



Centre Population
et Développement

Local mortality estimation in India: can we avoid census data?

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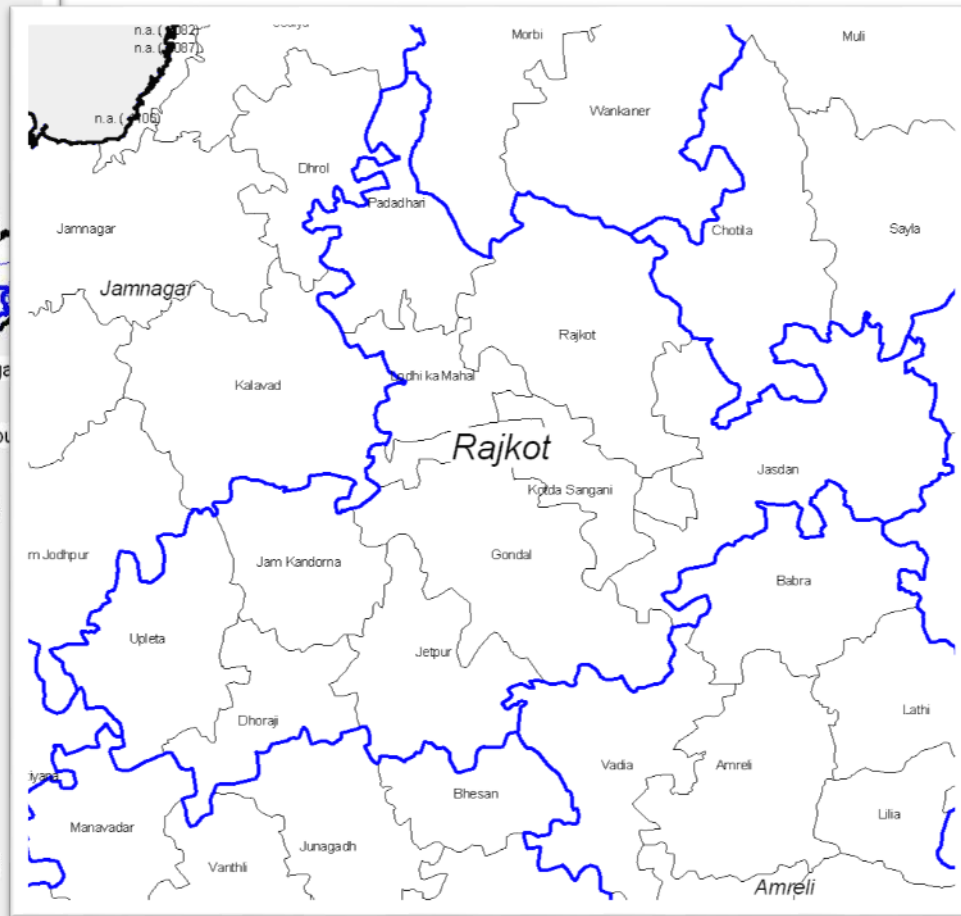
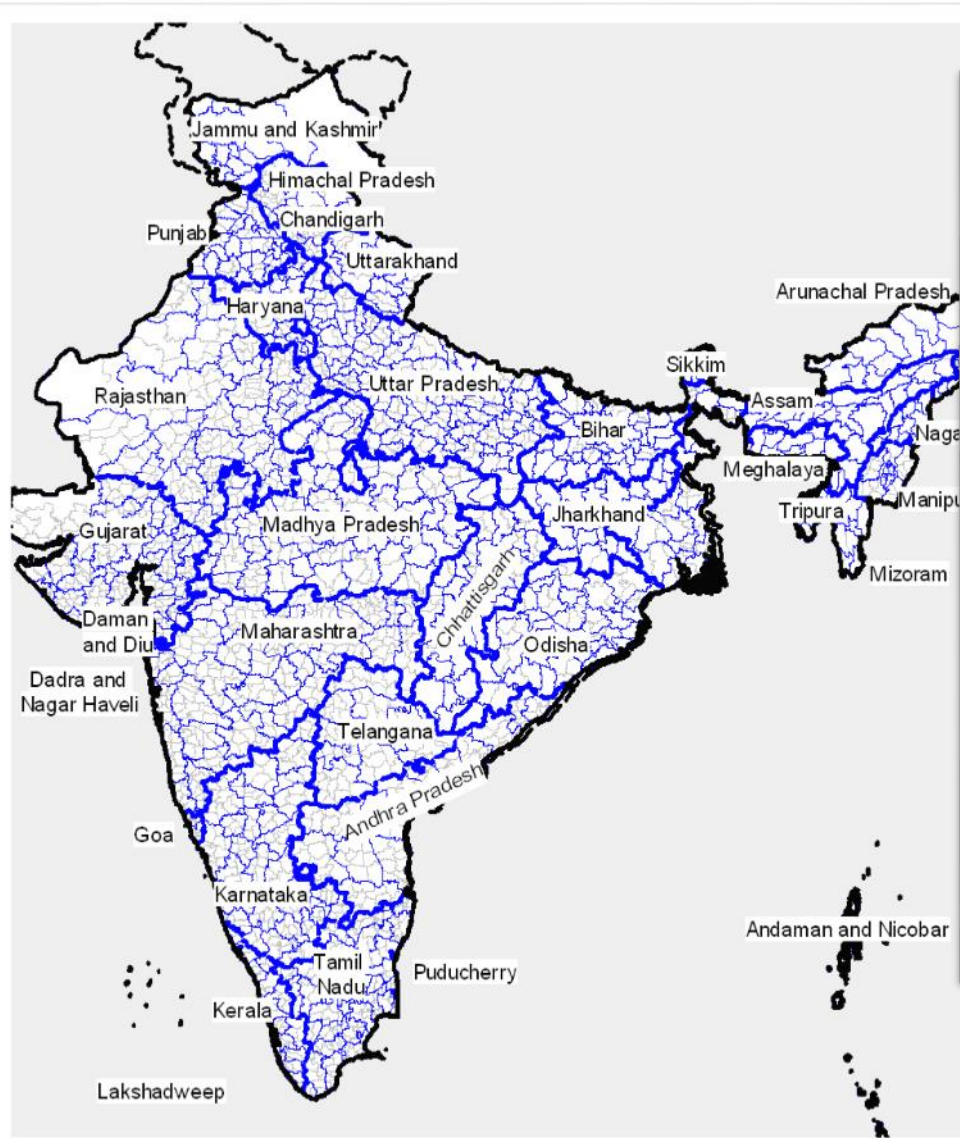
OUTLINE

- Local level mortality estimates in India
 - India and its administrative geography
 - Overview of available sources at district level
- Some indirect or incomplete estimates
 - AHS, SRS and census, SRS and DLHS-3
- Census-based estimates of child mortality
 - 2011 data and the Brass method
 - Results
- NFHS-4- based estimates of child mortality
 - Methods and results
- Internal assessment of the results
 - Statistical consistency (IMR vs CMR, male vs female)
 - Spatial consistency (maps, hot spots and spatial autocorrelation)
- External assessment with 2011 census estimates
 - Statistical correlation
 - Spatial consistency (maps, hot spots and spatial autocorrelation)
- Conclusion

INDIA'S ADMINISTRATIVE DIVISION

- 29 states and 7 union territories (including Delhi)
- States and territories further subdivided into districts
 - 722 in 2018 and 640 in 2011 (as used in NFHS-4)
 - Average district population : 1.9 million (2011)
- Districts further subdivided into 5,564 tehsils/taluks/blocks in 2011
 - Average subdistrict population: 217,600 (2011)
- Comparison
 - in the US, the average county population is 100,000 and we have life expectancy estimates at county level
 - In Germany, the average district (Landkreis, Stadtkreis) population is 200,000 and life expectancy estimates are also available

MAPS OF ADMINISTRATIVE UNITS: STATES, DISTRICTS AND TEHSILS



DISTRICT-LEVEL SOURCES ON MORTALITY

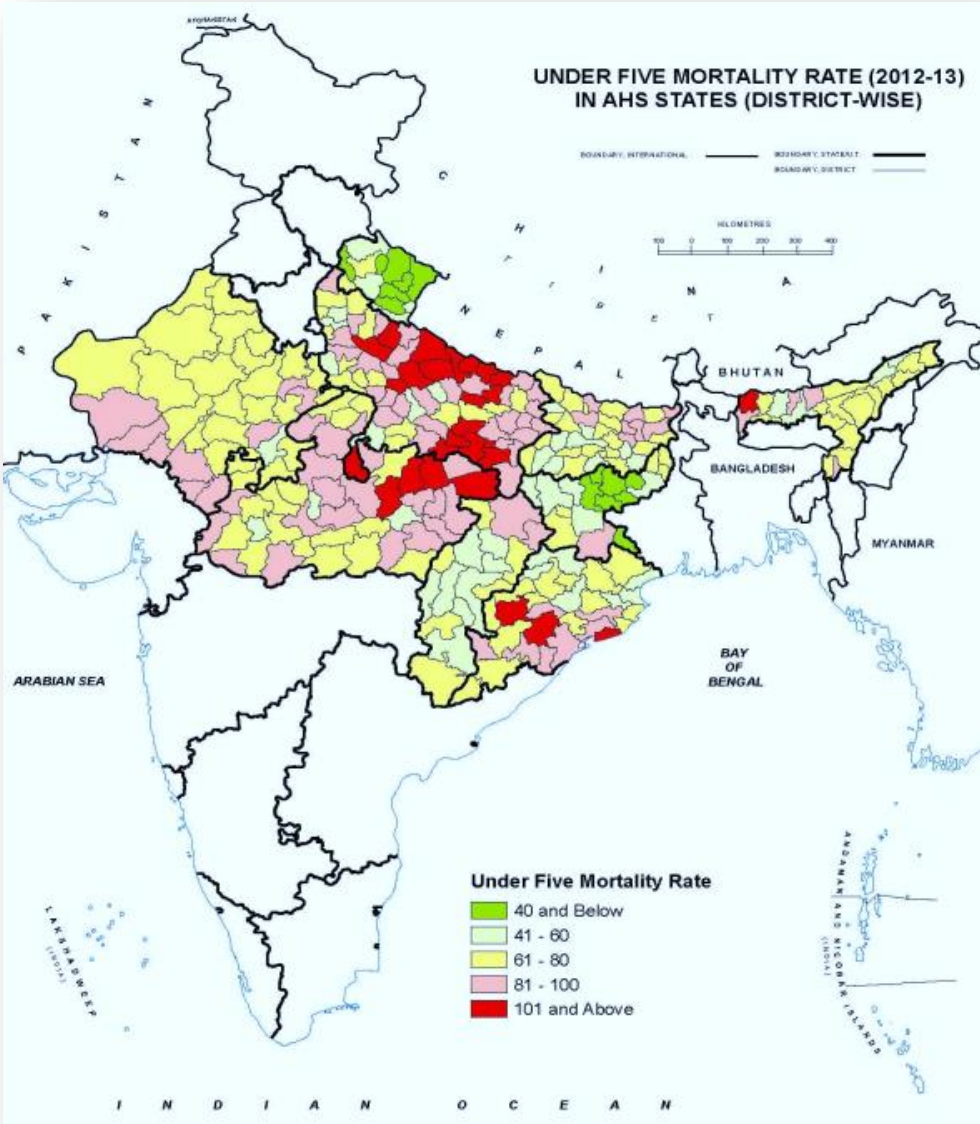
		Date	Universe	Sampling	Data type
Census	Census	Decennial	All India	District	<ul style="list-style-type: none"> • Survival by age
National Health and Family Survey 1,2 and 3	NFHS-1,2, and 3	1992-93, 1998-99 and 2005-06	All India	State (around 100,000 households)	<ul style="list-style-type: none"> • Births • Deaths by age (NFHS-1 & 2)
National Health and Family Survey 4	NFHS-4	2015-16	All India	District (around 600,000 households)	<ul style="list-style-type: none"> • Births • Deaths by age
District-Level Health Survey -1,2, 3	DLHS-1,2, and 3	1998-99, 2002-04, 2007-08	All India (except Nagaland from DLHS-3)	District (Around 600,000 households)	<ul style="list-style-type: none"> • Births • Deaths by age
District-Level Health Survey -4	DLHS-4	2012	All excluding EAG, Gujarat and Jammu and Kashmir states	District (350,000 households)	<ul style="list-style-type: none"> • Births • Deaths by age
Annual Health Survey	AHS	2011-14 (3 annual updates)	EAG States	District (around 4m households)	<ul style="list-style-type: none"> • Births • Deaths by age
Civil registration system	CRS	Annual	All India	“Exhaustive”	<ul style="list-style-type: none"> • Births • Deaths by age
Sample registration System	SRS	Annual	All India	State	<ul style="list-style-type: none"> • Mortality rates by age

