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

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1. Introduction

Motivations

- With one in two children having already experienced some form of violence (physical, psychological, or sexual) **child maltreatment** 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 child maltreatment, 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 **child maltreatment against children** in Nigeria.

- **weather shocks** are defined here as:
  - **wet shocks**: higher than usual **rainfall**,
  - **dry shocks**: higher than usual **consecutive dry days**.
- **child maltreatment** is defined as:
  - psychological violence,
  - physical 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., 2025).
  - **This paper**: low income country + excess/lack of rain (not disasters)

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Preview of the (Preliminary) Results

- We investigate different channels:
  - **Stress channel**: weather shocks directly affect human behavior via biological and cognitive pathways.
  - **Economic channel**: weather shocks affect economic conditions, which in turn alter incentives for violence.
  - **Exit option**: access to protective institutions (such as religious facilities) can shape violence.
- Our findings:
  - Climate shocks increase psychological violence in the short run via a stress channel.
  - Excess rainfall reduces physical violence in the long run via an economic channel.
  - Girls, urban children, and those farther from places of worship are more exposed.
  - Child labour and rural assets buffer long-run violence, possibly through a bargaining mechanism.

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2. Data

Data: Survey

- **2021 Multiple Indicator Cluster Survey (MICS) including geocoded data for Nigeria:**
  - Data on children were collected through interviews with 28,689 households conducted between September and December **2021**:
    - all children under age 5 living in the household: 30,835 children,
    - one child aged 5–17 randomly selected per household: 22,528 children.
  - The child discipline module includes eight **disciplinary practices**: two **violent psychological** practices, six **violent physical** practices, and one nonviolent disciplinary practices (UNICEF definition).
  - The questions were answered by the **mother** or **primary caregiver** of the selected child.

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Construction of Child Maltreatment Variables

"Adults use certain ways to teach children the right behaviour or to address a behaviour problem. I will read various methods that are used. Please tell me if you or any other adult in your household has used this method with (name) in the past month."

	Psychological	Physical	Severe	Any
Yelled	x			x
Called dumb/lazy	x			x
Spanked/hit bottom w. bare hand		x		x
Hit/slapped on the hand/arm/leg		x		x
Shook		x	x	x
Hit on bottom/elsewhere w. belt/brush/stick		x	x	x
Hit/slapped on the face/head/ears		x	x	x
Beat up as hard as one could		x	x	x

All variables are binary indicators equal to 1 if at least one listed act was reported in the past month.

Some Figures

Maltreatment	Overall	Under 5	5 to 17	p-value
	$n = 38,592$	$n = 20,767$	$n = 17,825$	
Any	89% (0.002)	85% (0.003)	93% (0.003)	<0.001
Psychological	82% (0.003)	78% (0.004)	88% (0.003)	<0.001
Physical	77% (0.003)	74% (0.004)	80% (0.004)	<0.001
Severe	44% (0.004)	36% (0.005)	53% (0.005)	<0.001

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

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

Child Discipline

	Overall $n = 38,592$	Under 5 $n = 20,767$	5 to 17 $n = 17,825$	p-val.	Psy.	Phys.	Severe
Yelled	80% (0.003)	75% (0.004)	85% (0.004)	<0.001	x		
Called dumb/lazy	29% (0.003)	23% (0.004)	36% (0.005)	<0.001	x		
Spanked/hit bottom w. bare hand	54% (0.004)	52% (0.005)	56% (0.005)	<0.001		x	
Hit/slapped on the hand/arm/leg	41% (0.004)	38% (0.005)	44% (0.005)	<0.001		x	
Shook	36% (0.003)	35% (0.005)	36% (0.005)	0.13		x	
Hit on bottom/elsewhere w. belt/brush/stick	32% (0.003)	25% (0.004)	40% (0.005)	<0.001		x	x
Hit/slapped on the face/head/ears	22% (0.003)	18% (0.004)	27% (0.005)	<0.001		x	x
Beat up as hard as one could	11% (0.002)	7.7% (0.003)	15% (0.004)	<0.001		x	x

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

Descriptive Statistics Depending on Violence Type (5 to 17 yo)

	Any kind				Psychological			
	Yes		No		Yes		No	
Sex: Female	50%	(0.018)	50%	(0.006)	51%	(0.014)	50%	(0.006)
Age	9.24	(0.11)	9.04	(0.03)	**9.01**	**(0.08)**	**9.06**	**(0.03)**
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 any animals	47%	(0.017)	45%	(0.005)	47%	(0.014)	45%	(0.006)
Own agricultural land	61%	(0.018)	62%	(0.006)	60%	(0.015)	62%	(0.006)

	Physical				Severe			
Sex: Female	51%	(0.011)	49%	(0.006)	**52%**	**(0.008)**	**48%**	**(0.007)**
Age	**9.67**	**(0.07)**	**8.91**	**(0.03)**	9.07	(0.05)	9.05	(0.04)
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 any animals	**48%**	**(0.011)**	**45%**	**(0.006)**	45%	(0.007)	45%	(0.007)
Own agricultural land	61%	(0.012)	62%	(0.006)	**59%**	**(0.008)**	**63%**	**(0.008)**

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

Data: Weather/Climate

- **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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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.

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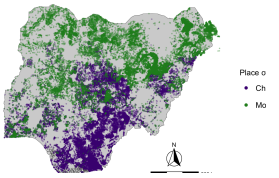
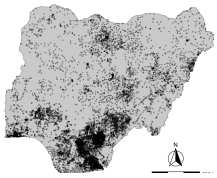
  - Droughts increasingly mitigated by irrigation
  - But excess rainfall is harder to manage and more destructive to output.

Weather

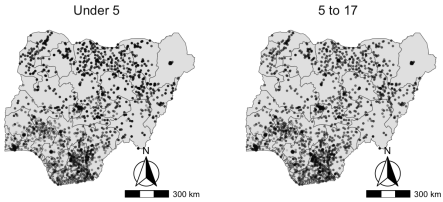
Data: Amenities (proxy for outside option, source: eHealth Africa)



Places of worship



Markets



Household Location

3. Methods

Empirical Strategy

$$\text{Violence}_{ihtge} = \alpha + \beta_1 \textbf{DrySpell}_{htg} + \beta_2 \textbf{HRain}_{htg} + \boldsymbol{\gamma_1} X_i + \boldsymbol{\gamma_2} \boldsymbol{X_h} + \boldsymbol{\lambda_t} + \boldsymbol{\lambda_g} + \boldsymbol{\lambda_e} + \varepsilon_{ihtge} \quad (1)$$

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

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$$\text{Violence}_{ihtge} = \alpha + \beta_1 \textbf{DrySpell}_{htg} + \beta_2 \textbf{HRain}_{htg} + \boldsymbol{\gamma_1} X_i + \boldsymbol{\gamma_2} \boldsymbol{X_h} + \underbrace{\boldsymbol{\lambda_t} + \boldsymbol{\lambda_g}}_{\text{meteo. grid}} + \overbrace{\boldsymbol{\lambda_e}}^{\text{interviewer}} + \varepsilon_{ihtge} \quad (1)$$

$\boldsymbol{\lambda_t}$: date

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- X_i child characteristics and $\boldsymbol{X_h}$ household characteristics
- Standards errors are clustered at the grid level.

