The Puzzle of High Child Malnutrition in South Asia

Seema Jayachandran

Northwestern University

Rohini Pande

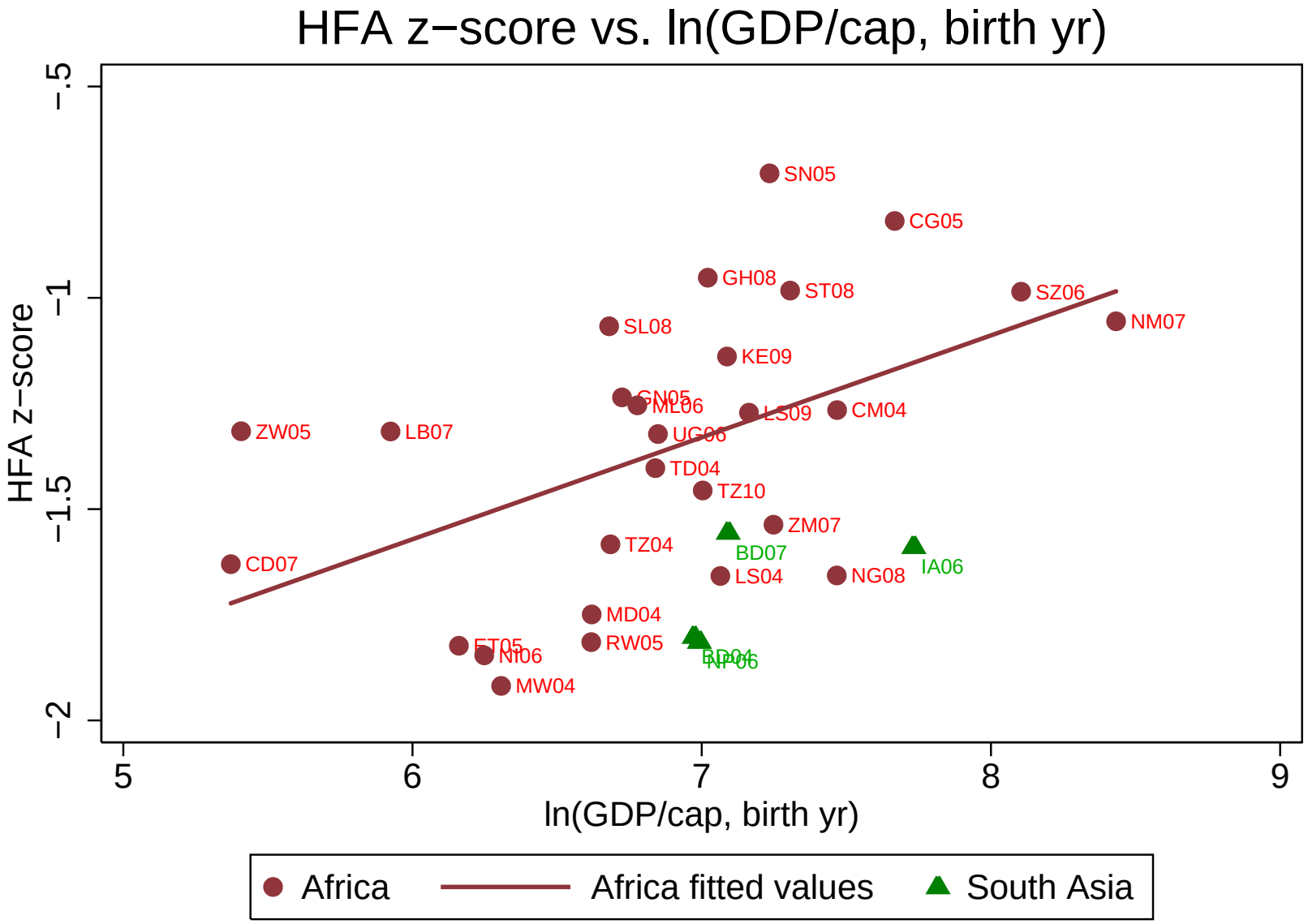
Harvard University

July 2012

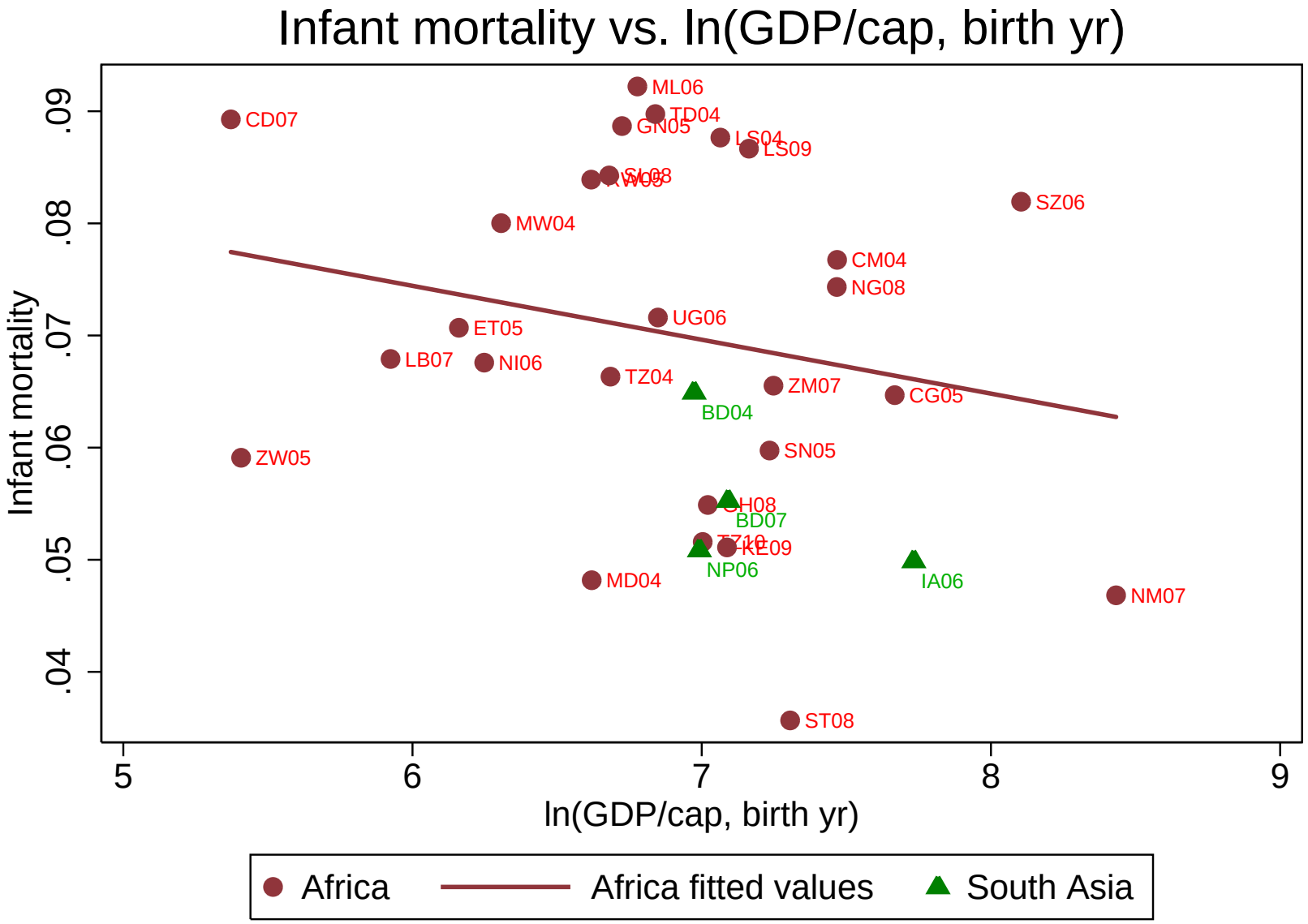
High rates of child malnutrition in South Asia

