

When It Rains, It (Possibly) Hurts: The Impact of Rainfall Shocks on Violence Against Children in Nigeria

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Motivations

- ▶ With one in two children having already experienced some form of violence (physical, psychological, or sexual) **domestic violence** represents a particularly alarming issue ([World Health Organization, 2020](#)).
- ▶ Simultaneously, the acceleration of **climate change** has led to more frequent and intense extreme weather events, which disproportionately affect vulnerable populations ([Fruttero et al., 2024](#)).
- ▶ In countries where **household incomes** remain heavily **dependent on agriculture**, climate shocks can exacerbate economic stress and contribute to an increase in domestic violence, further endangering children's well-being.

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Study Context: Focus on Nigeria

- ▶ With a population of more than 200 million, **Nigeria** is the most populous country in Africa, with almost **half of its population under the age of 18**.
- ▶ **Agriculture** remains a critical sector, employing 35% of the workforce and contributing to 22% to GDP in 2021.
- ▶ Nigeria has three main climatic zones: a hot and semi-arid Sahelian climate in the north, a tropical monsoon climate in the south, and a tropical savannah climate in the center.
- ▶ The **limited irrigation infrastructure** and the diversity of climatic zones make Nigerian agriculture particularly vulnerable to various extreme climatic shocks.

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Research Question

In this paper

We investigate how exposure to **weather shocks** affects different types of **domestic violence against children** in Nigeria.

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 - higher than usual **rainfall**,
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What We Know So Far

► Weather events and child maltreatment:

- Children were more likely to experience **unintentional injury** and **parental violence** during **floods** in Bangladesh in 2007 (Biswas et al., 2010).
- Positive correlation between **temperature increases** and **child maltreatment** in the United States (Evans et al., 2024).
- Exposure to various **disasters** (floods, fires, tornadoes, etc.) is associated with a **higher risk of violence** (Becker-Blease et al., 2010).
- Livestock mortality caused by **severe winter disasters** in Mongolia is linked to an increased probability of both **physical and psychological violence** (Roeckert et al., 2024).

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- While negative rainfall shocks increase the likelihood of child marriage in Africa (where bride prices are prevalent) the opposite effect is observed in India, where dowries (payments from the bride's family to the groom) are the norm (Corno et al., 2020).

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Data

- ▶ **2021 Multiple Indicator Cluster Survey (MICS) including geocoded data for Nigeria:**
 - Data on **41,532 children** were collected through interviews with 39,632 households conducted between September and December **2021**.
 - The child discipline module includes eight **disciplinary practices**: two **violent psychological** practices, six **violent physical** practices, and one nonviolent disciplinary practices.
- ▶ **CPC Global Unified Gauge-Based Analysis of Daily Precipitation dataset:**
 - Daily **temperature** and **precipitation** measurements on a 0.5 x 0.5 degree grid for the period 1980-2023.
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Some Figures

	N	Overall <i>n</i> = 17,912	Female <i>n</i> = 8,918	Male <i>n</i> = 8,995	p-value
Violence of any kind	17,912	93% (0.003)	93% (0.004)	93% (0.004)	>0.9
Psychological violence	17,912	88% (0.003)	87% (0.005)	88% (0.004)	0.4
Physical violence	17,912	80% (0.004)	80% (0.006)	81% (0.006)	0.13
Severe violence	17,912	53% (0.005)	52% (0.008)	55% (0.007)	<0.001

Table 1: Descriptive statistics. Standard deviations in round brackets.

▮ Children; ▮ Children labour; ▮ Household (1); ▮ Household (2); ▮ Household (3)

Descriptive Statistics Depending on Violence Type (1/2)