SOME INDIRECT OR INCOMPLETE ESTIMATES

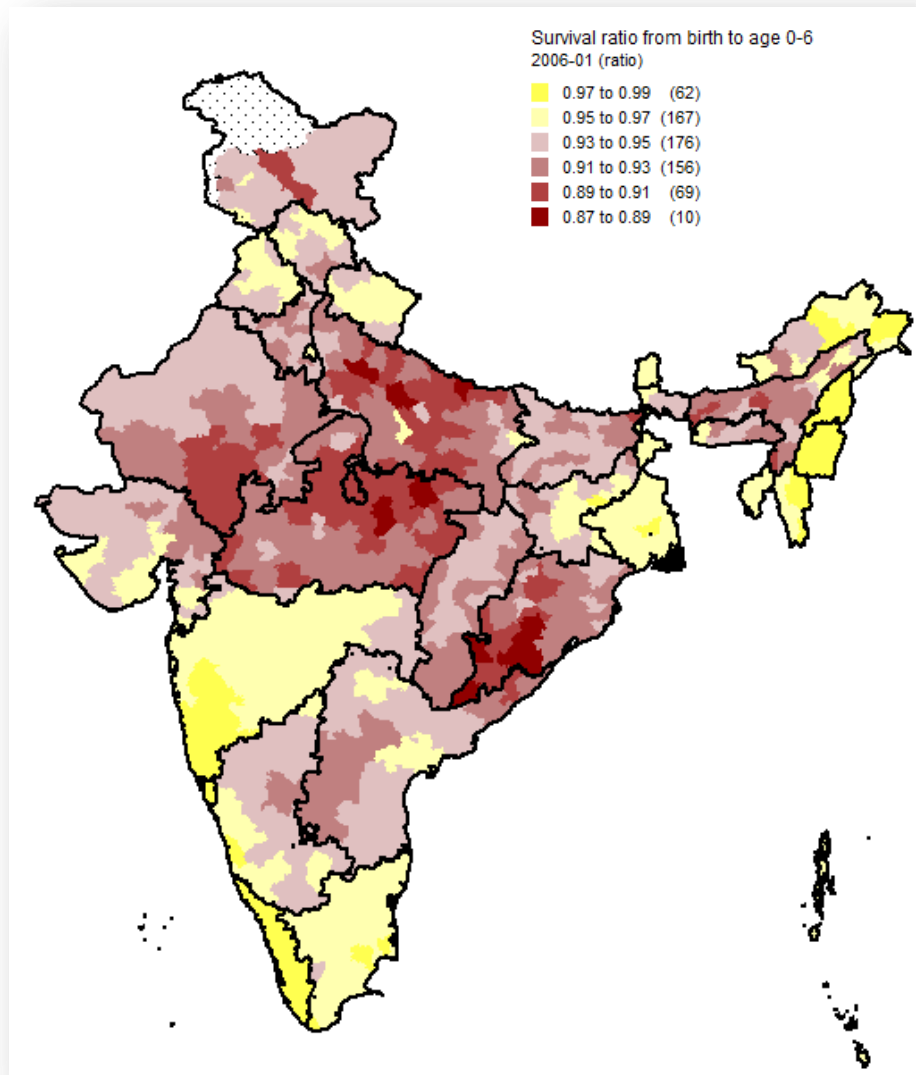
Focus on infant and child mortality

AHS, SRS and census, SRS and DLHS-3

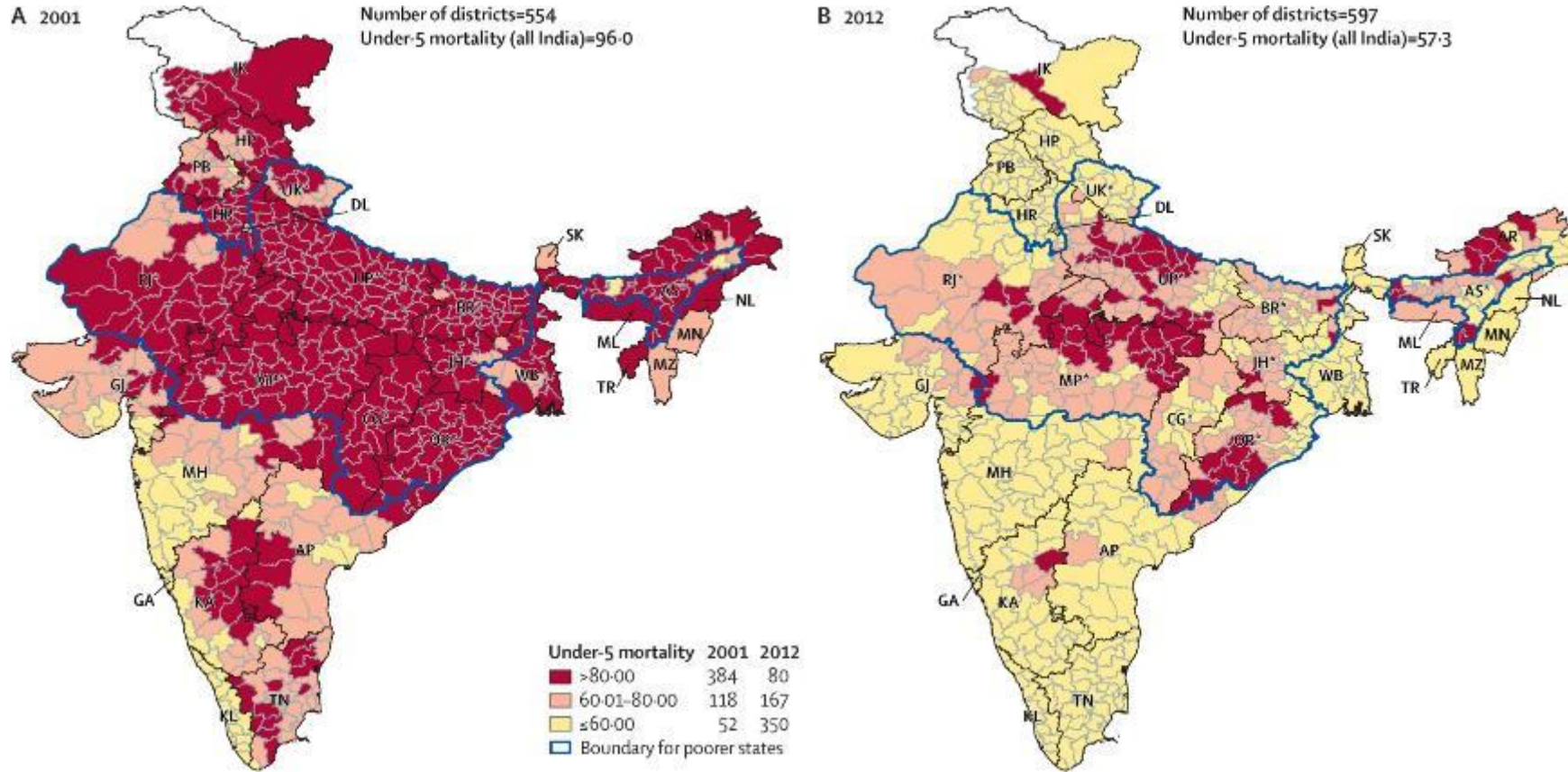
CHILD MORTALITY IN AHS STATES (2012-13)



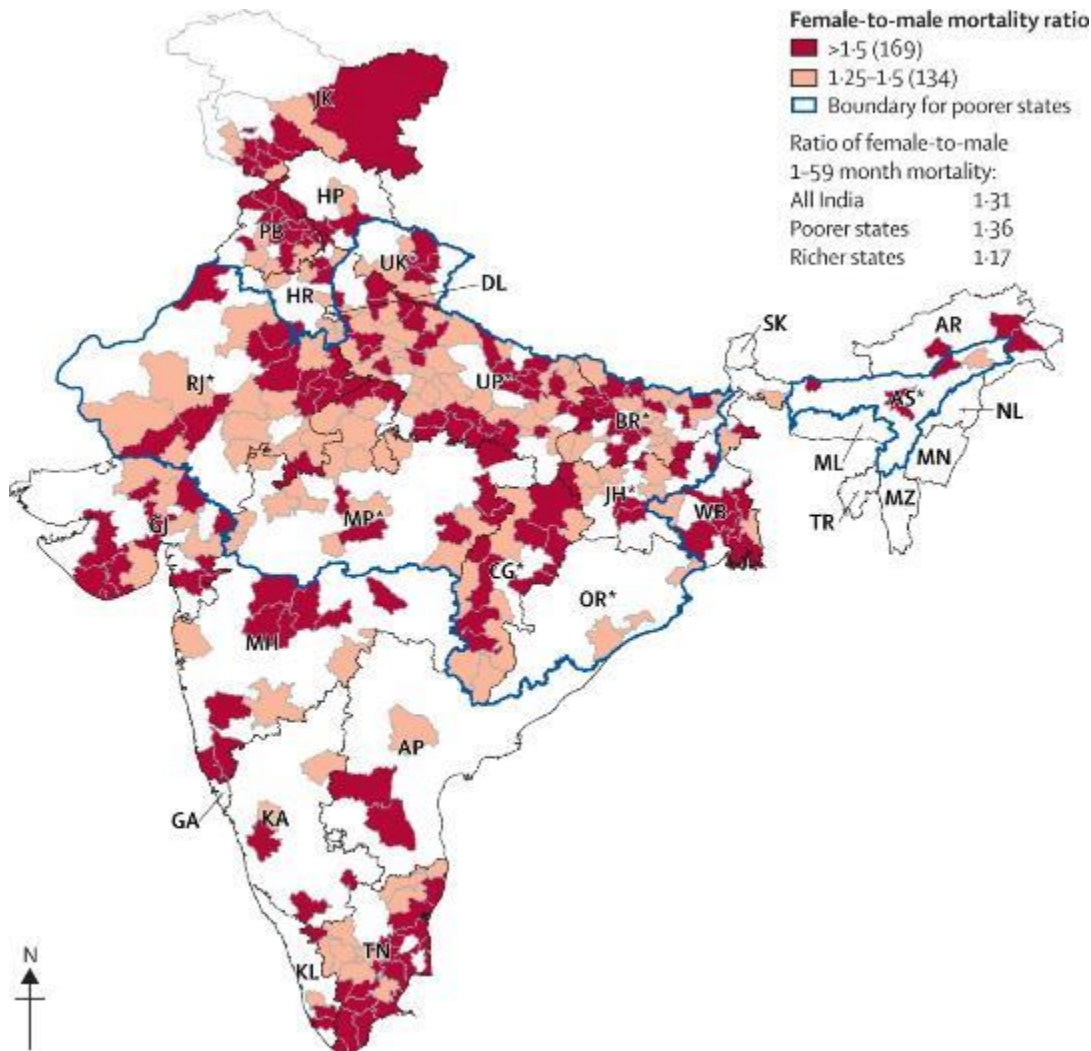
INDIRECT ESTIMATES FOR 2006-11 (BASED ON SRS AND 2001 CENSUS)



