

# The effect of temperature shocks on health at birth: evidence from Hungary

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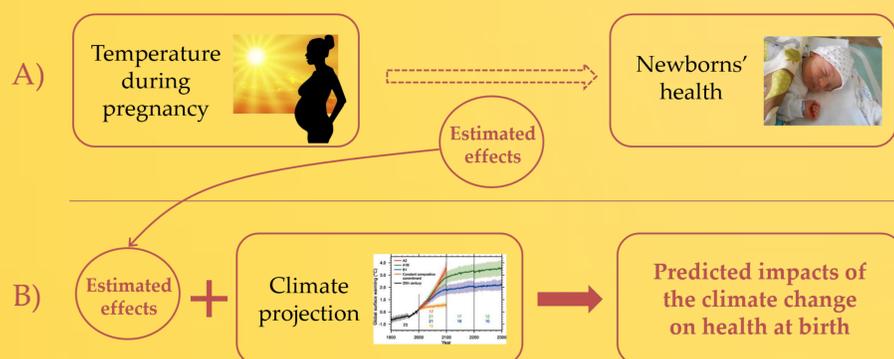
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## Key takeaways

- 1) Exposure to hot temperature in utero reduces fetal health
- 2) The effects are larger for newborns of low educated mothers
- 3) Climate change is predicted to decrease birth weight and gestation length, and to increase LBW rate and PTB rate

## 1. Research questions

- A. How does exposure to hot/cold temperatures during the pregnancy affect health at birth?
- B. Examining the potential impact of the climate change on the newborns' health indicators

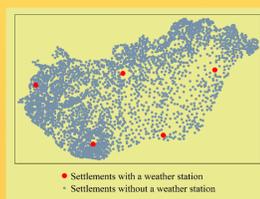


## 2. Live birth data

- Registry of live births of the Hungarian Central Statistical Office
- Administrative dataset that covers all births between 1990-2014
- Information on birth date, health at birth, family background, etc.
- Final sample
  - singleton births with at least 26 weeks of gestation
  - almost 2.5 million observations
- Indicators of health at birth (outcome variables)
  1. birth weight
  2. LBW - low birth weight (<2500 g)
  3. gestation length
  4. PTB -pre-term birth (<37 weeks)

## 3. Weather data

- European Climate Assessment & Dataset project
- Provide daily weather measures for five large cities from different parts of Hungary
- Interpolated temperature values for other settlements without a weather station
  - inverse distance weighting technique
- Temperature measures for the analysis
  - N of days during the pregnancy when mean daily temperature falls into the following temperature bins ( $T^k$ )
    - below  $-5^\circ\text{C}$ ,  $-5$  to  $0^\circ\text{C}$ ,  $0$  to  $5^\circ\text{C}$ , ...,  $20$  to  $25^\circ\text{C}$ , above  $25^\circ\text{C}$
- Exposure to the temperature bins is matched to each birth by the location of the mother's residence (at the time of the birth)



## 4. Climate change data

- Community Climate System Model (CCSM) version 4
  - one of the climate models that used for the IPCC fifth Assessment Report
- Two scenarios: RCP4.5 and RCP8.5
  - RCP4.5: intermediate increase in greenhouse gas (GHG) concentration
  - RCP8.5: rapidly rising GHG concentration
- Predicted distribution of daily temperatures, 2041-2050
  - averaged the estimations for grid points located within Hungary
- E.g., the N of days per year with avg. temperature  $>25^\circ\text{C}$  will increase by 7.8 (RCP4.5) to 14.8 (RCP8.5) days from a baseline of 9.6 days

## 5. Empirical methods

### A) The impact of temperatures on health at birth

$$H_{iyms} = \sum_k \beta^k T_{iyms}^k + \gamma'X_i + \eta_y + \tau_{sm} + \varepsilon_{iyms}$$

- $H$  = health at birth of newborn  $i$  (born in year  $y$  and month  $m$ , at settlement  $s$ )
- $T^k$  = N of pregnancy days in temperature bin  $k$
- $X$  = characteristics of the mother and the father
  - education, age, labor force status, marital status, pregnancy history of the mother
- $\eta$ ,  $\tau$  = birth year and settlement-by-calendar month fixed effects
- Instrumental variable approach
  - problem: the longer the gestation the higher  $T^k \rightarrow$  biased estimation
  - solution:  $T^k$  is instrumented by the number of days in  $T^k$  that would have been observed if the pregnancy had lasted exactly 39 weeks
- The effects of temperature are identified from interannual variation in temperature after adjustment for time-invariant settlement-specific seasonality and common shocks

### B) The impacts of the climate change

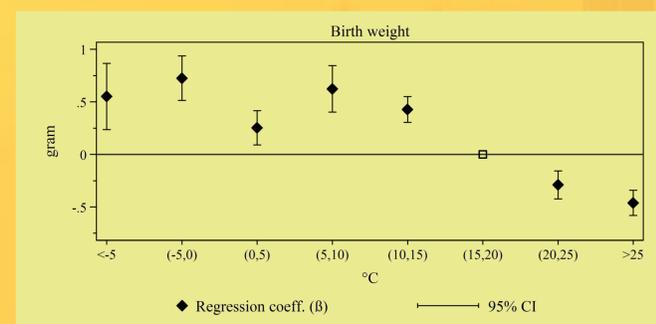
$$Y_r = \sum_k \beta^k (T_r^k - T_b^k)$$

- $Y$  = the predicted impact of the climate change under the scenario RCP  $r$
- $\beta^k$  = estimated impact of temperature bin  $k$  (from part A)
- $T_r$  = the predicted N of days in temperature bin  $k$  under the scenario RCP  $r$  during a 39-week-long pregnancy
- $T_b$  = the observed N of days in temperature bin  $k$  between 1990-2014 during a 39-week-long pregnancy

## 6. Results

### A) The impact of temperatures on health at birth

- Strong negative, non-linear relationship between birth weight and temperatures (see Figure below)
  - E.g. the impact of an additional day with average temperature  $>25^\circ\text{C}$  is  $-0.5$  gram



- Similar results for the other outcomes
  - Hot temperature is associated with shorter gestation length, higher LBW rate, and higher PTB rate
- Larger impacts for newborns of low educated mothers

### B) The impacts of the climate change (2041-2050)

- The predicted impacts are sizeable: 20-80 % of the effects of programs that aim to provide better nutrition and counseling to pregnant women, or consist of cash transfers (RCP8.5)

| The estimated impacts |                    |                  |                         |              |              |
|-----------------------|--------------------|------------------|-------------------------|--------------|--------------|
|                       | Mother's education | Birth weight (g) | Gestation length (week) | LBW (%point) | PTB (%point) |
| RCP4.5                | Total              | -9.3             | -0.049                  | 0.34         | 0.50         |
|                       | Primary            | -10.4            | -0.061                  | 0.50         | 0.72         |
|                       | Secondary          | -9.8             | -0.050                  | 0.31         | 0.51         |
|                       | Tertiary           | -6.6             | -0.031                  | 0.18         | 0.25         |
| RCP8.5                | Total              | -14.9            | -0.084                  | 0.49         | 0.76         |
|                       | Primary            | -16.9            | -0.102                  | 0.66         | 1.03         |
|                       | Secondary          | -15.7            | -0.085                  | 0.49         | 0.79         |
|                       | Tertiary           | -10.3            | -0.059                  | 0.24         | 0.38         |