Empirical Strategy: Heterogeneity Analysis

variable of interest

$$\begin{aligned}\text{Violence}_{ihtcge} =& \alpha + \beta_1 \textbf{DrySpell}_{htcg} + \zeta z + \delta_1 \textbf{DrySpell}_{htcg} \times z \\ &+ \beta_2 \textbf{HRain}_{htcg} + \delta_2 \textbf{HRain}_{htcg} \times z \\ &+ \boldsymbol{\gamma_1 X_i}^{-z} + \boldsymbol{\gamma_2 X_h}^{-z} + \boldsymbol{\lambda_t} + \boldsymbol{\lambda_g} + \boldsymbol{\lambda_e} + \varepsilon_{ihtce} \end{aligned} \quad (2)$$

The coefficients of the interaction:

- $\delta_1 > 0$, $\delta_2 > 0$: **Exacerbating effect**
- $\delta_1 < 0$, $\delta_2 < 0$: **Attenuating effect**

4. Results

Baseline Results: 5 to 17 years old

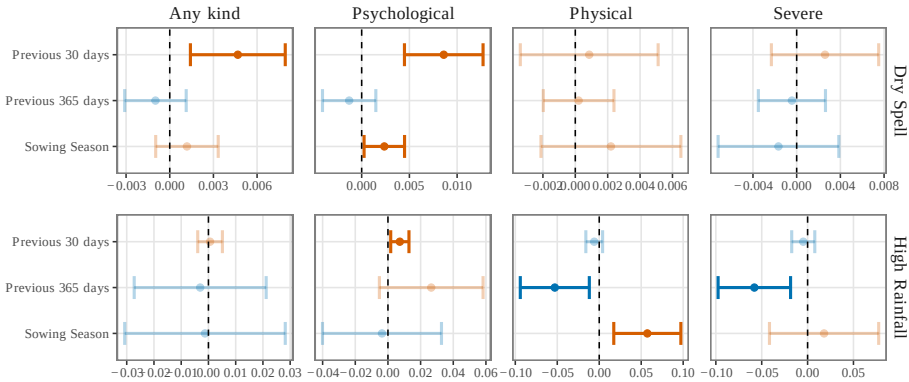

Figure 1: Coefficients β_1 (top) and β_2 (bottom) according to definition period.

(for children under 5 years old)

Benchmark Model

- **Short term (30 days)** : **stress channel hypothesis**
  - weather shocks (dry shocks and excess rainfall) are associated with an increase in **psychological violence**
- **Medium term (365 days)** : **economic channel hypothesis**
  - excess rainfall is associated with a **decrease in physical and severe violence**
  - no significant effect of prolonged dry spells
  - hypothesis: improvement in agricultural income.
- **Sowing Season** : the nature of the shock matters
  - a dry shock is associated with an increase in **psychological violence**
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Potential Mechanisms

We test three theoretical channels through heterogeneity analyses:

Stress Channel

Mechanism: *Immediate psychological burden following a shock.*

Proxies:

- *Gender (differential vulnerability)*

Horizon: *Short-run*

Economic Channel

Mechanism: *Shock to household income / resources*

Proxies:

- *Urban vs. Rural*
- *Agricultural assets*
- *Animal assets*
- *Child labour*

Horizon: *Long-run*

Exit Option

Mechanism: *Access to external social space reducing exposure*

Proxies:

- *Distance to nearest place of worship*

Horizon: *Short-run*

Heterogeneity: Gender

Gender (📊)

- Girls are more exposed to **psychological violence** than boys following climate shocks.
- This is observed both in the short-run and in the medium-run.
- They are less exposed to **severe violence** in the medium-run.

- This is consistent with literature on gender-differentiated vulnerability to household violence.

Heterogeneity: Urban vs. Rural (Economic Channel)

Rural households (📊)

- **Short-run:** slight attenuation of violence following drought.
- **Medium-run:** reduction in psychological and physical violence following excess rainfall.

Potential explanations:

- in rural households: mutual aid, ability to smooth shocks using own land/stored harvests ;
- in urban households: food scarcity and/or rising food prices following climate shocks which would provide fewer buffers against income fluctuations.

Heterogeneity: Agricultural and Animal Assets

Agricultural assets (📊)

- **Short-run:** slight attenuation but no clear effect.
- **Medium-run:** small effect on psychological violence following excess rainfall.
- Results not strongly significant overall.

Animal assets (📊)

- **Short-run:** no difference ⇒ consistent with stress channel.
- **Long-run:** small reduction in physical & severe violence following excess rainfall ⇒ consistent with economic channel.

Heterogeneity: Child Labour (bargaining channel)

Child labour (📊)

- **Short-run:** mitigating effect following excess rainfall shocks
- **Long-run:** children in working households show reduced psychological, physical & severe violence after excess rainfall shocks.

Potential explanation:

- child's **economic contribution** increases their **bargaining power** within the household.

Heterogeneity: Distance to Place of Worship (Exit Option)

Distance to place of worship (📊)

- **Short-run:** greater distance to a place of worship → **larger marginal effect** on psychological violence (dry spell shock; also slightly for high-rainfall shock).
- **Long-run:** mostly not significant.

Potential explanation:

- places of worship provide an *outside option* for children, reducing violence exposure.

Heterogeneity and Robustness Tests

- Heterogeneity
  - Child labour: hours
  - Mother lives in the household, Father lives in the household
  - Child age
  - Sanitation
  - Water source
  - Education of the head of the household
  - Wealth index
  - Climate classification
- Robustness
  - 95th quantile for rainfall, 99th quantile
  - Temperature bins
  - Placebo with wrongly matched weather data

5. Conclusion

Conclusion

- Climate shocks increase **psychological violence** in the **short run** via a stress channel.
- Excess rainfall **reduces physical violence** in the **long run** via an economic channel.
- Girls, urban children, and those farther from places of worship are more exposed.
- Child labour and rural assets buffer long-run violence, possibly through a bargaining mechanism.