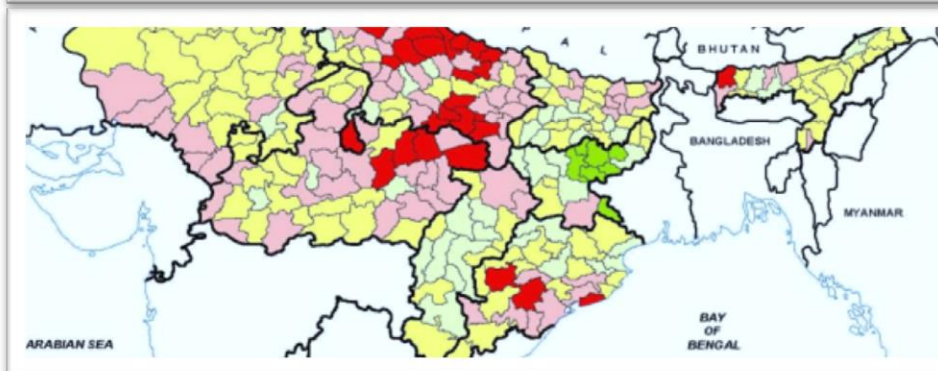
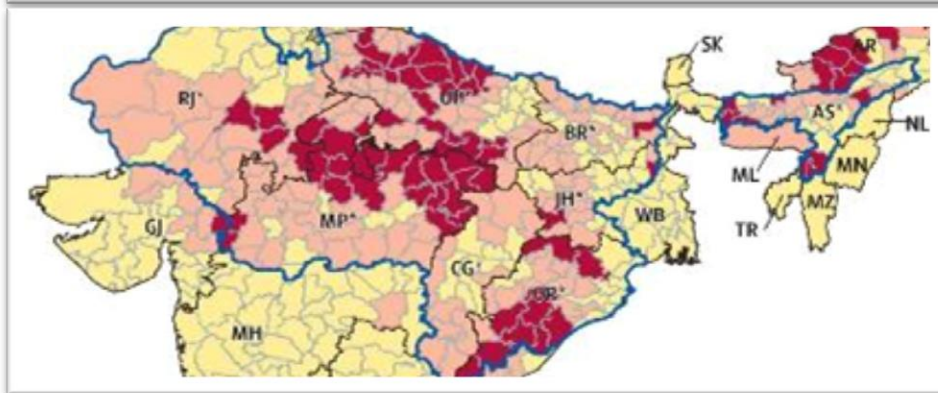
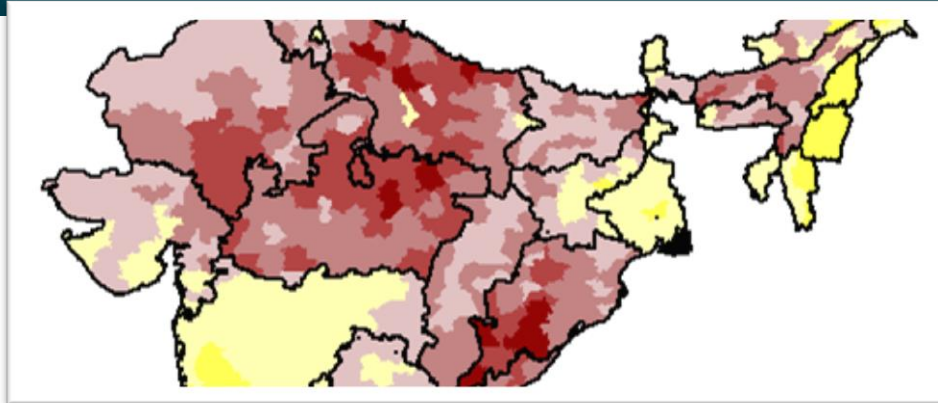
INDIRECT ESTIMATES FOR 2001 AND 2012 (BASED ON SRS AND DLHS-3)



FEMALE TO MALE RATIO OF MORTALITY BELOW TWO



COMPARISON OF THREE MAPS OF CHILD MORTALITY IN NORTH CENTRAL INDIA



CENSUS-BASED ESTIMATES OF CHILD MORTALITY

2011 data and the Brass method

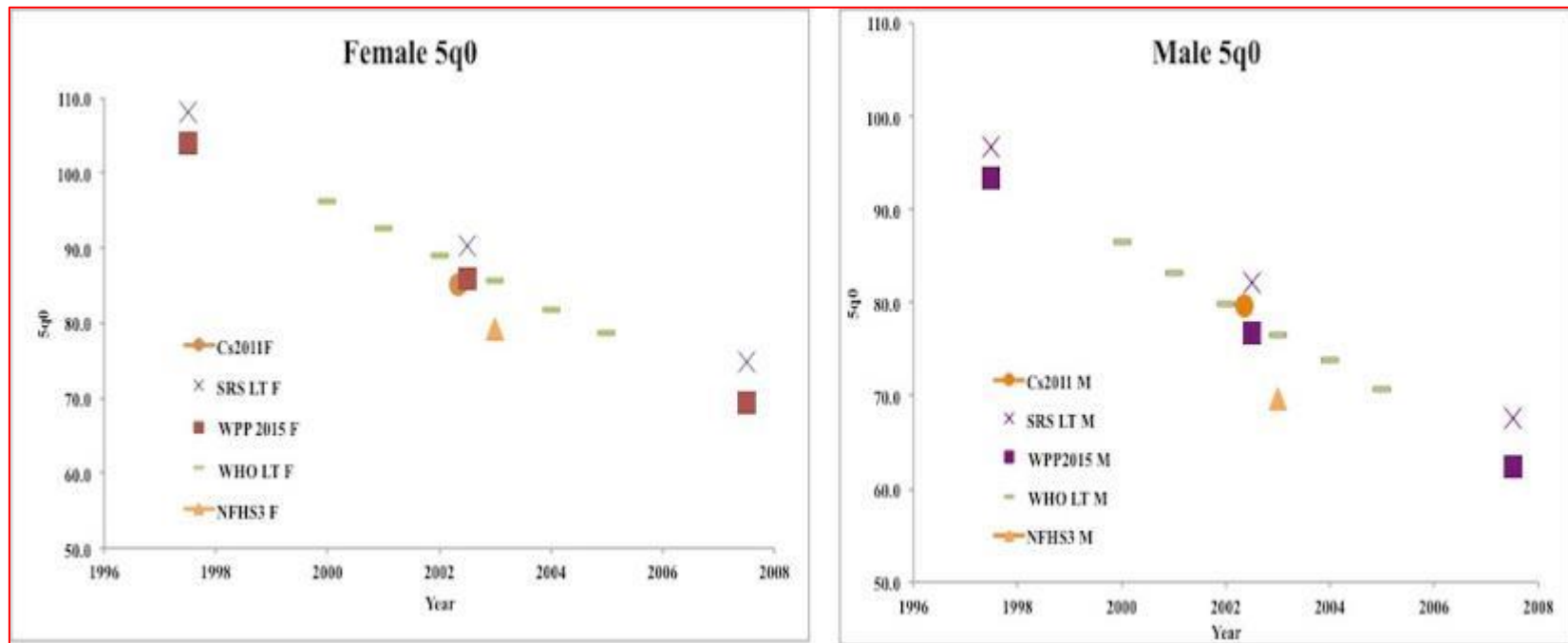
Results

CENSUS 2011 ESTIMATES: DATA AND METHODS

- The 2011 census provides:
 - Women by number and sex of ever-born children
 - Available by five-year age group and district
- Consistency tests:
 - Extreme values
 - Corrected by average rates of adjacent districts
- Method used: Brass method
 - Best reference age group: 35-39 years
- Results:
 - infant and U5 mortality by district and sex
 - Excess female U5 mortality and deaths computed by reference to WPP 2015 correlation between male and female mortality rates
- Spatial tests:
 - Simple mapping
 - Spatial autocorrelation

BRASS METHOD AND COMPARISON

- Comparison of U5 mortality rates for India from Census based on women aged 35-39 with estimates from other sources

