Disasters, early childhood development, and education

ADAPTED FROM:

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What we know about disasters

When large disasters are "compensated for" – with aid, with cash, or with policy – we often see quick returns to "normalcy"

- New Orleans, U.S. (Deryugina et al. 2018)
- Kobe, Japan (Sawada and Shimizutani 2008)
- Aceh, Indonesia (Frankenburg et al. 2013)

But major shocks during childhood have later effects:
Lower wages, schooling, physical and mental health as adults

We see very severe impacts of these shocks during the so-called critical period or "first 1,000 days of life"

- Reviews: Portner (2009) and Baez et al. (2011)
- Height/stature: Alderman et. al. 2006, Akresh et al. 2011, Macchini & Yang (2009)
- Cognitive development: Handa and Peterman (2007); Black et al. 2003; Case & Paxson (2010); Glewwe et al. 2001
- Later life income: Dercon and Porter (2010): Height losses after a famine led to (predicted) income losses of 3-8%

This study asks:

Are children protected later, given “enough” compensation and normalcy?

We study the impact of a **massive earthquake** followed by aid. We use detailed follow-up surveys **four years later** for child, adult, and household outcomes

We ask **three questions**:

1. What happened to childhood development in a disaster where families received substantial compensation in cash and in-kind?
2. Do we observe different effects if we look at physiology or at cognitive performance?
3. How do impact patterns vary depending on the age of exposure?

Coming up short:

Preview of impact results

"Build back better" recovery for families and communities

But we detected large, lasting effects for young children:

Ages 0-2 are significantly shorter than peers

Ages 3-11 show 2 years of lost learning compared to peers

Then we ask:

Can mothers protect their children?

We use a unique data set where we match mothers of children **to their birth villages**. Women's schooling is relatively recent, and we can identify **which mothers received primary education**.

We ask **two questions**:

1. Do more highly educated mothers protect their children against height and performance gaps after the disaster?
2. If they do, what might be the mechanisms of impact?

Protective mothers:

Preview of mitigation results

Primary education has a large effect on academic performance

In addition, mother's education prevented education gaps

But no protection was observed for physical development

Many possible channels, but not enough information to say how

Description of the Disaster

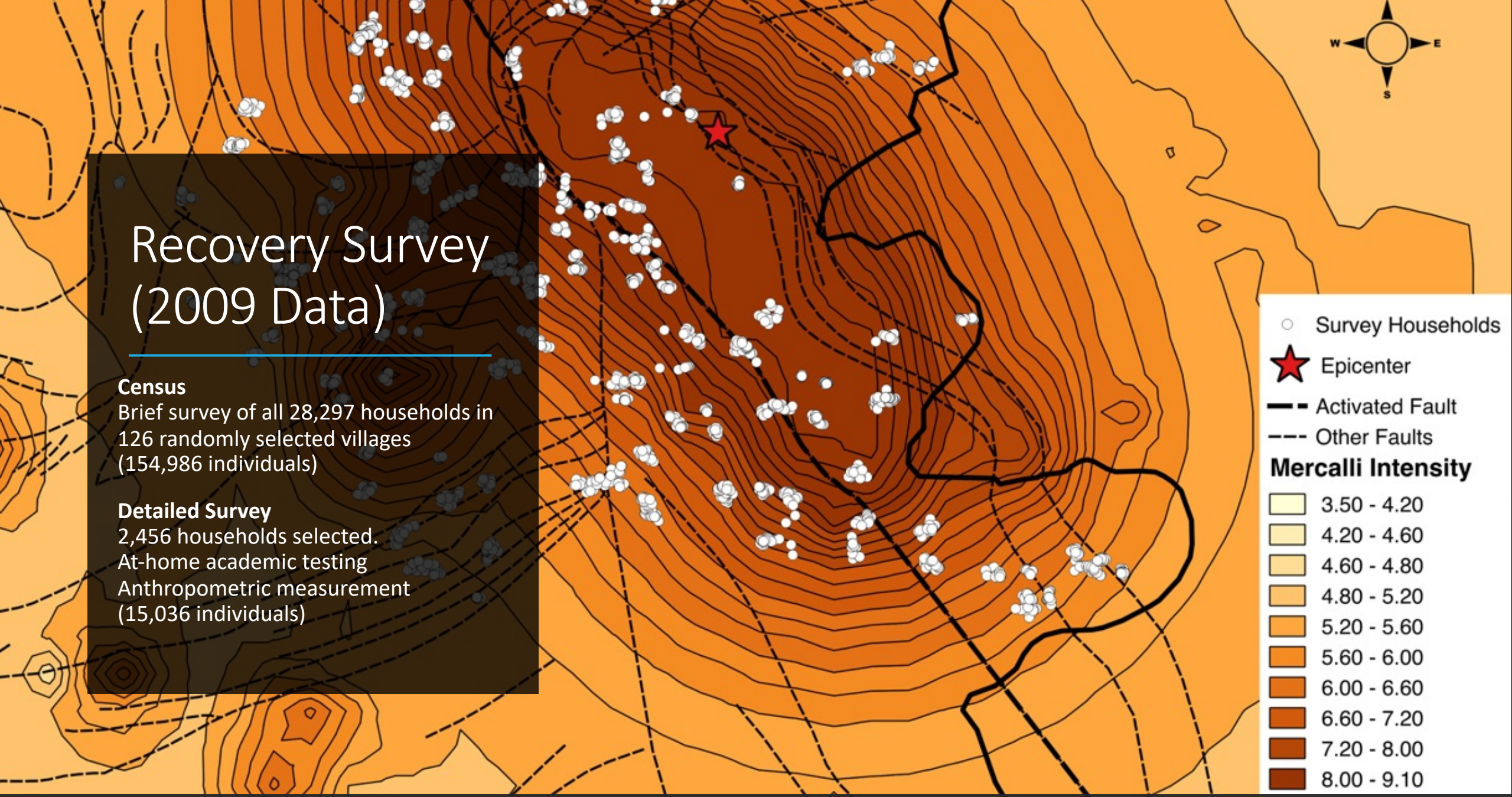
The Pakistan Earthquake: October 8, 2005

Comparable to **1906 San Francisco earthquake**, occurring in rural and mountainous Northern Pakistan

- Magnitude 7.6 earthquake left 73,000-78,000 dead
- 80% of houses and physical infrastructure destroyed

Earthquake are rare in the region, and there are many possible fault lines. **We use the unpredictability of the disaster** (in time and space) to establish causality.

