Early-life exposure to the Chinese famine and tuberculosis risk: Unrecognized biases from different measures of famine intensity

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We are concerned that Cheng et al. (1) did not take all famine-related changes in cohort size into account for their estimates of tuberculosis risk in relation to intensity of early-life nutrition deprivation in the Chinese province of Sichuan.

To measure prefecture-level famine intensity, Cheng et al. (1) used tabulations on the 2000 population census of Sichuan Province (2) to calculate a cohort size shrinkage index (CSSI) as $\frac{N_{non-famine} - N_{famine}}{N_{non-famine}}$, comparing the average birth cohort size in famine years of 1958 to 1962 to the average cohort size in nonfamine years of 1953 to 1957 and 1963 to 1967. Cheng at al. (1) followed the usual practice of Chinese famine studies to include both prefamine and postfamine births in calculating CSSI (3, 4). This calculation assumes that the numbers of prefamine (1953 to 1957) and postfamine (1963 to 1967) births both represent counterfactual cohort sizes in the absence of famine. We see a sharp increase in postfamine cohort size, however, in famine-affected regions including Sichuan (5).

To confirm the analysis by Cheng et al. (1), we used the public access datafile for Sichuan Province from the 2000 China census (6). Our aim was to quantify potential biases arising from including postfamine births in calculating CSSI. Including prefamine and postfamine births as done by Cheng et al. (1), our estimated CSSI distribution (median 0.488, interquartile range [IQR]: 0.450 to 0.523) is in close agreement with Cheng et al. (median 0.488, IQR: 0.438 to 0.521) (1, 7). However, with birth cohorts in nonfamine years only represented by prefamine births, we see a significant decline in CSSI (median 0.418, IQR: 0.325 to 0.466) (Fig. 1; $P < 0.01$).

The metaregression results reported by Cheng et al. (1) are also sensitive to including postfamine births as a counterfactual estimate of cohort size in the absence of famine. Again using the public access datafile (6), we estimate a 0.52 unit increase in log F1 famine incidence rate ratio (IRR) associated with a one-unit increase in CSSI when including prefamine and postfamine births (IRR 0.52, 95% CI: −0.23 to 1.28) (Fig. 2, red regression line). This is also compatible with the estimate reported by Cheng et al. (1) (IRR 0.76, 95% CI: 0.14 to 1.38). However, only including prefamine births the metaregression log IRR estimate is 0.28 (95% CI: −0.18 to 0.75) (Fig. 2, green regression line). We expect that Cheng et al. (1) in their data will be able to demonstrate a similar decrease.

When estimating famine intensity from prefamine, famine, and postfamine births in CSSI calculations it is crucial, therefore, to take the increased size of postfamine birth cohorts into account. Compared to CSSIs only including prefamine births, CSSIs including both prefamine and postfamine births will be biased upward after strong postfamine fertility increases. The relative impact of postfamine increases in cohort size on CSSI will be lowest where famine intensity was highest. These potential sources of bias need to be considered when using CSSIs to quantify famine intensity.

Data Availability. All data used in this study have been deposited in GitHub (https://github.com/qu-cheng/TB_famine/tree/master/Data) and Minnesota Population Center (https://international.ipums.org/international-action/sample_details/country/cn#tab_cn2000a).

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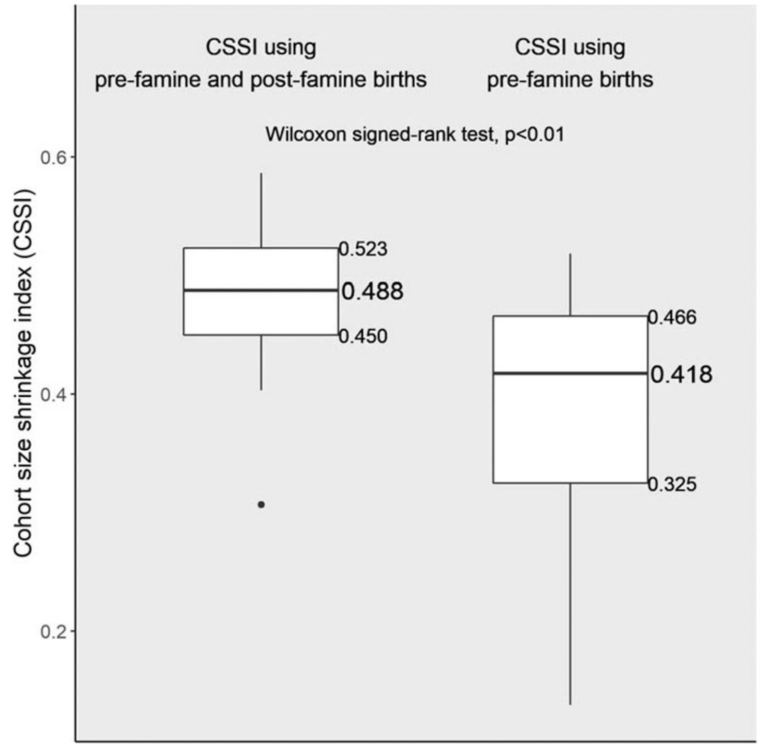

Fig. 1. Distributions of 21 prefecture-level CSSIs using different nonfamine years. Prefamine births: 1953 to 1957; postfamine births: 1963 to 1967. Box plots show the median and IQR of both CSSIs. Data source: 2000 national census for Sichuan Province (6).

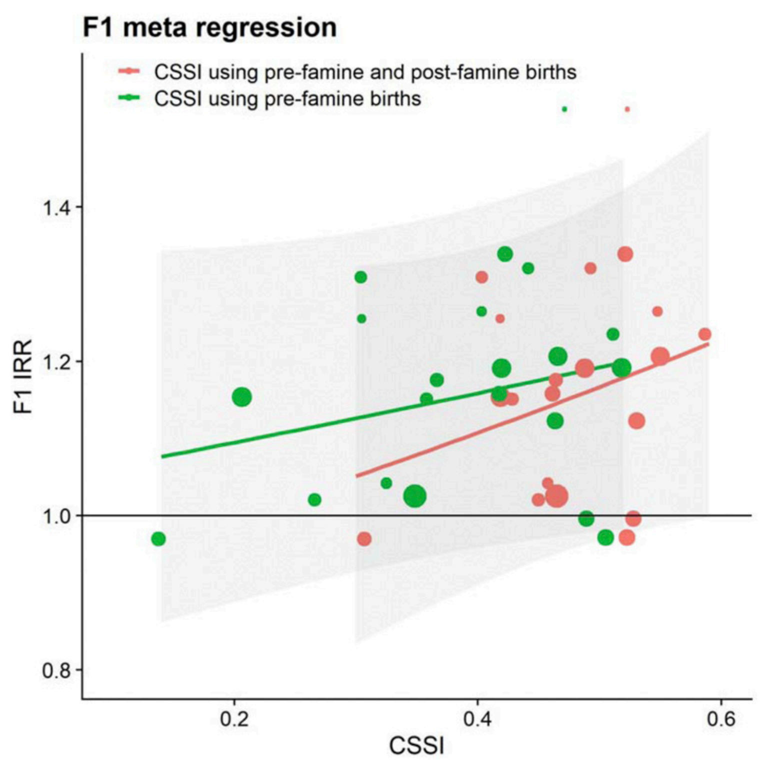

Fig. 2. Scatterplot of CSSI and IRR of F1 across prefectures. Each prefecture is represented by a dot. The size of the dot is proportional to the inverse variance of the estimated IRR of each prefecture. The lines represent the metaregression fits, and the shaded areas represent the 95% CIs.

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