The Earliest Inequality: Food Inflation, Family Structure, and Child Survival in the Brazilian Semiarid

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UFV

About me

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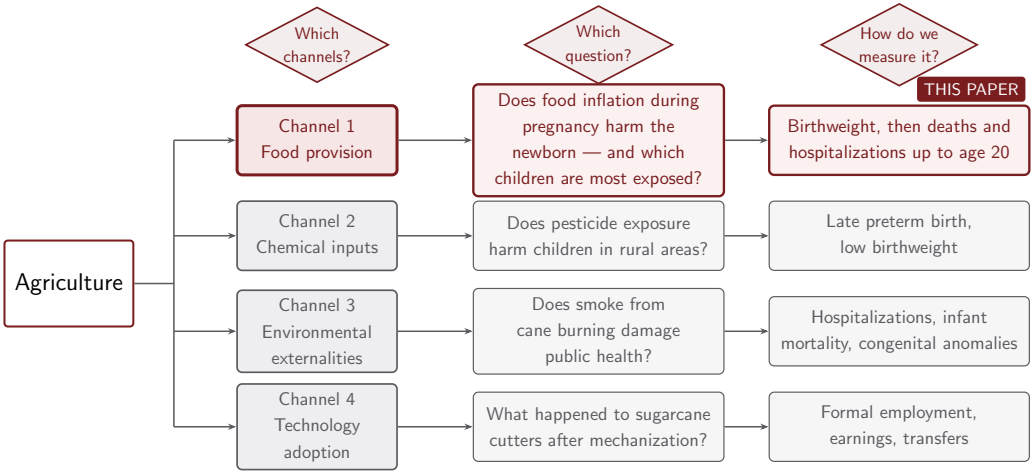
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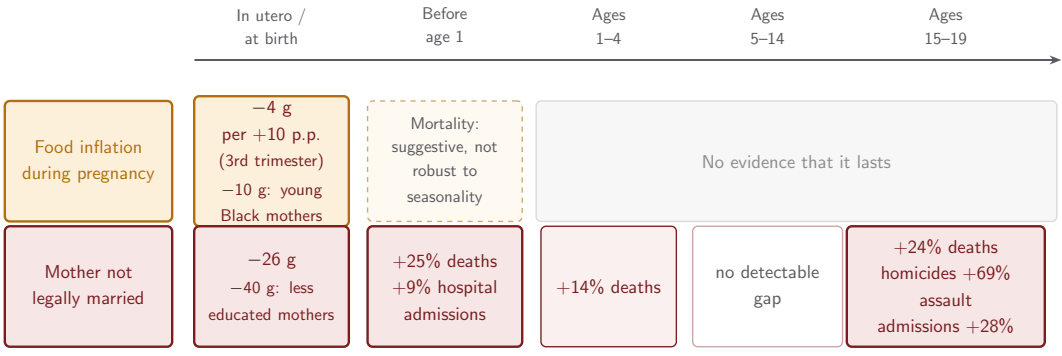
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These slides and my other papers

How does agriculture affect health?

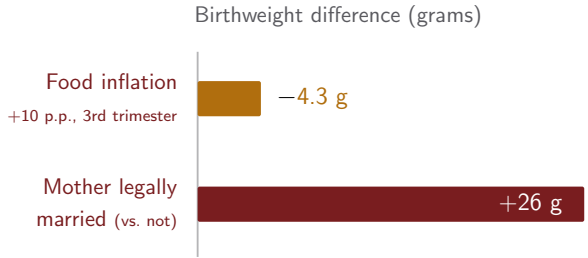


Two disadvantages before birth



Semiarid births 2000–2023 linked to death (SIM) and hospital (SIH) records. Percent gaps relative to children of legally married mothers.

How this paper evolved (an honest account)



−0.43 g per p.p. of 3rd-trimester food inflation (Table 2); legally married: +26.5 g (Table 3).