This was the first “big one” since 1935. Between then and 2005, there were no earthquakes above magnitude 7.0 in Pakistan. A smaller 6.2 magnitude earthquake in the North-West Frontier Province in 1974 affected other districts.



Recovery Survey (2009 Data)

Census
Brief survey of all 28,297 households in 126 randomly selected villages (154,986 individuals)

Detailed Survey
2,456 households selected.
At-home academic testing
Anthropometric measurement
(15,036 individuals)

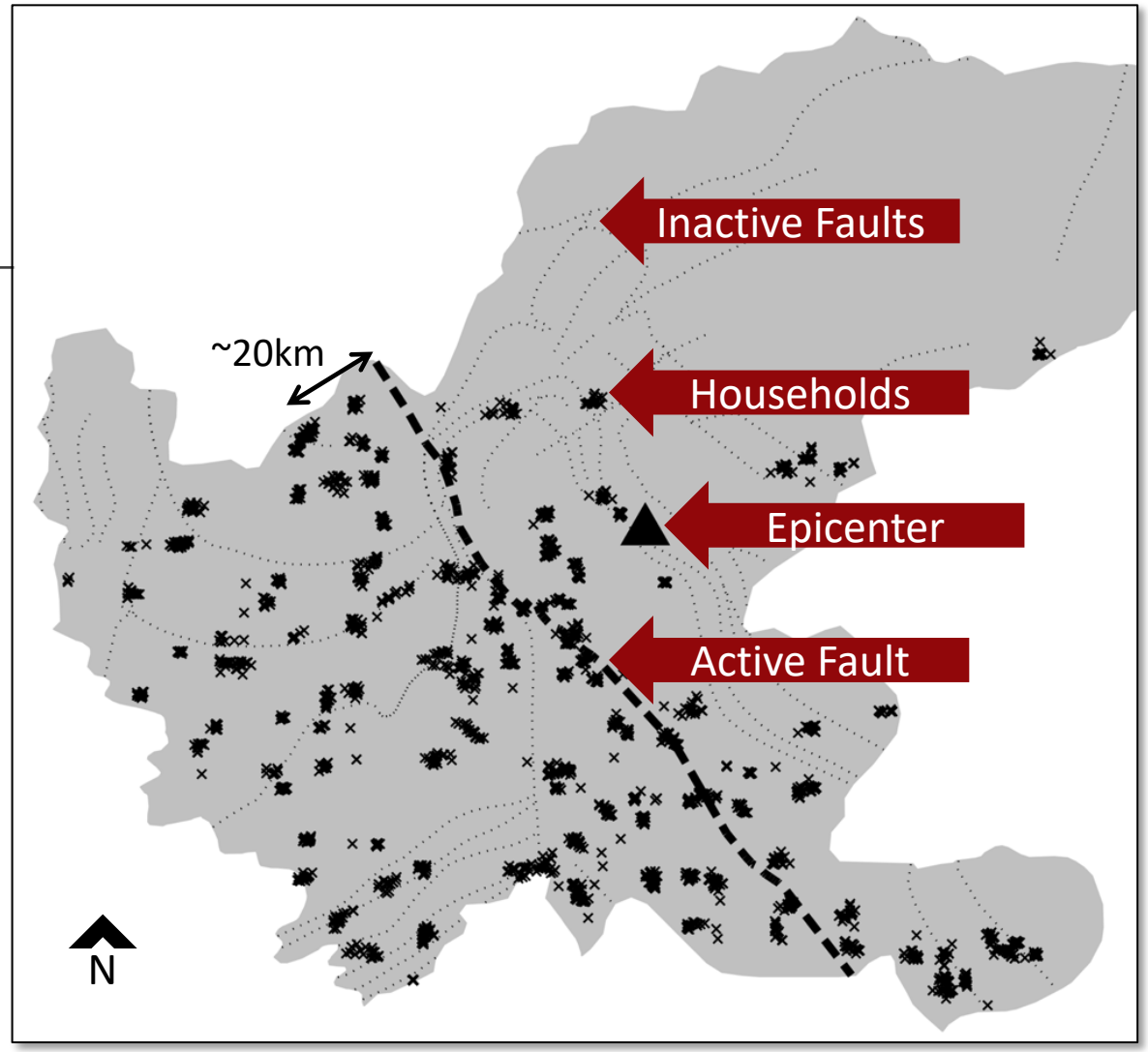
Measuring impact

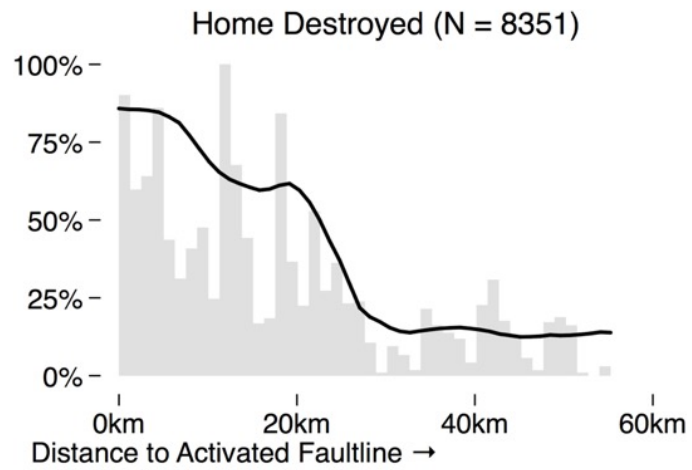
Earthquake intensity is linked to soil types and hilly terrain, which also impact poverty and education levels. So we cannot use geological measures directly.

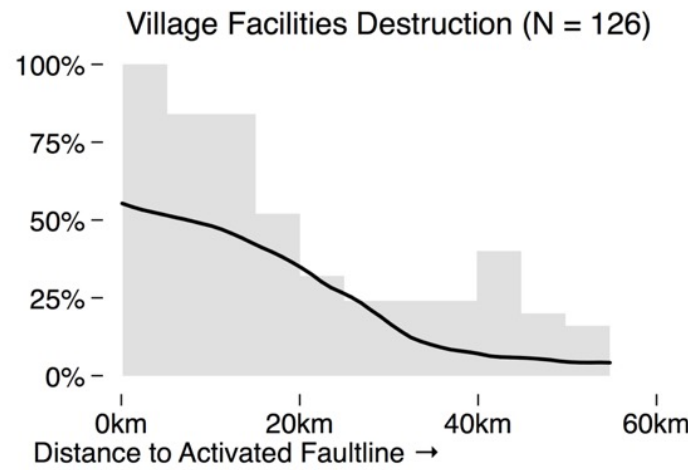
Instead, we measure exposure as “distance to the fault line” measured in linear kilometers.

