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

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joint with Marion Dovis[2] and Ewen Gallic[2,3]

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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.
- 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.

- **weather shocks** are defined here as:
  - **wet shocks**: higher than usual **rainfall**,
  - **dry shocks**: higher than usual **consecutive dry days**.
- **violence against children** is defined as:
  - psychological violence,
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What We Know So Far

- **Weather events and child maltreatment:**
  - **Low or middle income countries** (following **disasters** only):
    - Children were more likely to experience **unintentional injury** and **parental violence** during **floods** in Bangladesh in 2007 (Biswas et al., 2010).
    - 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).
  - **High income country**: Positive correlation between **temperature increases** and **child maltreatment** in the United States (Evans et al., 2024).
  - **This paper**: low income country + excess/lack of rain (not disasters)

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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 (UNICEF definition).
- **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.
- The MICS data we use correspond to 269 distinct grid cells in the weather dataset.

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Some Figures

	N	Overall $n = 17,912$	Female $n = 8,918$	Male $n = 8,995$	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)

Child Discipline

	N	Overall $n = 17,912$	Female $n = 8,918$	Male $n = 8,995$	p-val.	Psy.	Phys.	Severe
Yelled	17,906	85% (.004)	84% (.005)	85% (.005)	0.2	x		
Called dumb/lazy	17,898	36% (.005)	35% (.007)	37% (.007)	.034	x		
Shook	17,902	36% (.005)	36% (.007)	37% (.007)	0.2		x	
Spanked/hit bottom w. bare hand	17,907	56% (.005)	56% (.008)	56% (.007)	$>.9$		x	
Hit/slapped on the hand/arm/leg	17,905	44% (.005)	44% (.008)	45% (.007)	.2		x	
Hit on bottom/elsewhere w. belt/brush/stick	17,899	41% (.005)	38% (.008)	43% (.007)	$<.001$		x	x
Hit/slapped on the face/head/ears	17,901	27% (.005)	26% (.007)	27% (.007)	.14		x	x
Beat up as hard as one could	17,894	15% (.004)	14% (.005)	16% (.005)	.036		x	x

Table 2: Child discipline. Standard deviations in round brackets.

Descriptive Statistics Depending on Violence Type

	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	
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 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 → 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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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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Weather

Empirical Strategy

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

date: λ_t — interviewer: λ_e — meteo. grid: λ_g

- 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).
- $\textbf{Rainfall}_{htg}$ is the rainfall-based metrics for the household h in meteorological grid g at the date of interview t.
- X_i child characteristics and X_h household characteristics
- Standards errors are clustered at the grid level.

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meteo. grid

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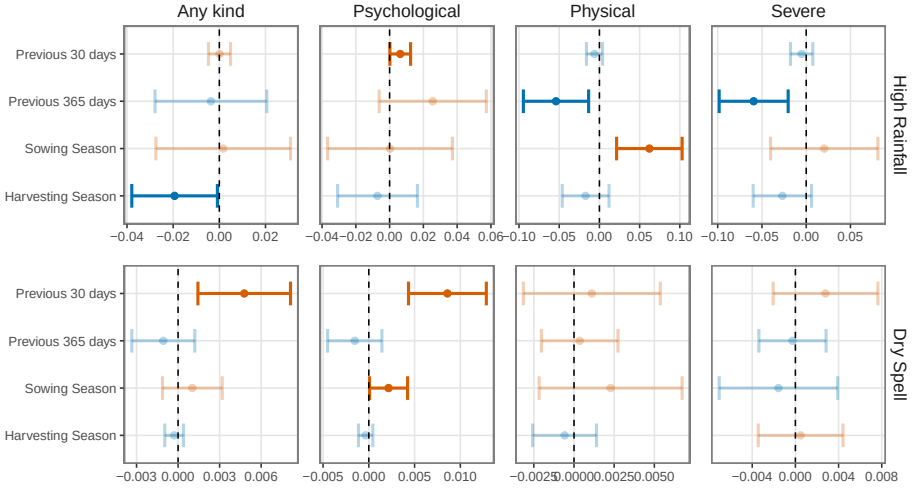
Empirical Strategy: Heterogeneity Analysis

variable of interest

$$\text{Violence}_{ihtcge} = \alpha + \beta_0 \text{Rainfall}_{htcg} + \beta_1 z + \beta_2 \text{Rainfall}_{htcg} \times z + \gamma_1 \boldsymbol{X_i}^{-z} + \gamma_2 \boldsymbol{X_h}^{-z} + \boldsymbol{\lambda_t} + \boldsymbol{\lambda_g} + \boldsymbol{\lambda_e} + \varepsilon_{ihtce}$$