- Malnutrition is high for children in South Asia
  - Stunting
  - Wasting
- Higher than other countries at similar level of development
- High relative to other health indicators, e.g., infant mortality, in South Asia

South Asia as outlier: Child height vs. GDP



South Asia is positive outlier for child survival



Problem is high profile in national debates

- India's Prime Minister Manmohan Singh called child malnutrition "a national shame" in a speech earlier this year

- "In the years to come, these children will join our workforce as scientists, farmers, teachers, data operators, artisans and service providers. We cannot hope for a healthy future for our country with a large number of malnourished children."

Previous literature

- Ramalingaswamy et. al (1997) coined the term "South Asian enigma" for South Asia's high rate of child malnutrition
  - Birth weight, status of women, and hygiene/sanitation
- Panagariya (2011) argues that the high rates are an artifact
  - Even among better off in India, there is high malnutrition, so the reference population is wrong for South Asia
  - True rate of stunting in India is 2%
- Deaton (2007) speculates that part of explanation is selective mortality (only larger Africans survive)
- Tarozzi and Mahajan (2007) find that girls' anthropometric outcomes look better than boys' in India

Motivation for this paper

- Is the puzzle of high malnutrition in South Asia just a genetic difference?
- Do malnutrition rates vary with in ways consistent with cultural norms in South Asia?
  - Examine demographic patterns: gender and birth order
  - Patterns consistent with behavioral component

Our answers

- High malnutrition in South Asia is likely not just a genetic difference
- Demographic patterns suggest behavioral choices by parents
  - Patterns driven almost entirely by girls for height
  - Pattern driven entirely by higher-parity children
- Health inputs line up with the same demographic patterns

Data source

- Demographic and Health Surveys from 2004 to present with anthropometric data

- 27 Sub-Saharan African surveys
  - Cameroon 2004, Chad 2004, Democratic Republic of the Congo 2007, Ethiopia 2005, Ghana 2008, Guinea 2005, Kenya 2008-9, Lesotho 2004, Lesotho 2009, Liberia 2007, Madagascar 2003-4, Malawi 2004, Mali 2006, Namibia 2006-7, Nepal 2006, Niger 2006, Nigeria 2008, Republic of Congo 2005, Rwanda 2005, Sao Tome 2008, Senegal 2005, Sierra Leone 2008, Swaziland 2006-7, Tanzania 2004-5, Tanzania 2010, Uganda 2006, and Zambia 2007

- 4 South Asian surveys
  - Bangladesh 2004, Bangladesh 2007, India 2005-06, and Nepal 2006
  - No anthropometrics in Pakistan DHS, no access to Sri Lanka DHS

Child anthropometric outcomes

- Sample consists of children under age 5 for whom anthropometric data are available
- Height-for-age z-score
- Weight-for-height z-score
- Also use infant mortality as outcome

How z-scores are calculated

- Use WHO guidelines for reference median and standard deviation of height and weight by age and sex

- z-score is calculated as the deviation from the reference median divided by the reference standard deviation

- Similar results for weight in kg and height in cm; not driven by quirks of reference population

Measuring the South Asia gap

- Regression-adjusted South Asia gap in child outcomes

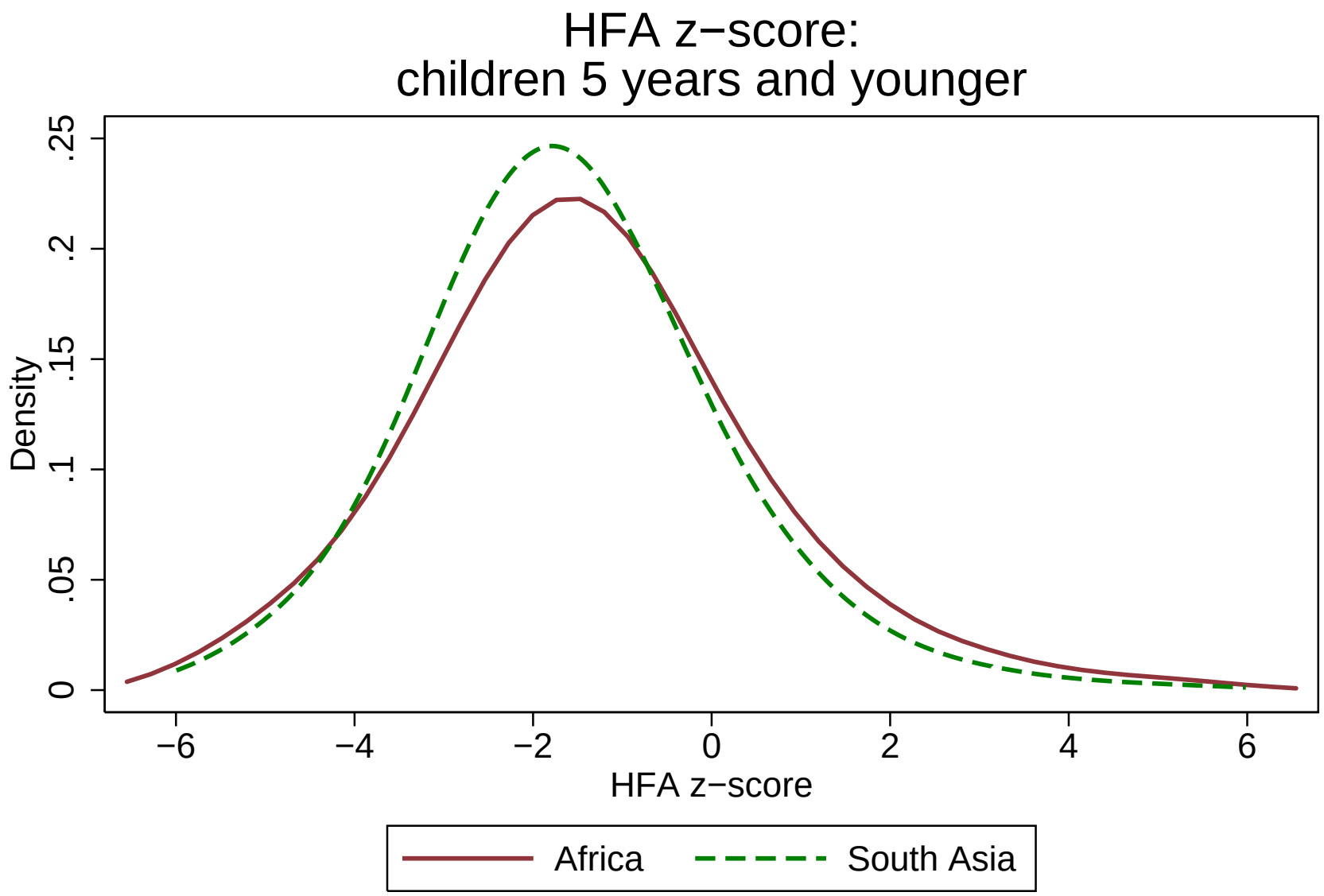
$$Outcome_i = \alpha + \beta SAsia_i + \gamma X_i + \varepsilon_i$$