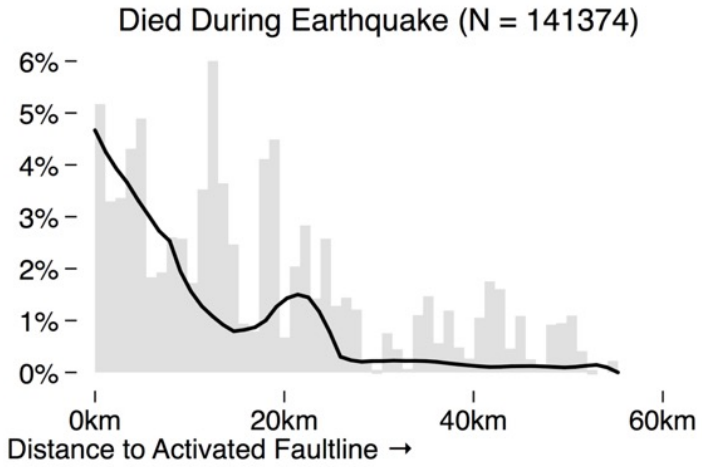
We adjust estimates for exposure to any fault, the local hilliness, and the distance to epicenter.

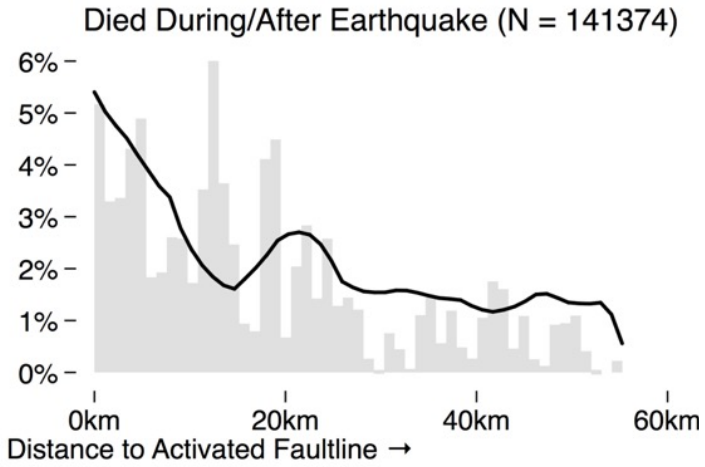
We include district effects so that we compare very similar villages to each other.







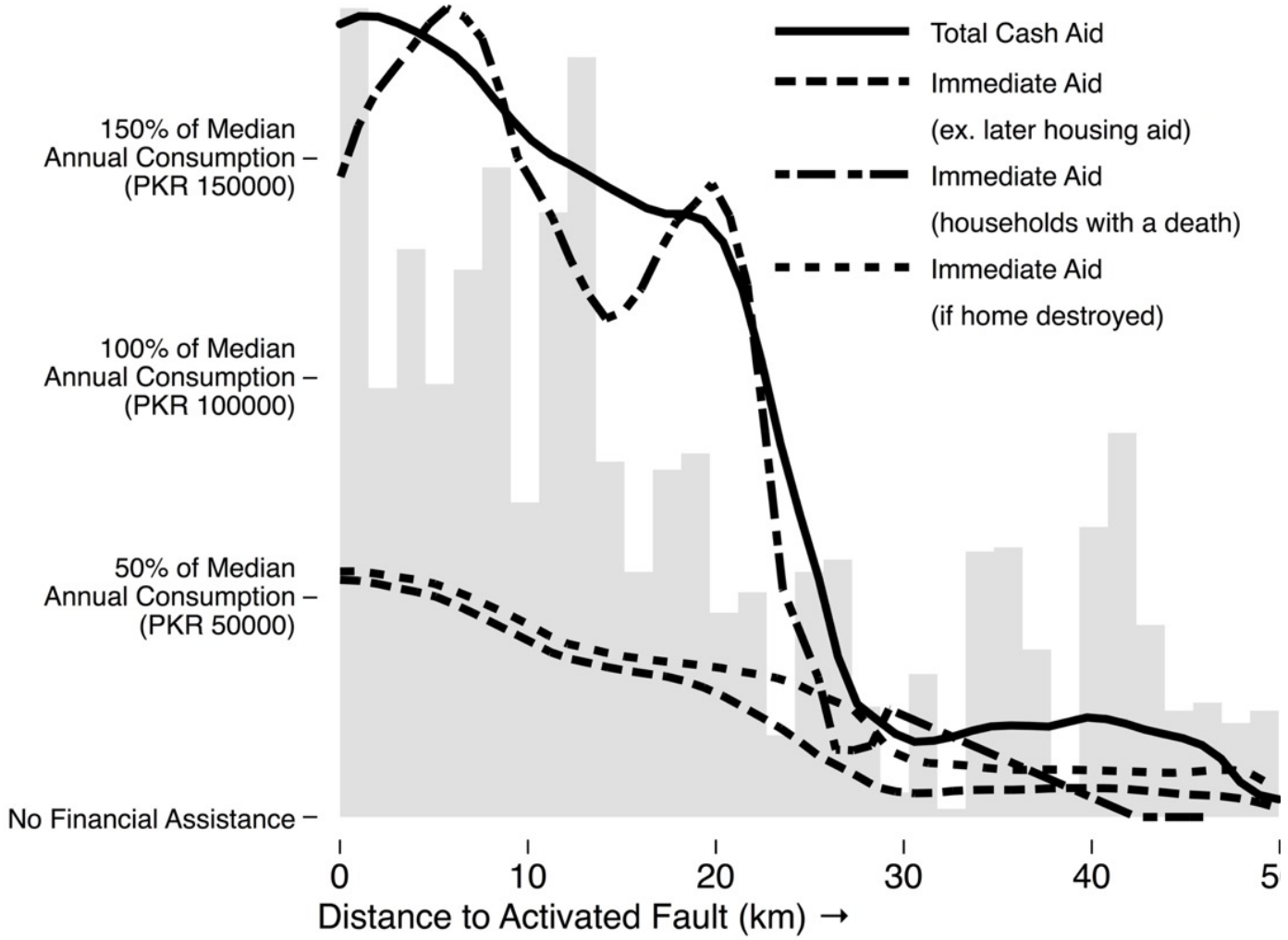




Death and Destruction

Very high levels of destruction up to about 20 kilometers from the fault.