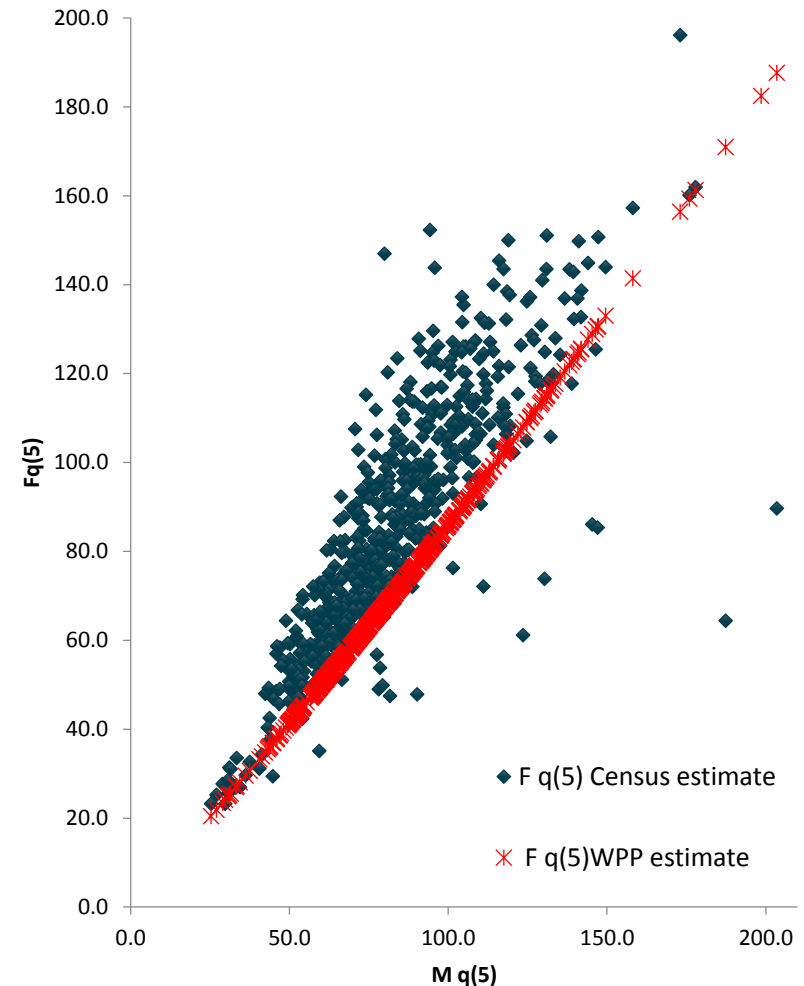


METHODS

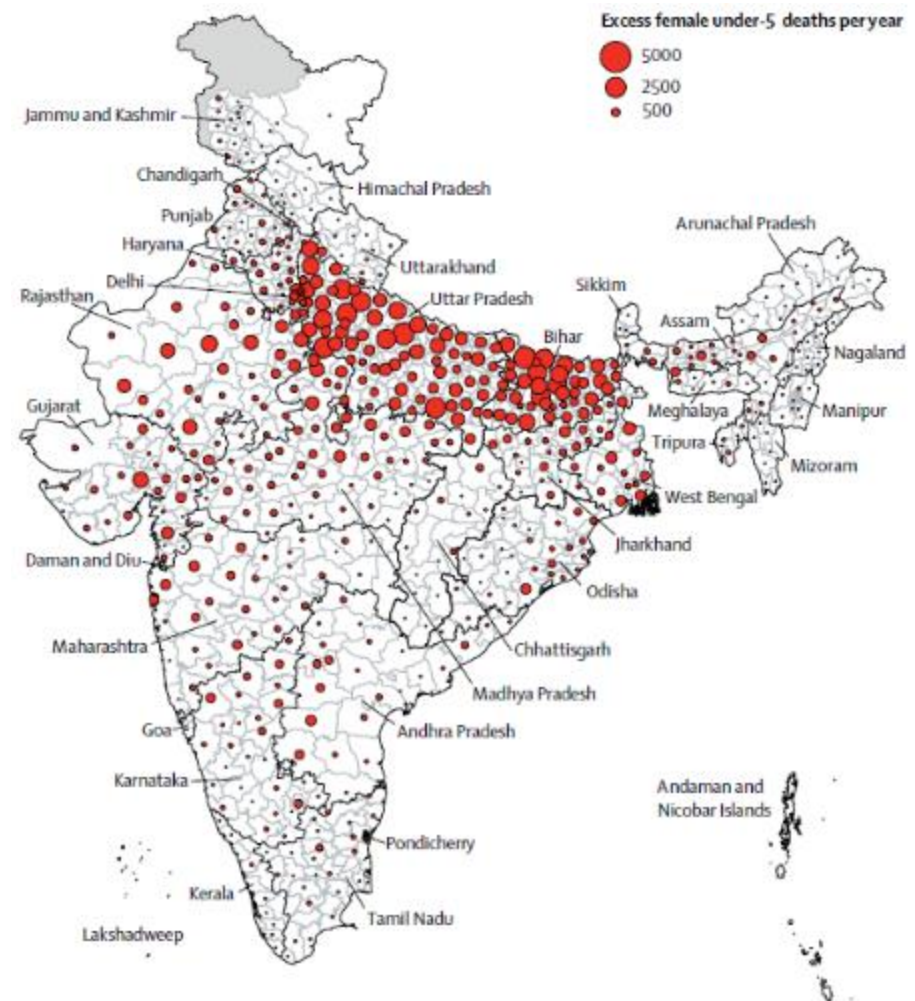
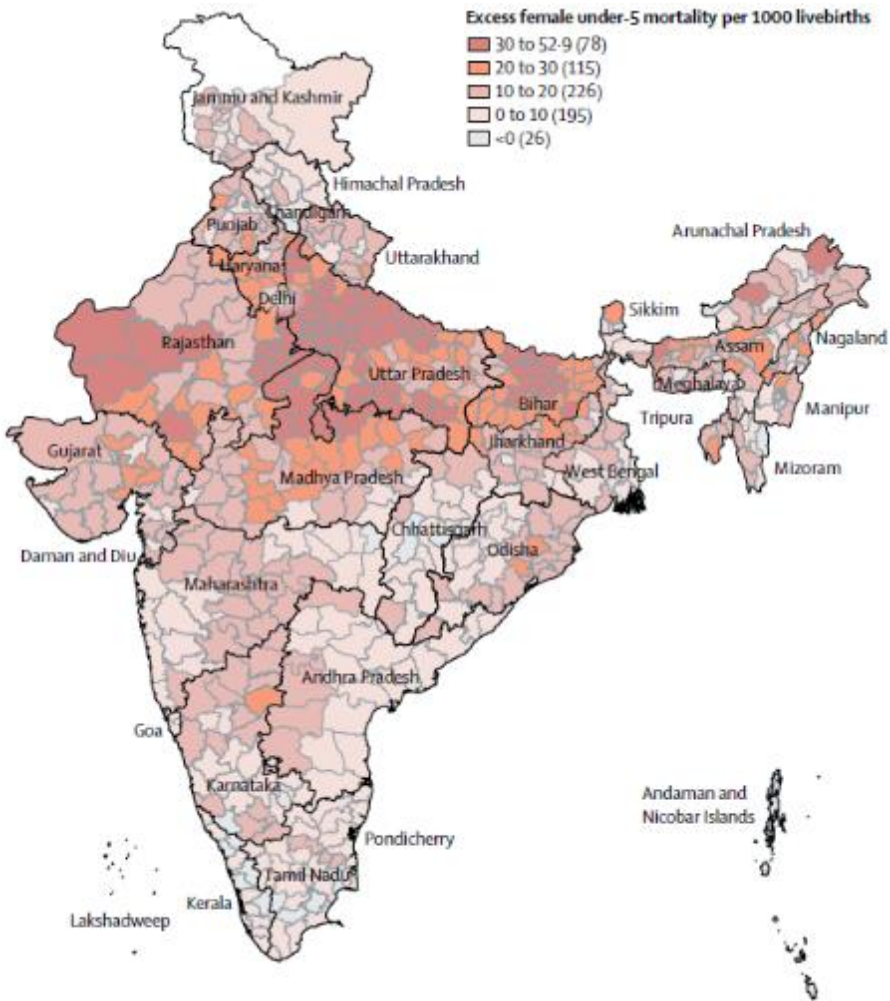
- To estimate excess female under five mortality rate, we fitted a quadratic model on the relationship between male and female using data from 37 countries with no evidence of gender preference at birth.
- The fitted model is

$${}_5q_0^f = A * ({}_5q_0^m)^2 + B * q_0^m - C$$

- With $A=0.0006$; $B=0.8013$ and $C=0.3462$



EXCESS MORTALITY AND DEATHS, 2005-11



NFHS-4- BASED ESTIMATES OF CHILD MORTALITY

NFHS-4 ESTIMATES: DATA AND METHODS

- NFHS64 sample is a district-based sample
 - 259,627 births (last 5 yrs) and 532,376 births (last 10 yrs)
- Method used: *syncmrates* routine in Stata
- Results: early and neonatal, infant, child and U5 mortality by district and sex
 - IMR: 28,5 per 1000, CMR: 6 per 1000 and U5: 34,4 per 1000 (last 5 years)
- Consistency tests:
 - Extreme values (e.g. zero values due to no reported death)
 - Age- and sex-wise correlation of mortality rates
- Spatial tests:
 - Simple mapping and spatial autocorrelation
- External consistency
 - Correlation with other district-level estimates

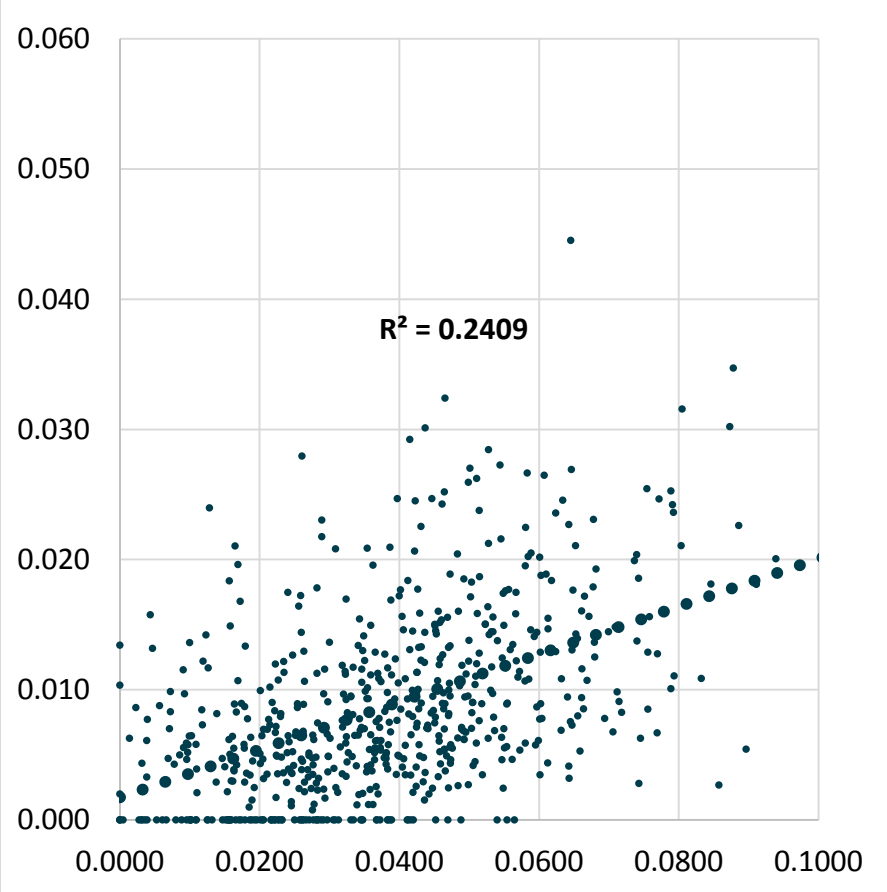
INTERNAL ASSESSMENT OF THE RESULTS

Statistical consistency (IMR vs CMR, male vs female)

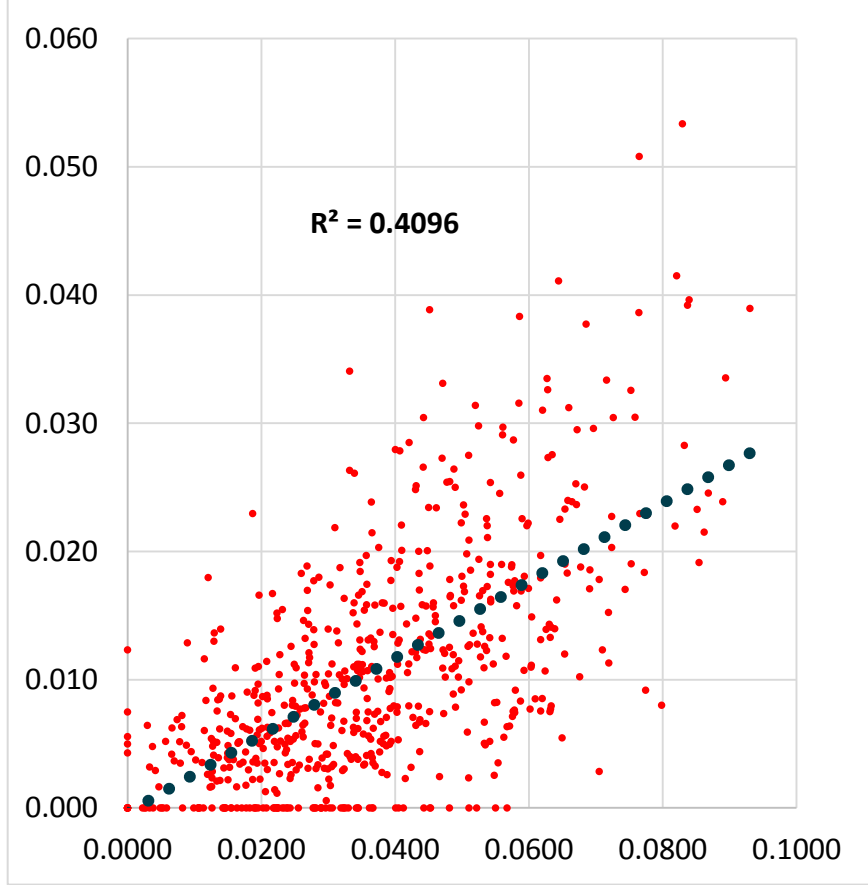
Spatial consistency (maps, hot spots and spatial autocorrelation)

INFANT VS. CHILD MORTALITY (BOTH SEXES) OVER 5 AND 10 YEARS

IMR vs CMR (5 years)



IMR vs CMR (10 years)



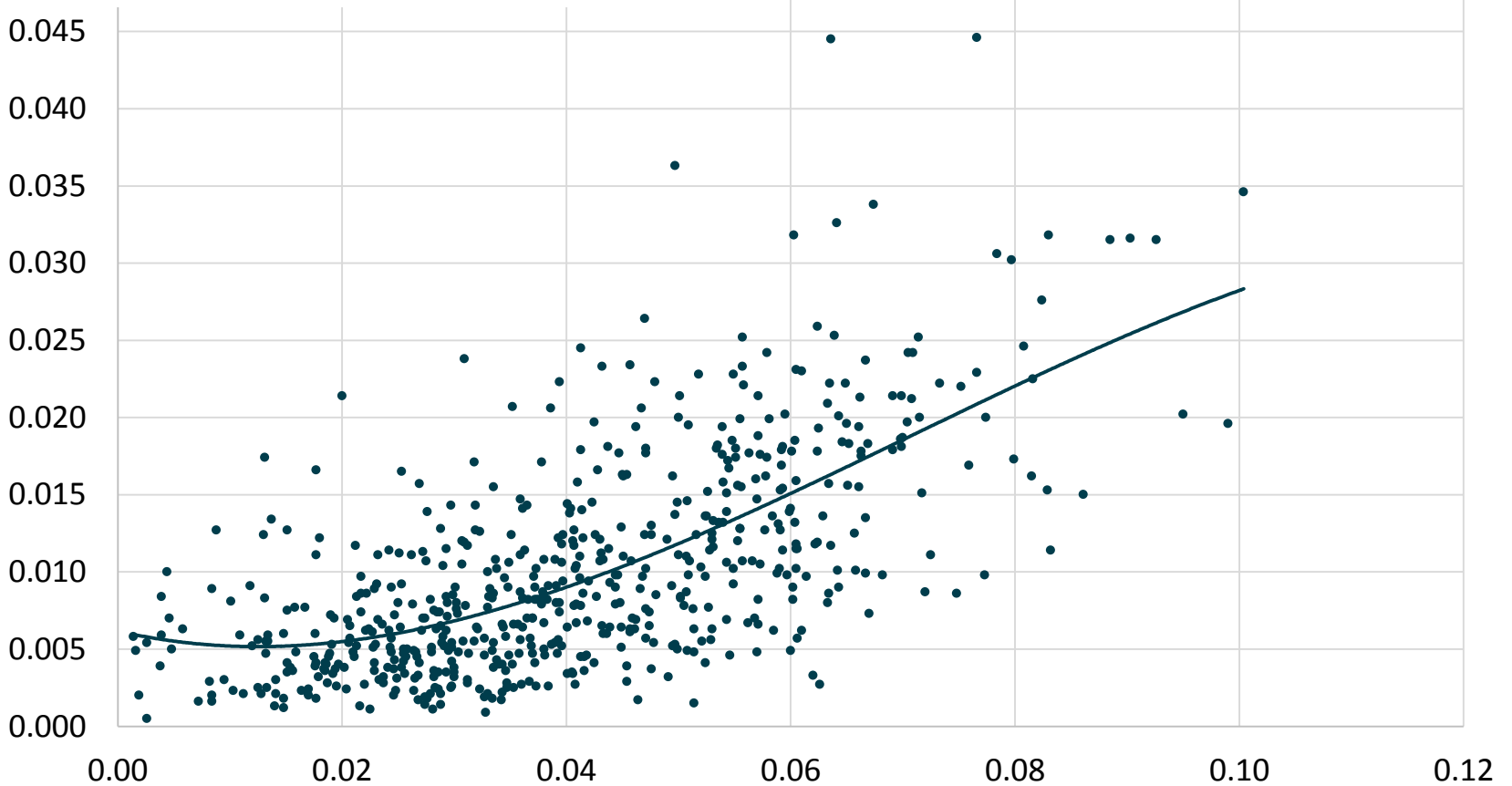
1. We remove all zero values from the rest of the analysis
2. We keep only estimates based on the births during the last 10 years