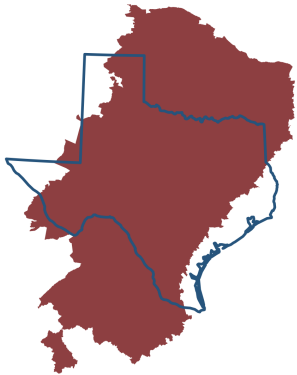
- We started with a food-price question: does food inflation during pregnancy lower birthweight in a poor region?
- Yes — but the effect is small
- Single motherhood seems to matter more. So we followed the children — to age 20

The Brazilian Semiarid

Where is the Semiarid — and how big is it?



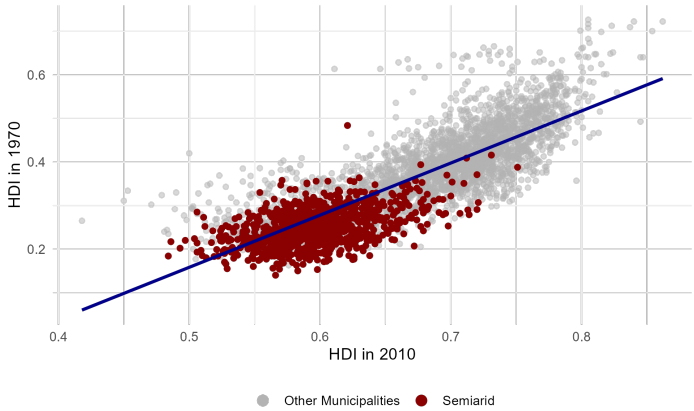
Semiarid municipalities (2017 delimitation)



Semiarid — Texas, same scale

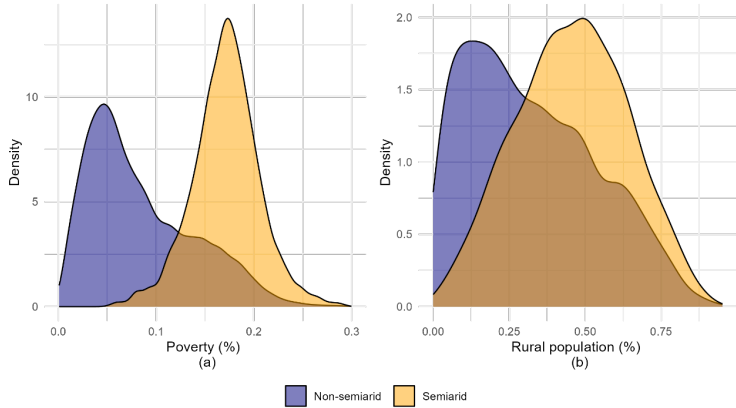
- 1,262 municipalities in 10 states
- $\approx$1.1 million km^2: about 1.6 times Texas
- $\approx$27 million people, 13% of Brazil
- Rain concentrated in 3–4 months; recurrent droughts

Poor, even by Brazilian standards



Municipal HDI, 1970 vs. 2010. Source: IBGE (2011).

More poverty, more rural



(a) Bolsa Família adults / population, 2013–2021; (b) rural households, Census 2010.

A natural place to look for food-price shocks

What We Did

Data: all births, and the births we can follow

	All births	Unique keys
Births	>8 million	≈2.6 million
Cohorts	2000–2023	2000–2014
Outcomes	birthweight	deaths, hospitalizations
Comparison, births 2000–2014:		
Mother not legally married	61.1%	61.4%
Mean birthweight	3,232 g	3,255 g
Mother's age	24.7	24.6
Born in small municipalities	67%	94%

Unique keys: 41% of 2000–2014 births; 79% in municipalities with <250 births/year.