Relatively low levels of immediate mortality that drop off very quickly, and no evidence of excess deaths afterwards.



"Joint Effect": Disaster + Aid + Cash

Massive relief effort led by Pakistan Army "to beat the winter"

Supported extensively by UN & other Western agencies (US military, etc)

Extensive air delivery of in-kind aid and housing construction support

Large amounts of additional **cash aid** delivered directly to households

Aid delivery almost exactly matches destruction pattern

Rebuilding took time – these are schools in the year after the earthquake

Results: Four Years Later

“Normalcy” indicated a surface-level recovery

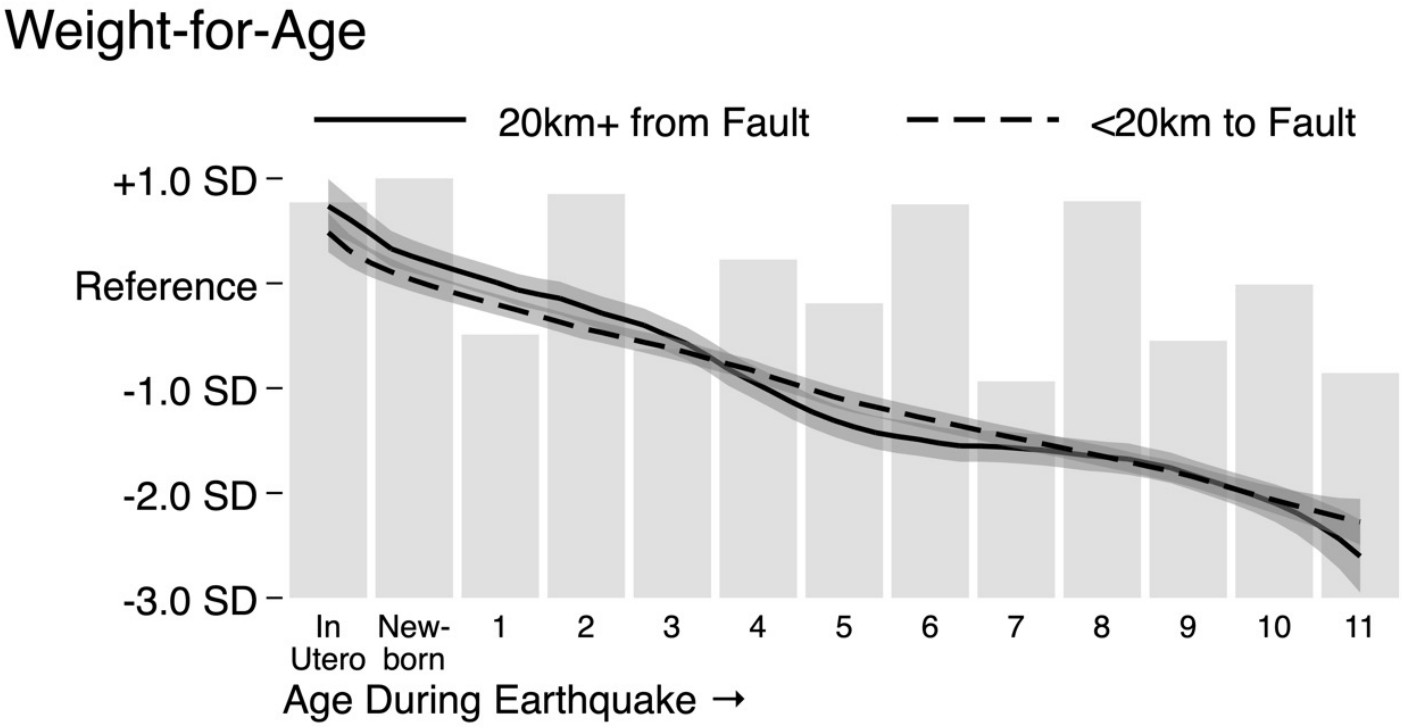
“Building Back Better”

- Homes near the fault are higher quality
- More likely to be masonry (permanent) construction
- More likely to have electricity and running water

Interpreting regressions:

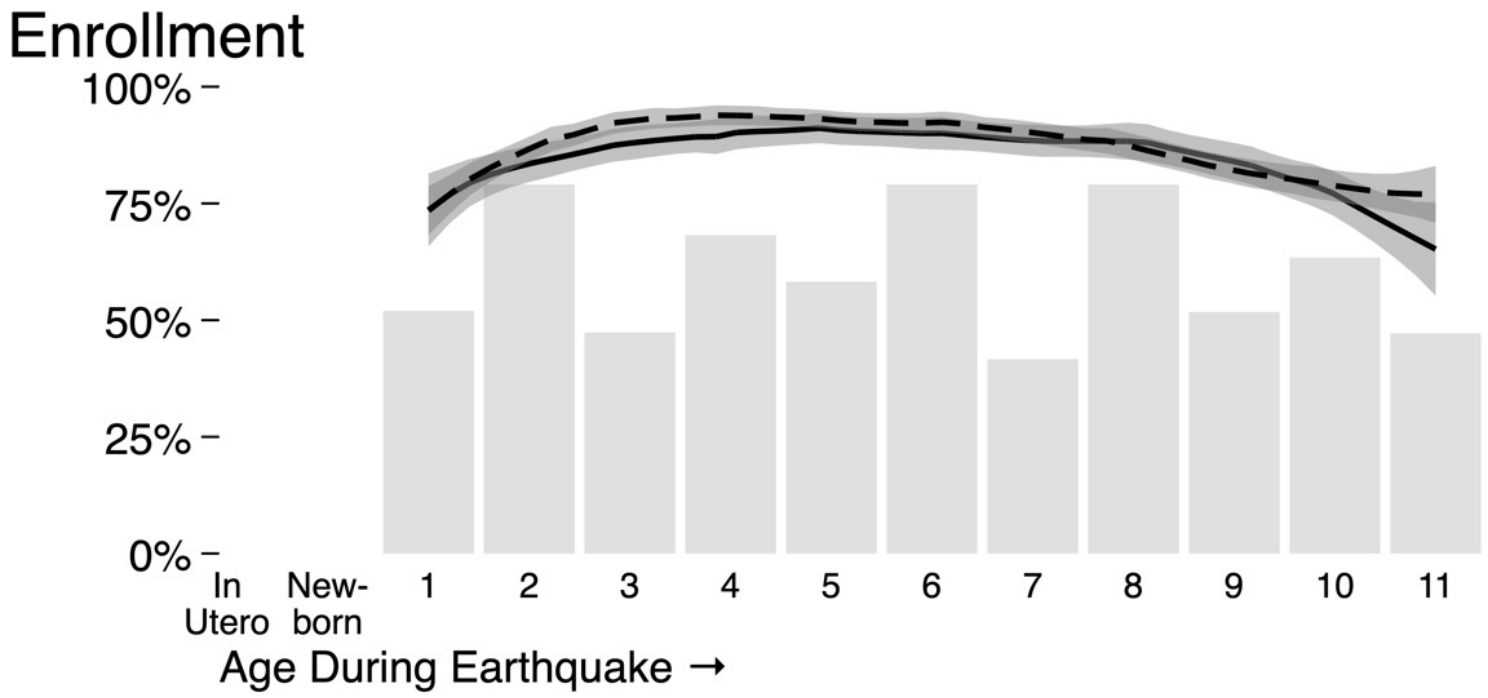
- Results are “per kilometer”
- Positive slope means “more of this far from the fault”
- Reasonable “average” comparison is 30km (<20km vs >20km)

