Levels and trends in contraceptive prevalence, unmet need, and demand for family planning for 29 states and union territories in India: a modelling study using the Family Planning Estimation Tool

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Summary

Background Improving access to reproductive health services and commodities is central to development. Efforts to assess progress on this front have been largely focused on national estimates, but such analyses can mask local disparities. We assessed progress in reproductive health services subnationally in India.

Methods We developed a statistical model to generate estimates and projections of levels and trends in family planning indicators for subpopulations. The model builds onto the UN Population Division's Family Planning Estimation Model and uses data from multiple rounds of the Demographic and Health Survey, the District Level Household & Facility Survey, and the Annual Health Survey. We present annual estimates and projections of levels and trends in the prevalence of modern contraceptive use, and unmet need and demand for family planning for 29 states and union territories in India from 1990 to 2030. We also compared projections of demand satisfied with modern methods with the proposed goal of 75%.

Findings There is a large amount of heterogeneity in India, with a difference of up to 55·1 percentage points (95% uncertainty interval 46·4–62·1) in modern contraceptive use in 2015 between subregions. States such as Andhra Pradesh, with 92·7% (90·9–94·2) demand satisfied with modern methods, are performing well above the national average (71·8%, 56·7–83·6), whereas Manipur, with 26·8% (16·7–38·5) of demand satisfied, and Meghalaya, with 45·0% (40·1–50·0), consistently lag behind the rest of the country. Manipur and Meghalaya require the highest percentage increase in modern contraceptive use to achieve 75% demand satisfied with modern methods by 2030. In terms of absolute numbers, Uttar Pradesh requires the greatest increase, needing 9·2 million (5·5–12·6 million) additional users of modern contraception by 2030 to meet the target of 75%.

Interpretation The demand for family planning among the states and union territories in India is highly diverse. Greatest attention is needed in Uttar Pradesh, Manipur, and Meghalaya to meet UN targets. The analysis can be generalised to other countries as well as other subpopulations.

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Introduction

Reproductive health is intricately linked to issues of women's and children's health, the spread of sexually transmitted diseases, poverty, education, gender equality, and human rights.[1] Improving access to reproductive health is thus central to the process of development, as reflected in Sustainable Development Goal 3.7,[2] which calls for universal access to family planning by 2030, and the FP2020 Initiative.[3] The FP2020 Initiative was launched in 2012 to coordinate global efforts to expand access to family planning services. It is a partnership of countries, donors, researchers, and development organisations to accelerate action and address the most pressing reproductive health needs. Donors have pledged US$2·6 billion for this effort and 36 countries have pledged to support the goals of expanding access to safe and effective family planning services, protecting human rights, and enhancing equity.[3] Considerable effort has been devoted to developing a conceptual framework and indicators to monitor progress towards future goals[4] and to support national programmes to monitor their progress and develop plans to improve performance.[5]

To date, assessments of progress in providing access to family planning have been largely focused on the estimation and projection of family planning indicators at the national level—ie, based on the UN Population Division's global Family Planning Estimation model (FPEM),[6] but such analyses might not detect local diversity. Thus, it is important to track progress at a finer (ie, subnational) level. Such population subgroups can be defined geographically (eg, states, urban *vs* rural residence) or based on socioeconomic factors (eg, household wealth quintiles). This shift in emphasis from national to subnational assessments and targets is

Research in context

Evidence before this study

Subnational-level data on family planning in India are available from national survey programmes. We searched PubMed and Scopus using the terms "sub-national", "family planning", "India", "projections", and "model-based" for articles published before March 1, 2016. We did not identify any studies that produced model-based estimates and projections of family planning indicators. Previous studies related to the analysis of rates and trends in family planning indicators at the subnational level in India have mainly relied on direct reporting of the survey results.