- The unique-key sample looks like the population, except that it is concentrated in small, poorer municipalities
- Food inflation: IPCA *food at home*, Fortaleza, Recife or Salvador (nearest metro area), cumulative by trimester of pregnancy

Empirical strategy

Birthweight

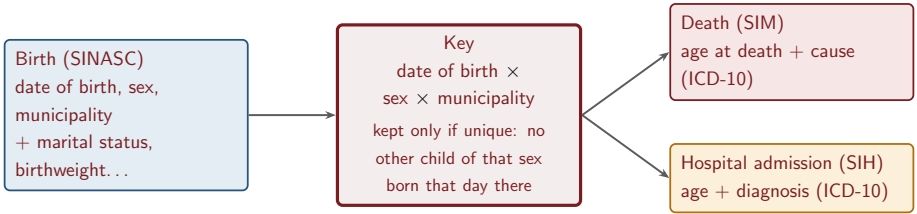
$$BW_{ict} = \sum_{k=1}^{3} \beta_k \, FI_{ct}^{k} + \gamma \, Fam_i + X_i'\delta + \mu_c + \tau_t + \varepsilon_{ict}$$

Survival and hospitalizations (linked records)

$$\mathbb{1}\{\text{death / admission at age } a\}_{ict} = \theta \, NotMarried_i + \sum_k \beta_k FI_{ct}^{k} + \text{FE} + \varepsilon_{ict}$$

- FI_{ct}^{k}: food inflation in trimester k; Fam_i: two-parent or legally married; μ_c, τ_t: municipality and year FE; X_i: sex, mother's age, race, schooling
- FI: plausibly exogenous to the household. Fam_i: not — we read γ and θ as associations

Following children without names: unique keys



- Public health microdata carry no names or IDs
- 41% of 2000–2014 births have a unique key; 79% in municipalities with <250 births/year

Individual linkage of Brazilian registries is a frontier tool (Britto et al., 2022, 2026), but it relies on names or IDs in restricted data. We follow children for two decades using only public records.

How good is the linkage?

Ghost keys: shift the date of birth to a day when no child of that sex was born in that municipality. Anything they find is a false link.

Probability that a link is wrong

5–7%

deaths, cohorts 2011 onward (16–18% in 2000–03)
hospital admissions: about 8%

Share of children's deaths we capture

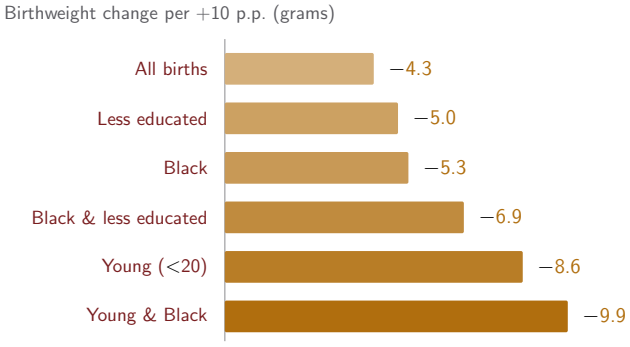
75–84%

infant deaths, cohorts 2011 onward (50–53% in 2000–03)
misses: children who moved municipality

Both rates are the same for children of married and not married mothers $\Rightarrow$ the gaps we report are lower bounds.

Food Inflation

Food inflation in the 3rd trimester lowers birthweight



3rd-trimester coefficient × 10; all significant at 1%. Mean birthweight 3,220 g.

- Only the 3rd trimester matters — when the fetus gains ∼70% of its weight
- Placebo: inflation in the 6 months after birth does not predict birthweight
- Larger for young, Black, less educated mothers
- A 7 p.p. shock (top 5% of the sample): ≈6 g for young mothers

Does it last? We cannot say it does

Fixed effects	Death before 1 per 1,000	Birthweight grams
Year	1.16 (0.38)	−4.3
Year + season	0.58 (0.31)	−3.8
Season + local climate	0.44 (0.29)	−3.4
Year + month	0.41 (0.33)	−3.9

Per +10 p.p. of 3rd-trimester food inflation. Mean: 15.9 deaths per 1,000; 3,222 g. Climate: NASA POWER, monthly, municipality.

- Infant mortality is seasonal, and so are food prices (they fall at the mid-year harvest)
- Season alone cuts the mortality coefficient in half; climate takes it to the month-FE level
- Birthweight barely moves across specifications

Food inflation leaves a mark at birth. The mortality association is only suggestive: we cannot separate it from other seasonal risks.