	(1) Distance to Faultline (km) Coefficient	(2) N	(3) R2	(4) Mean
PANEL A: Household Socioeconomic Characteristics				
Asset Index (PCA) (Post-Quake)	-0.00 0.00	2,456	0.122	0.00
Household Infrastructure Index	-0.02*** 0.01	2,456	0.168	0.00
Permanent House (Post-Quake)	-0.01** 0.00	2,456	0.089	0.64
Electricity	-0.01*** 0.00	2,456	0.142	0.90
Water In House (Post-Quake)	-0.00* 0.00	2,456	0.057	0.50
Log Consumption per Capita	0.00 0.00	2,456	0.072	10.04
PANEL B: Access to Public Infrastructure				
Log Dist to Gov't School (min)	-0.00 0.00	2,454	0.039	2.78
Log Dist to Market (min)	0.00 0.01	2,452	0.119	3.62
Log Dist to Distr Office (min)	-0.00 0.00	2,449	0.240	4.83
Log Dist to Medical (min)	-0.00 0.01	2,444	0.048	3.79
Log Dist to Private School (min)	-0.01 0.01	2,369	0.037	3.40
PANEL C: Adult Health				
Adult Height	0.02 0.02	6,907	0.007	145.32
Adult Weight	0.02 0.02	6,907	0.012	45.59
Adult Height (18-24)	-0.01 0.04	1,717	0.012	130.25
Adult Weight (18-24)	0.02 0.03	1,717	0.011	34.12



Child weights confirm recovery

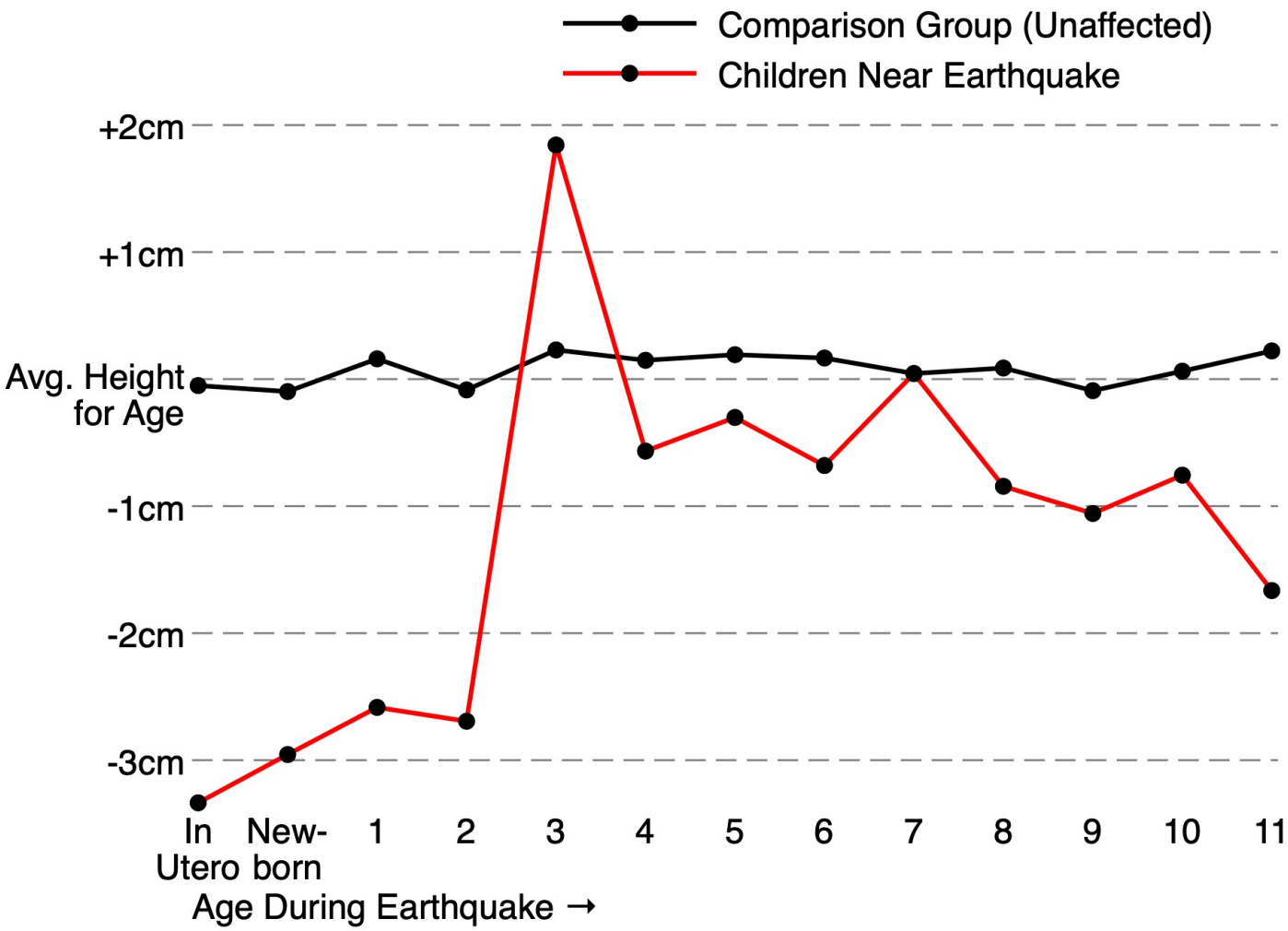
- Children at all ages had very similar weights regardless of their exposure to the earthquake
- Children still become undernourished relative to US levels (reference for age) as they get older
- **But no evidence that earthquake resulted in lasting deprivation in 2009 for exposed children**