Added value of this study

This study makes use of advances in modelling for family planning indicators by providing a systematic and comprehensive set of estimates and projections for family planning indicators for Indian states and union territories from 1990 to 2030. Our results show that there is a large amount of heterogeneity in the country in current levels and past trends. Modern contraception use in 2015 ranged from 14·7% (uncertainty interval 8·9–22·3) to 69·8% (65·8–73·5), and rates of change in modern use between 1990 and 2015 ranged from a decrease of 10·0% (0·5–20) to an increase of 33·9% (20·1–46·4) across states and union territories. Projections to 2030 suggest continued disparities of up to 41·2 percentage points (14·5–63·2) in modern contraceptive use subnationally in India.

Implications of all the available evidence

The great disparities in access to family planning across Indian states and union territories highlight the need for context-specific action and a focus on areas where action is needed most.

particularly pertinent in light of the focus on equity in the post-2015 global development agenda.[7] Additionally, it is crucial to empower country stakeholders to take an active role in planning, monitoring, and evaluating at the local level, which is possible only if they can generate the relevant estimates and projections of indicators of access to reproductive health with little external support.

In 2015, 52·2% (95% uncertainty interval [UI] 37·8–66·1) of Indian women of reproductive age who are married or live with unmarried partners (in union) use modern contraceptive methods, compared with 36·1% (28·0–45·0) in 1990.[8] In absolute numbers, the number of women using modern contraceptive methods has doubled, from 58 million in 1990, to 124 million in 2015.[8] The unmet need for modern methods has fallen from 25·4% (95% UI 20·1–31·4; 41·0 million women) in 1990, to 20·4% (12·7–30·1; 51·0 million women) in 2015, while the demand for family planning satisfied with modern methods has risen from 58·6% (41·7–59·7) to 71·8% (56·7–73·6) in the same period. However, this national progress may mask local disparities, especially in a country of high demographic diversity such as India. To our knowledge, previous studies related to the analysis of rates and trends in family planning indicators for states or union territories in India have mainly relied on observations at the state or union territory level from household surveys.[9,10] Although survey data provide valuable information on family planning indicators, this information is not necessarily recent; as of September, 2016, 12 states or union territories have no survey information available beyond 2013, three have no information beyond 2007, and one has no information beyond 2005.

In this Article, we present a user-friendly web application, the Family Planning Estimation Tool (FPET), which can provide subnational monitoring. This is the only tool that can provide an annual series of estimates as well as projections past the most recent survey data of rates and trends in indicators of utilisation and demand (specifically contraceptive prevalence, unmet need, and demand for family planning) at the subnational level. The disparities between demand and utilisation can provide an indication of relative access to reproductive health. We used the tool to obtain estimates and projections of subnational family planning indicators for India from 1990 to 2030.

Methods

Definitions

The contraceptive prevalence rate (CPR) is defined as the percentage of women currently using any contraceptive method, and the modern contraceptive prevalence rate is the same but limited to women using modern contraceptive methods, including sterilisation, condoms, oral hormonal pills, intrauterine devices, injectables, implants, vaginal barrier methods, and emergency contraception. The unmet need for family planning is defined as the percentage of women who do not want any more children or want to delay the birth of the next child for at least 2 years and yet are not using any contraceptive method. Observations for unmet need in our database are, wherever possible, based on a recently revised algorithm for measuring this indicator.[11] Demand for family planning satisfied with modern methods is defined as modern contraceptive prevalence expressed as a percentage of total demand for family planning, where total demand is the sum of total contraceptive prevalence and unmet need for family planning.

Data

The database for this study includes the contraceptive prevalence rate and unmet need for family planning as well as estimates of the base population of women for 29 states and union territories in India (the state of Telangana is not considered because it separated from Andhra Pradesh only in 2014; Adaman and Nicobar and Pondicherry have not been included because they are very small and have only one recent observation in 2015).

The family planning indicators were obtained from multiple rounds of the Demographic and Health Survey (DHS), the District Level Household & Facility Survey (DLHS), and the Annual Health Survey (AHS; appendix pp 2–3). There are 213 observations each of the total contraceptive prevalence rate, modern contraceptive prevalence rate, and the unmet need for family planning from 1992 to 2015 from a total of 11 survey series (appendix p 2). Most recent data are from the 2015–16 DHS for those states or union territories where preliminary estimates were available.

