

Supplementary Material

Statistical models

As a consequence, a total of 6 models were developed. Model I included only ecological measures (temperature, temperature variation, and rainfall) as explanatory variables; Model II included only social factors (education, internet use, population density, and poverty) as covariates; Model III included both ecological and social factors as explanatory variables; Model IV incorporated spatially structured random effects with all socioecological covariates; Model V incorporated spatially unstructured random effects with all socioecological covariates; Model VI incorporated both structured and unstructured random effects with all socioecological covariates.

The expected log relative risk θ_k , for these models thus represented as follows:

$$\theta_k = \alpha + (\text{Temp}_k) \beta_1 + (\text{Tempva}_k) \beta_2 + (\text{Rain}_k) \beta_3 \dots \text{Model I}$$

$$\theta_k = \alpha + (\text{Edu}_k) \beta_1 + (\text{Int}_k) \beta_2 + (\text{povi}_k) \beta_3 + (\text{pop}_k) \beta_4 \dots \text{Model II}$$

$$\theta_k = \alpha + (\text{Temp}_k) \beta_1 + (\text{Tempva}_k) \beta_2 + (\text{Rain}_k) \beta_3 + (\text{Edu}_k) \beta_4 + (\text{Int}_k) \beta_5 + (\text{povi}_k) \beta_6 + (\text{pop}_k) \beta_7 \dots \text{Model III}$$

$$\theta_k = \alpha + (\text{Temp}_k) \beta_1 + (\text{Tempva}_k) \beta_2 + (\text{Rain}_k) \beta_3 + (\text{Edu}_k) \beta_4 + (\text{Int}_k) \beta_5 + (\text{povi}_k) \beta_6 + (\text{pop}_k) \beta_7 + u_k \dots \text{Model IV}$$

$$\theta_k = \alpha + (\text{Temp}_k) \beta_1 + (\text{Tempva}_k) \beta_2 + (\text{Rain}_k) \beta_3 + (\text{Edu}_k) \beta_4 + (\text{Int}_k) \beta_5 + (\text{povi}_k) \beta_6 + (\text{pop}_k) \beta_7 + v_k \dots \text{Model V}$$

$$\theta_k = \alpha + (\text{Temp}_k) \beta_1 + (\text{Tempva}_k) \beta_2 + (\text{Rain}_k) \beta_3 + (\text{Edu}_k) \beta_4 + (\text{Int}_k) \beta_5 + (\text{povi}_k) \beta_6 + (\text{pop}_k) \beta_7 + u_k + v_k \dots \text{Model VI}$$

where α is a constant, β_1 is the coefficient for temperature, β_2 is the coefficient for temperature variation, β_3 is the coefficient for rainfall, β_4 is the coefficient for percentage of education at district level, β_5 is the coefficient for percentage of internet user at district level, β_6 is percentage of poverty at district level, and β_7 is the population density per square kilometer, v_k is a spatially unstructured random effect that is assumed to be normally distributed with mean zero and variance σ_v^2 and u_k is spatially structured random effect that was modeled using a conditional autoregressive (CAR) prior $u_k \sim N(\bar{u}_{-k}, \sigma_u^2 / n_k)$, where $-k$ denotes the neighbors of the k th district based on a simple adjacency matrix and n_k is the corresponding number of neighbors.

SUPPLEMENTARY TABLE S1. Spearman correlation between pneumonia and socioecological covariates in Children Under Five-Years Old — Bangladesh, 2012–2016.

Variables	1	2	3	4	5	6	7	8
1 Pneumonia	–							
2 Temperature	0.094							
3 Temperature variation	0.161	0.235						
4 Rainfall	–0.019	0.268*	–0.146					
5 Education	0.008	–0.011	–0.129	0.068				
6 Internet use	0.126	0.063	0.223	0.017	–0.066			
7 Population density	–0.148	–0.25*	–0.276*	0.028	0.075	0.162		
8 Poverty	0.069	–0.14	0.163	–0.077	0.095	–0.209	–0.336*	–

Note: – represent its pneumonia itself, there will be no number.

* $P < 0.05$.

SUPPLEMENTARY TABLE S2. Descriptive statistics of childhood pneumonia and different socioecological factors — Bangladesh, 2012–2016.

Variables	Mean \pm SD	Range
Pneumonia	747.82 \pm 245.32	355.53–1612.10
Temperature ($^{\circ}$ C)	30.97 \pm 0.48	29.50–31.98
Temperature variation ($^{\circ}$ C)	3.63 \pm 0.55	2.00–4.99
Rain (mm)	164.54 \pm 101.37	3.13–386.96
Education (%)	54.66 \pm 7.75	37.50–73.70
Internet use (%)	0.62 \pm 0.76	0.14–6.03
Poverty incidence (%)	27.45 \pm 15.31	2.60–70.80
Under five years population density (per square km)	117.72 \pm 87.05	10.81–656.54

SUPPLEMENTARY TABLE S3. Model comparison for relative risk of monthly childhood pneumonia, underlying socioecological factors, and different random effects — Bangladesh, 2012–2016.

Model	Random effect	Deviance Information Criterion (DIC)	Effective number of parameters (pD)
Model I	No	19954.20	30.146
Model II	No	17382.41	5.001
Model III	No	13773.00	11.134
Model IV	<i>u</i>	665.98	63.940
Model V	<i>v</i>	665.67	63.812
Model VI	<i>u and v</i>	665.47	63.719

SUPPLEMENTARY TABLE S4. List of high-risk districts of Bangladesh for childhood pneumonia from 2012 to 2016.

Name of the district	Relative Risk (95% Credible interval)	Location
Rangamati	5.97 (5.63–6.31)	South-eastern
Pirojpur	4.71 (4.48–4.93)	South-western
Jhalkathi	4.38 (4.09–4.66)	South-western
Jaipurhut	3.95 (3.70–4.19)	North-eastern
Bandarbon	3.77 (3.48–4.07)	South-eastern
Meherpur	3.50 (3.23–3.78)	South-western
Rajbari	3.31(3.11–3.50)	Central
Khagrachari	3.25 (3.02–3.49)	South-eastern
Panchagarh	2.96 (2.78–3.14)	Northern