	Any kind		Psychological	
	No	Yes	No	Yes
Sex: Female	50% (.017)	50% (.006)	51% (.014)	50% (.006)
Age	9.25 (.11)	9.04 (.03)	9.02 (.08)	9.07 (.03)
Age 14+	13% (.008)	6.7% (.003)	10% (.010)	7.7% (.003)
Work previous week				
Farm	31% (0.015)	36% (0.005)	31% (0.012)	36% (0.005)
Fetched water	45% (0.017)	56% (0.006)	45% (0.014)	57% (0.006)
Own agricultural land	61% (0.018)	62% (0.006)	61% (0.015)	62% (0.006)
	Physical		Severe	
	No	Yes	No	Yes
Sex: Female	51% (.011)	49% (.006)	52% (.008)	48% (.007)
Age	9.67 (.07)	8.91 (.03)	9.07 (.05)	9.05 (.04)
Age 14+	8.7% (.008)	7.8% (.003)	8.9% (.005)	7.0% (.003)
Work previous week				
Farm	35% (0.010)	36% (0.005)	32% (0.007)	38% (0.007)
Fetched water	53% (0.011)	56% (0.006)	52% (0.008)	59% (0.008)
Own agricultural land	61% (0.012)	62% (0.006)	59% (0.008)	64% (0.008)

Table 2: Comparing by type. Standard deviations in round brackets.

Descriptive Statistics Depending on Violence Type (2/2)

		Any kind		Psychological	
		No	Yes	No	Yes
Wealth index quintile					
Poorest		28% (0.015)	21% (0.004)	26% (0.011)	21% (0.004)
Second		20% (0.013)	20% (0.004)	20% (0.010)	20% (0.004)
Middle		14% (0.012)	20% (0.004)	16% (0.010)	20% (0.004)
Fourth		16% (0.013)	20% (0.005)	17% (0.011)	20% (0.005)
Richest		21% (0.017)	19% (0.005)	21% (0.014)	19% (0.006)
		Physical		Severe	
Wealth index quintile					
Poorest		25% (0.009)	20% (0.004)	23% (0.006)	20% (0.005)
Second		20% (0.008)	20% (0.004)	20% (0.005)	21% (0.005)
Middle		17% (0.008)	20% (0.005)	18% (0.005)	21% (0.006)
Fourth		18% (0.009)	21% (0.005)	19% (0.006)	21% (0.007)
Richest		20% (0.011)	18% (0.006)	20% (0.008)	17% (0.007)

Table 3: Comparing by type. Standard deviations in round brackets.

Weather Shocks: Two Metrics

► **Wet Shock** (⚙️ technical details; 🗺️ maps):

- **90th percentile of daily precipitation** (on **wet days, >1mm**), computed over a 31-day window centered on each calendar day.
 - Oct. 1st, 2021 rainfall compared to all Oct. 1st, 1981–2010 ± 15 days \rightarrow 930 daily obs.
- **High Rainfall**: total rainfall on days exceeding this **threshold**, within a **period** (standardized).

► **Dry Shock** (⚙️ technical details; 🗺️ maps):

- Longest sequence of consecutive dry days (<1mm) within a **period**.
- **Dry Spell**: persistence of low-rainfall conditions.

► **Periods**: previous 30 days; previous 365 days; sowing season; harvesting season.

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Weather Shocks

Why these two weather metrics?

► Climate projections

- Rainfall in Nigeria **projected to increase** by 5–20% (Oladipo et al., 2010).

► Ambiguous agricultural effects of the weather

- Can relax credit constraints and improve yields
- But harmful if it disrupts critical phases like sowing → mold, failed germination.

► Policy and resilience

- Droughts increasingly mitigated by irrigation
- But excess rainfall is harder to manage and more destructive to output.



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Empirical Strategy

$$\text{Violence}_{ihtge} = \alpha + \beta \text{Rainfall}_{htg} + \gamma_1 X_i + \gamma_2 X_h + \lambda_t + \lambda_g + \lambda_e + \varepsilon_{ihtge} \quad (1)$$

date
interviewer
↓
↓
meteo. grid

- ▶ Violence_{ihtge} is an indicator for whether child i in household h in meteorological grid g , interviewed by interviewer e at time t , has experienced violence (any, psychological, physical or severe).
- ▶ Rainfall_{htg} is the rainfall-based metrics for the household h in meteorological grid g at the date of interview t .
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- ▶ Standards errors are clustered at the grid level.