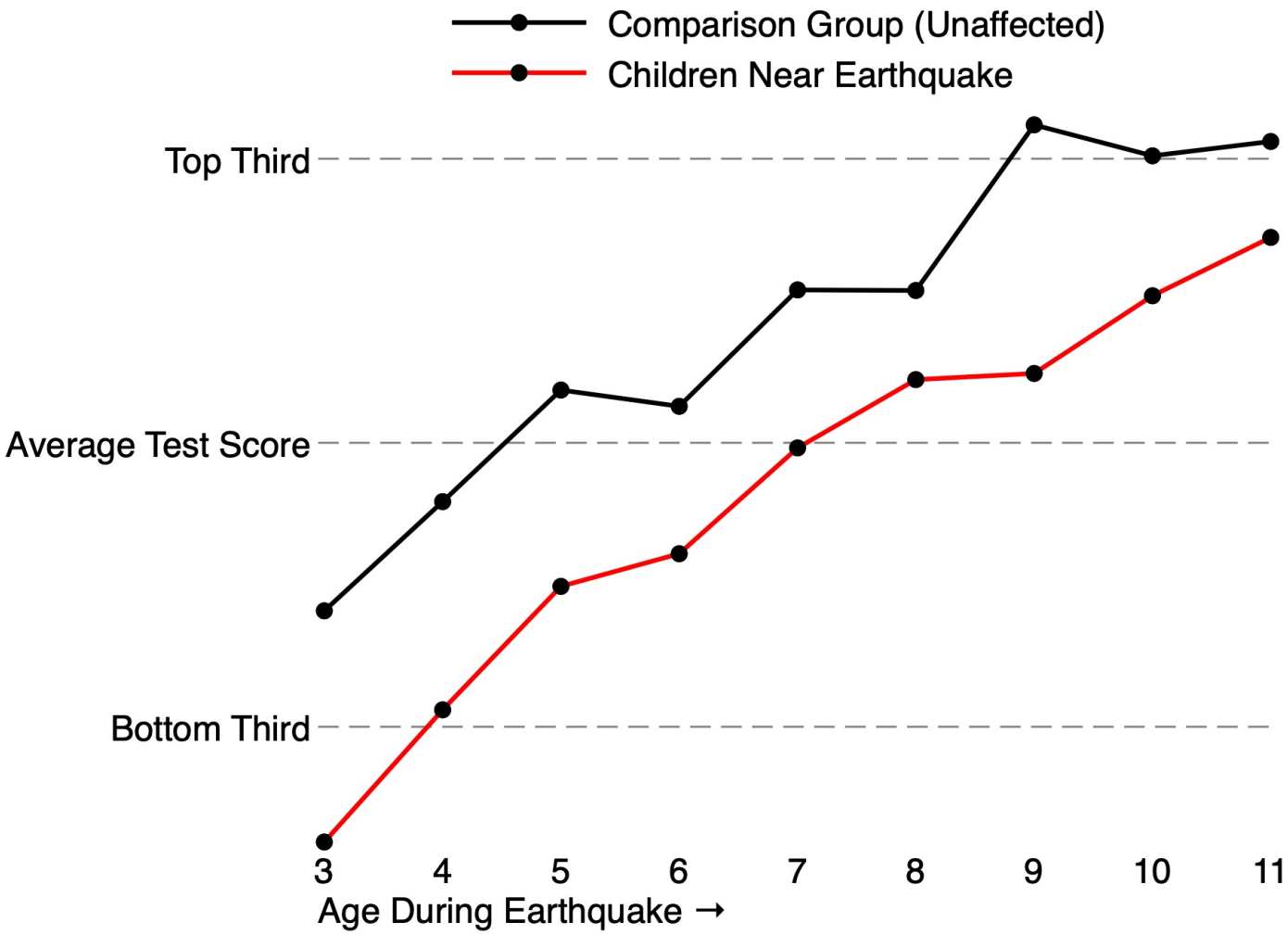
School enrollment rates are high everywhere

- No evidence of current deprivation in educational opportunity in exposed villages
- No substantial differences by child gender; **schooling at these ages is near universal**
- Note: ages are age at exposure. Add four years for current ages.

Young children showed large growth gaps



- Children exposed to the earthquake at the age of two or younger were **substantially shorter than their peers.**
- The effect got larger as children got younger, with children *in utero* then (age 3 now) showing the largest lags



And all children lagged in tests

- Custom test administered to all children ages 7–15 at survey time, regardless of schooling status
- Testing on English, Mathematics, and Urdu (local language)
- Constant gap of about 0.25 standard deviations for earthquake-exposed group
- No difference by age or gender, equal to **two years of lost school**

