**Subnational Projection of Kin Size, Structure, and Dependency in India**

## Introduction:

Kinship remains a cornerstone of individual, social, and economic life in India. In the absence of a comprehensive welfare system (Tiwari, 2013), families rely on kinship networks to exchange care, financial resources, and support. Grandparents often assist with childcare, while adult sons or sons-in-law contribute financially to support ageing parents and young children. Daughters and daughters-in-law take on domestic and caregiving roles at home (Das Gupta, 2010). Within families, these structures determine who gives and receives support, how responsibilities and resources are shared, and who is most vulnerable when support is scarce. At the community level, kinship determines patterns of inheritance, property ownership, and social mobility, reinforcing both opportunities and inequalities (Donner, 2022; Jain et al., 2023). Together, these exchanges shape broader national-level trends in labor participation, pensions, and social welfare demand.

India is experiencing a rapid demographic transition marked by sharp fertility declines and steady gains in life expectancy. The total fertility rate fell from 5.4 births per woman in 1970 to about 2.0 in 2020, averaging 2.14 in urban and 1.63 in rural areas. During the same period, life expectancy at birth rose from 48.6 to 70.2 years (UN, 2024). This transformation, however, remains uneven across the country. Southern and western states such as Kerala, Tamil Nadu, and Maharashtra have experienced below-replacement fertility for nearly two decades and have achieved life expectancies exceeding 70 years in 2020. Northern and central states Uttar Pradesh, Bihar, and Madhya Pradesh, continue to exhibit relatively higher fertility, around three births per woman, and shorter life expectancy, averaging 65–67 years in 2020 (IIPS & ICF, 2021).

Most existing studies on family and kinship in India focus on households or on a limited set of close kin, such as parents, children, and siblings, using census or large-scale survey data (Prasad et al., 2020). Extended kin, such as grandparents, aunts, uncles, and cousins, have received far less attention, with existing work largely limited to national-level estimates (Adhikari & Alburez-Gutierrez, 2025; Alburez-Gutierrez et al., 2023). Given the pronounced regional variation in fertility and mortality across states and between rural and urban areas, national averages do not adequately represent the diversity of kinship structures or the distinct realities of each region.

This study moves beyond national analysis to explore how kin size, structure, and dependency vary across India's demographic and geographic regions. Using subnational fertility and mortality estimates from 1980 to 2100, we capture long-term regional differences in demographic change and their implications for kin networks. Specifically, we address two questions:
(1) How do subnational variations in fertility and mortality in India shape kin size and structure from 1980 to 2100?
(2) How does the kin dependency ratio vary across regions, and how might it change under future demographic trajectories?

This study lays the foundation for future research on kinship dynamics in India. The subnational kin size and structure estimated and forecasted in this paper can serve as a basis for examining

various topics such as care demand and availability, the relationship between extended kin and coresident households, the experience of kin loss and its health consequences, and patterns of intergenerational exchange. A comprehensive understanding of the number and types of kin available across regions is essential for analyzing these topics, which help elucidate kin-based support systems and for designing regionally responsive welfare policies.

**Data and Method**

Subnational demographic data in lower- and middle-income countries are often limited and noisy, and India is no exception. The primary source for subnational fertility and mortality estimates is the Sample Registration System (SRS). However, the data are not accessible through a central repository but are dispersed across multiple tables in the reports. We manually extracted data from the “Compendium of India’s Fertility and Mortality Indicators, 1971–2013” report. This report provides age-specific fertility rates (ASFR) and age-specific mortality rates (ASMR) by state and by rural–urban residence. Temporal coverage varies considerably: in some states, data begin in 1970, while in others they begin in 1980 or 2004. We manually extracted each table embedded within text from the PDF files and compiled a harmonized database. Since ASMR values were available only up to the 70+ age group, we used the Co-Kannisto method (Sevcikova et al., 2017) to extrapolate ASMR from ages 70 to 100, based on observed patterns in ASMR between ages 50 and 65. To address irregularities in age gradients, sex differentials, and period trends, we applied isotonic regression to smooth the estimates while preserving realistic demographic patterns and region-specific characteristics.