- β is the difference between South Asia and Sub-Saharan Africa
- Vector of control variables X includes dummies for child's birth order, DHS survey type, survey year, and child age in months

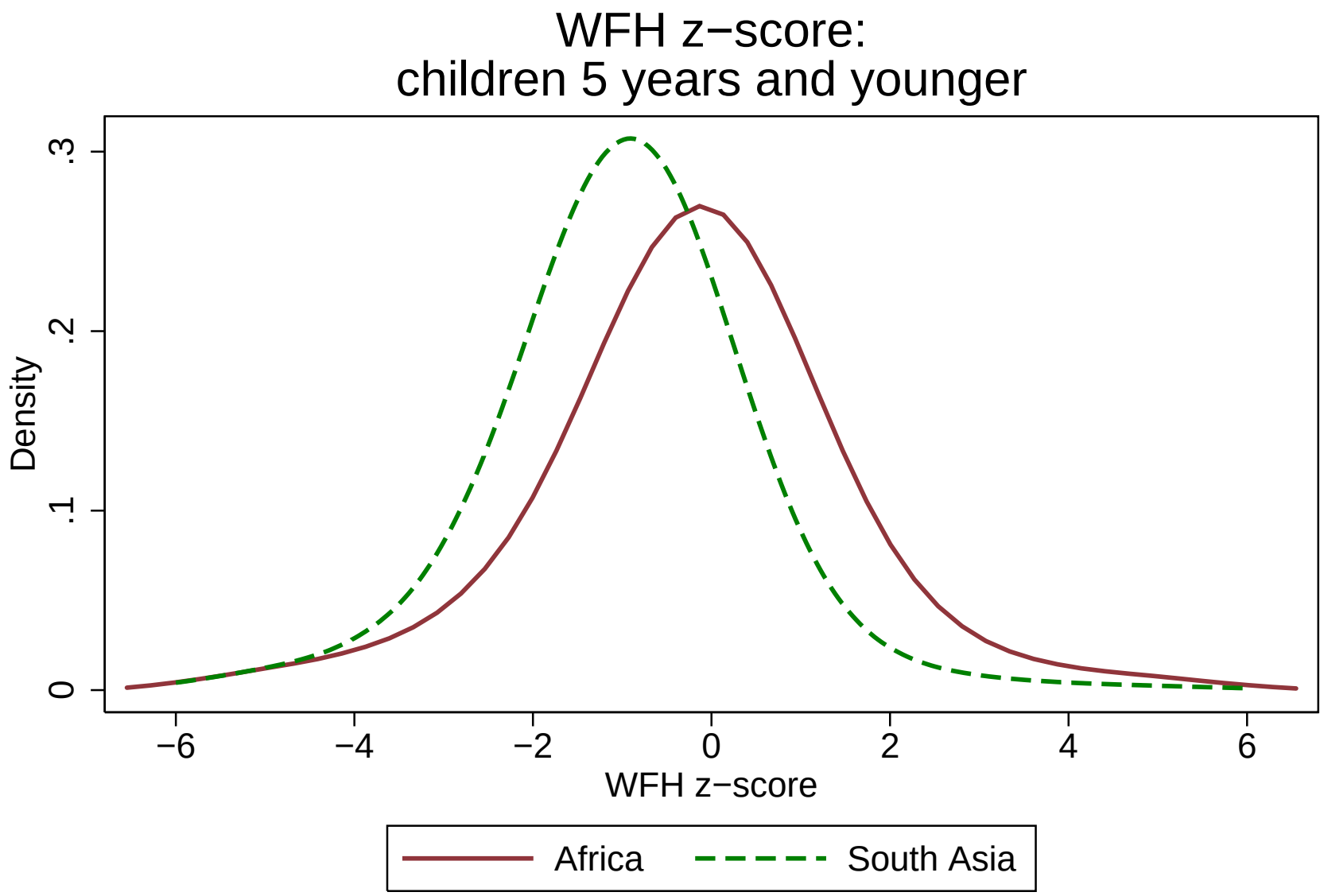
Summary statistics

	Africa mean	South Asia gap (raw)	South Asia gap (adj)
Weight (kg)	10.826	-0.528***	-0.855***
	[0.01]	[0.016]	[0.014]
Height (cm)	81.136	1.151***	-0.573***
	[0.035]	[0.062]	[0.043]
WFH z-score	-0.057	-0.896***	-0.756***
	[0.008]	[0.011]	[0.013]
Child wasting	0.124	0.076***	0.073***
	[0.001]	[0.002]	[0.003]
HFA z-score	-1.449	-0.178***	-0.185***
	[0.007]	[0.011]	[0.013]
Child stunted	0.392	0.031***	0.037***
	[0.001]	[0.003]	[0.003]
WFA z-score	-0.879	-0.698***	-0.635***
	[0.005]	[0.008]	[0.01]
Child underweight	0.206	0.16***	0.157***
	[0.001]	[0.002]	[0.003]