The base population of women refers to women of reproductive age (15–49 years old) who are married or in union. We did not analyse unmarried women. We fitted polynomial regression curves to data on the base population from 1970, 2001, and 2011, and projections for 2026. These curves provided estimates and projections for the 29 states and union territories. The order of the polynomial used to provide yearly estimates and projections for each state or union territory was chosen on the basis of the most appropriate fit to the data (third order polynomials were used unless they caused the trend to deviate by more than 50% above or below the linear trend line between the two census estimates; in such situations, second order polynomials were used). State-specific estimates of the base population obtained from the 2001 and 2011 censuses of India provided the data for 2001 and 2011. Data for 1970 and 2026 were obtained by applying state-specific marriage rates to female population estimates for these years. Female population numbers for 1970 and 2026 were based on the state-specific population projections by the Technical Group on Population Projections constituted by the National Commission on Population India.[12] The marriage rates used to obtain the 1970 estimates per state were obtained from the 2001 census, adjusted for changing state boundaries. The state-specific marriage rates used for the 2026 MWRA estimates were derived from a linear projection of the 2001 and 2011 census marriage rates by state.

Statistical analysis

Our statistical model for subnational estimates and projections or back-projections builds on the Bayesian hierarchical model that is used by the UN Population Division to assess progress in providing access to family planning.[6,8] This model (the global FPEM), combines systematic trends in total contraceptive prevalence and the ratio of modern to total prevalence, modelled by logistic growth curves, with a time series model for fluctuations around these trends. A Bayesian hierarchical model is used to estimate the parameters of the logistic functions, so that the global, regional, and subregional rates and trends are taken into account in the estimation on top of the country experience (since some countries have limited data available). To estimate unmet need, the model takes advantage of an expected (and empirically observed) statistical relation between total contraceptive prevalence and unmet need. Model projections depend on the current level of an indicator and past experience, as summarised in the country-specific model parameters. For example, changes in contraceptive prevalence occur according to an underlying trend that assumes growth rates are slow at low levels of the indicator, rates are fastest at intermediate levels, and will slow down again at high levels. Therefore, if a country currently has intermediate contraceptive prevalence then there is room for continued growth in the projection period. Conversely, if a country currently has high contraceptive prevalence, lower growth rates are expected in the projection period. Finally, a data model adjusts for differing data quality and for data that do not pertain to the base population of interest (eg, data for married women not aged 15–49 years).

Our estimates and projections were obtained from a population-specific (local) extension of the global FPEM. In the local model implementation, non-country-specific parameters (eg, the subregional rate of uptake of contraceptive methods and data quality parameters), were not estimated but fixed at the point estimates from

See Online for appendix

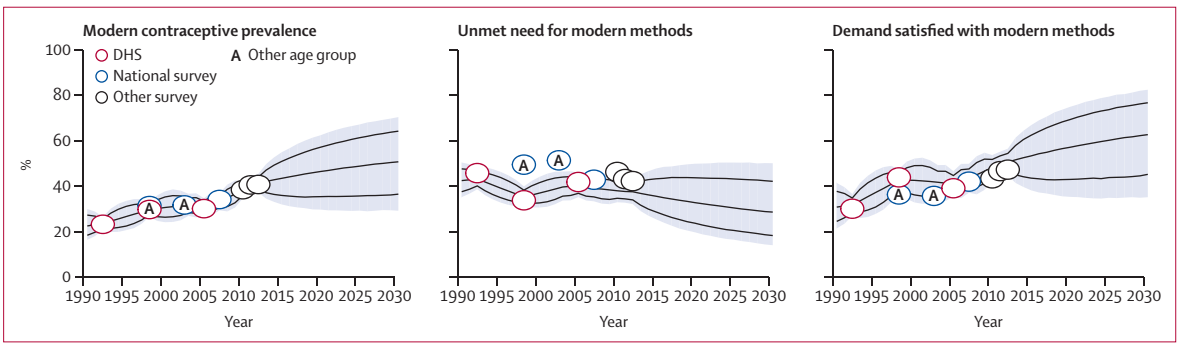

Figure 1: **Data and modelled rates and trends of modern contraceptive prevalence, unmet need for modern contraceptive methods, and demand satisfied with modern contraceptive methods for Assam**

Circles represent survey observations; black lines represent the median fit and 80% uncertainty intervals; blue shaded areas represent 95% uncertainty intervals. Circles labelled A represent a non-standard age group of women.