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Empirical Strategy: Heterogeneity Analysis

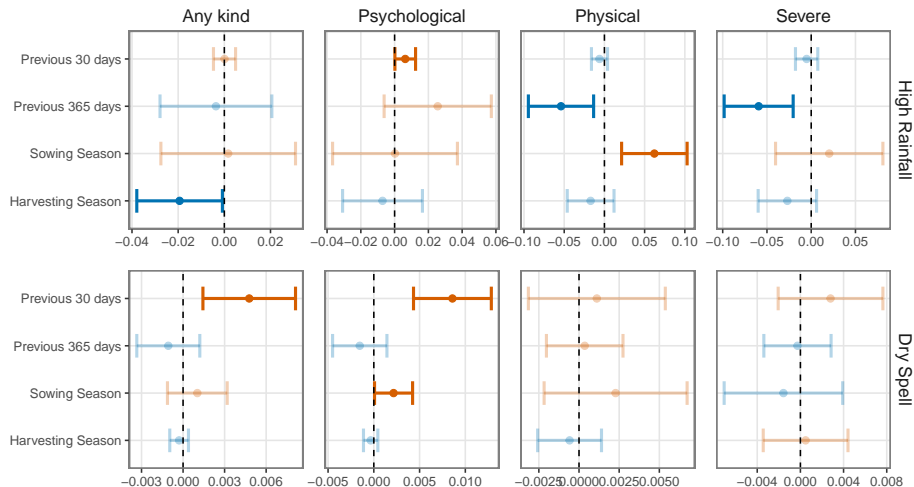
$$\begin{aligned}
 \text{Violence}_{ihtce} = & \alpha + \beta_0 \text{Rainfall}_{htcg} + \beta_1 \text{Z} + \beta_2 \text{Rainfall}_{htcg} \times \text{Z} \\
 & + \gamma_1 \mathbf{X}_i^{-z} + \gamma_2 \mathbf{X}_h^{-z} + \lambda_t + \lambda_g + \lambda_e + \varepsilon_{ihtce}
 \end{aligned}$$

variable of interest

► $\beta_2 > 0$: **Exacerbating effect**

► $\beta_2 < 0$: **Attenuating effect**

Baseline Results: Exceptional Rainfall (top) and Dry Spell (bottom)



Heterogeneity Analysis

- ▶ **Sex of the child** (▮▮▮):
 - **Rainfall**: no systematic gender-based differences
 - **Dry days**: higher probability of experiencing **psychological violence** for girls in the short-term (30 days)
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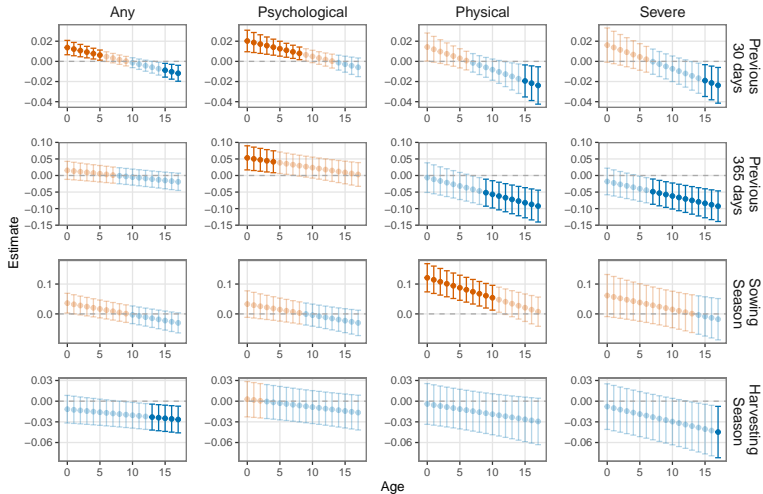
Potential Mechanisms

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Potential Mechanisms: Income-Generating Through Age



Placebo Analysis

- ▶ Random spatial reallocation ()
- ▶ Other outcomes: school closure due to strikes ()

Placebo Analysis

- ▶ Random spatial reallocation (L)
- ▶ Other outcomes: school closure due to strikes (L)

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- ▶ **In the short term**, rainfall shocks **increase psychological violence** only.
- ▶ Over a full agricultural year, excess rainfall **reduces physical and severe violence**.
- ▶ But **during the sowing season**, rainfall and droughts **increase violence**:
 - Rainfall → physical violence
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Economic coping mechanisms such as:

- ▶ Child labor or
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Next Steps

► Robustness tests

► Geocoded information (Source: eHealth Africa).



Public Schools.

Places of worship.

Markets.

Next Steps

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- ▶ Geocoded information (Source: eHealth Africa).



Public Schools.

Places of worship.

Markets.