We used fertility and mortality estimates from SRS for the period 1981-2006, excluding states that lacked consistent data from 1980 onward. For subsequent years, we used estimates from KC et al. (2018), which combine census-based fertility and mortality data from 2011 and 2021 and project subnational demographic trends up to 2100. The data from 1980 is available only for 17 bigger states disaggregated by rural and urban residence, resulting in a total of 34 subnational units. To estimate the number of kin by age and sex, we applied a two-sex, time-variant kinship model (Williams et al., 2023)). This model uses age- and sex-specific fertility and survival probabilities to compute the living kin composition for an average member of the population. That average member of the population has a specific age and sex and is referred to as "Focal". Survival probabilities for men and women were derived from life tables constructed using age- and sex-specific mortality rates. As data on male fertility were unavailable, we followed the approach used by (Adhikari & Alburez-Gutierrez, 2025), assuming that the male fertility schedule follows the same pattern as the female schedule, but shifted by five years to reflect the typical age gap between fatherhood and motherhood. In its simplest form, the two-sex, time-varying kinship model estimates the number of living kin by integrating ASFR and ASMR over time. It identifies the age distribution of parents at the time a focal individual is born using age- and sex-specific fertility rates, and then applies survival matrices to project the changing number of kin with age. In matrix notation, the model can be expressed as:

$$K(x+5,t+5)=U_t K(x,t)+\beta(x,t) \quad ,$$

Here, the vector $K(x,t)$ represents the number of Kin of age $x$ at time $t$. $U_t$ is the survival matrix, representing the surviving Kin from age $x$ ¿ $x$+5. $\beta(x,t)$ represents the recruitment of new kin from the ASFR.

**Preliminary Findings**

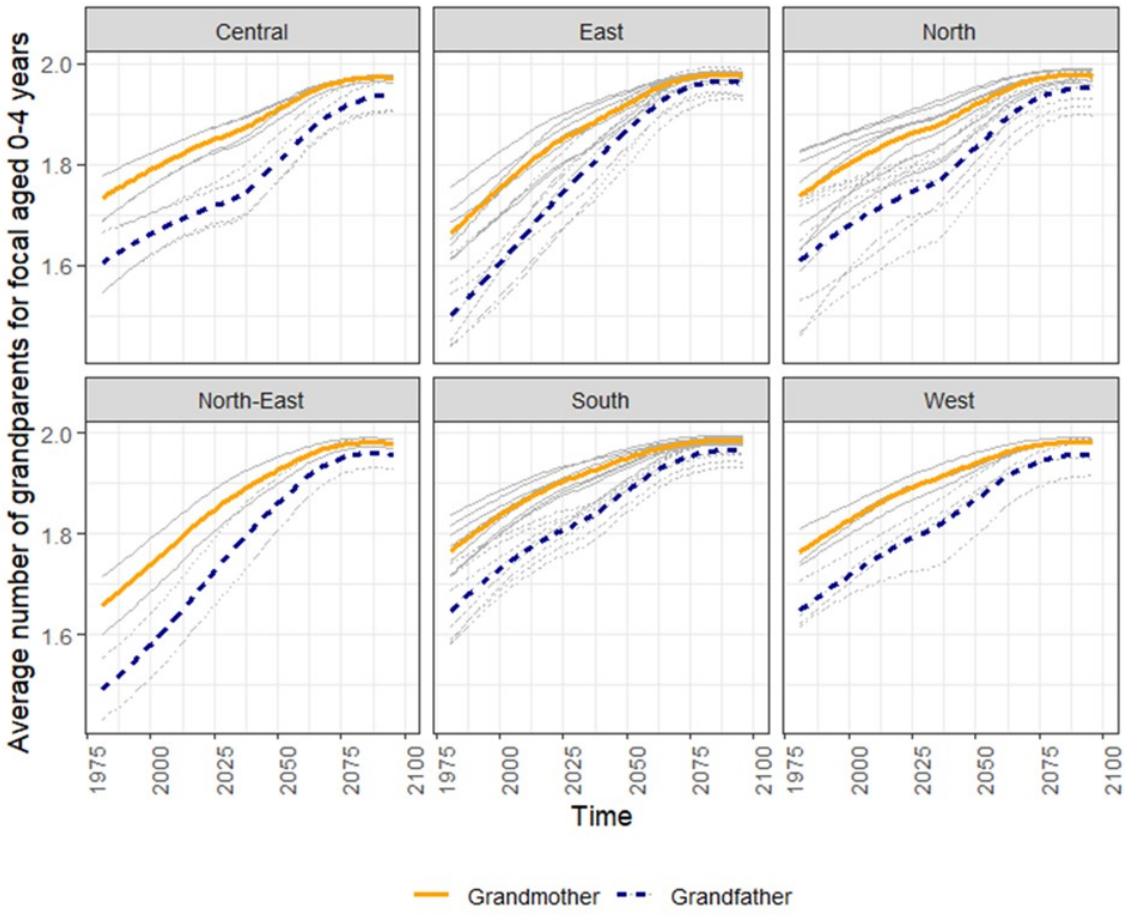


**Figure 1:** Average number of living grandparents for Focal aged 0-4 years across Indian regions from 1980 to 2100 (thin grey lines are states within region and thick lines for broader region).