	Prevalence of modern contraceptive use in 2015	Unmet need for modern methods in 2015	Demand satisfied with modern methods in 2015	Change in prevalence of modern contraceptive use, 1990–2015	Prevalence of modern contraceptive use in 2030	Unmet need for modern methods in 2030	Demand satisfied with modern methods in 2030	Increase in percentage of users of modern methods required to meet 75% demand satisfied target compared with 2015	Additional number of users of modern methods (millions) required to meet 75% demand satisfied target compared with 2015
Andhra Pradesh	69·8 (65·8 to 73·5)	5·5 (4·5 to 6·7)	92·7 (90·9 to 94·2)	25·1 (14·2 to 36·2)	70·5 (51·4 to 84·2)	6·5 (2·7 to 13·9)	91·5 (79·4 to 96·9)	..	..
Arunachal Pradesh	47·2 (36·4 to 58·0)	23·3 (16·3 to 31·2)	66·9 (55·3 to 77·4)	29·6 (16·9 to 42·3)	55·4 (35·4 to 73·9)	18·9 (9·4 to 31·8)	74·5 (54·1 to 88·4)	8·8 (–3·0 to 20·0)	0·04 (0·02 to 0·06)
Assam	40·9 (28·9 to 52·9)	35·6 (25·5 to 47·7)	53·5 (38·3 to 67·0)	21·7 (7·6 to 35·4)	48·5 (26·0 to 69·1)	28·6 (14·1 to 50·0)	62·9 (35·3 to 82·6)	17·5 (4·1 to 31·0)	1·37 (0·72 to 2·01)
Bihar	26·0 (22·5 to 29·9)	22·9 (20·5 to 25·6)	53·1 (48·0 to 58·3)	6·3 (–1·7 to 13·3)	41·0 (24·4 to 60·0)	21·2 (12·5 to 31·1)	65·6 (46·7 to 82·3)	21·2 (9·9 to 30·7)	5·08 (3·04 to 6·78)
Chhattisgarh	57·0 (46·4 to 67·1)	16·7 (11·2 to 23·6)	77·3 (67·2 to 85·4)	26·0 (–0·5 to 49·1)	60·9 (40·8 to 77·9)	14·9 (6·7 to 26·9)	80·2 (61·6 to 91·9)	..	..
Delhi	58·0 (42·3 to 72·0)	19·6 (11·3 to 31·7)	74·7 (57·9 to 86·2)	6·4 (–12·1 to 23·7)	60·3 (38·7 to 78·0)	18·0 (8·1 to 33·8)	77·0 (54·7 to 90·4)	0·9 (–12·5 to 16·0)	0·54 (0·21 to 0·90)
Goa	25·7 (22·3 to 29·6)	20·1 (17·9 to 22·5)	56·1 (51·0 to 61·1)	–10·0 (–20·0 to –0·5)	38·8 (22·7 to 57·5)	20·8 (12·6 to 30·6)	64·9 (45·8 to 81·2)	19·5 (8·1 to 29·5)	0·06 (0·03 to 0·09)