Thank you

Comments are welcome!



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8. Data Appendix

Some Figures: Children Characteristics

	N	Overall <i>n</i> = 17,912	Female <i>n</i> = 8,918	Male <i>n</i> = 8,995	p-value
Age	17,912	9.06 (0.03)	9.12 (0.04)	9.00 (0.04)	0.067
Age 14+	17,912	7.9% (0.003)	8.2% (0.004)	7.6% (0.004)	0.3
Is natural mother alive	17,912	96% (0.002)	96% (0.003)	97% (0.003)	0.7
Is natural father alive	17,912	93% (0.003)	92% (0.004)	93% (0.004)	0.2

Table 4: Children characteristics. Standard deviations in round brackets.

◀ Back to characteristics on violence

Some Figures: Child Labour

	N	Overall <i>n</i> = 17,912	Female <i>n</i> = 8,918	Male <i>n</i> = 8,995	p-value
Farm work prev. week	17,912	36% (0.005)	33% (0.007)	38% (0.007)	<0.001
Fetches water prev. week	17,912	55% (0.005)	58% (0.008)	52% (0.007)	<0.001

Table 5: Child Labour. Standard deviations in round brackets.

◀ Back to characteristics on violence

Some Figures: Household Composition (1/2)

	N	Overall <i>n</i> = 17,912	Female <i>n</i> = 8,918	Male <i>n</i> = 8,995	p-value
No. women 15-49	17,912	1.39 (0.01)	1.38 (0.01)	1.39 (0.01)	0.7
No. men 15-49	17,912	1.14 (0.01)	1.12 (0.01)	1.16 (0.01)	0.12
No. children under 5	17,912	1.01 (0.01)	1.02 (0.02)	1.01 (0.01)	0.7
No. children 5-17	17,912	2.82 (0.02)	2.78 (0.02)	2.86 (0.03)	0.12
Sex of HH: Female	17,912	14% (0.004)	15% (0.005)	13% (0.005)	0.002
Age of HH head	17,912	48 (0)	48 (0)	48 (0)	0.8

Table 6: Household Composition. Standard deviations in round brackets.

[!\[\]\(339a16584d5da0f0a3ca4e9ec17bf6a1_img.jpg\) Back to characteristics on violence](#)

Some Figures: Household Composition (2/2)

	N	Overall <i>n</i> = 17,912	Female <i>n</i> = 8,918	Male <i>n</i> = 8,995	p-value
Ethnicity of HH head	17,912				0.8
Hausa		27% (0.004)	27% (0.006)	27% (0.006)	
Igbo		16% (0.005)	16% (0.008)	16% (0.007)	
Yoruba		16% (0.004)	16% (0.006)	16% (0.005)	
Fulani		7.6% (0.002)	7.8% (0.004)	7.5% (0.003)	
Other or None		33% (0.005)	33% (0.007)	34% (0.006)	
Education of HH head	17,912				0.8
None		31% (0.005)	31% (0.007)	31% (0.006)	
Primary		21% (0.005)	22% (0.007)	21% (0.006)	
Junior secondary		4.8% (0.002)	4.9% (0.004)	4.8% (0.003)	
Senior secondary		26% (0.005)	25% (0.007)	26% (0.007)	
Higher/tertiary		17% (0.004)	17% (0.006)	17% (0.006)	
Religion of HH head	17,912				0.9
Christianity		48% (0.005)	48% (0.008)	48% (0.007)	
Islam		51% (0.005)	51% (0.008)	51% (0.007)	
Other or None		0.7% (0.001)	0.7% (0.001)	0.6% (0.001)	

Table 7: Household Composition. Standard deviations in round brackets.

Some Figures: Other Household Characteristics

	N	Overall <i>n</i> = 17,912	Female <i>n</i> = 8,918	Male <i>n</i> = 8,995	p-value
No. members / sleep. room	17,912	3.10 (0.02)	3.11 (0.02)	3.09 (0.02)	0.7
Own agricultural land	17,912	62% (0.006)	60% (0.008)	63% (0.008)	0.025
Own any animals	17,912	45% (0.005)	45% (0.007)	46% (0.007)	0.4
Area type: Rural	17,912	59% (0.006)	58% (0.008)	60% (0.008)	0.062
Wealth index quintile	17,912				0.7
Poorest		21% (0.004)	21% (0.005)	21% (0.005)	
Second		20% (0.004)	20% (0.005)	21% (0.005)	
Middle		20% (0.004)	20% (0.006)	19% (0.005)	
Fourth		20% (0.005)	20% (0.007)	20% (0.006)	
Richest		19% (0.005)	19% (0.008)	18% (0.007)	

Table 8: Other Household Characteristics. Standard deviations in round brackets.