INFANT VS. CHILD MORTALITY (BOTH SEXES) OVER THE PREVIOUS 10 YEARS

IMR vs CMR

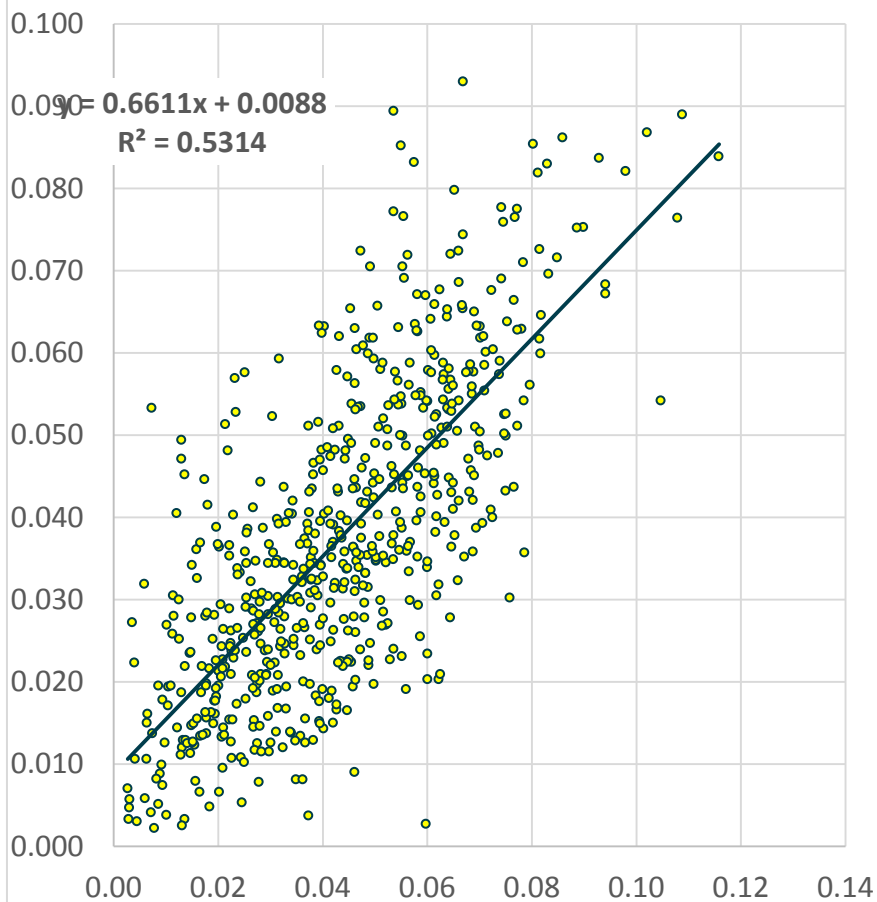
$$y = -34.583x^3 + 7.3339x^2 - 0.167x + 0.0062$$

$R^2 = 0.4419$

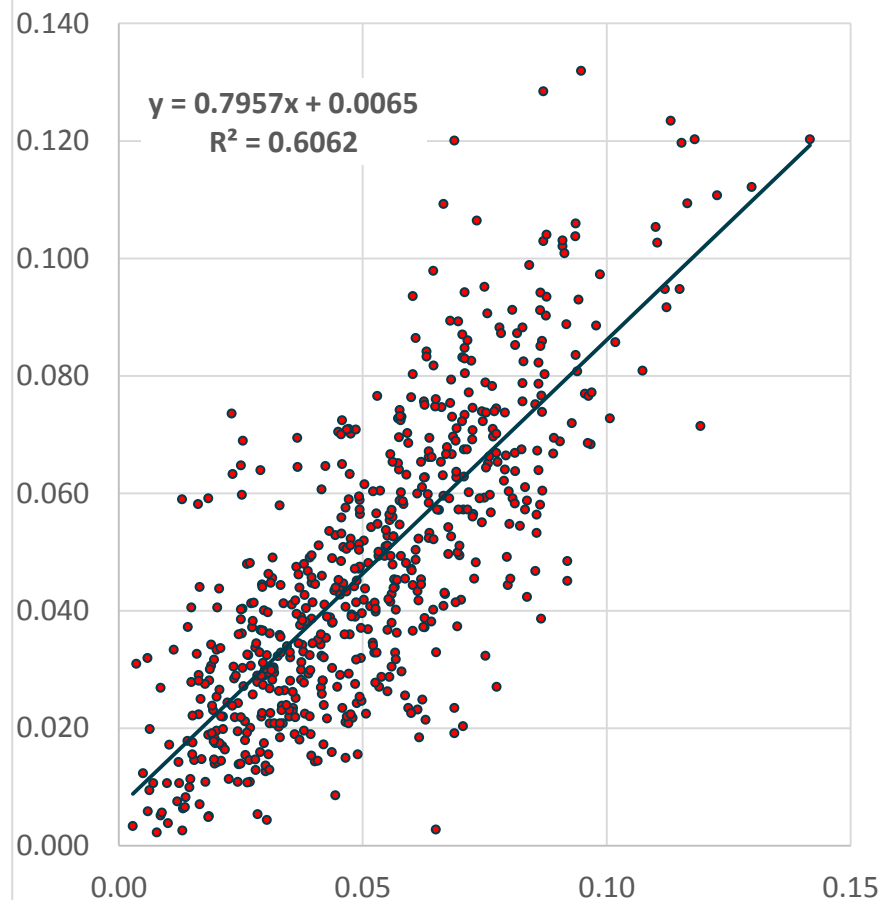


INFANT AND CHILD MORTALITY OVER THE PREVIOUS 10 YEARS: MALE VS FEMALE RATES

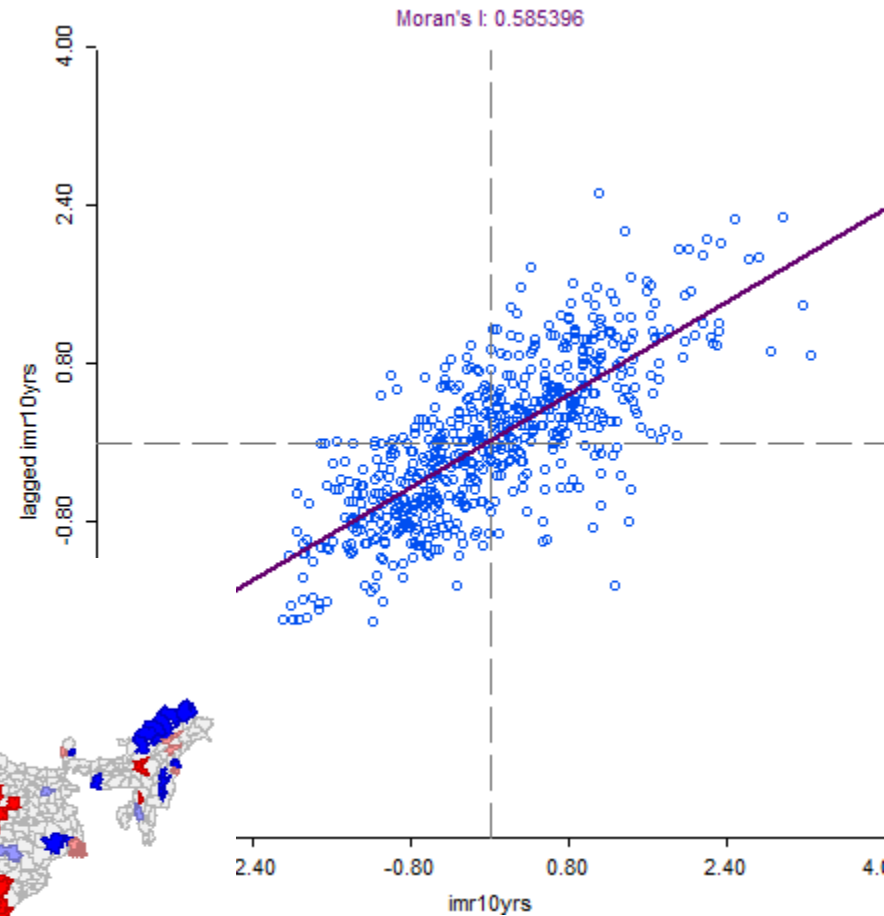
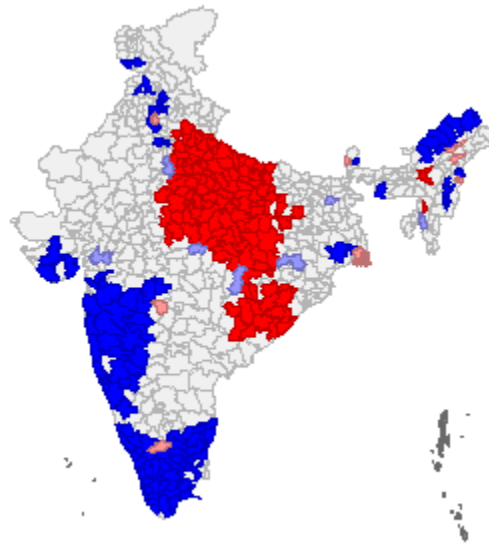
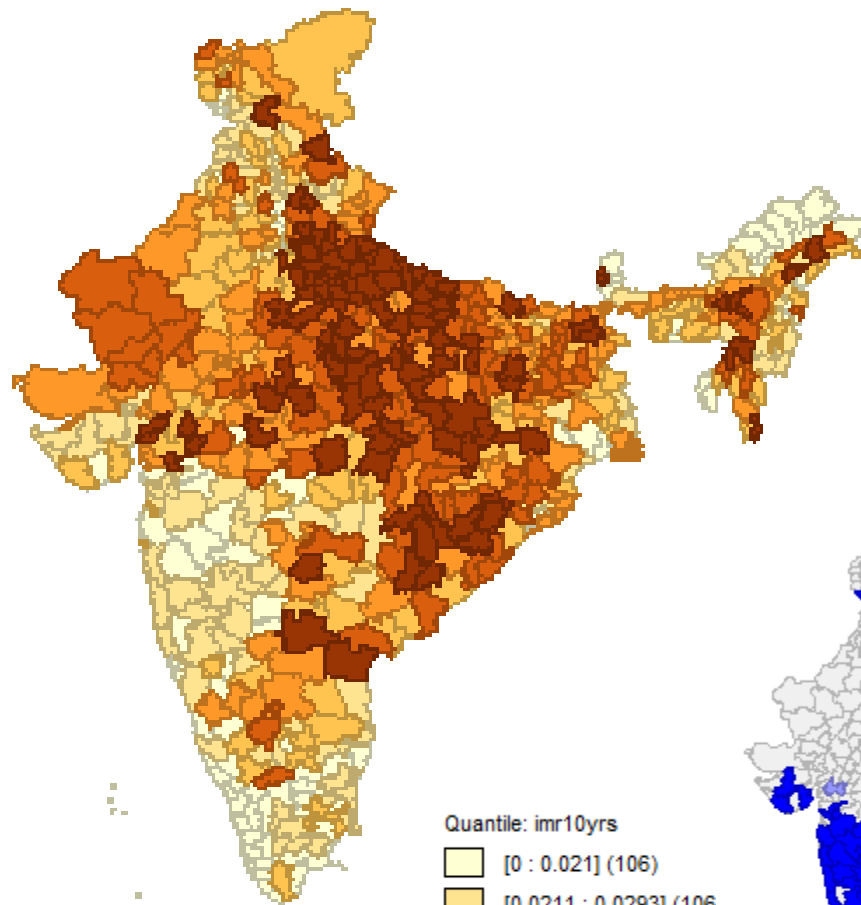
IMR: females vs. males