Figure 1 shows a steady increase in the average number of living grandparents for Focal aged 0-4 years across all Indian regions from 1980 to 2100. Throughout the period, Focal consistently has more living grandmothers (1.8-1.9 in 2025) than grandfathers (1.7-1.8 in 2025), although the gap narrows slightly over time and reaches nearly two grandparents of each sex by 2100. Regional differences are evident. In 1980, the North East and East had the lowest average number of grandparents, at approximately 3.2, while the West, North, and Central had slightly higher numbers of around 3.4. By 2020, the number of grandparents in the North and East regions had nearly converged, each with about 3.4 grandparents on average. By 2100, we expect the average number of living grandparents to converge to around 3.8 across all six regions for Focal aged 0–4 years.

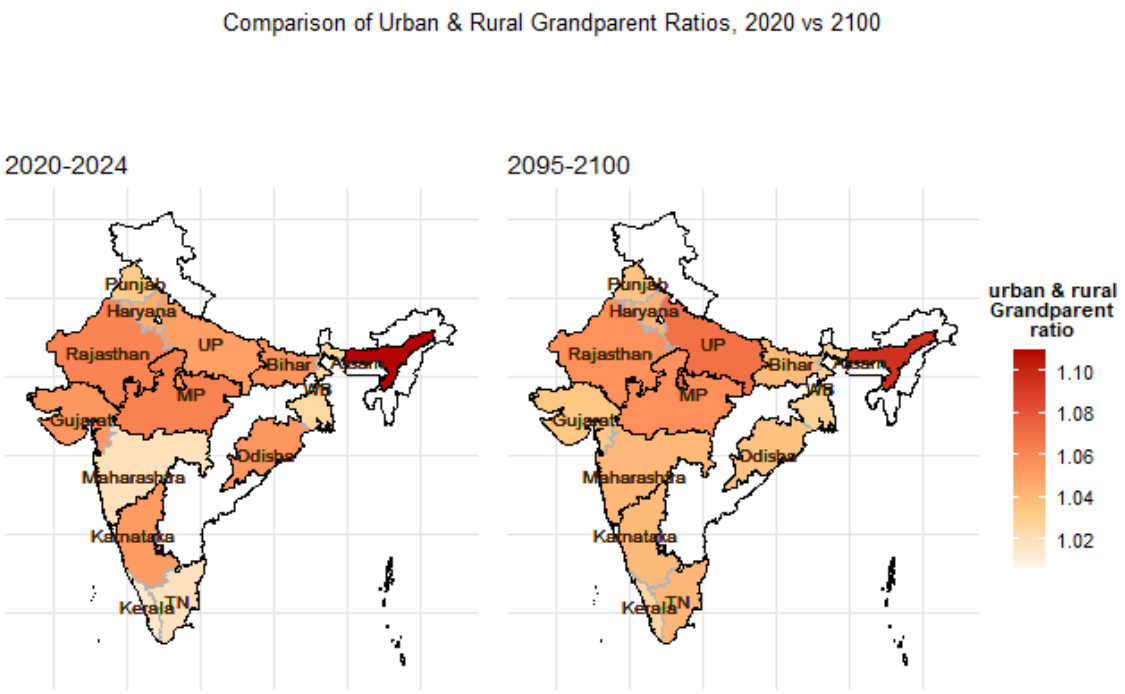


Figure 2: Ratio of living grandparents between urban and rural residence across Indian States, 2020-2024 and 2095-2100 for the Focal aged 0-4 years. (States where data is unavailable are filled with white color)

Figure 2 shows the urban-rural ratio of living grandparents for Focal aged 0-4 years across Indian states. In all states, urban areas have more living grandparents than rural areas (in both 2020 and 2100). The urban-rural ratio is highest in states like Assam, where Focal is expected to have more than 1.10 times as many grandparents in urban areas as in rural areas. Conversely, southern states such as Kerala and Tamil Nadu show relatively small differences (between 1.01 and 1.03). The ratio is projected to decline in states like Gujarat, Odisha, and Bihar, but to rise in others, such as Uttar Pradesh and Karnataka. These trends reflect varying rates of mortality decline and shifts in the age of grandparenthood across regions. Such differences in the number of grandparents across regions and over time reflect that intergenerational exchanges in support vary between regions and, within a given region, change over time.

**Next Step:**

These are the preliminary findings of the study, and the next steps involve estimating and forecasting all types of living kin (parents, children, uncles/aunts, siblings, cousins, nephews/nieces, grandchildren, great-grandparents, great-grandchildren) and their composition (by age & sex) across states and by rural-urban residence. We further estimate and forecast the kin dependency ratio for each state, stratified by urban and rural areas, to capture support networks at the subnational level.

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