Next steps

- Additional heterogeneity test: do children in polygamous households face a *different* baseline risk of violence?
- Additional robustness check: do regions exposed to the Boko Haram insurgency respond differently to weather shocks?

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Thank you

Comments are welcome!

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6. Appendix

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8. Data Appendix

Some Figures: Gender

	Overall	Female	Male	p-value
Children: under 5	$n = 20,767$	$n = 10,237$	$n = 10,530$	
Any	85% (0.003)	85% (0.005)	86% (0.004)	0.4
Psychological	78% (0.004)	77% (0.006)	78% (0.005)	0.2
Physical	74% (0.004)	73% (0.006)	75% (0.006)	0.009
Severe	36% (0.005)	35% (0.007)	36% (0.006)	0.2
Children: 5–17	$n = 17,825$	$n = 8,880$	$n = 8,945$	
Any	93% (0.003)	93% (0.004)	93% (0.004)	0.9
Psychological	88% (0.003)	87% (0.005)	88% (0.004)	0.4
Physical	80% (0.004)	80% (0.006)	81% (0.006)	0.15
Severe	53% (0.005)	52% (0.008)	55% (0.007)	$<$0.001

Table 4: Child gender. Standard deviations in round brackets.

Back to characteristics on violence

Some Figures: Children Characteristics

	Overall $n = 38,592$	Under 5 $n = 20,767$	5 to 17 $n = 17,825$	p-value
Age	5.6 (0.0)	2.6 (0.0)	9.1 (0.0)	<0.001
Sex: Female	50% (0.004)	49% (0.005)	50% (0.005)	0.5
Natural mother alive	98% (0.001)	99% (0.001)	96% (0.002)	<0.001
Natural father alive	95% (0.002)	98% (0.002)	93% (0.003)	<0.001

Table 5: Children characteristics. Standard deviations in round brackets.

Back to characteristics on violence

Some Figures: Child Labour

	Overall $n = 38,592$	Under 5 $n = 20,767$	5 to 17 $n = 17,825$	p-value
Farm work prev. week	16% (0.002)	0% (0.000)	35% (0.005)	<0.001
Fetched water prev. week	26% (0.003)	0% (0.000)	55% (0.005)	<0.001

Table 6: Child Labour. Standard deviations in round brackets.

Back to characteristics on violence

Some Figures: Household Composition (1/2)

	Overall $n = 38,592$	Under 5 $n = 20,767$	5 to 17 $n = 17,825$	p-value
No. women 15-49	1.50 (0.01)	1.61 (0.01)	1.39 (0.01)	<0.001
No. men 15-49	0.60 (0.01)	0.62 (0.01)	0.57 (0.01)	<0.001
No. children under 5	1.56 (0.01)	2.03 (0.01)	1.01 (0.01)	<0.001
No. children 5-17	2.77 (0.01)	2.72 (0.02)	2.82 (0.02)	<0.001
Sex of HH: Female	10% (0.002)	7.1% (0.003)	14% (0.004)	<0.001
Age of HH head	46 (0)	44 (0)	48 (0)	<0.001

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

Back to characteristics on violence

Some Figures: Household Composition (2/2)

	Overall $n = 38,592$	Under 5 $n = 20,767$	5 to 17 $n = 17,825$	p-value
Ethnicity of HH head				<0.001
Hausa	32% (0.003)	35% (0.004)	27% (0.004)	
Igbo	14% (0.004)	12% (0.005)	16% (0.006)	
Yoruba	13% (0.002)	11% (0.003)	16% (0.004)	
Fulani	8.9% (0.002)	9.9% (0.002)	7.6% (0.002)	
Other or None	32% (0.003)	31% (0.004)	33% (0.005)	
Education of HH head				<0.001
None	33% (0.003)	35% (0.004)	31% (0.005)	
Primary	20% (0.003)	18% (0.004)	21% (0.005)	
Junior secondary	4.7% (0.002)	4.6% (0.002)	4.8% (0.002)	
Senior secondary	26% (0.003)	26% (0.004)	26% (0.005)	
Higher/tertiary	17% (0.003)	17% (0.004)	17% (0.004)	
Religion of HH head				0.9
Christianity	42% (0.004)	37% (0.005)	48% (0.005)	
Islam	57% (0.004)	62% (0.005)	51% (0.005)	
Other or None	0.7% (0.000)	0.7% (0.001)	0.7% (0.001)	

Table 8: Household Composition. Standard deviations in round brackets.

Back to characteristics on violence

Some Figures: Other Household Characteristics

	Overall $n = 38,592$	Under 5 $n = 20,767$	5 to 17 $n = 17,825$	p-value
No. members / sleep. room	3.27 (0.01)	3.41 (0.01)	3.10 (0.02)	<0.001
Own agricultural land	65% (0.004)	67% (0.005)	62% (0.006)	<0.001
Own any animals	48% (0.004)	51% (0.005)	45% (0.005)	<0.001
Area type: Rural	63% (0.004)	66% (0.005)	59% (0.006)	<0.001
Wealth index quintile				<0.001
Poorest	24% (0.003)	26% (0.004)	21% (0.004)	
Second	22% (0.003)	23% (0.004)	20% (0.004)	
Middle	20% (0.003)	20% (0.004)	20% (0.004)	
Fourth	18% (0.003)	17% (0.004)	20% (0.005)	
Richest	17% (0.003)	15% (0.004)	19% (0.005)	
Closest market (km)	4.7 (0.0)	5.0 (0.0)	4.4 (0.0)	<0.001
Closest worship place (km)	2.8 (0.0)	2.9 (0.0)	2.7 (0.0)	<0.001

Table 9: Other Household Characteristics. Standard deviations in round brackets.

Back to characteristics on violence

Some Figures: Weather Shocks

	Overall $n = 38,592$	Under 5 $n = 20,767$	5 to 17 $n = 17,825$	p-value
High Rainfall (prev. 30 days)	0.96 (0.01)	0.99 (0.02)	0.93 (0.02)	0.13
High Rainfall (prev. 365 days)	0.54 (0.01)	0.55 (0.01)	0.52 (0.01)	0.044
High Rainfall (Sowing season)	-0.14 (0.01)	-0.12 (0.01)	-0.17 (0.01)	<0.001
Dry Spell (prev. 30 days)	6.1 (0.0)	6.2 (0.0)	6.0 (0.0)	<0.001
Dry Spell (prev. 365 days)	82 (0)	85 (0)	78 (1)	<0.001
Dry Spell (Sowing season)	12 (0)	12 (0)	12 (0)	<0.001

Table 10: 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

$$\mathcal{W} = \{(w_{d_y-15}, \ldots, w_{d_y+15})\}_{y=1981}^{2010}, \tag{3}$$

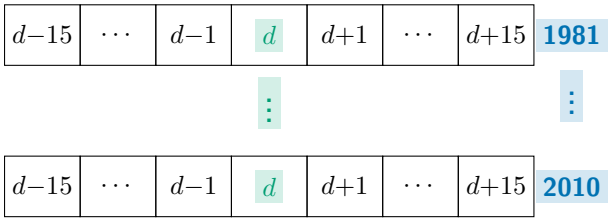


Figure 2: Reference data for day d: $31 \times 30 = 930$ obs.