◀ Back to characteristics on violence

Some Figures: Weather Shocks

	N	Overall <i>n</i> = 17,912	Female <i>n</i> = 8,918	Male <i>n</i> = 8,995	p-value
High Rainfall (prev. 30 days)	17,912	0.92 (0.02)	0.92 (0.03)	0.93 (0.03)	>0.9
High Rainfall (prev. 365 days)	17,912	0.52 (0.01)	0.52 (0.01)	0.52 (0.01)	0.9
High Rainfall (Sowing season)	17,912	-0.17 (0.01)	-0.18 (0.01)	-0.17 (0.01)	0.5
High Rainfall (Harvest. season)	17,912	1.07 (0.02)	1.05 (0.03)	1.09 (0.03)	0.3
Dry Spell (prev. 30 days)	17,912	6.0 (0.0)	6.0 (0.1)	6.0 (0.0)	0.7
Dry Spell (prev. 365 days)	17,912	78 (1)	77 (1)	78 (1)	0.9
Dry Spell (Sowing season)	17,912	12 (0)	11 (0)	12 (0)	0.7
Dry Spell (Harvesting season)	17,912	22 (0)	22 (0)	23 (0)	0.9

Table 9: Weather Shocks. Standard deviations in round brackets.

◀ Back to definitions of the weather shocks

Weather Shocks High Rainfall (1/2)

- ▶ Consider, e.g., **interview date $t = 2021-10-01$** (**$d = 274\text{th day of year}$**).
- ▶ **Step 1:** **typical precipitation** for **day d**

$$\mathcal{W} = \{(w_{d_y-15}, \dots, w_{d_y+15})\}_{y=1981}^{2010} \quad (2)$$

$d-15$	\dots	$d-1$	d	$d+1$	\dots	$d+15$	1981
							\vdots
$d-15$	\dots	$d-1$	d	$d+1$	\dots	$d+15$	2010

Figure 1: Reference data for day d : $31 \times 30 = 930$ obs.

- ▶ **Step 2:** Compute \mathcal{P}_d , **90th percentile** of nonzero values in \mathcal{W}

Weather Shocks: High Rainfall (2/2)

► **Step 3:** Compute **Rainfall on rainy days**: $w_t = r_t \cdot 1\{r_t > 1\}$

► **Step 4:** Compute **Exceptional Rainfall**:

$$\text{Except. Rain}_t = \sum_{i=t-30}^t w_i \cdot 1\{w_i \geq \mathcal{P}_i\}$$

Rainfall in upper tail

$t - 30 = 2021-09-01$

$t = 2021-10-01$

$w_{t-30} \cdot 1\{w_{t-30} \geq \mathcal{P}_{244}\}$...	$w_{t-1} \cdot 1\{w_{t-1} \geq \mathcal{P}_{273}\}$	$w_t \cdot 1\{w_t \geq \mathcal{P}_{274}\}$
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► **Step 5:** Standardization

$$\text{High Rainfall}_t = \frac{\text{Except. Rain}_t - \mu_{\text{Except. rain},t}}{\sigma_{\text{Except. rain},t}}$$

Computed over 1981–2023

Weather Shocks: Dry Spell

Maximum length of a dry spell: longest sequence of consecutive **days with $r_t < 1$ mm** over the **past 30 days**:

$$DS_t = \max_{k \in [1, 30]} \left\{ k : \exists i \in [t - 29, t - k + 1] \text{ such that } r_j < 1 \text{ for all } j \in [i, i + k - 1] \right\}. \quad (3)$$

$t - 30$	$t - 29$	$t - 28$	$t - 27$	$t - 26$	$t - 25$
$t - 24$	$t - 23$	$t - 22$	$t - 21$	$t - 20$	$t - 19$
$t - 18$	$t - 17$	$t - 16$	$t - 15$	$t - 14$	$t - 13$
$t - 12$	$t - 11$	$t - 10$	$t - 9$	$t - 8$	$t - 7$
$t - 6$	$t - 5$	$t - 4$	$t - 3$	$t - 2$	$t - 1$