- $\beta_2 > 0$: **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)
- **Household income** (📊): no systematic differences

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Potential Mechanisms

- **Child Work** (📊): **attenuating effect**. Involvement in income-generating activities may strengthen children's bargaining position, improve their outside options.
- **Agricultural Assets** :
  - Land Ownership (📊): no statistical difference.
  - Animal Ownership (📊): a mitigating effect on physical violence specifically during the harvesting and sowing seasons under heavy rainfall conditions but no differences for dry shocks.

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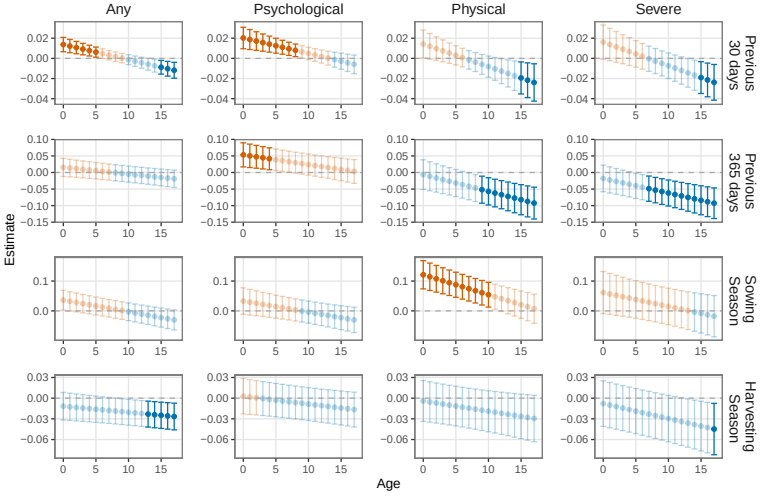
Potential Mechanisms: Income-Generating Through Age (High Rainfall)



Placebo Analysis

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

Placebo Analysis

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

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- **Over a full agricultural year**, excess rainfall **reduces physical and severe violence**.
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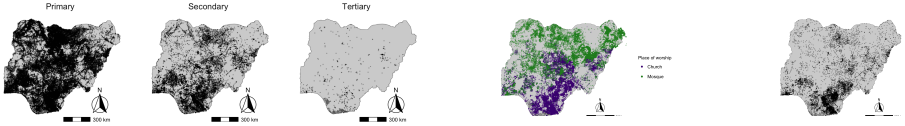
Next Steps

- Robustness tests
- Geocoded information (Source: eHealth Africa).



Public Schools. Places of worship. Markets.

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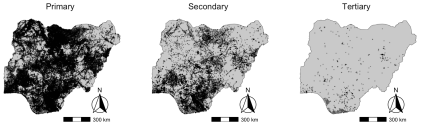

Public Schools. Places of worship. Markets.

Thank you

Comments are welcome!

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8. Data Appendix

Some Figures: Children Characteristics

	N	Overall $n = 17,912$	Female $n = 8,918$	Male $n = 8,995$	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 $n = 17,912$	Female $n = 8,918$	Male $n = 8,995$	p-value
Farm work prev. week	17,912	36% (0.005)	33% (0.007)	38% (0.007)	<0.001
Fetched 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 $n = 17,912$	Female $n = 8,918$	Male $n = 8,995$	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.

Back to characteristics on violence

Some Figures: Household Composition (2/2)

	N	Overall $n = 17,912$	Female $n = 8,918$	Male $n = 8,995$	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.

Back to characteristics on violence

Some Figures: Other Household Characteristics

	N	Overall $n = 17,912$	Female $n = 8,918$	Male $n = 8,995$	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 $n = 17,912$	Female $n = 8,918$	Male $n = 8,995$	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 (Havest. 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** ($d = 274$**th day of year**).
- **Step 1**: **typical precipitation** for **day** d

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

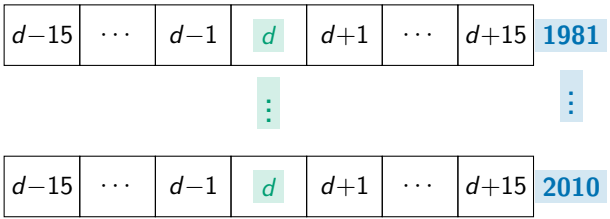


Figure 1: Reference data for day d: $31 \times 30 = 930$ obs.