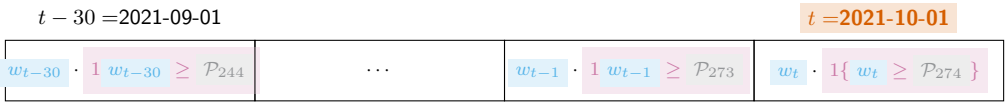
- **Step 2**: Compute $\mathcal{P}_d$, **90th percentile** of nonzero values in $\mathcal{W}$

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**:

$$DS_t = \max_{k \in [1,30]} \left\{ k : \exists i \in [t-29, t-k+1] \text{ such that } r_j < 1 \text{ for all } j \in [i, i+k-1] \right\}. \tag{4}$$

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

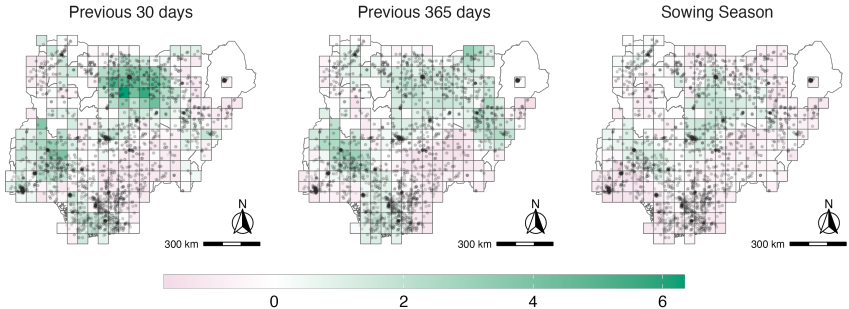
Here, there are two sequences of consecutive **dry days** of length 5 and 2:

$$DS_t = 5$$

Back to definitions of the weather shocks

Wet Shock: High Rainfall

Figure 3: 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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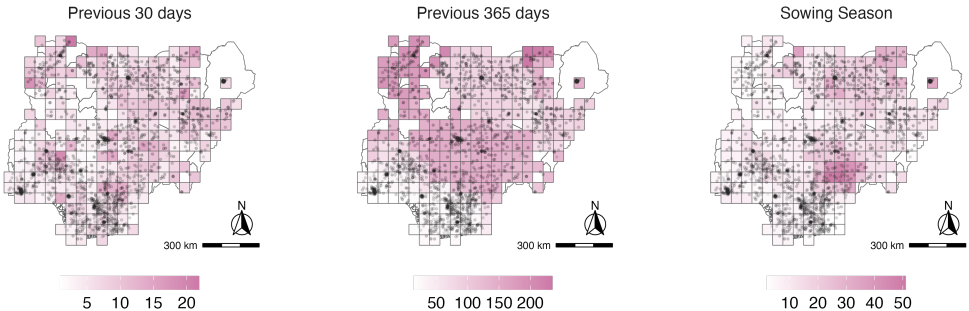
Dry Shock: Dry Spell

Figure 4: 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

Baseline Results: Under 5 years old

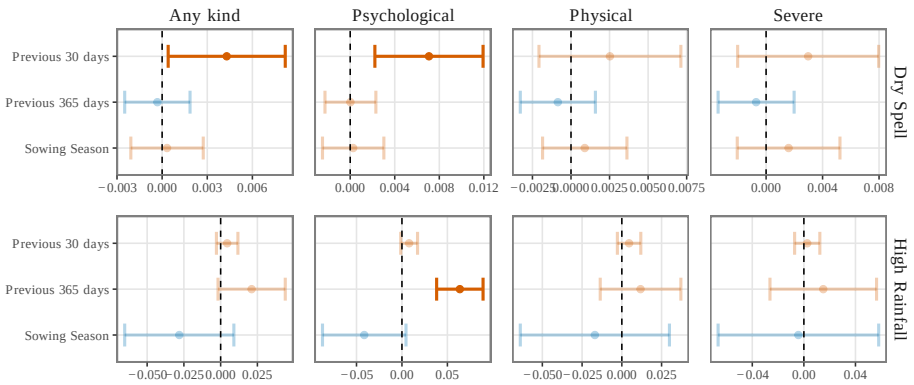

Figure 5: Coefficients β_1 (top) and β_2 (bottom) according to definition period.

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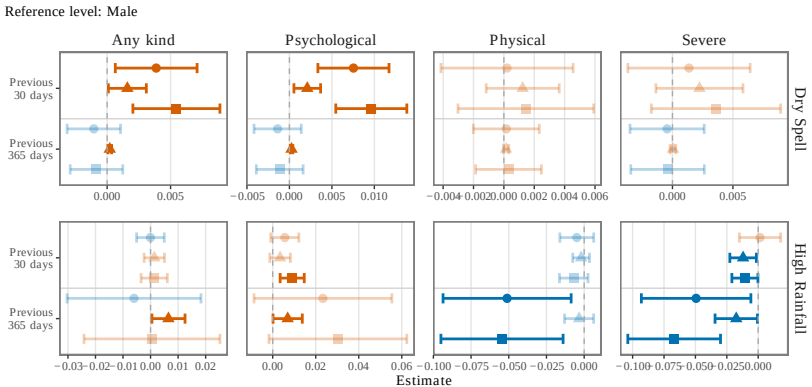
Heterogeneity Analysis: Sex of the Child



