

Does Childhood Immunization Rebound After Extreme Shocks? Evidence from Floods and Strikes in Pakistan Online Appendix

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ONLINE APPENDIX

A1. Strikes by vaccinators

One of the encumbering shocks to health service delivery was the strikes announced by the public health officials responsible for vaccinating children. This led to the suspension of immunization services in some of the districts of Sindh, Pakistan. These strikes took place in Hyderabad, Matiari, Sujawal, Malir, Kambar, Jacobabad, Sukkur, and Tharparkar (between November 1, 2021, to December 11, 2021); Karachi Central, East, and West, and Korangi (between November 15 to November 30, 2021) and again in Karachi West (between November 3, 2021, to December 6, 2021). We extracted vaccinators' strike-level information at the provincial and town level from the notifications issued by the Vaccination Welfare Association Sindh (Reference number: 815/821) and news published in local newspapers¹. The reasons for vaccinators striking were demanding the restoration of vaccinators employed through National testing services, an increase in pay scales equal to that of their counterparts in other provinces and payment of outstanding dues. The strikes were followed by enhanced outreach activities in Hyderabad, Karachi Central, East and West, Korangi, Malir, Matiari, Sujawal, Jacobabad, Sukkur, and Tharparkar (between December 20, 2021, to January 4, 2022) and Kambar (between December 20, 2021, to January 10, 2022).

A2. Switching

One of the potential problems with the validity of our estimates would be if caregivers moved between towns due to disruption in health services and seek care in unimpacted towns. We plot the rate of switching across event time and find a statistically significant increase in switching vaccine locations in shock-affected towns post-shock (Figure A1).

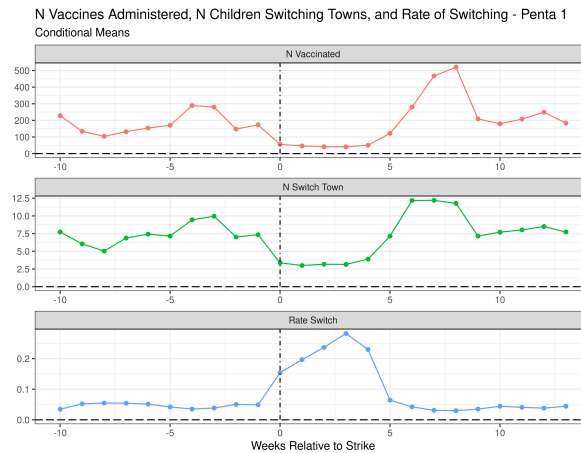


FIGURE A1. AMOUNT OF SWITCHING VS VACCINES PENTA-1: CONDITIONAL MEANS

¹A detailed description of the news regarding vaccinators strike in Sindh can be found <https://www.dawn.com/news/print/1658397>; <https://www.dawn.com/news/print/1568645>.

A3. Findings: longer time window

We also tested the impact of shocks using a more extended time window (i.e., 13 weeks rather than ten weeks) and dropped one of the districts (where a conditional cash transfer was rolled out and coincided with strikes by vaccinators). We find that immunization rates declined in flooded districts compared to non-flooded districts post floods though not statistically significant (Table A1, column 3); however, we do find a significant negative impact for Callaway and Sant’Anna (2021) estimates (column 4). The findings are similar for Penta-1 as an outcome but not statistically significant (columns 1 and 2). Immunization rates were lower post strikes in strikes districts than in nonstrike districts by 0.4657 log points (Table A1, column 7). Our results using data for a longer time window are qualitatively similar to those using a shorter time window for strikes. The findings are also qualitatively similar using Callaway and Sant’Anna (2021) method (column 8) and for Penta-1 as an outcome (columns 5 and 6).

TABLE A1—IMPACT OF SHOCKS (FLOODS AND STRIKES) ON THE NUMBER OF DOSES OF VACCINES ADMINISTERED (IN LOGS)

Shock: Dependent variable:	Floods				Strikes			
	Penta-1		Total vaccines		Penta-1		Total vaccines	
Model:	DiD	CS	DiD	CS	DiD	CS	DiD	CS
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
T*Post	-0.0747 (0.0491)	-0.1313 (0.1172)	-0.0454 (0.0389)	-0.1658 (0.0912)	-0.4396 (0.0481)	-0.3294 (0.1199)	-0.4675 (0.0564)	-0.3225 (0.1425)
N	2,288	2,288	2,288	2,288	2,793	2,793	2,793	2,793

Note: Standard errors are in parentheses. Fixed effects include town and time-fixed effects. The outcome of interest is the log of the number of doses of Penta-1 and the total vaccines administered (including BCG, Pentavalent-1, Pentavalent-2, Pentavalent-3, Measles-1 and Measles-2). ‘T*Post’ is the average treatment effect of shocks (strikes and floods). DiD is the average effect of the shock estimated through difference in difference. CS refers to estimates from Callaway and Sant’Anna (2021) method. This includes the sample from 13 weeks before and after the shock and dropping data from one of the districts (where the conditional cash transfer program was rolled-out). N refers to the sample size. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