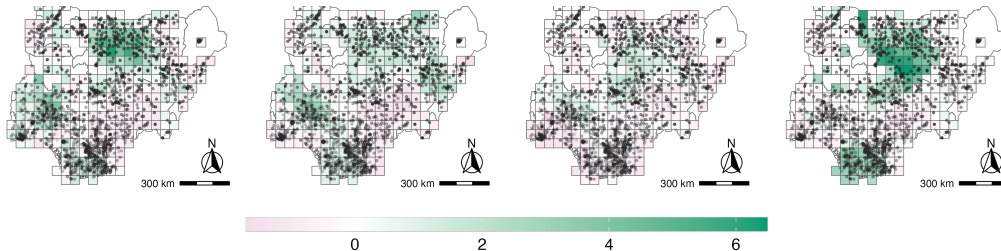
Here, there are two sequences of consecutive **dry days** of length 5 and 2:

$$DS_t = 5$$

◀ Back to definitions of the weather shocks

Wet Shock: High Rainfall

Figure 2: Average standardized high rainfall at the grid cell level.

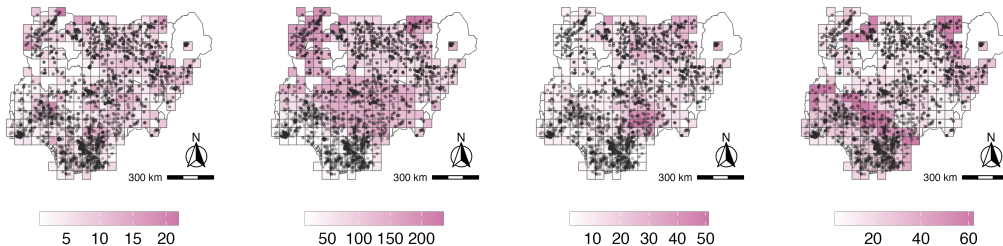


Notes: Each black dot represents a surveyed child. Standardized total rainfall for precipitation above the 90th percentile, computed at the grid cell level. To account for variations in interview dates within a grid cluster, we average the indicators, leading to reference periods that may differ across clusters within a cell.

◀ [Back to definitions of the weather shocks](#)

Dry Shock: Dry Spell

Figure 3: Average dry spell (max. number of consecutive dry days) at the grid cell level.

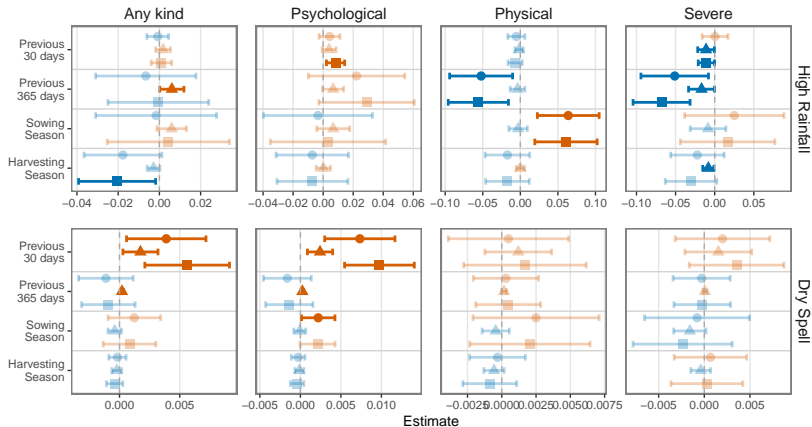


Notes: Each black dot represents a surveyed child. Dry spell is computed at the grid cell level. To account for variations in interview dates within a grid cluster, we average the indicators, leading to reference periods that may differ across clusters within a cell.

