** (0.00189)	-0.00576*** (0.00164)	-0.00140 (0.00166)	-0.112*** (0.0131)	-0.0597*** (0.0106)	-0.0369*** (0.00992)
	Mothers age				0.0179*** (0.00149)	0.00227 (0.00148)	-0.00129 (0.00143)
	Married				0.0438*** (0.0164)	0.00755 (0.0177)	0.00254 (0.0182)
	Total children				0.0669*** (0.0137)	0.0570*** (0.00960)	0.0439*** (0.00910)
	Education primary				0.180*** (0.0200)	0.0882*** (0.0158)	0.0588*** (0.0153)
	Education secondary				0.394*** (0.0249)	0.181*** (0.0185)	0.116*** (0.0184)
Maternal Controls	Education higher				0.616*** (0.0369)	0.284*** (0.0282)	0.197*** (0.0283)
	Constant	-0.135* (0.0725)	0.317*** (0.0704)	0.538*** (0.0710)	-0.884*** (0.0750)	0.112 (0.0727)	0.465*** (0.0754)
	Observations	433,113	421,161	420,104	433,110	421,158	420,101
	R-squared	0.181	0.114	0.092	0.195	0.116	0.093
	Year FE	Yes	Yes	Yes	Yes	Yes	Yes
		Month FE	Yes	Yes	Yes	Yes	Yes
		Adm. Region FE	Yes	Yes	Yes	Yes	Yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Results

Anthropometric Outcomes by Rural/Urban Status and Economic Status

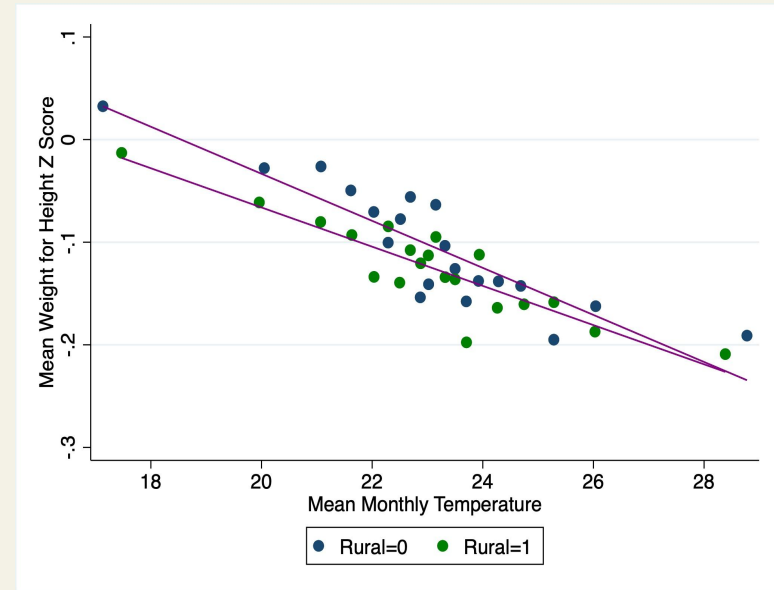
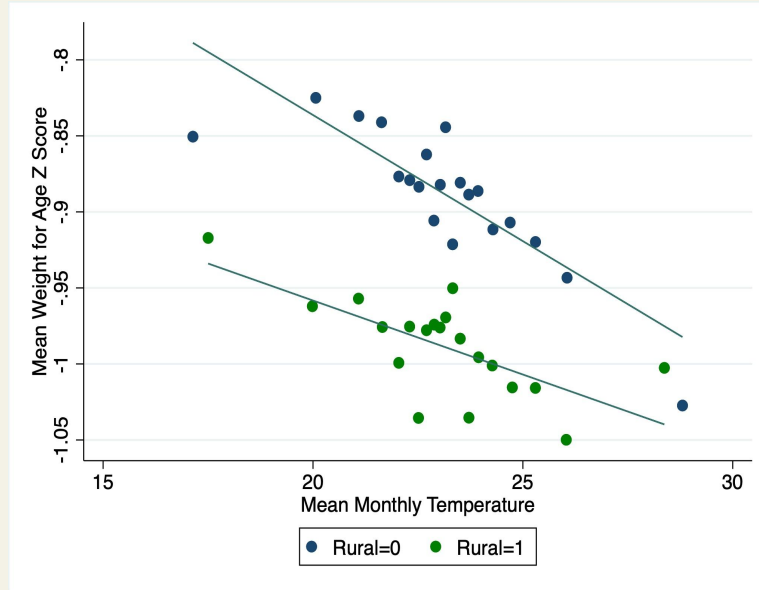
VARIABLES	15 WAZ	16 WHZ	17 WAZ	18 WHZ
Monthly Temperature	-0.0118*** (0.00349)	-0.0261*** (0.00330)	-0.0174*** (0.00338)	-0.0256*** (0.00285)
Rural	-0.171*** (0.0603)	-0.0880 (0.0696)		
Rural*Monthly Temperature	-0.00694*** (0.00256)	0.000500 (0.00280)		
Ln_GDP-PC			0.188*** (0.0573)	0.116** (0.0481)
Ln_GDP-PC*Monthly Temperature			0.000892 (0.00292)	-0.00188 (0.00232)
Observations	433,113	421,161	433,113	421,161
R-squared	0.178	0.110	0.167	0.109
Year FE	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes
Country FE	Yes	Yes	Yes	Yes