Single Motherhood

At birth: the marriage gap is largest where resources are scarcest

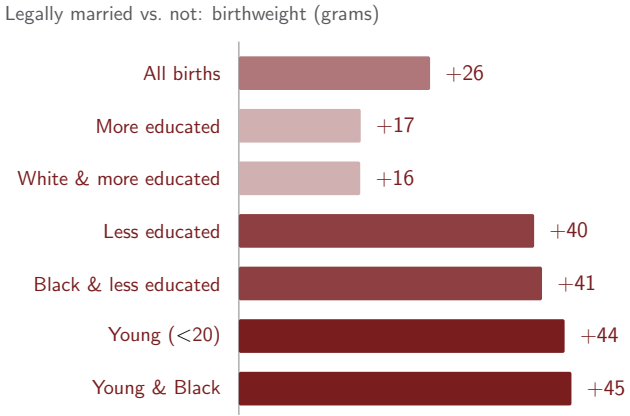
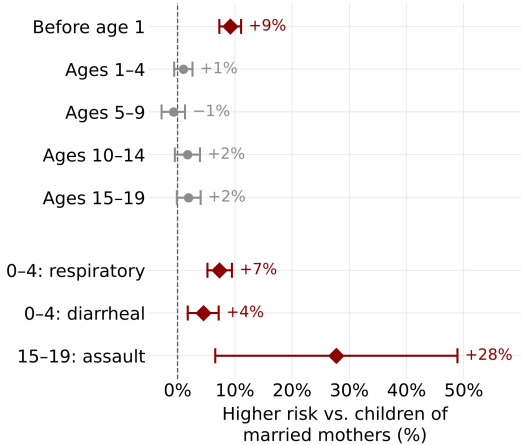


Table 3; all significant at 1%. Two-parent (incl. consensual unions): +19 g.

- Comparable to cash transfers in Uruguay (+23–30 g) and cisterns in the Semiarid (+46 g)
- About 5–8 times the effect of a +10 p.p. food-inflation shock in the same group
- Question: does this gap fade after birth?

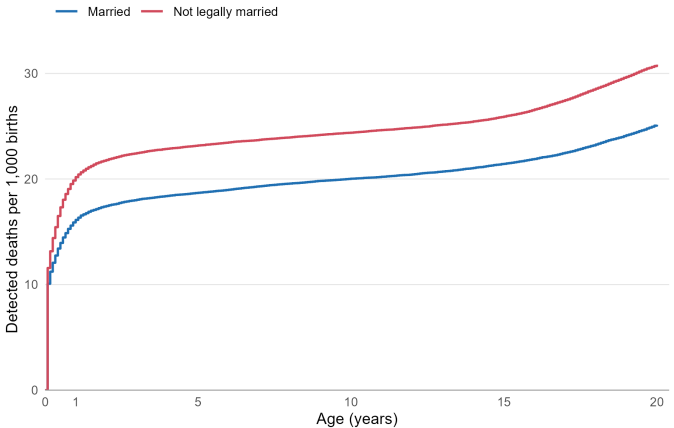
Hospitalizations: a first-year gap, and assault in adolescence



SUS admissions, excl. childbirth. 95% CIs, clustered by municipality.

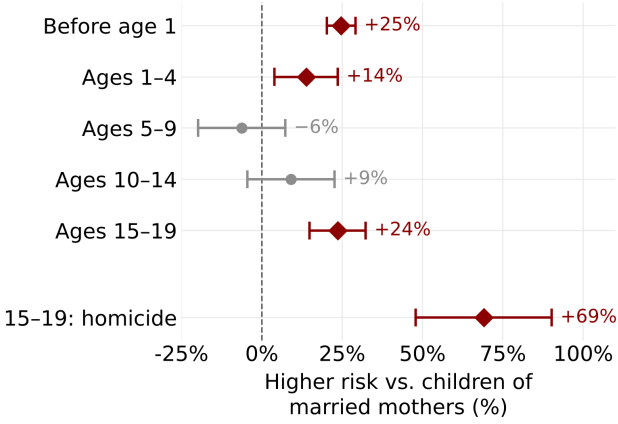
- Before 1: +9.5 per 1,000 births, mostly respiratory (+4.8) and diarrheal (+1.6)
- After 1: no all-cause gap
- Ages 15–19: assault admissions +0.18 per 1,000 (a lower bound)
- Not private insurance: same gap among low-schooling mothers, who rely on SUS (+9.1 per 1,000)