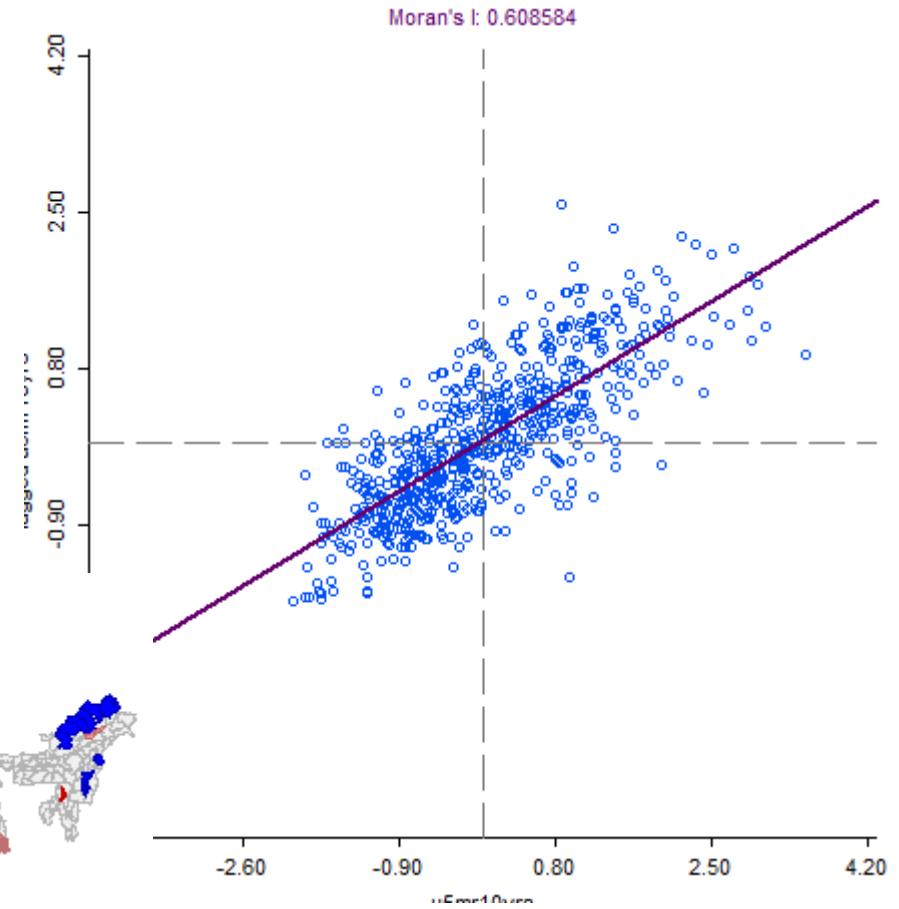
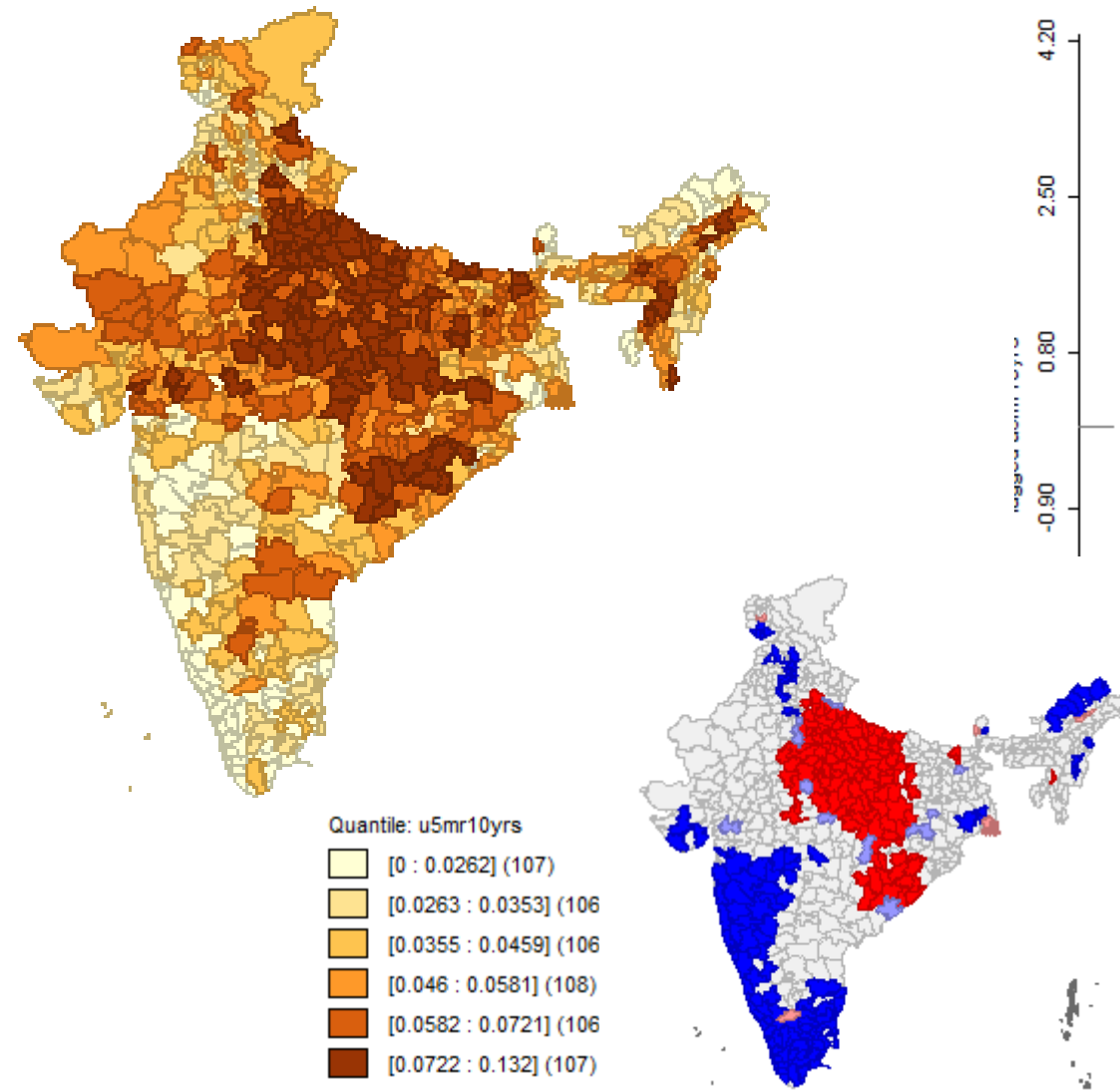
U5: females vs. males



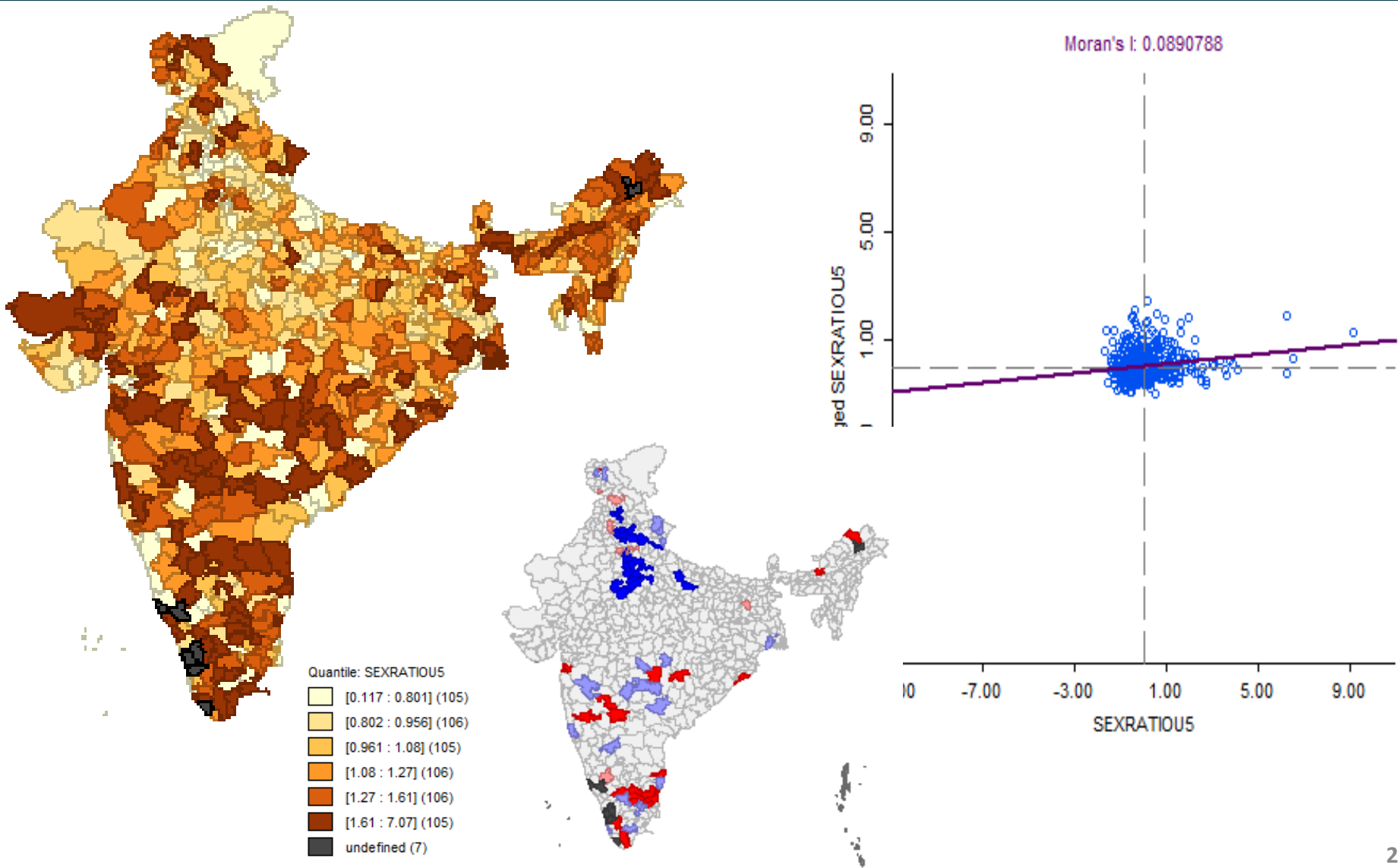
INFANT MORTALITY (NFHS-4): MAP, HOT SPOTS AND MORAN'S I