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

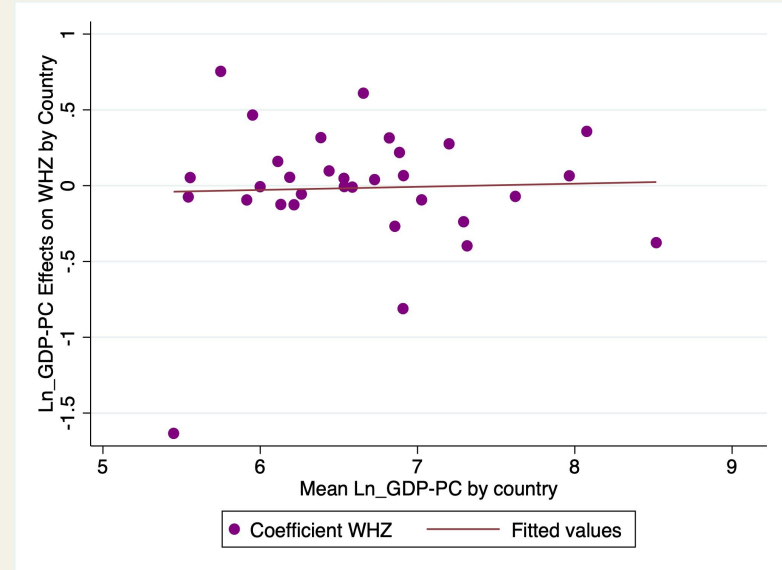
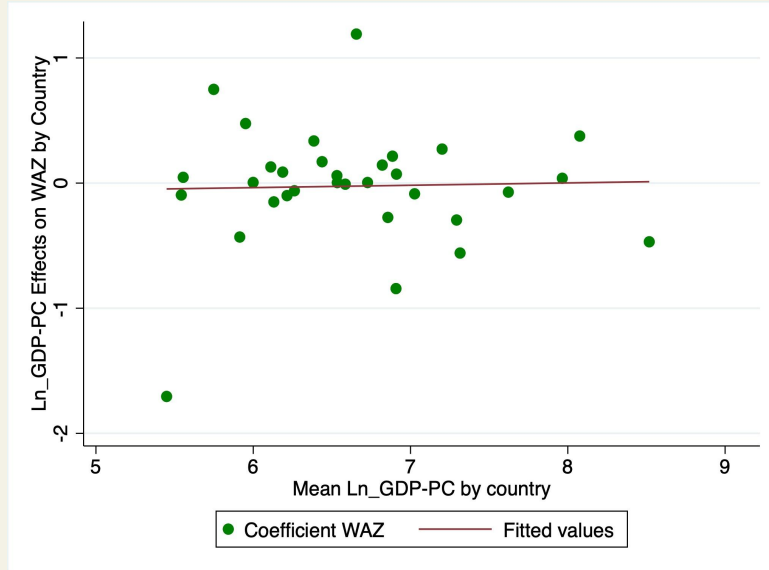
Results

Monthly Temperature and Anthropometric Outcomes for Rural and Urban Children: WAZ and WHZ Analysis