Gujarat	57·6 (41·9 to 71·4)	16·7 (9·6 to 27·3)	77·5 (61·6 to 87·9)	13·0 (–5·6 to 30·5)	60·5 (38·8 to 78·7)	15·3 (6·8 to 29·6)	79·7 (58·3 to 91·8)	..	..
Haryana	58·4 (54·0 to 62·5)	13·8 (12·0 to 15·8)	80·9 (77·7 to 83·7)	16·4 (5·9 to 26·7)	60·9 (41·9 to 77·0)	13·8 (6·8 to 24·4)	81·4 (64·4 to 91·7)	..	..
Himachal Pradesh	58·7 (47·8 to 68·8)	15·5 (9·8 to 22·8)	79·1 (68·4 to 87·2)	6·8 (–7·8 to 21·1)	62·1 (41·9 to 78·9)	13·8 (6·1 to 25·5)	81·8 (63·2 to 92·8)	..	..
Jammu and Kashmir	47·6 (32·3 to 62·7)	24·2 (15·0 to 36·0)	66·2 (49·0 to 80·3)	10·4 (–7·7 to 28·2)	53·4 (32·3 to 72·8)	20·9 (10·0 to 36·9)	71·7 (48·1 to 87·7)	8·3 (–6·0 to 23·3)	0·34 (0·11 to 0·57)
Jharkhand	45·9 (35·0 to 56·5)	28·6 (20·7 to 37·7)	61·5 (49·0 to 72·6)	28·4 (4·5 to 46·5)	54·1 (32·8 to 73·1)	22·8 (11·4 to 39·3)	70·2 (46·6 to 86·2)	12·1 (0·0 to 23·4)	1·18 (0·55 to 1·75)
Karnataka	54·1 (49·4 to 58·8)	10·9 (9·3 to 12·7)	83·2 (79·9 to 86·1)	9·0 (–2·0 to 20·1)	59·7 (40·2 to 76·7)	11·4 (5·1 to 20·4)	84·0 (67·6 to 93·6)	..	..
Kerala	54·7 (44·0 to 64·9)	19·6 (13·2 to 27·3)	73·6 (62·6 to 82·6)	3·0 (–11·0 to 17·0)	58·1 (38·6 to 75·0)	17·9 (8·8 to 31·2)	76·4 (56·4 to 89·3)	2·4 (–9·0 to 13·4)	0·55 (–0·18 to 1·25)
Madhya Pradesh	52·4 (47·7 to 57·0)	14·2 (12·4 to 16·3)	78·6 (75·0 to 81·8)	16·5 (–7·1 to 37·8)	58·3 (39·3 to 75·0)	13·9 (6·8 to 23·7)	80·7 (63·8 to 91·5)	..	..
Maharashtra	63·5 (59·1 to 67·5)	11·7 (10·1 to 13·5)	84·4 (81·6 to 86·9)	13·0 (2·2 to 24·0)	65·4 (46·5 to 80·5)	11·5 (5·2 to 21·3)	85·0 (69·4 to 93·8)	..	..
Manipur	14·7 (8·9 to 22·3)	40·3 (30·9 to 50·4)	26·8 (16·7 to 38·5)	–7·7 (–17·6 to 2·4)	28·8 (13·2 to 48·8)	35·0 (22·2 to 50·9)	44·9 (22·5 to 67·2)	33·8 (21·6 to 44·3)	0·15 (0·11 to 0·19)
Meghalaya	21·1 (18·1 to 24·5)	25·7 (23·1 to 28·5)	45·0 (40·1 to 50·0)	7·6 (1·2 to 13·2)	35·5 (19·8 to 54·3)	25·4 (16·1 to 36·1)	57·9 (38·4 to 76·2)	25·3 (14·1 to 34·7)	0·13 (0·08 to 0·17)
