



Extreme heat slows infant immunization: evidence from 41 low- and middle-income countries

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Routine infant immunization is a cornerstone of preventive care, yet its delivery depends on a tight sequence of timely caregiver-clinic contacts in the first months of life. We examine whether extreme heat during the World Health Organization (WHO) primary immunization window (weeks 6–18 after birth) slows early life vaccination timing across 41 low- and middle income countries (LMICs). Combining hourly Universal Thermal Climate Index (UTCI) data from ERA5 with 351,157 live births in Demographic and Health Surveys (DHS) Phase 7 (2012–2024), we measure heat exposure as the count of very-strong heat days (daily maximum UTCI > 38 °C) within this window, predetermined by birth date, not by realized vaccination timing. We compare children born in adjacent months within the same ~25 km grid cell – who faced different heat during the same WHO age window – while absorbing country specific schedule timing and age-at-interview effects. One within-cell standard deviation of heat exposure (~12 days) lowers cumulative DPT and Polio attainment by about 85 child-doses per 1,000 children and increases early zero-dose and incomplete immunization by roughly 11 and 15 children per 1,000 respectively, in the 4 weeks after the WHO primary window. The gap narrows gradually, closing by ~28 weeks, leaving a deficit during the early protection window. Effects are larger among poorer households and caregivers reporting access barriers, consistent with heat raising the cost of timely clinic contacts on both demand and supply sides. Routine immunization is climate-vulnerable health infrastructure for adaptation planning, even where vaccines are formally available.