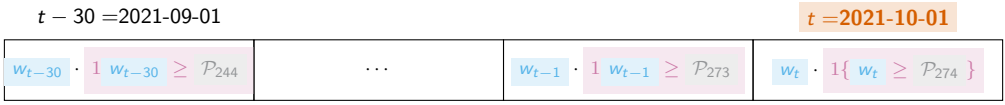
- **Step 2**: Compute $\mathcal{P}_d$, **90th percentile** of nonzero values in $\mathcal{W}$

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 **Exceptionnal Rainfall**:

Rainfall in upper tail

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



- **Step 5**: Standardization

Computed over 1981–2023

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

Back to definitions of the weather shocks

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**:

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

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

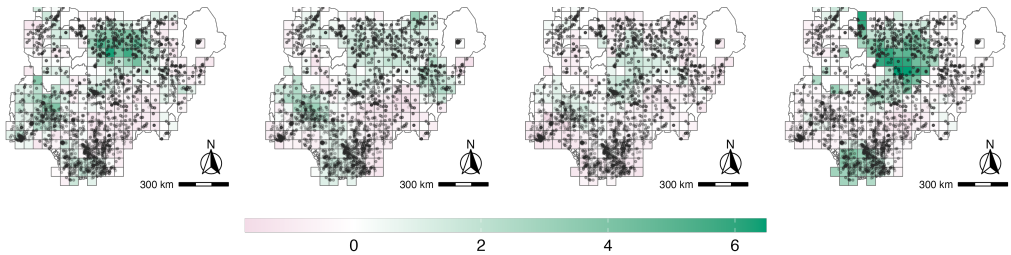
Here, there are two sequences of consecutive **dry days** of length 5 and 2:

$$DS_t = 5$$

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.

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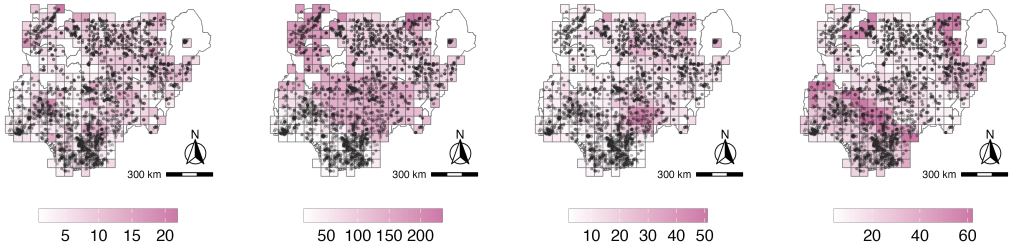
Dry Shock: Dry Spell

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.

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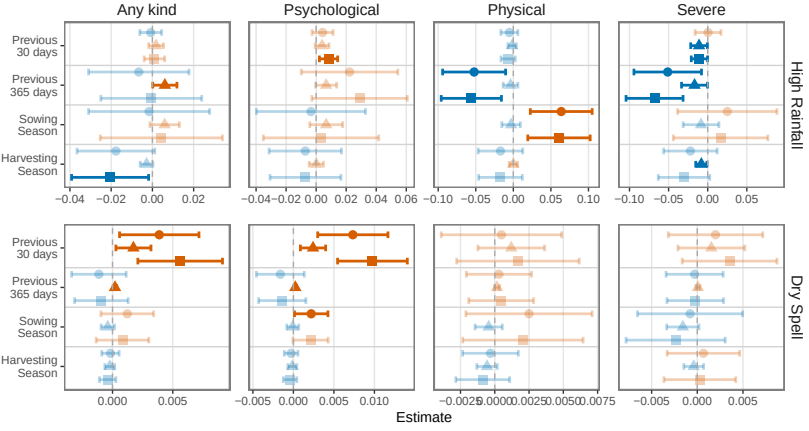
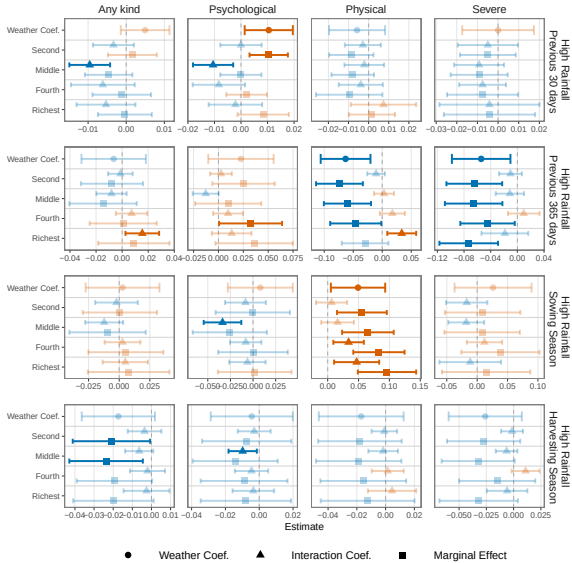
9. Additional Results