U5 MORTALITY (NFHS-4): MAP, HOT SPOTS AND MORAN'S I



SEX RATIO OF CHILD MORTALITY (NFHS-4): MAP, HOT SPOTS AND MORAN'S I



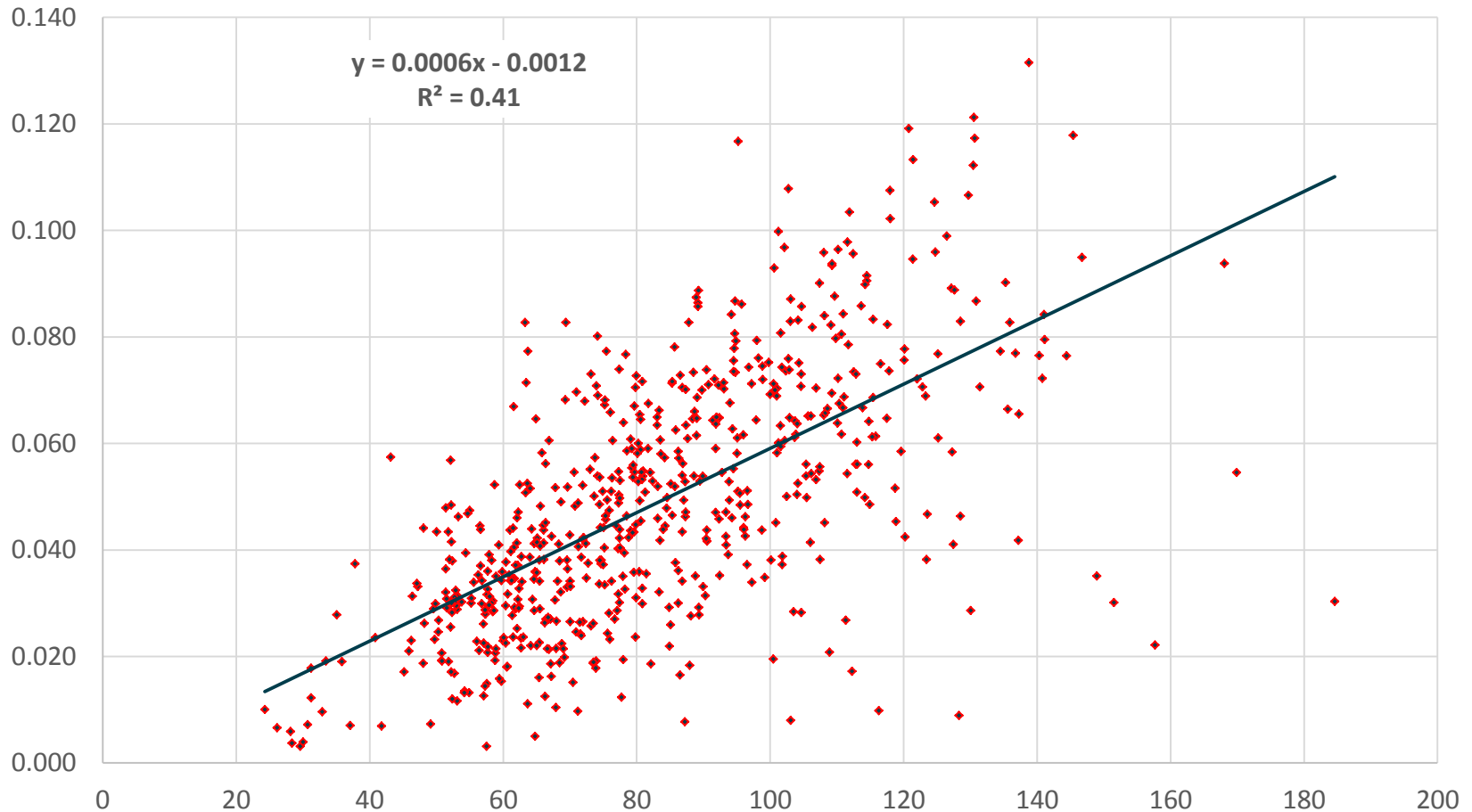
EXTERNAL ASSESSMENT WITH 2011 CENSUS ESTIMATES

Statistical correlation

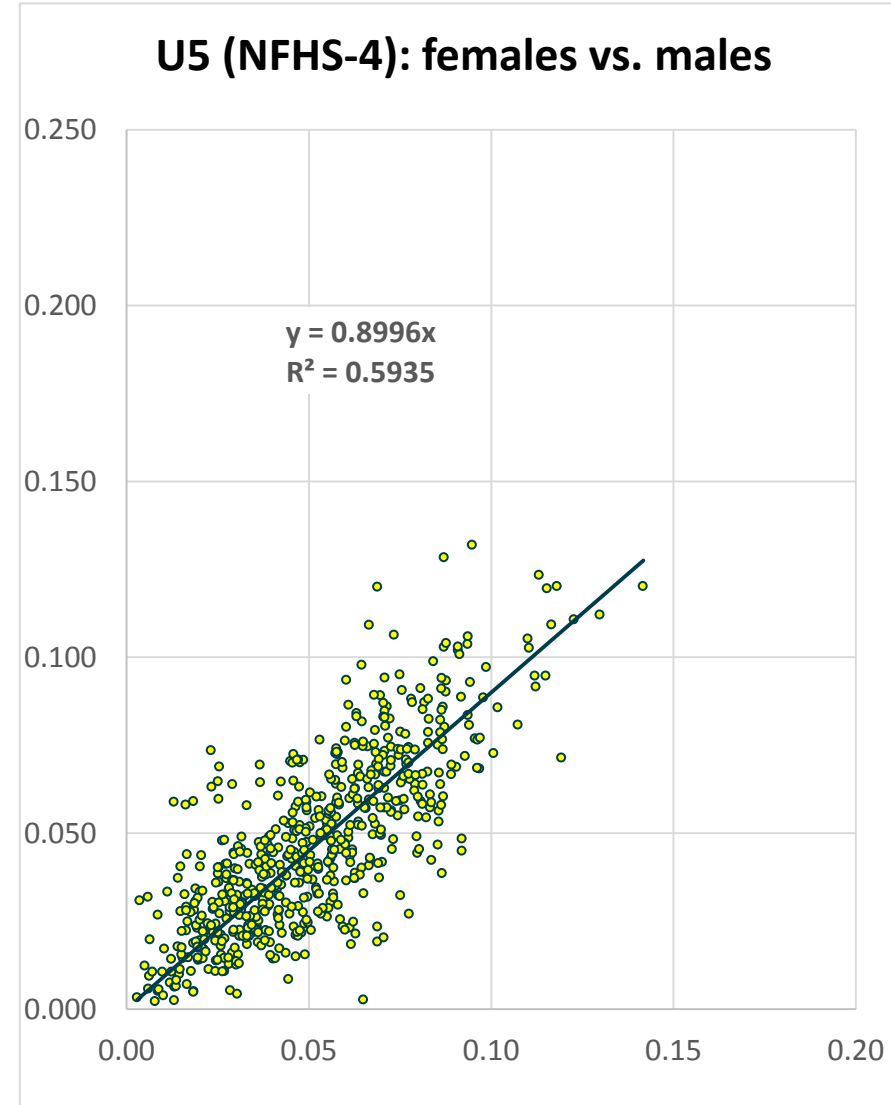
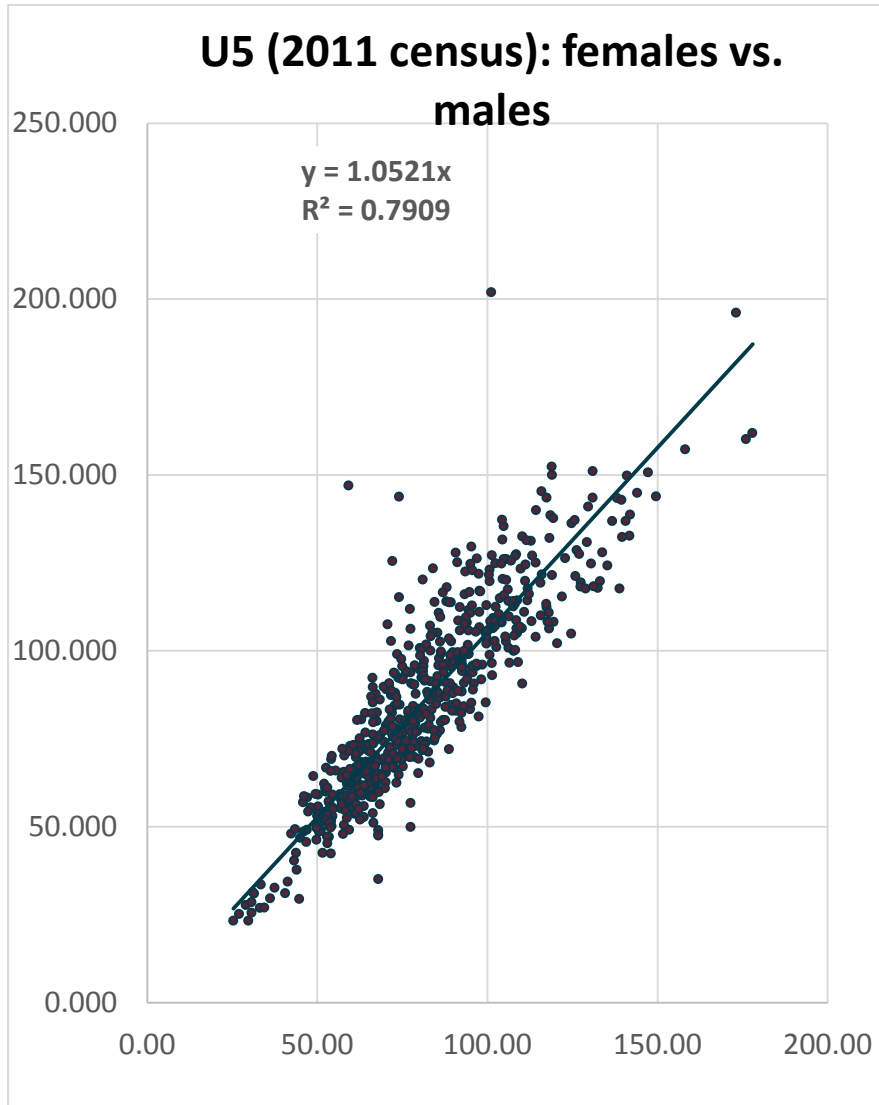
Spatial consistency (maps, hot spots and spatial autocorrelation)

U5 MORTALITY (BOTH SEXES): NFHS-4 VS. 2011 CENSUS (LANCET 2018)