◀ [Back to definitions of the weather shocks](#)

9. Additional Results

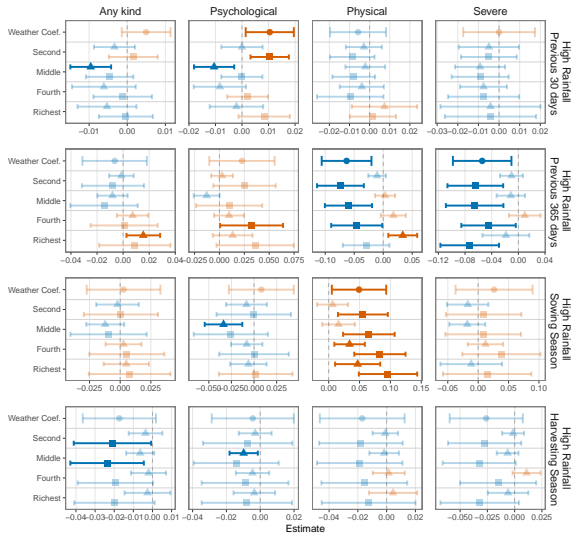
Heterogeneity Analysis: Sex of the Child (ref: Male)



● Weather Coef. ▲ Interaction Coef. ■ Marginal Effect. (Child Sex: Female)

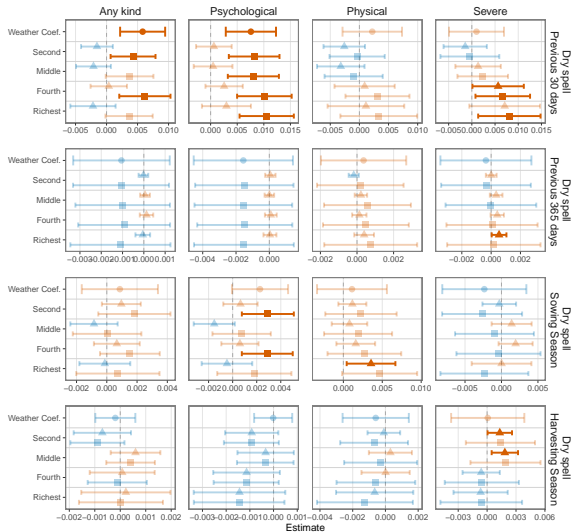
[Back to the results](#)

Heterogeneity Analysis: HH Income (ref: Poorest) | High Rainfall

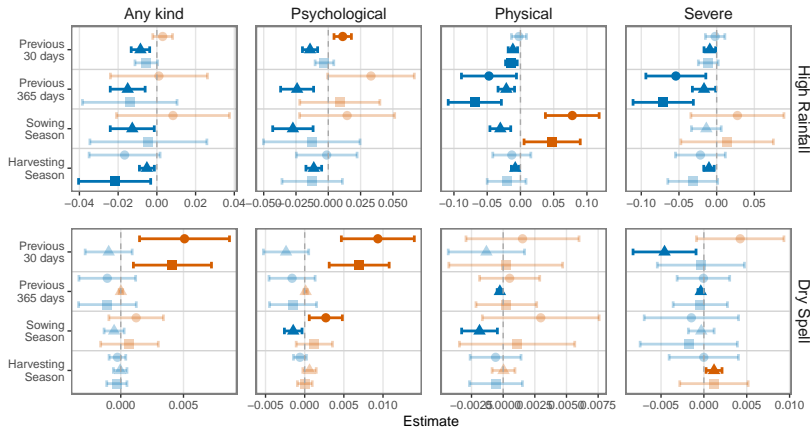


dry spell on the next slide

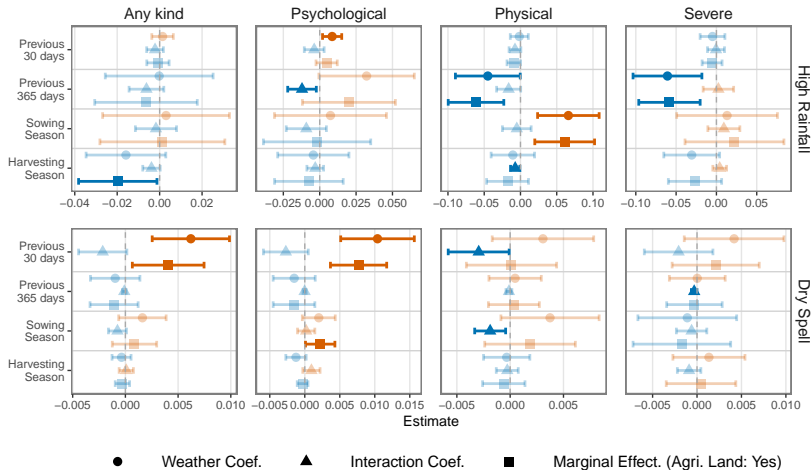
Heterogeneity Analysis: HH Income (ref: Poorest) | Dry Spell