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



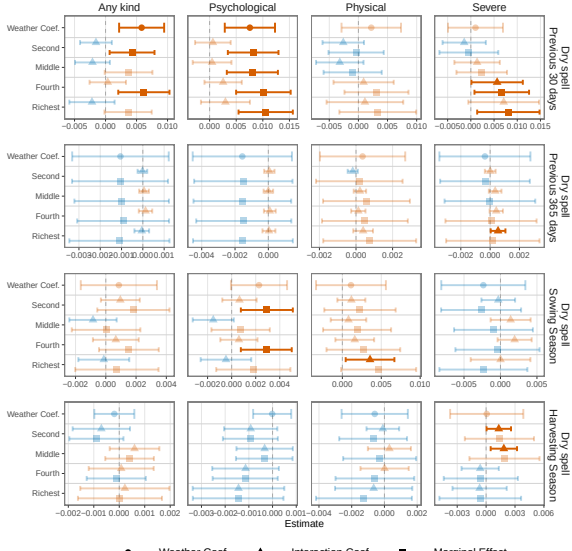
Back to the results

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



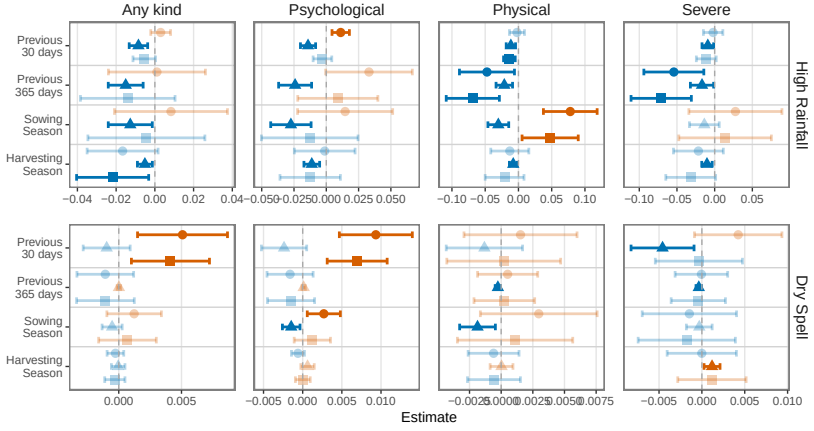
dry spell on the next slide

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



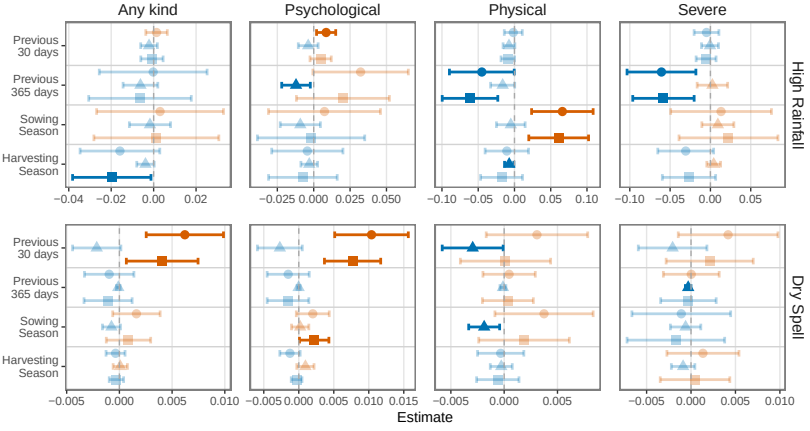
Back to the results

Potential Mechanisms: Child Work (ref: No Labor)