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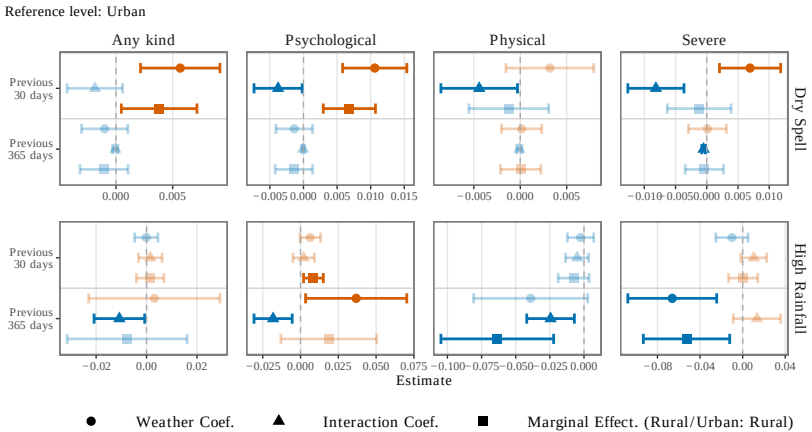
Heterogeneity Analysis: Urban vs. Rural Households



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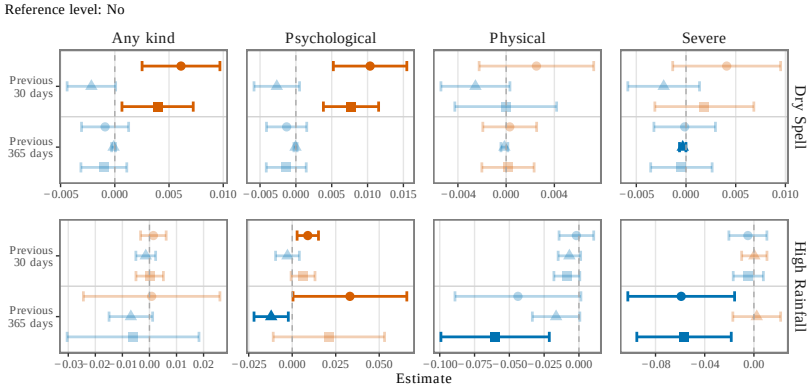
Heterogeneity Analysis: Agricultural Assets



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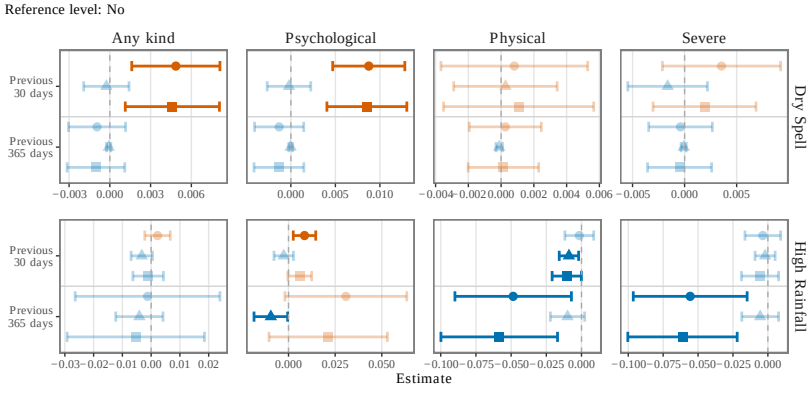
Heterogeneity Analysis: Animal Assets



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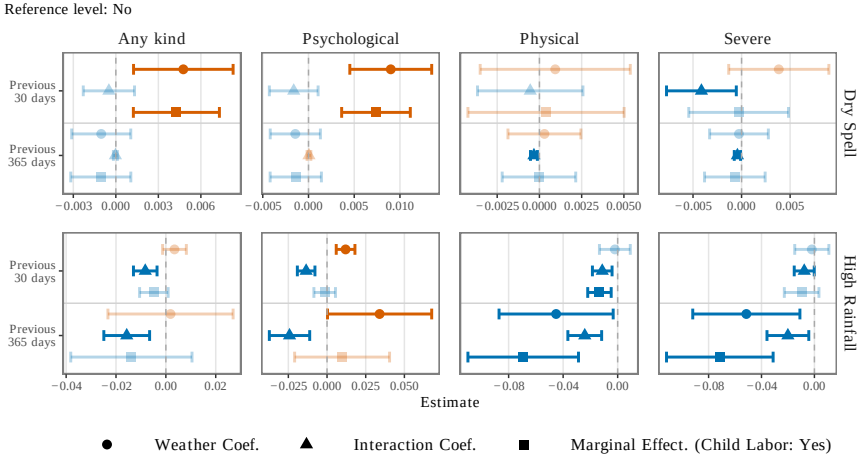
Heterogeneity Analysis: Child Labour



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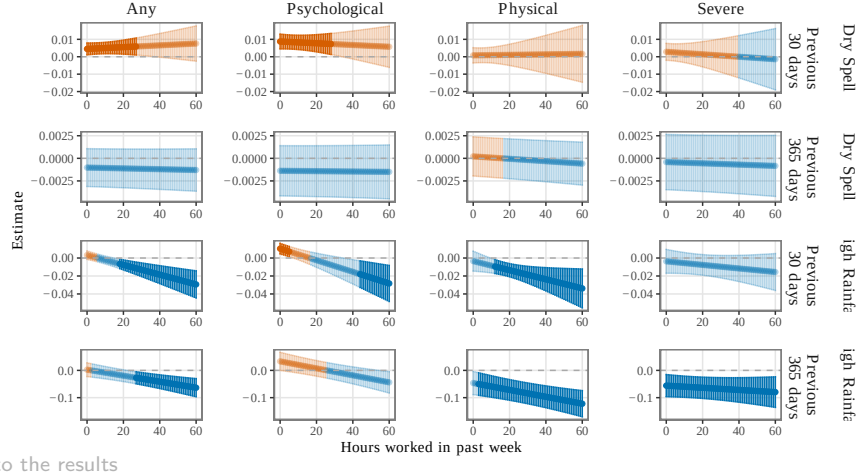
Heterogeneity Analysis: Child Labour (Hours)



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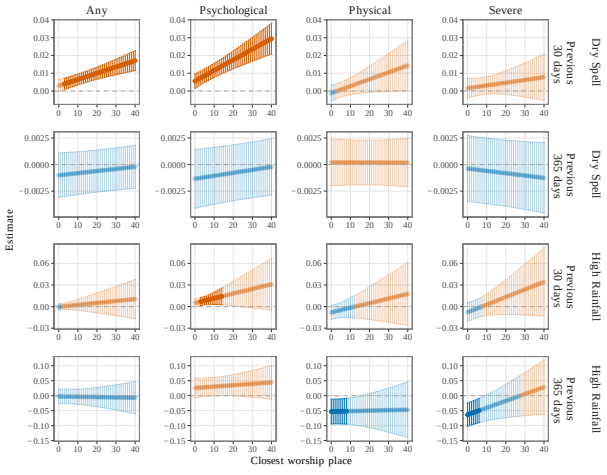
Heterogeneity Analysis: Distance to Place of Worship