Child growth and human capital results

	(1) Weight (Z-score)	(2) Height (Z-score)	(3) School Enrollment	(4) Grade Attainment	(5) Test Scores (IRT)	(6) Test Scores + Disruption	(7) Test Scores + Gender	(8) Test Scores + Age
Distance from Faultline (km)	-0.007*	0.002	-0.000	0.00	0.008**	0.006*	0.007	0.012***
	(0.004)	*(0.005)*	*(0.001)*	*(0.01)*	*(0.004)*	*(0.003)*	*0.005*	*(0.005)*
Weeks out of School After Earthquake						-0.004*		
						(0.002)		
In Utero * Distance from Faultline (km)	0.003	0.036**						
	(0.006)	*(0.017)*						
Age 0-2 * Distance from Faultline (km)	0.005	0.015*						
	(0.005)	*(0.009)*						
Male	-0.041	0.037	0.077***	0.12	0.068	0.00	0.040	0.066
	(0.048)	*(0.081)*	*(0.016)*	*(0.11)*	*(0.043)*	*(0.04)*	*0.074*	*(0.044)*
(log) Consumption per Capita	-0.001	0.084	0.026**	0.25**	0.141***	0.11***	0.141***	0.139***
	(0.045)	*(0.082)*	*(0.011)*	*(0.10)*	*(0.045)*	*(0.04)*	*(0.044)*	*(0.045)*
Distance from Faultline (km) * Male							0.002	
							(0.004)	
Distance from Faultline (km) * Age 6								-0.004
								(0.004)
Distance from Faultline (km) * Age 7								-0.002
								(0.005)
Distance from Faultline (km) * Age 8								-0.007
								(0.005)
Distance from Faultline (km) * Age 9								0.005
								(0.004)
Distance from Faultline (km) * Age 10								-0.008*
								(0.004)
Distance from Faultline (km) * Age 11								-0.008
								(0.006)
Dependent Variable Mean	*-0.944*	*-2.155*	*0.903*	*4.17*	*0.131*	*0.23*	*0.131*	*0.131*
Geographic Controls	X	X	X	X	X	X	X	X
Individual and SES Controls	X	X	X	X	X	X	X	X
Age Dummies	X	X	X	X	X	X	X	X
Regression R2	0.247	0.077	0.074	0.338	0.099	0.110	0.100	0.104
Number of Observations	4,002	4,001	1,874	1,874	1,874	1,547	1,874	1,874

Benchmarking the effect

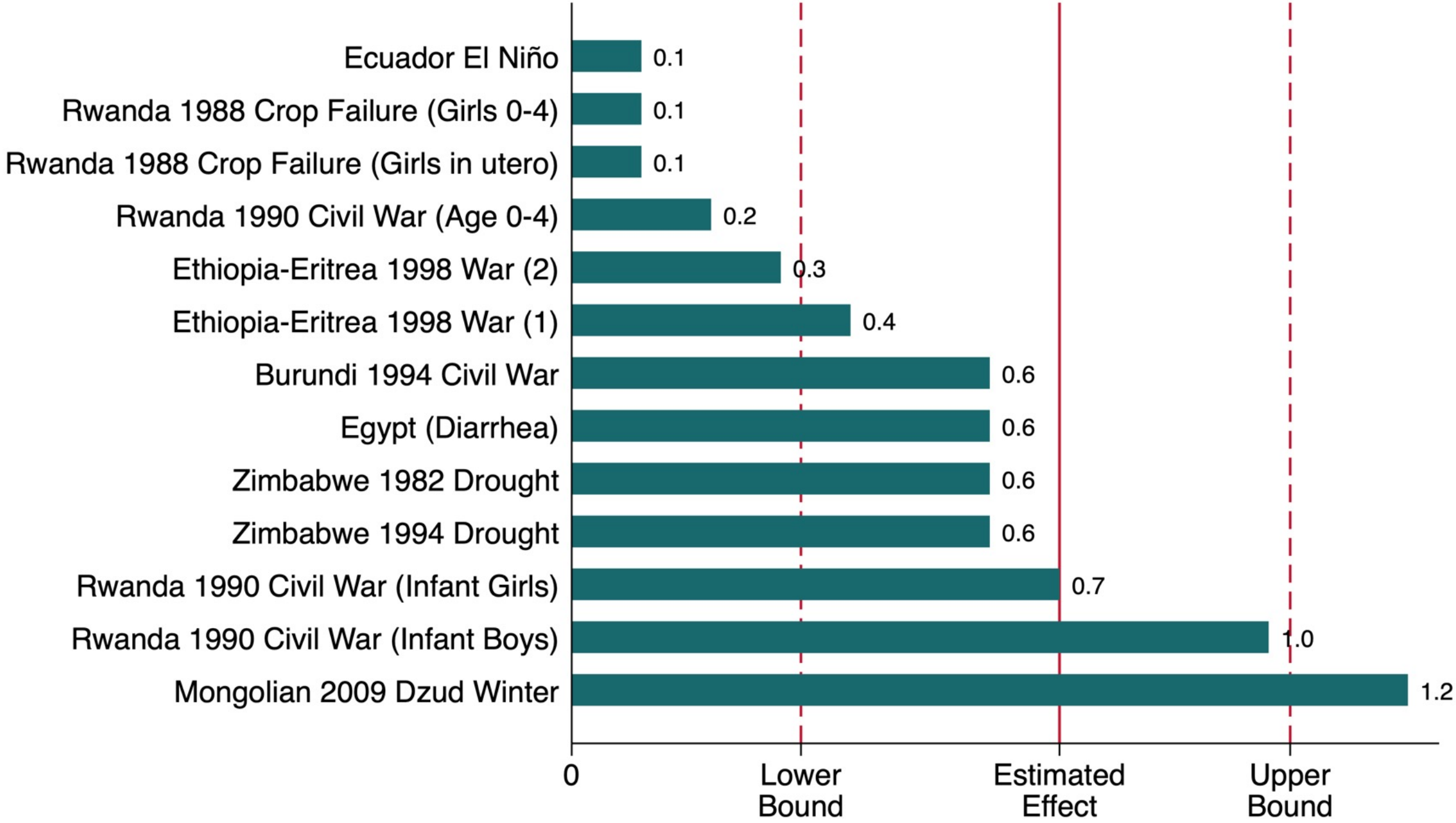
We can roughly guess at the cost of these impacts for children later in life using known correlations between height, schooling, and wages in our census data.

Estimate peak losses occur in 2024, when the youngest child is 18 and nearly all are working adults

Individual losses for this cohort are 15%-18%, which corresponds to 5% of total earnings in the area

About 2/3rds due to loss in schooling years, with additional 1/3 due to loss of height – a possible signal for cognitive development and other health issues

This could be an upper-bound if there is social support, or a lower-bound. For instance, we cannot anticipate additional health losses such as vulnerability to disease.


Ecuador El Niño
0.1
Rwanda 1988 Crop Failure (Girls 0-4)
0.1
Rwanda 1988 Crop Failure (Girls in utero)
0.1
Rwanda 1990 Civil War (Age 0-4)
0.2
Ethiopia-Eritrea 1998 War (2)
0.3
Ethiopia-Eritrea 1998 War (1)
0.4
Burundi 1994 Civil War
0.6
Egypt (Diarrhea)
0.6
Zimbabwe 1982 Drought
0.6
Zimbabwe 1994 Drought
0.6
Rwanda 1990 Civil War (Infant Girls)
0.7
Rwanda 1990 Civil War (Infant Boys)
1.0
Mongolian 2009 Dzud Winter
1.2
0
Lower Bound
Estimated Effect
Upper Bound

Protective mothers?