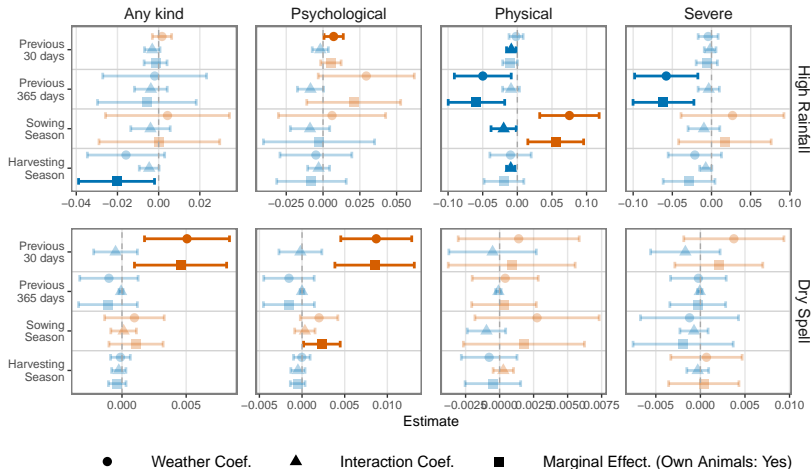
Potential Mechanisms: Child Work (ref: No Labor)



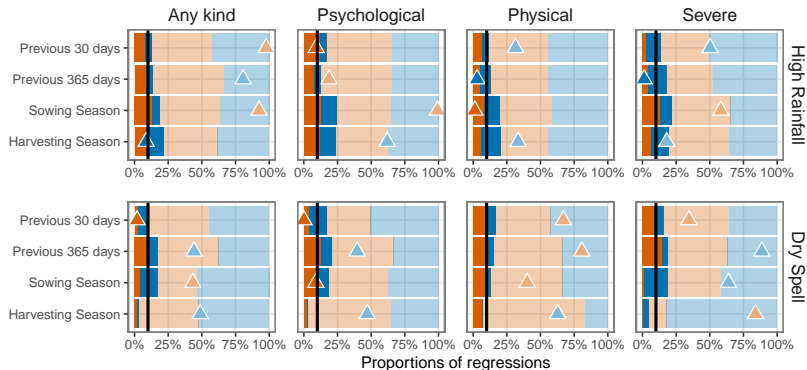
Potential Mechanisms: Land Ownership (ref: No Land Ownership)



Potential Mechanisms: Animal Ownership (ref: No Animals)



Placebo Analysis: Random Spatial Reallocation

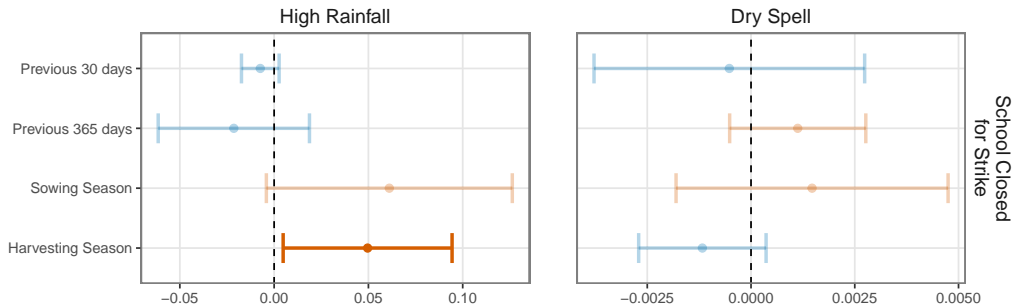


Weather Coef. Signif + Signif - Not Signif + Not Signif -

p-value using real data negative coef. positive coef.

Weather data replaced with random cell (10 years before). Bars: % regressions (101 repl.) with signif./non-signif. coefs. Triangles: p-value of the coefficient estimated using actual weather data. Vertical bar: 10% threshold.

Placebo Analysis: School Closed Due to Teachers Strike



◀ Back to the results