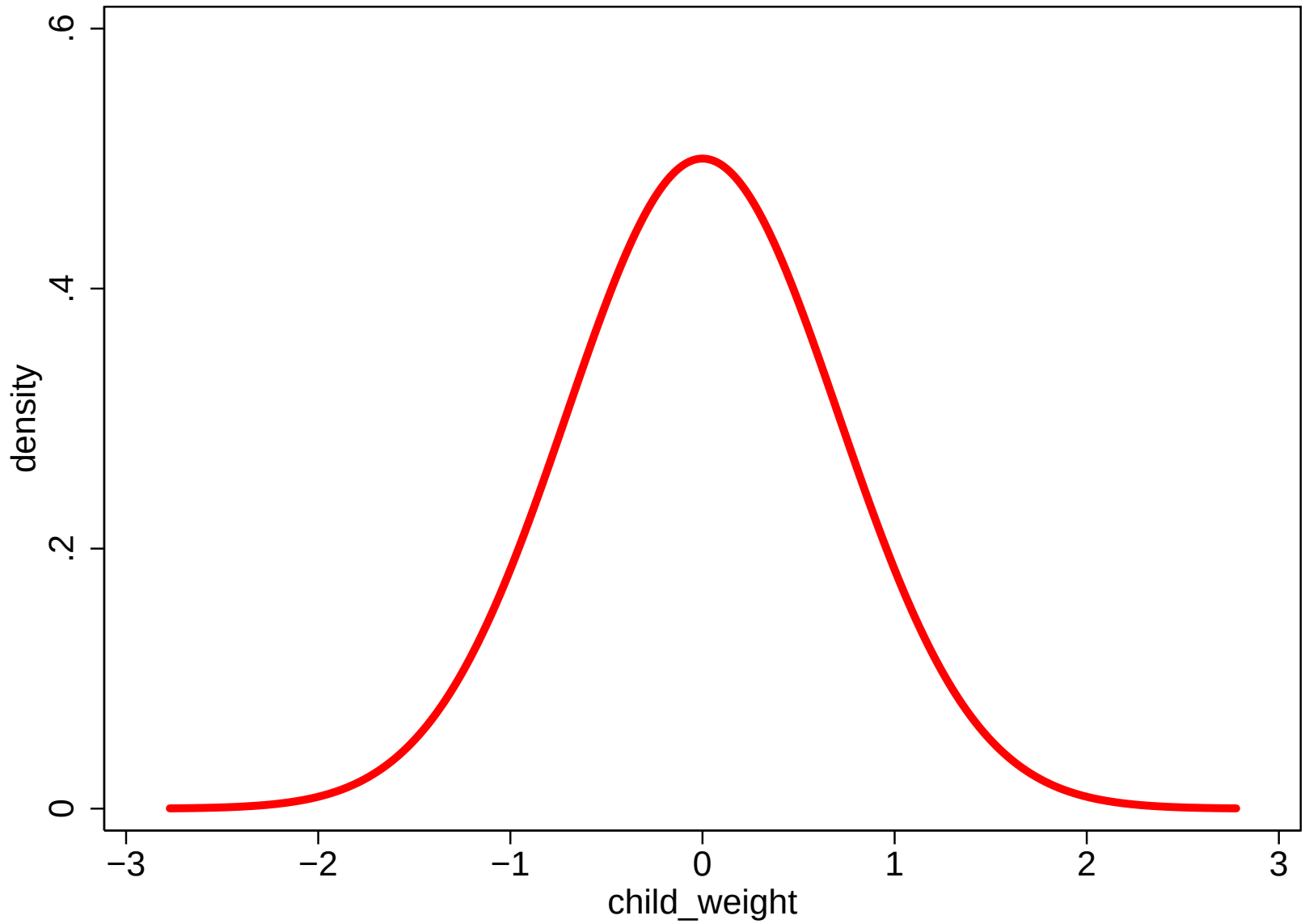
Distribution of height



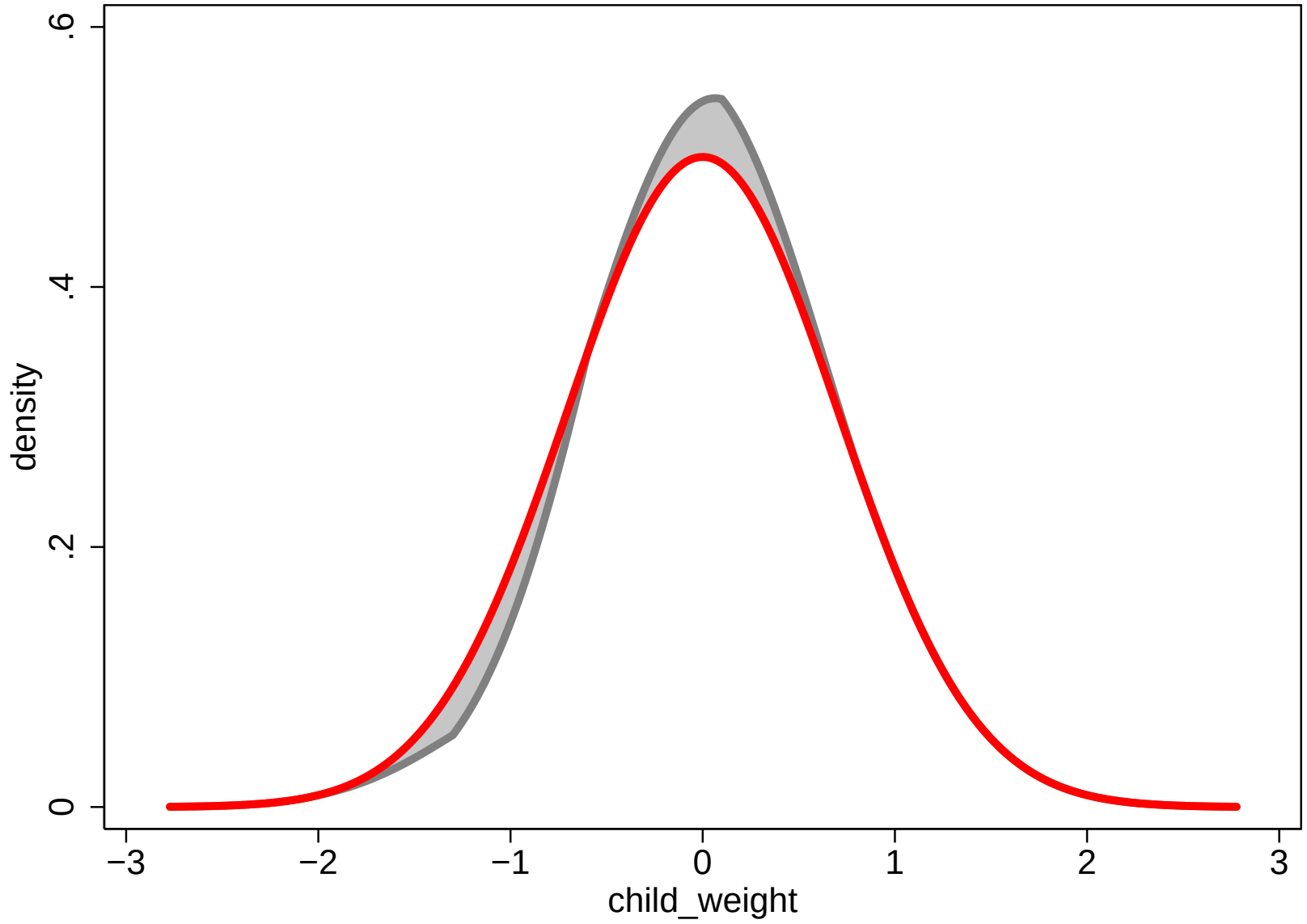
Distribution of weight



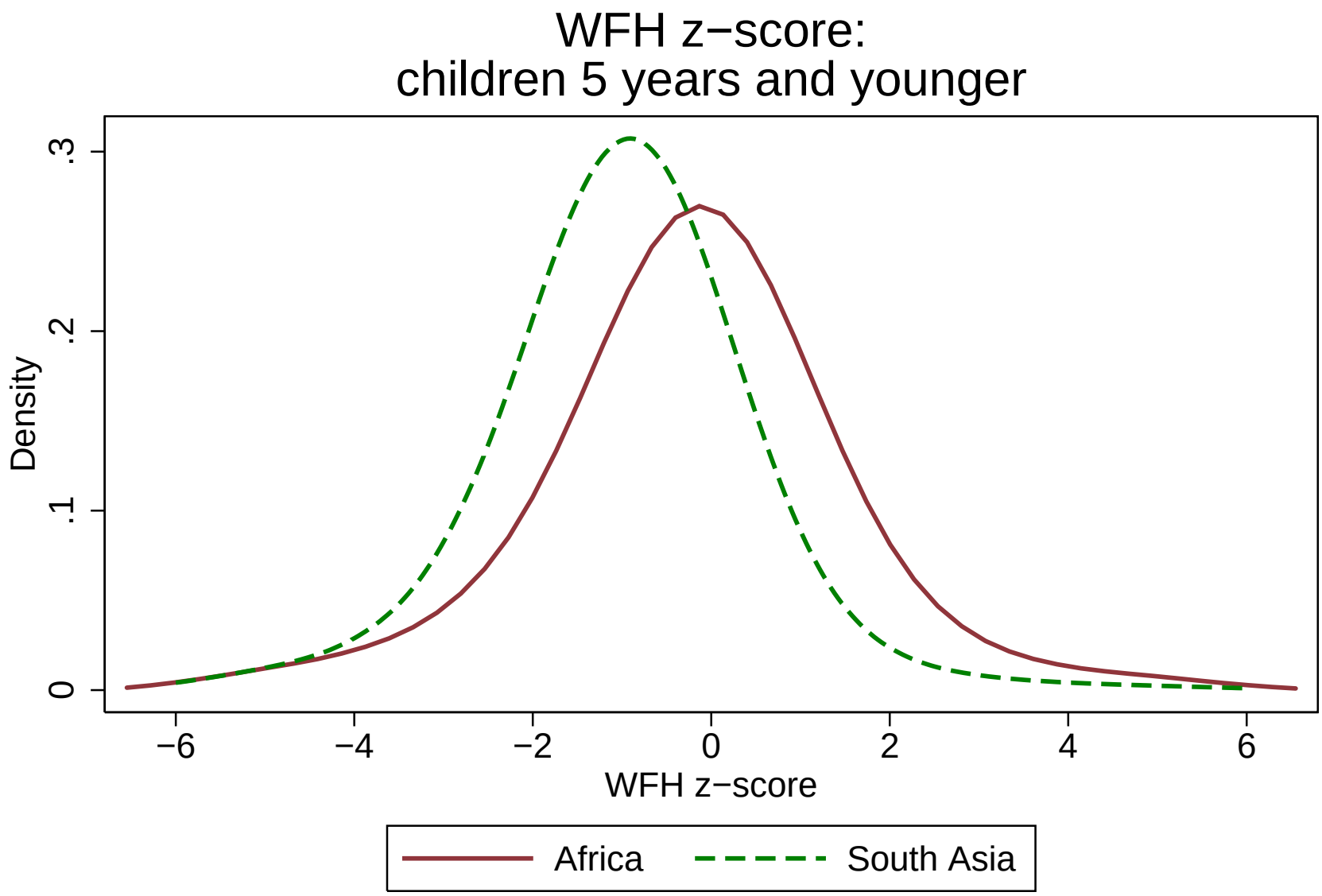
What selective mortality would look like



What selective mortality would look like



Does not appear to be selective mortality



Behavioral channels don't explain the S. Asia gap

	WFH z-score	HFA z-score	Deceased
Without covariates	-0.756***	-0.185***	-0.022***
	[0.013]	[0.013]	[0.002]
Prenatal	-0.721***	-0.175***	-0.009***
	[0.014]	[0.014]	[0.002]
Breastfeeding	-0.745***	-0.187***	0.027***
	[0.014]	[0.014]	[0.002]
Diarrhea	-0.769***	-0.201***	0.024***
	[0.013]	[0.013]	[0.001]
Maternal education	-0.805***	-0.295***	-0.018***
	[0.014]	[0.013]	[0.002]
Water	-0.691***	-0.243***	-0.023***
	[0.017]	[0.016]	[0.002]
Food	-0.784***	-0.204***	0.023***
	[0.014]	[0.014]	[0.002]
Fertility	-0.765***	-0.212***	-0.009***
	[0.014]	[0.013]	[0.002]
Empowerment	-0.811***	-0.214***	-0.019***
	[0.014]	[0.014]	[0.002]
All covariates	-0.774***	-0.341***	0.045***
	[0.019]	[0.017]	[0.001]

How the South Asia gap varies with demographic factors

- By gender of the child
- By birth order of the child

Measuring heterogeneous patterns

- Is the South Asia gap concentrated among girls?