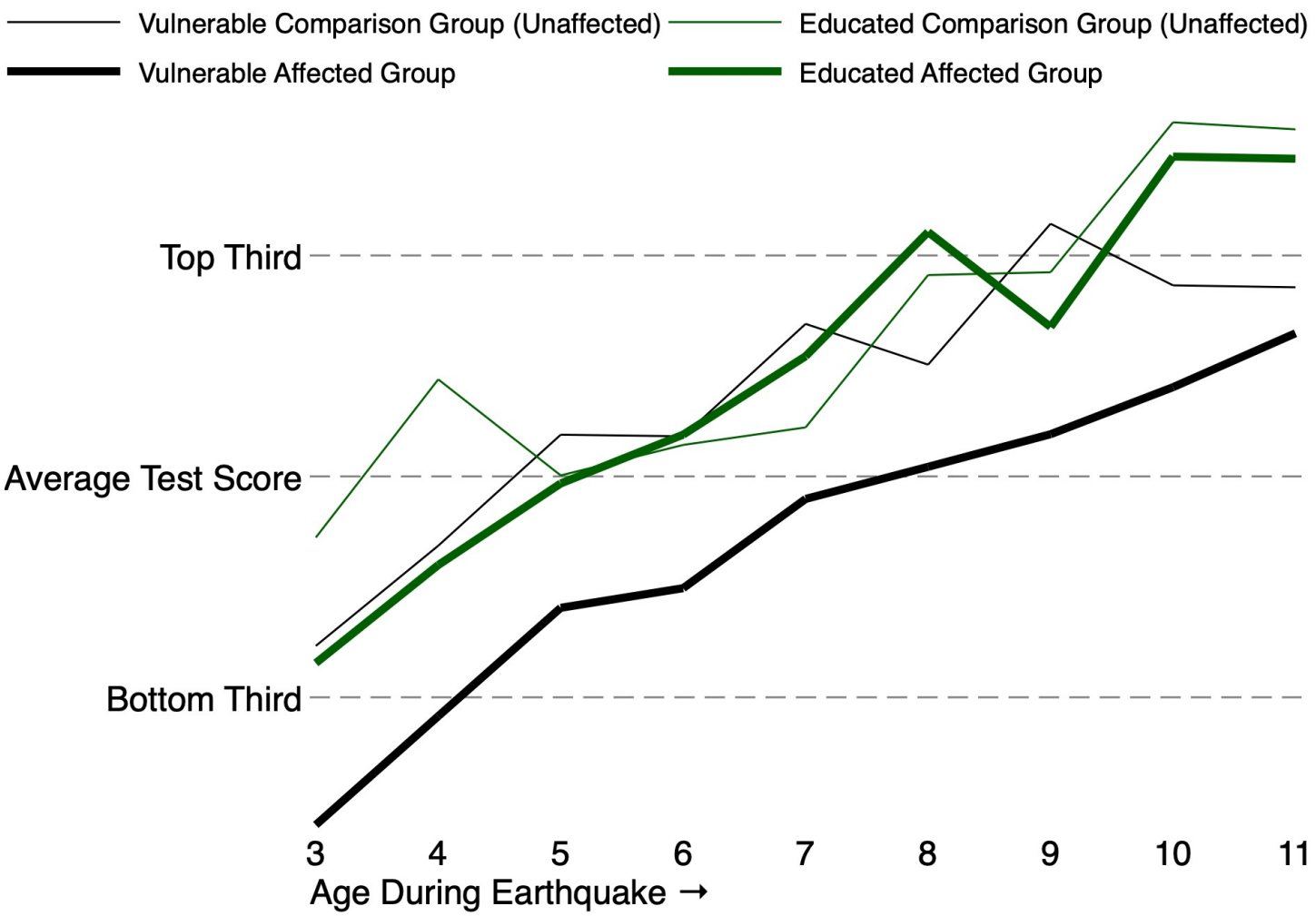
Can educated mothers protect their children?

We define maternal education as mothers with at least primary schooling.

In our sample, 68% report 0 years of schooling, **10% report primary schooling and 16% report more than primary schooling**

Women's education in the mother's generation is associated with father's education, child school enrollment, private schooling, with household wealth, and mental health levels.

We examine the difference in the impact of the earthquake for children by maternal education…



These children showed no learning loss!

Children of educated mothers who were exposed to the earthquake appeared exactly like children with no exposure.

Where there was no exposure, there was almost no persistent gap between the two.

Result suggests a “protective” effect, driven by the ability of the family to compensate for disruptions.

Where do effects come from and how do mothers help?

We cannot say much about channels, but we make two remarks:

Part of test score losses were due to school disruption, with every week of additional disruption leading to additional week of learning losses. But:

- Schools were closed on average for 14 weeks, so **closures cannot account for 2 years of learning losses**
- Formal mediation analysis confirms that disruption accounts for 6-10% of learning losses
- **Maternal protection effect does also not run through school switching.** We see the same effect in villages with only one school to choose.

We examined a number of other potential protective interactions in the data. Maternal mental health, household elevation and household assets do not mitigate test score losses, but may mitigate losses in height. Very inconclusive on what exactly causes and mitigates.

Results review:

Setting:

Major unpredictable earthquake

Rural, mountainous area in Pakistan with homogeneous villages throughout

Massive local and international aid

“Compensated shock”: Cash aid to households up to 150% of annual consumption with very low spillovers

No confounding from migration, mortality, risk preference, or fault location (lots of faults in region)

What we find:

Complete recovery, except:

Children then aged 0–3 show major height deficits at current ages 4–7 (0.5–1.0 SD)

Children then aged 3–11 show major educational attainment deficits at current ages 7–15 (0.24 SD)

Children whose mother completed primary school are largely protected from educational (but not height) impact; this protective effect is causal (IV regression)

Setting of massive in-kind and cash aid, with recovery to parity in infrastructure, consumption, health, and school enrollment

We show that development gaps persist between children affected and unaffected by the earthquake – both nutritional and educational

55% of households had a child who could have been affected by the growth lag

Uneducated mothers were 75% of our sample with 82% of school-age children

Mothers who have completed their primary school education causally provide a baseline gain in test scores (0.27 SD) and a protective effect that mitigates 87% of the earthquake impact (=0.3–0.6 SD)

Therefore the academic advantages of children the top 25% of women are magnified 2-3x relative to others through this differential effect

Discussion

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