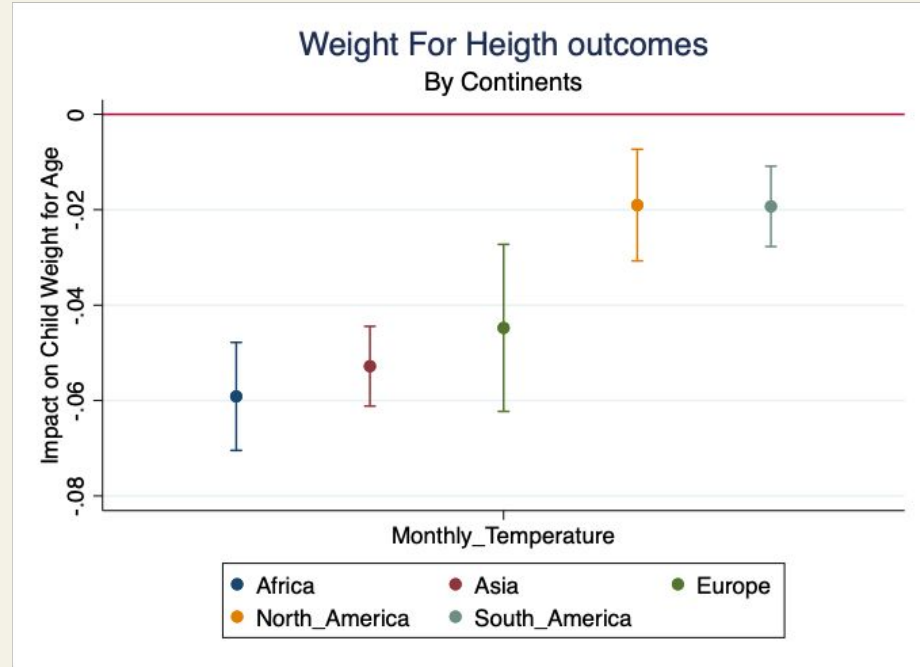
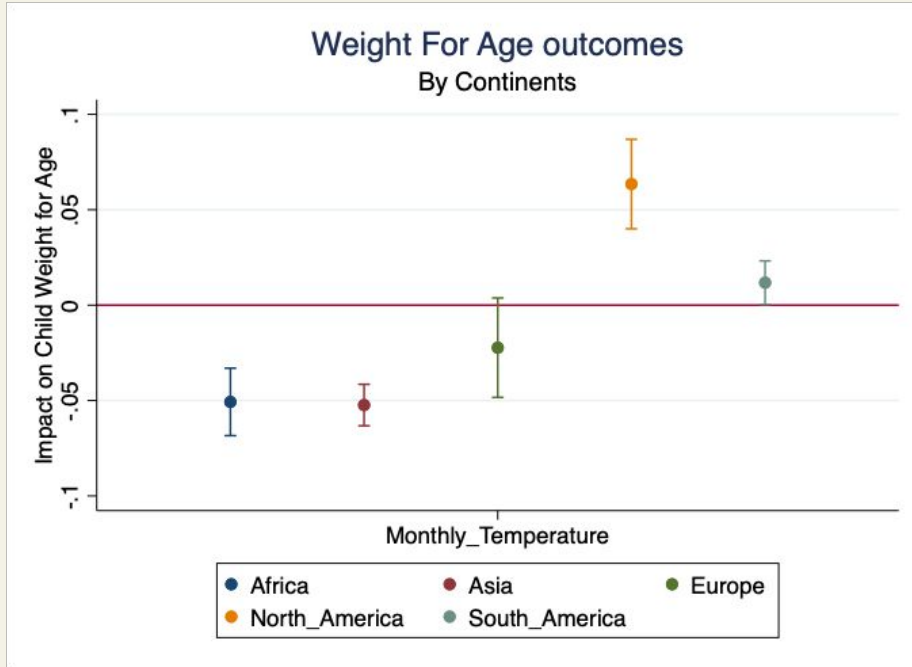
Results