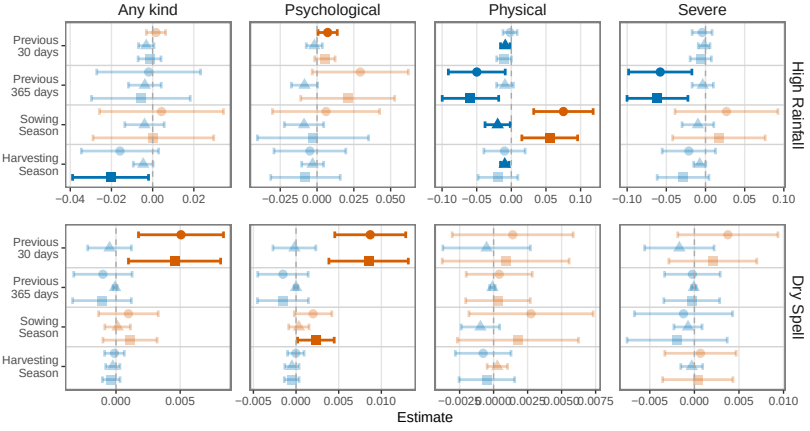
Back to the results

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



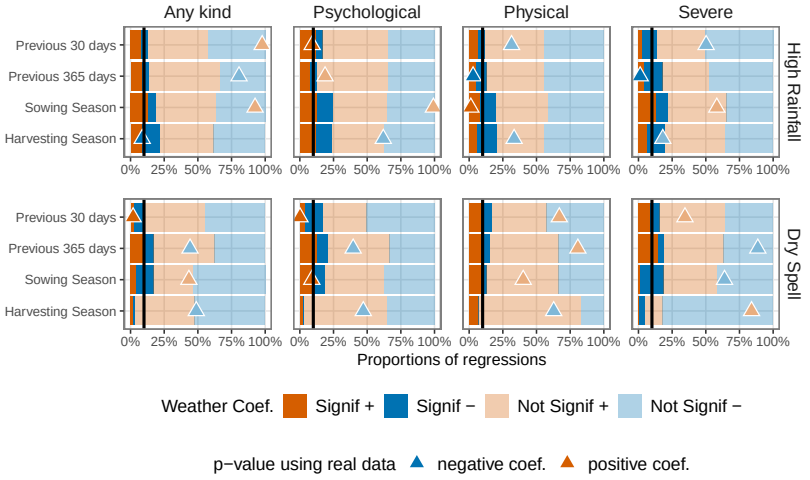
Back to the results

Potential Mechanisms: Animal Ownership (ref: No Animals)



Back to the results

Placebo Analysis: Random Spatial Reallocation



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.

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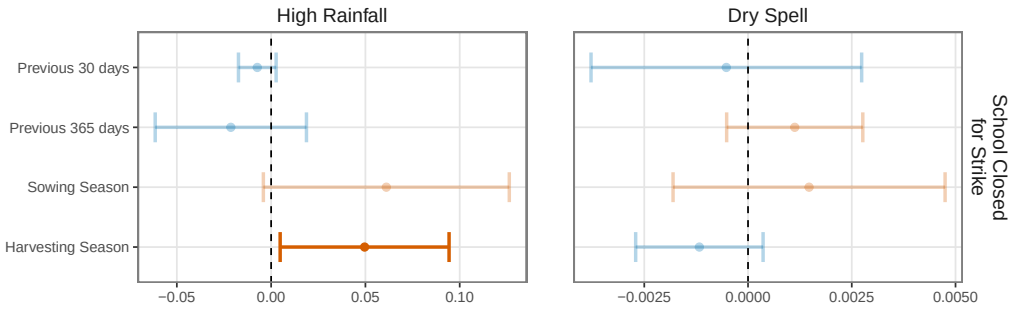
Placebo Analysis: School Closed Due to Teachers Strike



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