$$\begin{aligned} Outcome_i &= \alpha + \beta SAsia_i + \delta SAsia_i \times Female_i \\ &\quad + \theta Female_i + \gamma X_i + \varepsilon_i \end{aligned}$$

- Is the South Asia gap concentrated among higher birth-order children?

$$\begin{aligned} Outcome_i &= \alpha + \beta SAsia_i + \delta SAsia_i \times BirthOrder_i \geq 2 \\ &\quad + \theta BirthOrder_i \geq 2 + \gamma X_i + \varepsilon_i \end{aligned}$$

- Examine interaction terms γ

South Asia differential by gender

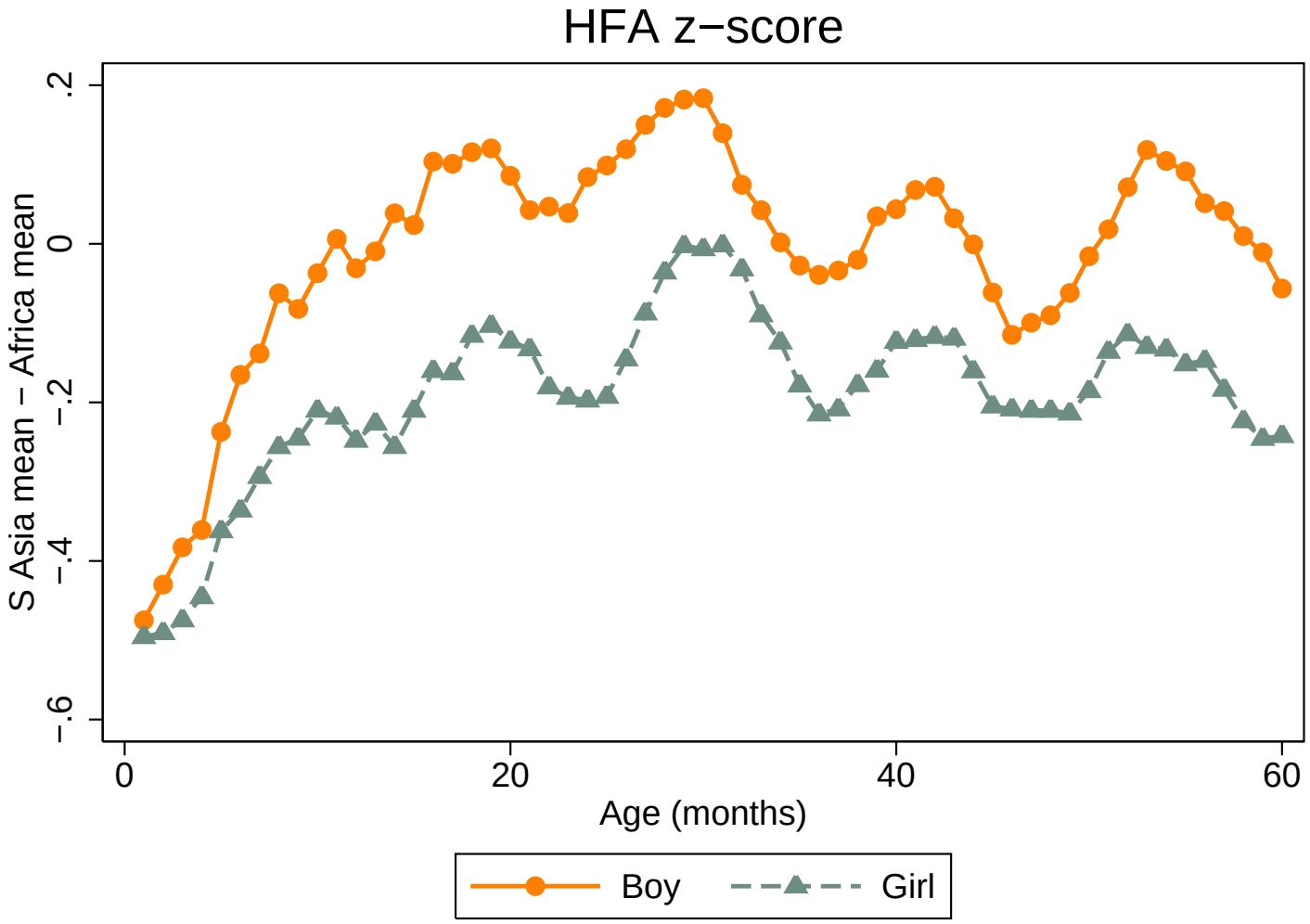
	(1) WFH z-score	(2) HFA z-score	(3) Deceased
South Asia	-0.774***	-0.088***	-0.028***
	[0.017]	[0.017]	[0.002]
South Asia*Female	0.037*	-0.199***	0.012***
	[0.021]	[0.020]	[0.002]
Female child	0.011	0.231***	-0.013***
	[0.015]	[0.013]	[0.001]
Observations	192,056	192,056	218,833

- Within South Asia, no gender gap in HFA (-0.199+0.231)
- But large gender gap using Africa as a comparison group (-0.199)

Robustness of South Asia $\times$ female gap

- Not due to different levels of development; robust to including GDP$\times$female and other controls
- Our interpretation: Household behaviors, not something biological and exogenous to the household explains the pattern
- NB: Patterns are observationally equivalent to discrimination against boys in Africa

S. Asia × female deficit not present at birth



NB: Fluctuations due to less heaping of measurements in India

Fewer inputs for girls

	(1) Mother's BMI	(2) Mother anemic	(3) Total vaccinations	(4) Breastfed $\geq$ 18 months
South Asia	-0.024***	0.023***	0.378***	0.116***
	[0.000]	[0.005]	[0.025]	[0.004]
South Asia*Female	0.000	0.014***	-0.171***	-0.032***
	[0.000]	[0.005]	[0.028]	[0.005]
Female child	-0.000	0.001	-0.006	0.007***
	[0.000]	[0.003]	[0.017]	[0.003]
Observations	125,823	81,563	178,852	181,301