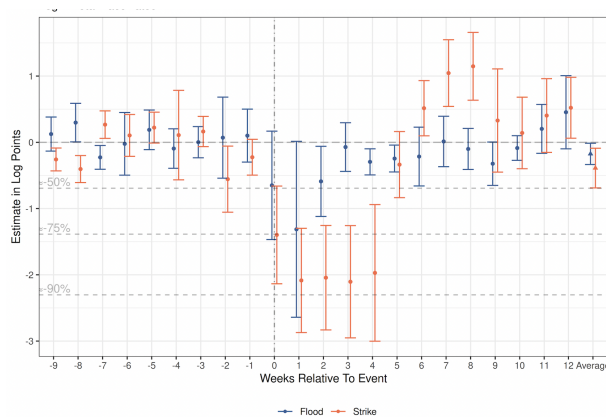


FIGURE A2. CALLAWAY AND SANT’ANNA (2021) ESTIMATES FOR THE TOTAL NUMBER OF DOSES FOR ALL VACCINES

Note: The outcome of interest is the log of the total number of doses of vaccines administered (including BCG, Penta-1, Penta-2, Penta-3, Measles-1 and Measles-2). Estimates derived from Callaway and Sant’Anna (2021) method. Red dots are the estimate for the impact of strikes, and blue dots are the estimates for the impact of floods. Bars around the estimates represent confidence intervals. The sample is 13 weeks before and after the shock.

A4. Findings: Other childhood immunization in the schedule

We also estimated the impact of shocks on the number of doses of other childhood immunization in the schedule (i) Bacille Calmette-Guerin (BCG), (ii) Penta-2, (iii) Penta-3, (iv) Measles-1 and (v) Measles-2. Our findings are consistent with earlier findings suggesting that strikes led to a significant decrease in the number of vaccines administered, resulting in lower immunization in strike towns than in the nonstrike cities. All vaccines witnessed a decline after the strikes (Table A2, Panel B, columns 1 to 5). Additionally, we find that floods led to a decline in the number of doses of vaccines in flooded towns as compared to non-flooded towns post floods though statistically significant for Penta-2, Penta-3, and Measles-2 (Table A2, Panel A, columns 1 to 5). Our results provide conclusive evidence that shocks that led to disruption of health activities significantly reduced the number of doses of routine childhood immunization.

TABLE A2—IMPACT OF SHOCKS (FLOODS AND STRIKES) ON THE NUMBER OF DOSES OF VACCINES ADMINISTERED (IN LOGS)

<i>Dependent variable:</i>	BCG (1)	Penta-2 (2)	Penta-3 (3)	Measles-1 (4)	Measles-2 (5)
<i>Panel A: Shock (Floods)</i>					
T*Post	-0.0504 (0.0549)	-0.2490 (0.0691)	-0.2050 (0.0711)	-0.0751 (0.0566)	-0.2616 (0.0801)
N	2,384	2,384	2,384	2,384	2,384
<i>Panel B: Shock (Strikes)</i>					
T*Post	-0.6212 (0.0613)	-0.6697 (0.0661)	-0.8114 (0.0795)	-0.4974 (0.1040)	-0.6192 (0.1007)
N	2,844	2,844	2,844	2,844	2,844

Note: Standard errors are in parentheses. Fixed effects include town and time-fixed effects. The outcome of interest is the log of the number of doses of BCG, Penta-2, Penta-3, Measles-1 and Measles-2. ‘T*Post’ is the average effect of the shock (strikes and floods) estimated through difference in difference. This includes the sample from 10 weeks before and after the shock. N refers to the sample size. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.

A5. Heterogeneity in shock effect

TABLE A3—HETEROGENEOUS IMPACT: SHOCKS (FLOODS AND STRIKES) ON THE NUMBER OF DOSES OF VACCINES ADMINISTERED (IN LOGS)

<i>Shock:</i>	Floods		Strikes		Floods		Strikes	
	(1) Boys	(2) Girls	(3) Boys	(4) Girls	(5) Below primary	(6) Above primary	(7) Below primary	(8) Above primary
T*Post	-0.2616 (0.1278)	-0.2803 (0.1576)	-0.2996 (0.1527)	-0.3140 (0.1507)	-0.4064 (0.8305)	-0.2006 (0.1240)	-0.2952 (0.1763)	-0.1613 (0.2410)

Note: Standard errors are in parentheses. Fixed effects include town and time-fixed effects. The outcome of interest is the log of the number of doses of total vaccines administered (including BCG, Pentavalent-1, Pentavalent-2, Pentavalent-3, Measles-1 and Measles-2). ‘T*Post’ is the average treatment effect of shocks (strikes and floods). Estimates presented are using Callaway and Sant’Anna (2021) method. We present results across various sub-samples (columns 1 to 4 across the gender of a child and columns 5 to 8 are if the mother’s education is above or below primary level.) N refers to the sample size. * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$.