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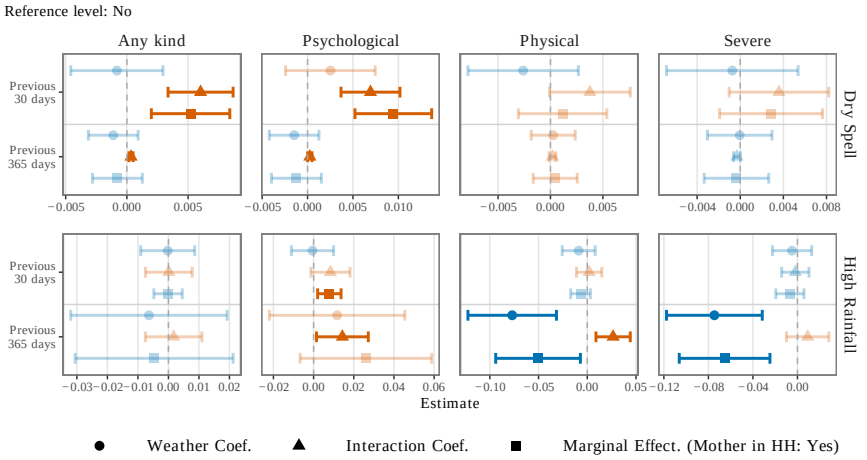
Heterogeneity Analysis: Mother lives in the household (children 5 to 7)



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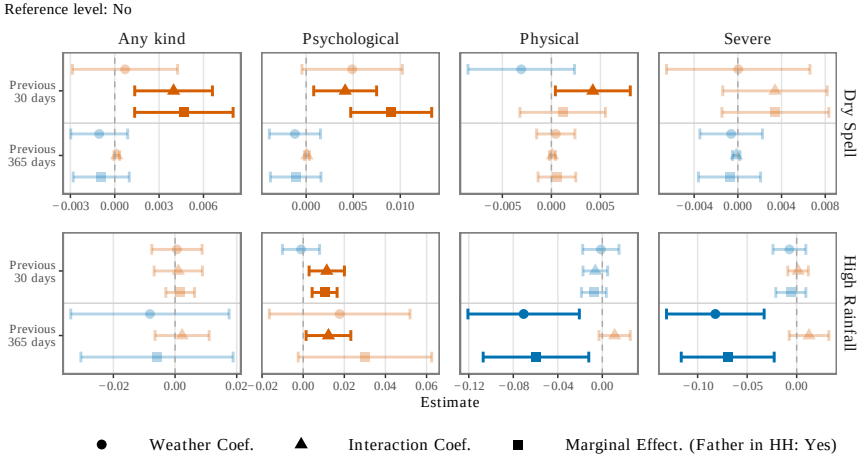
Heterogeneity Analysis: Father lives in the household



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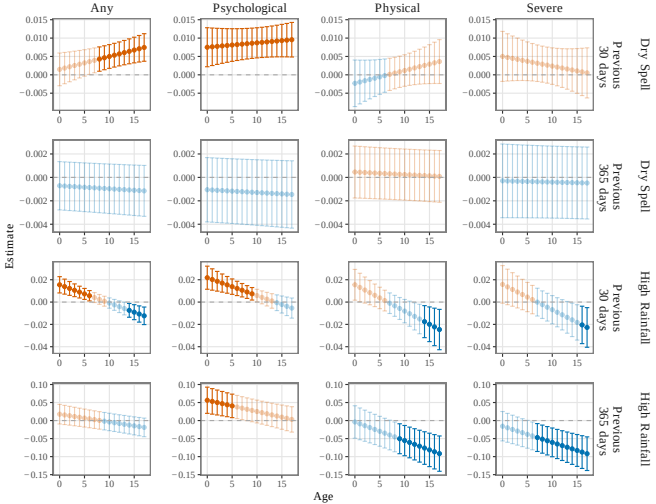
Heterogeneity Analysis: Child Age



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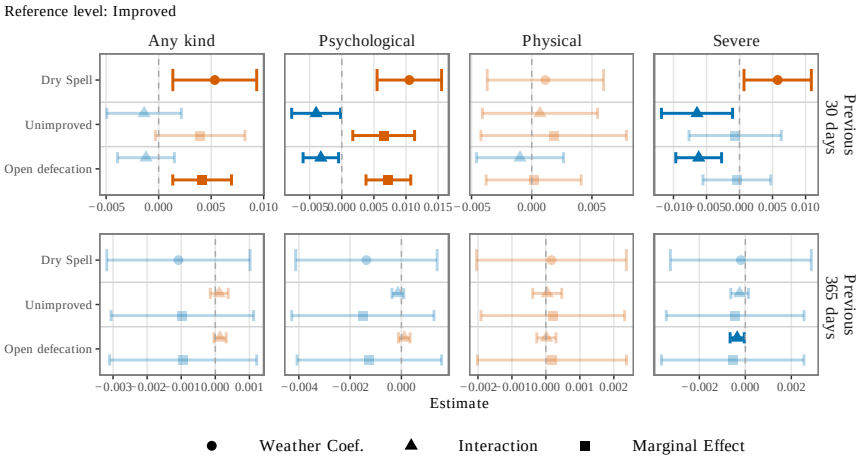
Heterogeneity Analysis: Sanitation (Dry Spell)



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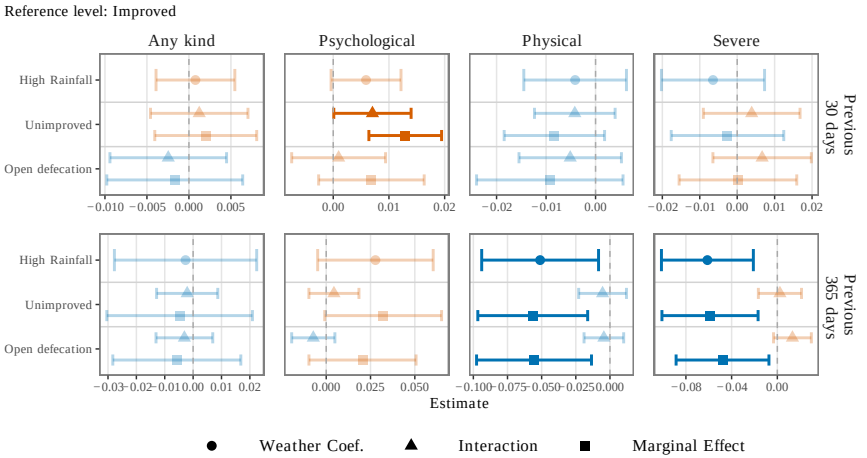
Heterogeneity Analysis: Sanitation (High Rainfall)