Recap

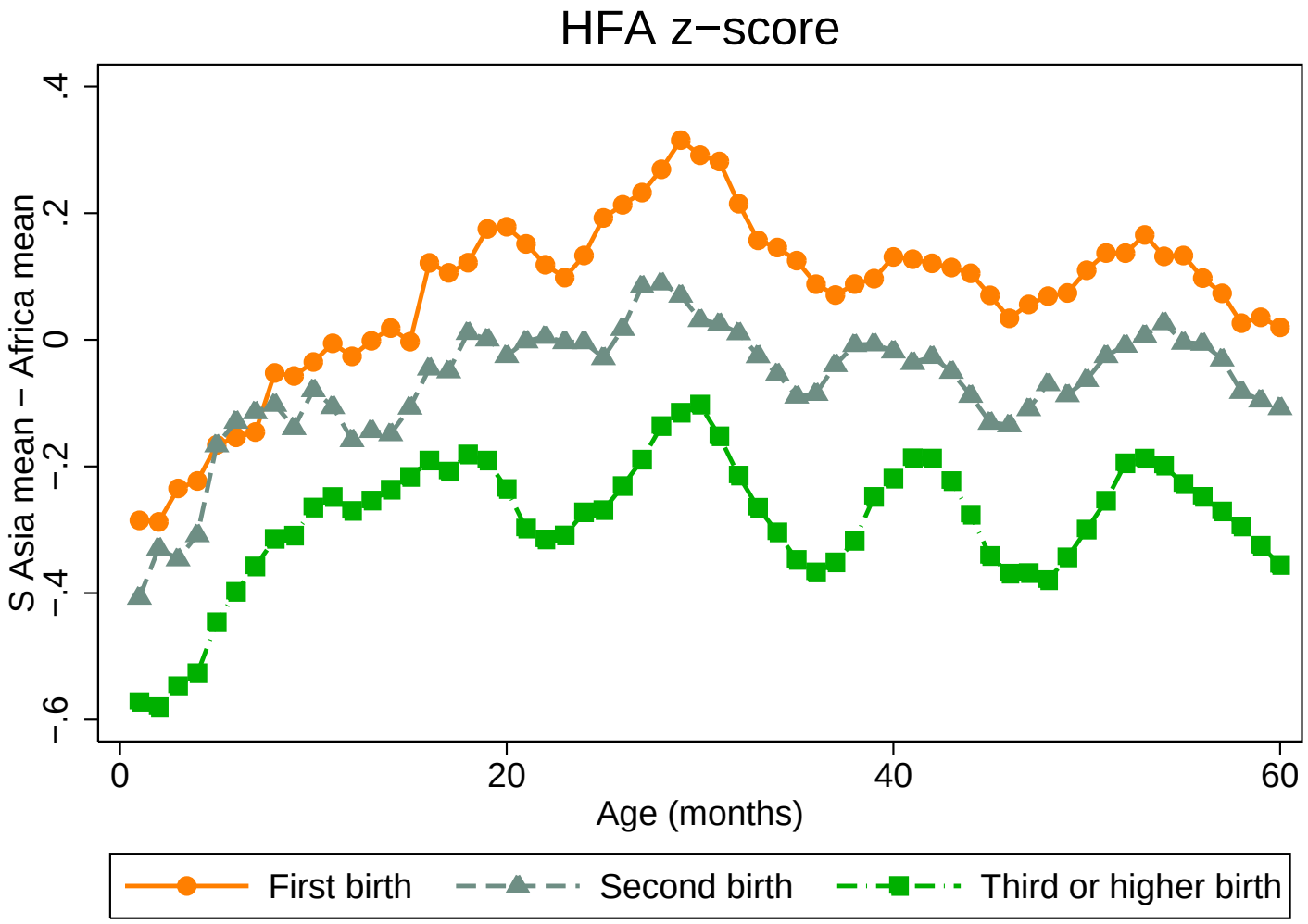
- Malnutrition gap in South Asia is bigger for girls for height, not weight
- This finding is in contrast to previous literature examining gender differences just within South Asia
- Suggests that poor countries have a different "natural rate" of gender differences in height, analogous to sex ratios
- Parental investments line up the same way, with a South Asian gap for females

$\Rightarrow$ Next patterns by birth order

South Asia differential by birth order

	(1) WFH z-score	(2) HFA z-score	(3) Deceased
South Asia	-0.726***	0.092	-0.039**
	[0.133]	[0.136]	[0.019]
2nd child	-0.064***	-0.096***	-0.008***
	[0.025]	[0.021]	[0.002]
3rd+ child	-0.192***	-0.381***	0.003
	[0.027]	[0.023]	[0.002]
South Asia*2nd child	-0.039	-0.155***	0.001
	[0.032]	[0.028]	[0.003]
South Asia*3rd+ child	-0.106***	-0.338***	0.014***
	[0.035]	[0.032]	[0.004]
Observations	192,056	192,056	218,833

South Asia differential by birth order: height



Robustness of birth order differential

- Main specification controls for mother's age in 5 year bins, interacted with South Asia
- Results robust to
  - Excluding mother's age
  - Including child's age
- Also not picking up family's socioeconomic status
  - Including family size (using within-family variation)
  - Including asset index or other measures of family SES

Birth order pattern seen for both girls and boys

	(1) WFH z-score	(2) HFA z-score	(3) Deceased
South Asia	-0.702***	0.114***	-0.033***
	[0.033]	[0.029]	[0.004]
South Asia*2nd child	-0.042	-0.108***	-0.002
	[0.045]	[0.039]	[0.004]
South Asia*3rd+ child	-0.093**	-0.328***	0.006
	[0.039]	[0.035]	[0.004]
Female child	0.007	0.239***	-0.020***
	[0.035]	[0.028]	[0.003]
Female child*2nd child	-0.003	-0.009	0.010**
	[0.048]	[0.040]	[0.004]
Female child*3rd+ child	0.007	-0.011	0.010***
	[0.040]	[0.032]	[0.003]
S Asia*Female child	0.014	-0.151***	0.010**
	[0.044]	[0.038]	[0.005]
S Asia*Female child*2nd child	0.029	-0.079	0.001
	[0.062]	[0.055]	[0.006]
S Asia*Female child*3rd+ child	0.039	-0.073	0.004
	[0.054]	[0.048]	[0.006]

Do investments in child health show same patterns?