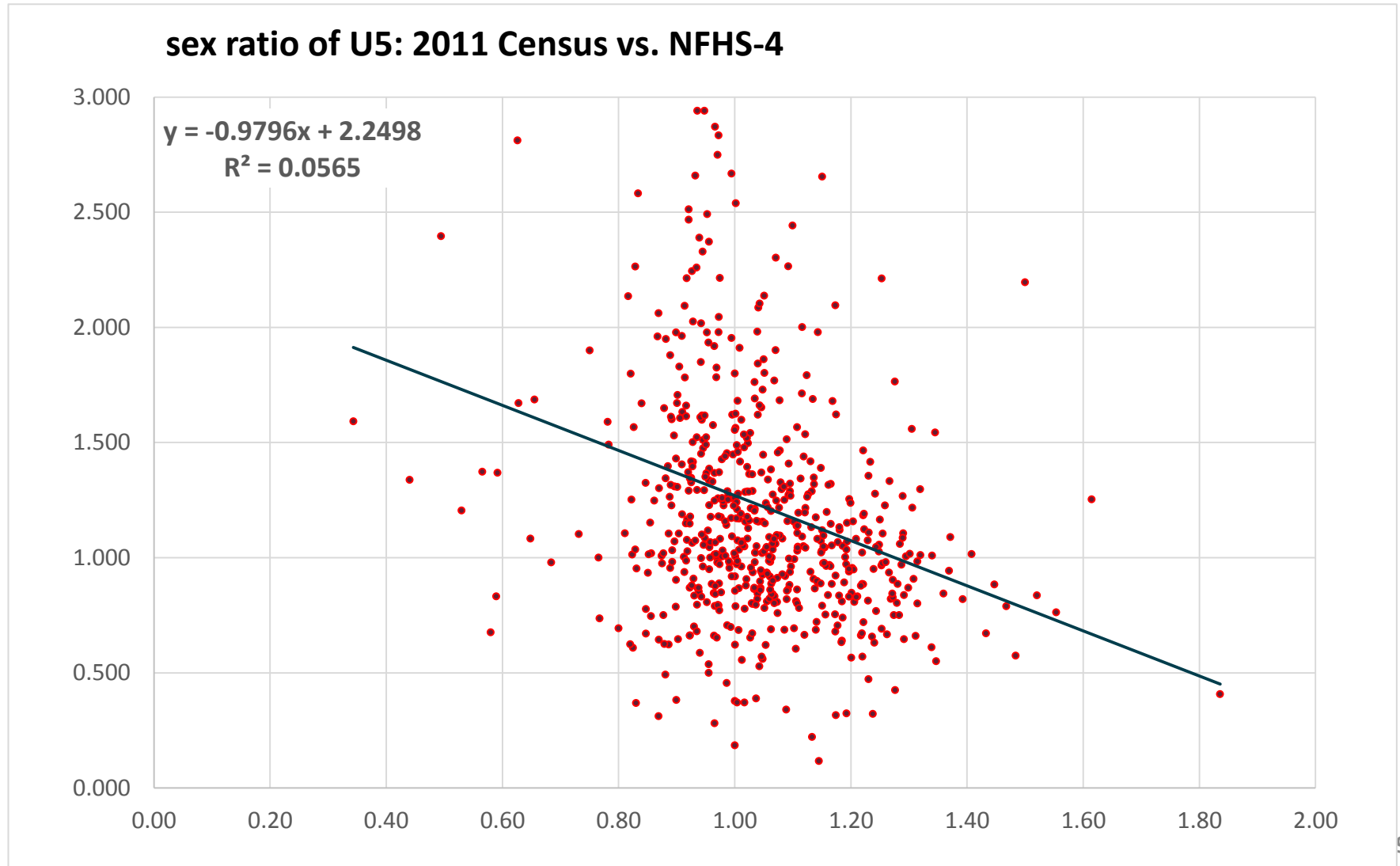
U5: NFHS64 vs. 2011 census



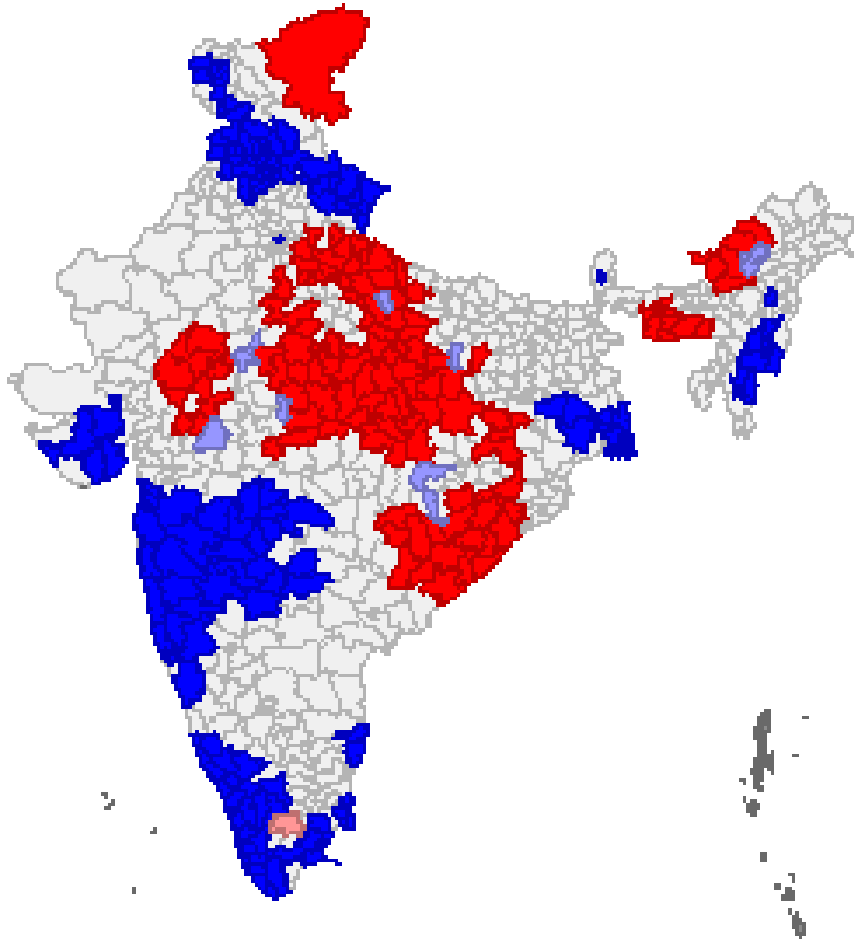
MALE VS FEMALE U5 MORTALITY : 2011 CENSUS VS NFHS-4 RATES



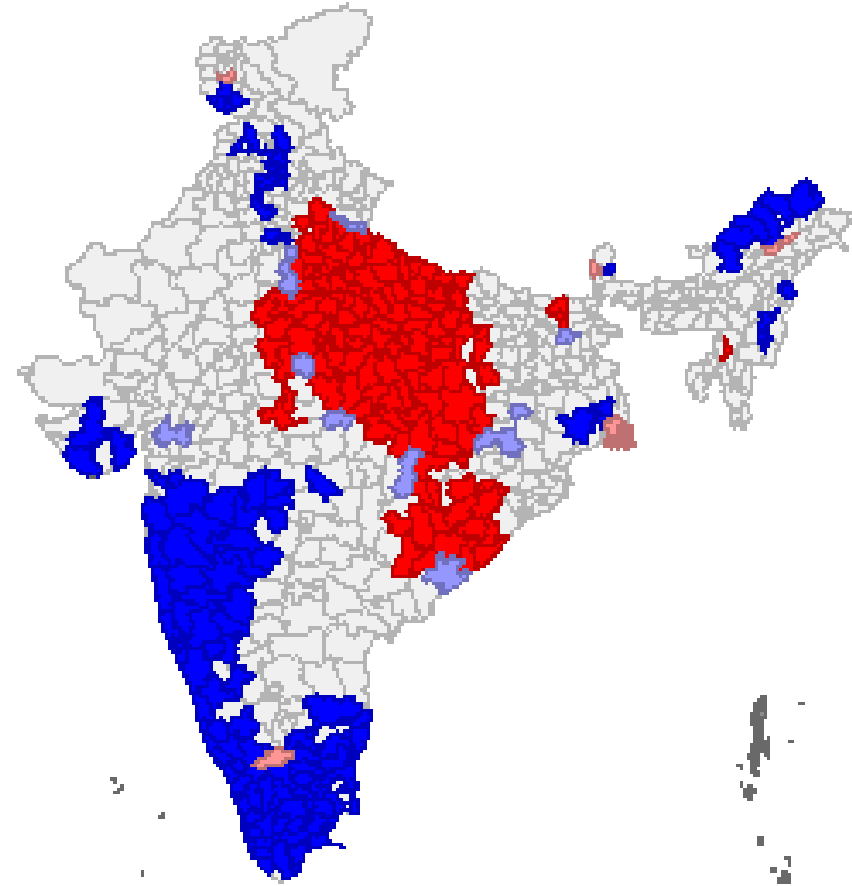
SEX RATIO OF U5 MORTALITY : 2011 CENSUS VS. NFHS-4



UNDER-FIVE MORTALITY HOT SPOTS: CENSUS VS NFHS-4

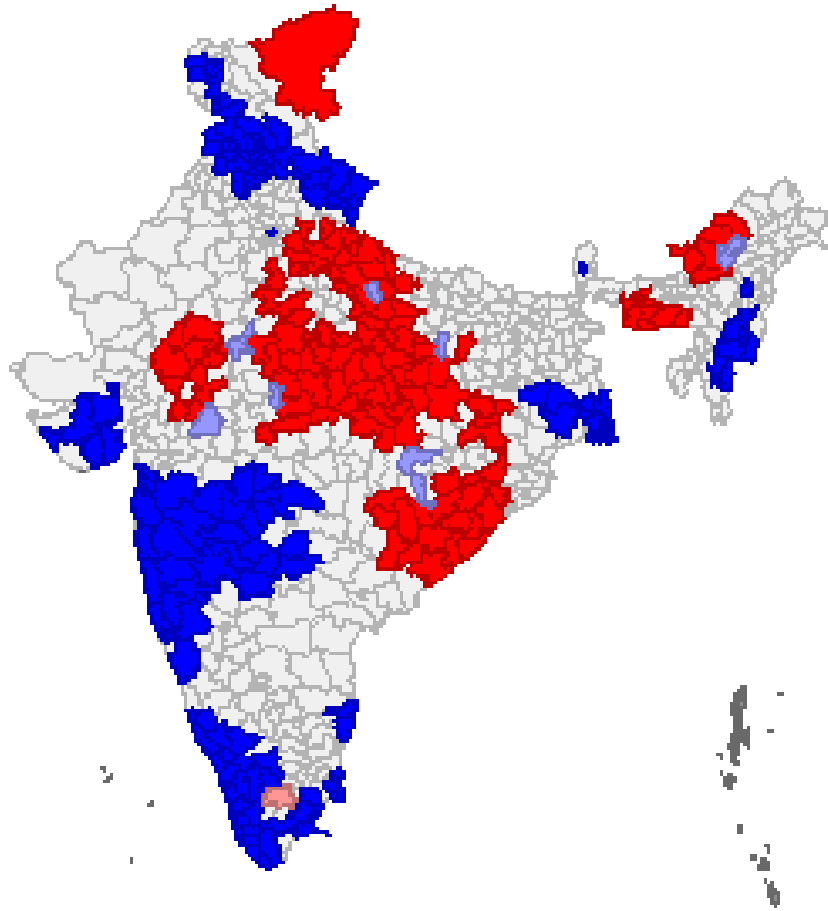


2011 Census

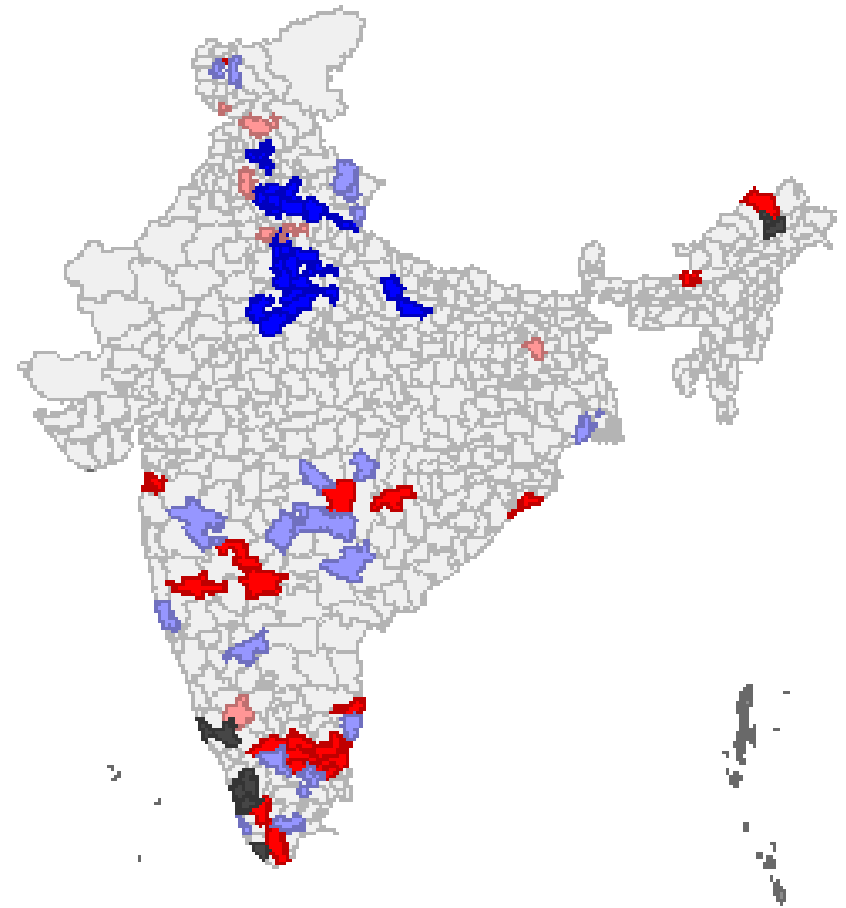


NFHS-4

EXCESS FEMALE MORTALITY HOT SPOTS: CENSUS VS NFHS-4



2011 Census



NFHS-4

CONCLUSION

- Considering the size of population, estimates for district or below are the need of the hour!
- Regional patterns of child mortality from NFHS and Census are mostly consistent.
 - Sex differentials appear to be far less consistent
- NFHS-4 and Census data have their own advantages in terms of data quality and representiveness
 - NFHS-4 provides quality data with a large number of potential correlates (education, parity etc.)
 - NFHS-4 estimates over 10 years are not effective for evaluating the rapid of mortality reduction
 - Reliability of estimates may be weaker at district level
- Census covers all districts with nearly exhaustive counts
 - Can we avoid census data to estimate district mortality? Not yet!