Deaths: cohorts 2000–2004 to age 20, the curves never meet



- 740,180 births with unique keys
- By age 20: 31 vs. 25 detected deaths per 1,000
- Curves split in the first year, run parallel, and diverge again after 15

The gap fades in childhood and returns as homicide



Cohorts 2000–2004. 95% CIs, clustered by municipality.

- Before 1: +3.97 deaths per 1,000 births
- Ages 5–14: no detectable gap
- Ages 15–19: +0.86 per 1,000
- Homicides: +0.66 per 1,000; among boys +1.23 (+73%)

Which deaths? Preventable ones — not congenital anomalies

Death before 10, by cause	Gap/1,000	% mean
Perinatal conditions	1.38	15
Ill-defined causes	0.63	34
Infectious & diarrheal	0.50	28
Respiratory	0.21	15
Malnutrition	0.18	42
External causes	0.18	19
Congenital anomalies	0.07	3

Cohorts 2000–2014; gaps add up to 3.24 per 1,000.

- The gap sits in causes tied to living conditions and care
- Congenital anomalies — least related to the household — show no gap
- Larger in levels for less educated mothers (3.17 vs. 2.49), but 18–19% of the mean in both groups

Takeaway

- Food inflation during the 3rd trimester lowers birthweight, most among young, Black, less educated mothers — a short-run disadvantage
- Single motherhood is associated with lower birthweight, higher infant mortality and hospitalizations, and, two decades later, more homicides — a disadvantage that lasts
- Method: unique keys plus ghost keys let us follow children for 20 years with public data and measure the linkage error
- Not an argument to promote marriage. The policy question is how to make single motherhood less costly: prenatal nutrition, income support, prenatal care

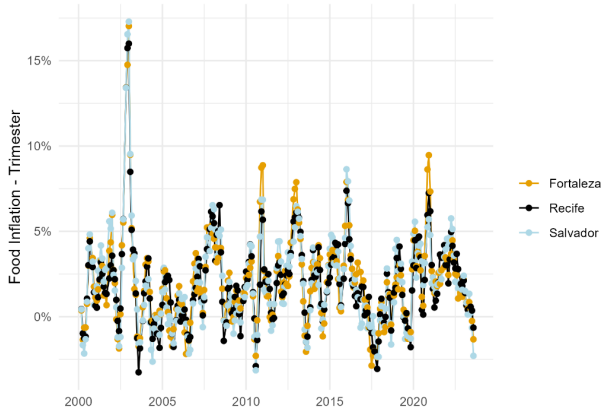
The disadvantage visible at birth is still visible, as violence, twenty years later.

Thank you! Questions?

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Backup

Backup: Food inflation in the three price zones



Trimester food-at-home inflation (IPCA), 2000–2023. Mean 1.9 p.p., s.d. 3.0 p.p.