Mizoram	60·1 (48·9 to 70·3)	16·4 (10·2 to 24·4)	78·5 (67·3 to 87·1)	8·7 (–6·5 to 23·5)	63·3 (43·1 to 80·1)	13·5 (5·5 to 25·4)	82·4 (63·7 to 93·6)	..	..
Nagaland	37·0 (21·7 to 54·3)	29·8 (19·8 to 41·3)	55·2 (36·7 to 72·5)	25·0 (8·7 to 43·1)	49·1 (27·7 to 70·8)	23·7 (11·7 to 39·4)	67·2 (43·3 to 85·4)	17·8 (2·4 to 32·2)	0·06 (0·02 to 0·10)
Odisha	48·3 (37·3 to 59·2)	26·6 (18·8 to 36·2)	64·5 (51·4 to 75·5)	15·7 (1·0 to 29·9)	54·8 (34·0 to 73·0)	21·4 (10·7 to 37·8)	71·9 (48·8 to 87·0)	9·2 (–2·9 to 21·0)	1·25 (0·39 to 2·04)
Punjab	60·3 (49·7 to 69·9)	15·1 (9·9 to 21·9)	79·9 (70·2 to 87·3)	12·0 (–2·0 to 25·9)	77·1 (64·2 to 87·0)	14·7 (6·9 to 26·8)	80·7 (62·2 to 91·6)	..	..
Rajasthan	62·3 (51·8 to 71·2)	16·0 (10·8 to 23·0)	79·5 (69·9 to 86·6)	33·9 (20·1 to 46·4)	65·5 (45·2 to 81·3)	13·9 (6·3 to 26·5)	82·4 (63·9 to 92·7)	..	..
Sikkim	48·4 (43·4 to 53·3)	22·3 (19·6 to 25·3)	68·5 (63·6 to 72·8)	16·8 (–1·3 to 32·9)	55·7 (36·3 to 73·3)	18·7 (9·3 to 30·5)	74·7 (55·6 to 88·5)	7·7 (–2·1 to 15·7)	0·02 (0·01 to 0·03)
Tamil Nadu	53·7 (48·9 to 58·5)	11·4 (9·8 to 13·2)	82·5 (79·0 to 85·4)	10·8 (–0·2 to 21·5)	59·2 (39·9 to 75·9)	11·7 (5·4 to 20·6)	83·5 (67·0 to 93·2)	..	..
Tripura	43·1 (38·5 to 47·8)	31·9 (27·0 to 37·8)	57·5 (50·8 to 63·5)	14·3 (3·7 to 24·1)	49·8 (29·0 to 68·6)	26·3 (13·8 to 45·3)	65·3 (40·1 to 82·9)	14·7 (4·9 to 23·3)	0·17 (0·10 to 0·22)
Uttar Pradesh	40·7 (29·8 to 52·0)	35·0 (25·8 to 45·5)	53·7 (40·1 to 66·3)	24·1 (11·3 to 36·9)	51·7 (29·8 to 71·2)	26·2 (13·3 to 44·9)	66·2 (41·5 to 84·1)	18·0 (5·5 to 30·2)	9·18 (5·53 to 12·61)
Uttarakhand	50·9 (46·3 to 55·3)	19·9 (17·5 to 22·6)	71·8 (67·7 to 75·6)	15·2 (–8·3 to 36·7)	56·4 (37·7 to 73·7)	17·6 (9·0 to 29·3)	76·1 (57·3 to 89·0)	5·0 (–4·6 to 13·2)	0·26 (0·09 to 0·39)
West Bengal	57·5 (52·9 to 61·9)	21·7 (17·8 to 26·6)	72·6 (66·8 to 77·4)	21·7 (10·8 to 32·3)	59·6 (39·1 to 75·7)	19·9 (10·0 to 37·3)	74·9 (52·1 to 88·1)	2·6 (–6·5 to 10·4)	2·10 (0·51 to 3·44)