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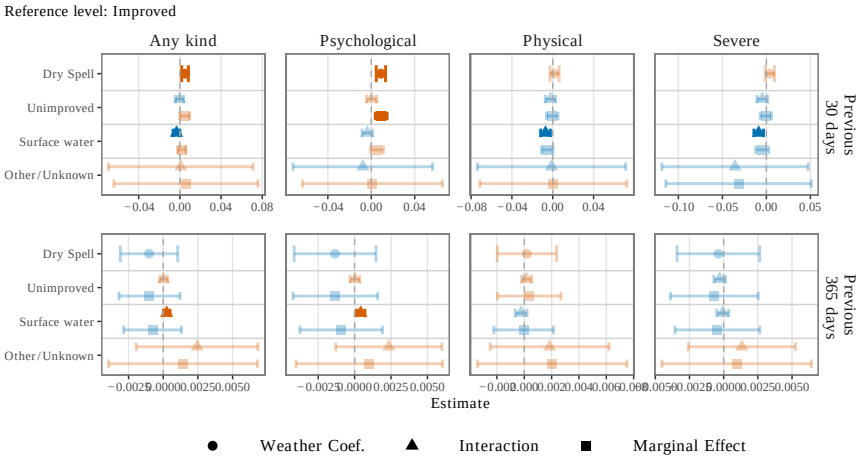
Heterogeneity Analysis: Water Source (Dry Spell)



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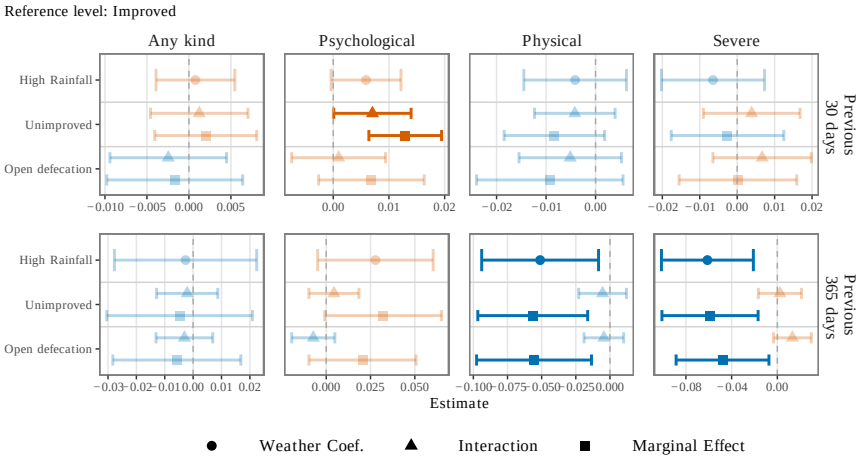
Heterogeneity Analysis: Water Source (High Rainfall)



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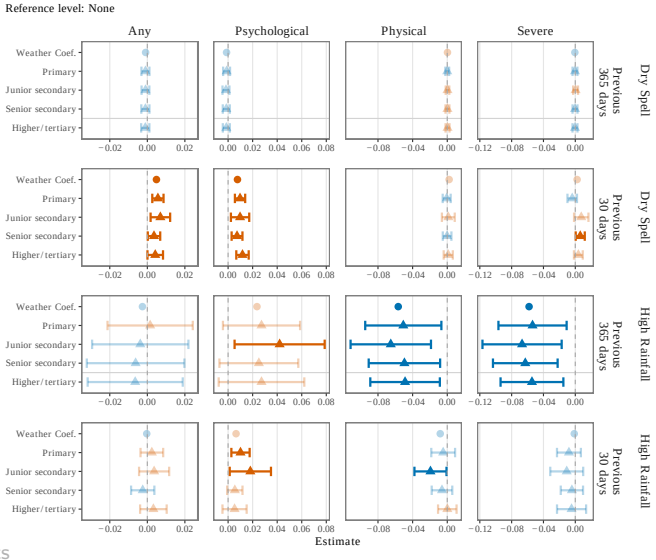
Heterogeneity Analysis: Education of the head of the household



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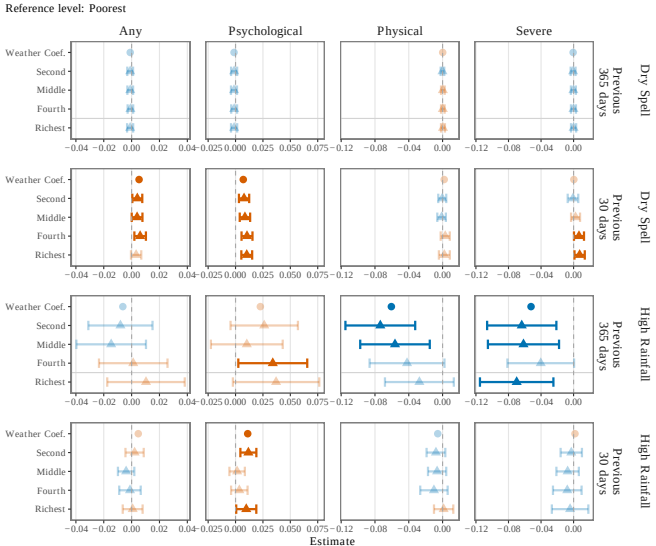
Heterogeneity Analysis: Wealth Index



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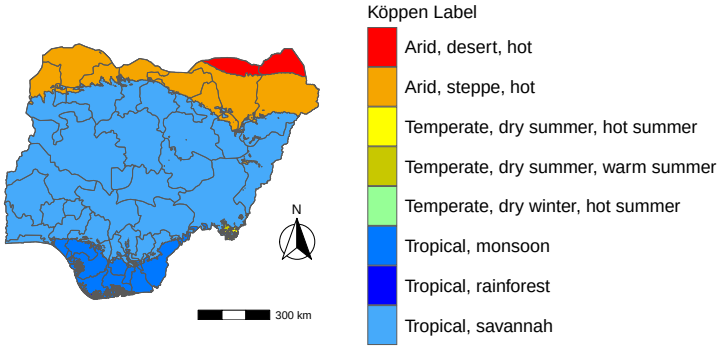
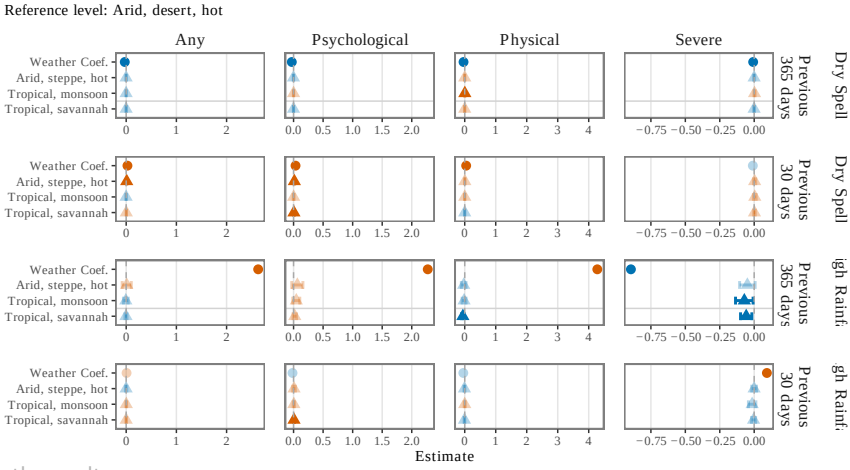
Heterogeneity Analysis: Climate Classification