Relationship between economic status and child undernutrition across countries



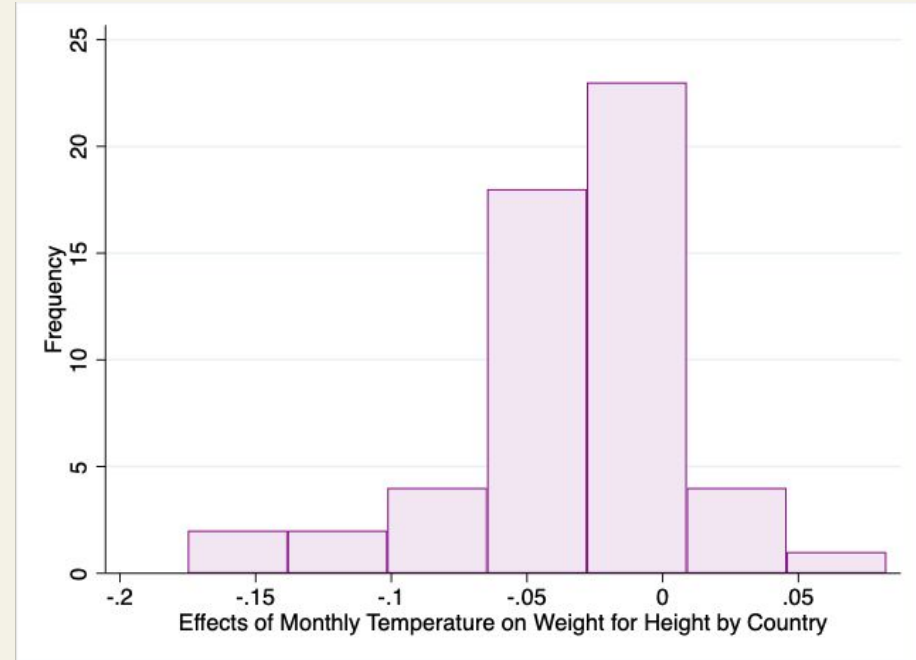
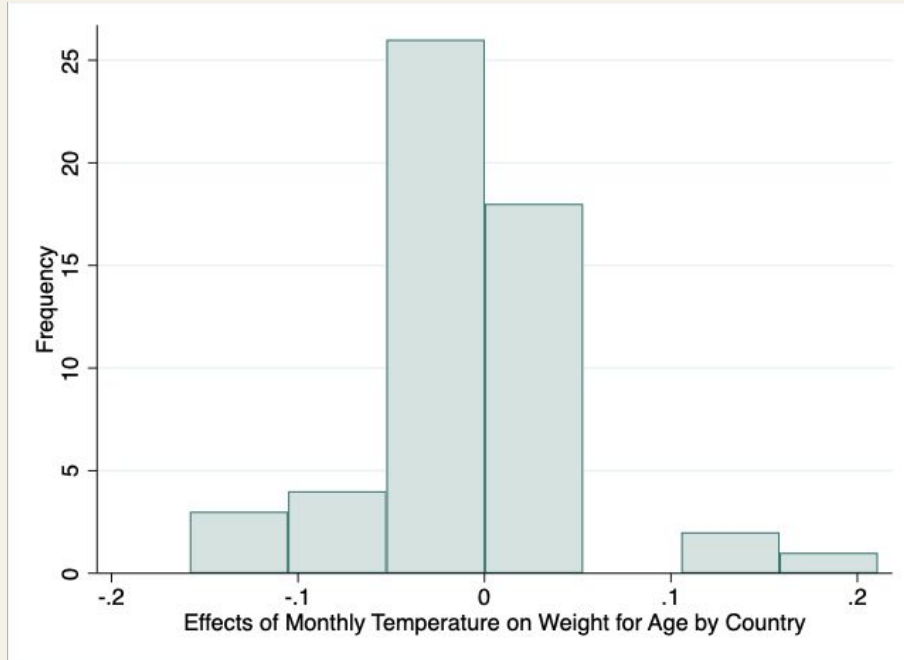
Results

Comparison of Impact of Monthly Temperature on Child Anthropometric Outcomes Across Continents.



Results

The Impact of Monthly Temperature on Child Anthropometric Outcomes: A Global View



Conclusions:

- High temperatures negatively affect children's weight-for-age and weight-for-height z scores.
- Fixed effects weakened the observed association, implying unobserved variables can influence the relationship between monthly temperature and anthropometric outcomes.
- Temperatures above 20°C significantly impact child growth and development in many countries.
- Rural children have lower weight-for-age and weight-for-height z scores than urban children.
- Economic status may not be a significant factor in explaining variation in child undernutrition across countries.
- Our analysis reveals a consistent negative association between temperature increase and child anthropometric outcomes across most countries in our sample.
- Future research should explore cross-regional variables, such as local sanitation, healthcare, and climate factors, to better understand the factors affecting anthropometric outcomes.

Thanks!

Do you have any questions?