Data are % (95% uncertainty interval). The increase in percentage of users of modern methods required to meet 75% demand satisfied target was obtained by subtracting the percent of women who were using modern methods in 2015 from 75% of the projected percentage total demand in 2030 (D_{2030}). We calculated the additional number of users of modern methods required to meet 75% demand satisfied target by subtracting the number of women who are using modern methods in 2015 from 75% of the projected total demand in 2030. ..=states and union territories that had already attained 75% demand satisfied with modern methods in 2015.

***Table*: Prevalence of use, unmet need for, and demand satisfied for modern contraceptives in Indian states and union territories in 2015, and projections to 2030**

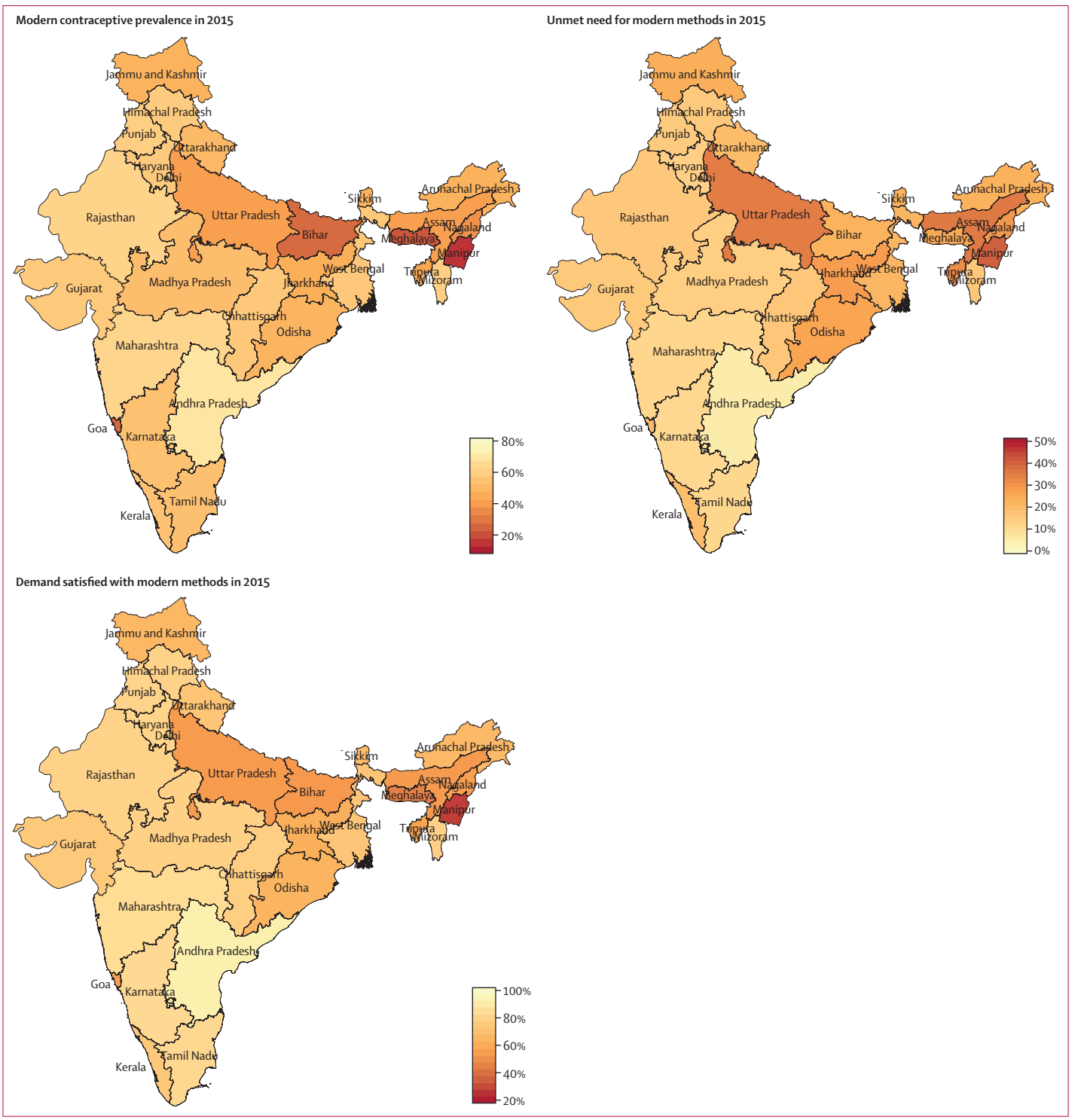

Figure 2: **Percentages of modern contraceptive prevalence, unmet need for, and demand satisfied with modern methods in 2015 for 29 states and union territories in India**

the most recent global model run.[8] The local model can be considered as a model with informative priors informed by the global model (appendix pp 10–11). No additional methodological changes were made.