- We use the Köppen-Geiger climate classification (Beck et al., 2023).



Heterogeneity Analysis: Climate Classification



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Robustness Analysis: 95th Quantile for Rainfall

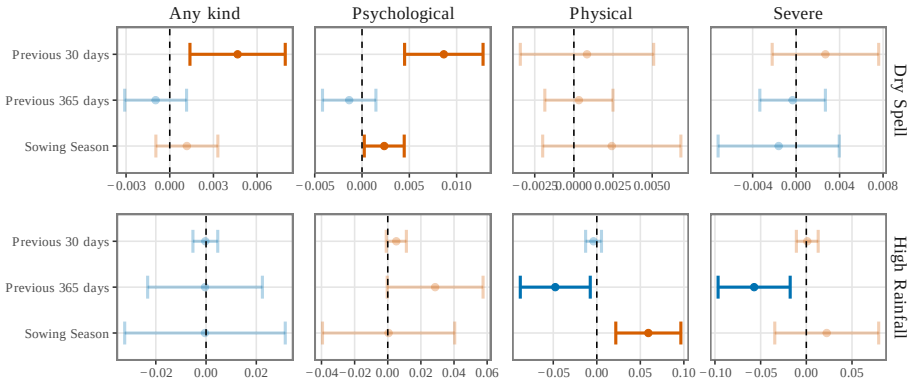

Figure 6: Coefficients β_1 (top) and β_2 (bottom) according to definition period.

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Robustness Analysis: 99th Quantile for Rainfall

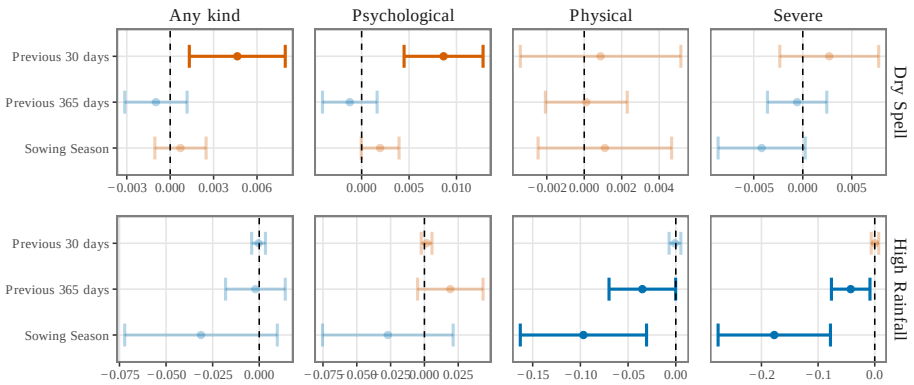

Figure 7: Coefficients β_1 (top) and β_2 (bottom) according to definition period.

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Robustness Analysis: Temperature bins

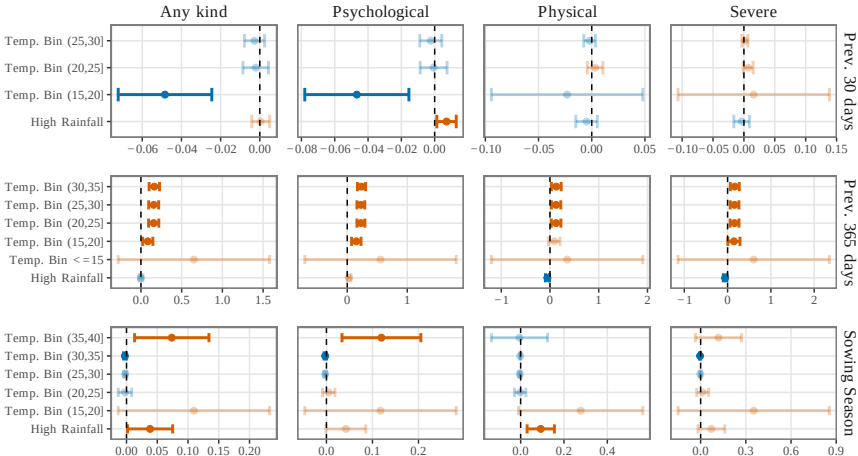

Figure 8: Using temperature bins instead of dry spell.

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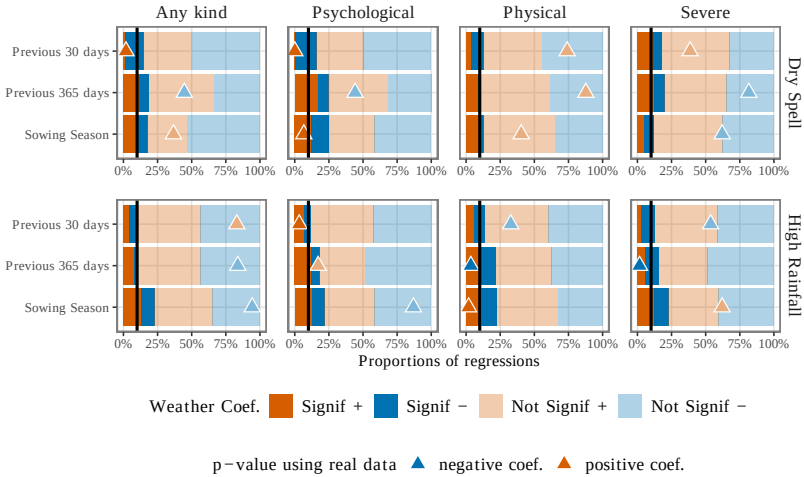
Placebo Analysis: Random Spatial Reallocation



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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