Backup: Baseline birthweight results (Table 2)

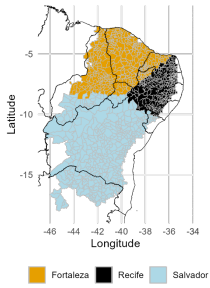
	All	Less ed.	More ed.	Black	Young	Young Bl.	Bl. less ed.	White more ed.	Interact.
Two parent	19.32***	26.91***	13.29***	19.80***	22.94***	22.72***	27.09***	10.13***	14.08***
FI (3rd)	−0.43***	−0.50***	−0.40***	−0.53***	−0.86***	−0.99***	−0.69***	−0.57**	−0.45***
FI (2nd)	0.08	−0.10	0.26*	0.05	0.04	0.05	−0.18	−0.01	0.06
FI (1st)	0.26***	0.06	0.50***	0.28**	0.59***	0.58**	0.02	0.36	0.27***
Two parent × low sch.									11.72***
Births (M)	8.54	4.07	4.47	6.78	1.87	1.50	3.22	1.18	8.66

Municipality and year FE; SEs clustered by municipality. 1st-trimester coefficient: food inflation is seasonal, so 1st- and 3rd-trimester windows fall in opposite phases of the price cycle; not read as protective.

Backup: Placebo with post-birth food inflation (Table 4)

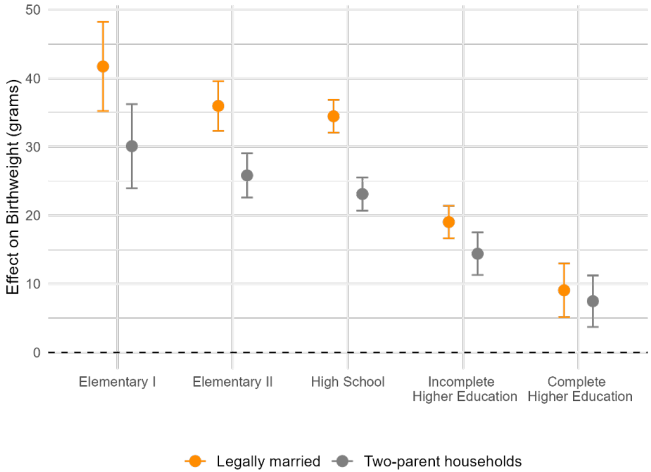
	(A) In utero	(B) Placebo	(C) Both
FI 3rd trimester	−0.434***		−0.485***
FI 2nd trimester	0.076		0.094
FI 1st trimester	0.263***		0.280***
FI months 1–3 after birth		0.080	−0.012
FI months 4–6 after birth		0.062	−0.193*
Births	8,543,090	8,671,085	8,543,090

Backup: Price zones



Each municipality gets the food inflation of the nearest metro area: Fortaleza, Recife or Salvador.

Backup: Family structure by maternal education



Orange: legally married; gray: two-parent household. 95% CIs. Labels: gap per 1,000 births.

Backup: Infant and child mortality (Table 6)

Detected deaths per 1,000	Before 1	Before 5	Before 10
Not legally married (vs. married)	2.97***	3.17***	3.24***
Single (vs. married)	2.97***		3.27***
No partner (vs. married or union)	2.26***		2.57***
Mean	15.9	18.3	19.4

Cohorts 2000–2014, 2,327,313 births. SEs clustered by municipality and birth year; wild cluster bootstrap $p < 0.001$. Infant gap by cohort: 4.29 (2000–03), 2.58 (2004–10), 1.98 (2011–14), 1.62 (2015–22).

Backup: Linkage validation by cohort and marital status (Table 5)

Cohorts	Mother	Links /1,000	Ghost links /1,000	Age & weight agree (%)	Capture
2000–2003	Married	27.8	5.1	70.9	49.
	Not married	35.3	5.5	72.4	53.
2004–2010	Married	20.5	2.4	79.6	63.
	Not married	23.8	2.4	80.5	65.
2011–2014	Married	15.4	1.1	85.9	74.
	Not married	18.3	1.2	85.6	76.
2015–2023	Married	12.8	0.7	87.8	82.
	Not married	15.3	0.7	89.4	83.

Links: births matched to exactly one SIM death record. Ghost links: date of birth shifted by ±7, ±28, ±364 days to keys with no recorded birth. Agreement: mother's age (±1 year) and birthweight (±100 g) on the infant death certificate vs. birth record; random pairs agree in 41%. Captured: share of infant deaths found by a key without municipality that the municipality key also finds.

References I

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