- Post-birth: vaccinations, breastfed, maternal anemia, maternal weight
- Pre-birth: prenatal care, iron supplements, home delivery

Post-natal channels

	(1) Mother's BMI	(2) Mother anemic	(3) Total vaccinations	(4) Breastfed $\geq$ 18 months
South Asia	-0.017***	0.013**	0.802***	0.097***
	[0.000]	[0.006]	[0.028]	[0.005]
2nd child	0.005***	-0.011**	-0.091***	0.056***
	[0.000]	[0.005]	[0.023]	[0.004]
3rd+ child	0.007***	-0.007*	-0.474***	0.112***
	[0.000]	[0.004]	[0.022]	[0.003]
South Asia*2nd child	-0.003***	0.013*	-0.161***	0.006
	[0.001]	[0.007]	[0.033]	[0.007]
South Asia*3rd+ child	-0.012***	0.022***	-0.837***	-0.005
	[0.001]	[0.006]	[0.035]	[0.006]
Observations	125,823	81,563	178,852	181,301

Pre-natal channels

	(1) Any prenatal care	(2) Took iron supplements	(3) Child born at a home
South Asia	-0.037***	0.024***	0.140***
	[0.005]	[0.006]	[0.005]
2nd child	-0.016***	-0.017***	0.088***
	[0.004]	[0.005]	[0.004]
3rd+ child	-0.072***	-0.062***	0.201***
	[0.003]	[0.004]	[0.004]
South Asia*2nd child	-0.018***	-0.025***	0.028***
	[0.006]	[0.007]	[0.006]
South Asia*3rd+ child	-0.147***	-0.160***	0.130***
	[0.005]	[0.007]	[0.006]
Observations	137,455	136,594	191,662

1. Is the explanation for the South Asia birth-order pattern unwanted births?

- Birth order 2 and higher children are less likely to be "wanted" in S. Asia
- Based on DHS question on whether that pregnancy was wanted by the mother
- Not wanting child is more strongly associated with bad outcomes in S. Asia than Africa
- But explains small part of birth order patterns

2. Is the explanation favoritism toward eldest sons?

- Discrimination against girls is consistent with preferences in S. Asia
- But what explains better outcomes for earlier-born children?
- Is favoritism toward eldest sons the explanation?
- Families may make prenatal investments until they have a son, so low-parity children (even girls) do well
- Might make post-natal investments in eldest sons, so high parity children do poorly, even sons

Parents indeed invest more in eldest sons

	(1) WFH z-score	(2) HFA z-score	(3) Deceased
South Asia	-0.759***	-0.076	-0.032*
	[0.136]	[0.138]	[0.019]
Eldest son	0.151***	0.206***	-0.000
	[0.025]	[0.020]	[0.002]
South Asia*Eldest son	0.022	0.262***	-0.013***
	[0.031]	[0.027]	[0.003]
Doesn't have son yet	0.104***	0.254***	-0.007***
	[0.023]	[0.021]	[0.002]
South Asia*Doesn't have son yet	0.046	0.062**	0.000
	[0.030]	[0.028]	[0.003]
Observations	192,056	192,056	218,833

But eldest sons do not explain the birth order pattern

	(1) WFH z-score	(2) HFA z-score	(3) Deceased	(4) WFH z-score	(5) HFA z-score	(6) Deceased
South Asia	-0.726***	0.092	-0.039**	-0.700***	0.078	-0.037*
	[0.133]	[0.136]	[0.019]	[0.137]	[0.139]	[0.019]
2nd child	-0.064***	-0.096***	-0.008***	-0.030	-0.047**	-0.010***
	[0.025]	[0.021]	[0.002]	[0.027]	[0.023]	[0.002]
3rd+ child	-0.192***	-0.381***	0.003	-0.136***	-0.301***	-0.001
	[0.027]	[0.023]	[0.002]	[0.034]	[0.028]	[0.003]
South Asia*2nd child	-0.039	-0.155***	0.001	-0.052	-0.153***	-0.000
	[0.032]	[0.028]	[0.003]	[0.036]	[0.032]	[0.004]
South Asia*3rd+ child	-0.106***	-0.338***	0.014***	-0.130***	-0.336***	0.012***
	[0.035]	[0.032]	[0.004]	[0.043]	[0.039]	[0.004]
Eldest son				0.090***	0.070***	-0.001
				[0.029]	[0.023]	[0.002]
South Asia*Eldest son				-0.035	0.113***	-0.009**
				[0.036]	[0.031]	[0.003]
Doesn't have son yet				0.044	0.121***	-0.008***
				[0.028]	[0.024]	[0.002]
South Asia*Doesn't have son yet				-0.016	-0.097***	0.005
				[0.036]	[0.034]	[0.004]
Observations	192,056	192,056	218,833	192,056	192,056	218,833

3. Is the explanation malnourished/mistreated mothers?

- In societies that discriminate against females, women's malnourishment adversely affects birth outcomes
- Perhaps this is more pronounced for later births
- Use sex ratio as birth as a county-level measure of discrimination against women

Mistreated women associated with poor outcomes for high parity children

	(1) WFH z-score	(2) HFA z-score	(3) Deceased
South Asia	-0.895***	-0.023	-0.017***
	[0.034]	[0.030]	[0.004]
2nd child	1.314**	1.176**	-0.117*
	[0.577]	[0.506]	[0.066]
3rd+ child	3.074***	2.223***	-0.137**
	[0.560]	[0.497]	[0.066]
South Asia*2nd child	0.054	-0.073*	-0.008
	[0.050]	[0.041]	[0.005]
South Asia*3rd+ child	0.122***	-0.222***	0.000
	[0.046]	[0.039]	[0.005]
Sex ratio at birth	3.429***	0.946**	-0.178***
	[0.401]	[0.375]	[0.052]
Sex ratio at birth*2nd child	-1.288**	-1.103**	0.098
	[0.564]	[0.492]	[0.064]
Sex ratio at birth*3rd+ child	-3.082***	-2.212***	0.123*
	[0.547]	[0.484]	[0.063]

Even within Africa, sex ratio associated with poor outcomes for high parity children

	(1) WFH z-score	(2) HFA z-score	(3) Deceased
2nd child	2.371	1.947	0.259
	[2.764]	[2.126]	[0.195]
3rd+ child	5.626**	0.974	-0.032
	[2.446]	[1.861]	[0.167]
Sex ratio at birth	-5.784**	-10.749***	0.282*
	[2.318]	[1.794]	[0.165]
Sex ratio at birth*2nd child	-2.312	-1.849	-0.265
	[2.682]	[2.061]	[0.188]
Sex ratio at birth*3rd+ child	-5.543**	-1.001	0.021
	[2.373]	[1.805]	[0.162]

Summary and next steps

- Relative to Africa, there is more stunting of girls in South Asia
- Striking birth order gradient: Malnutrition in South Asia driven by higher birth-order children
- Health inputs follow the same gender and birth order patterns
- Wantedness and favoritism toward eldest sons do not account for a lot of the birth order gradient
- Ill treatment of mothers (skewed sex ratio) may be root cause
- Next steps: Further explore this explanation or other explanations for birth order gradient

Conclusions

- High malnutrition in South Asia does not appear to just be due to genetic differences or mortality selection
- Strong within-family patterns suggest behavioral choices by parents are driving South Asia's abnormally high rate of child malnutrition