When fitted to national data, the local model gave very similar results to those of the global one (appendix p 12). In addition to providing national estimates, the local model can also be fitted to subnational data to obtain

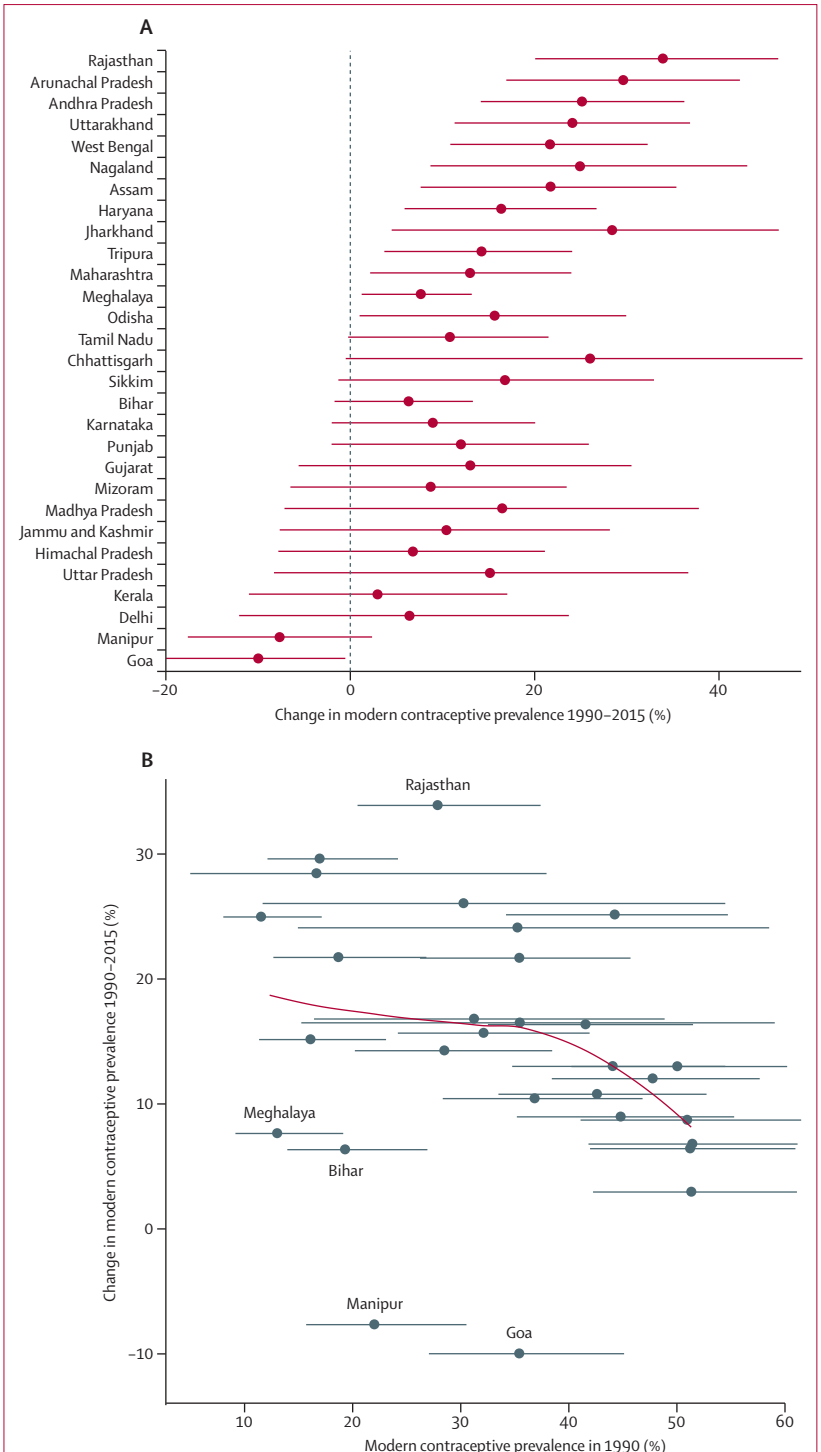

Figure 3: **Changes of use of, demand for, and access to modern contraceptive methods, 1990–2015**
(A) Change in percentage of modern contraceptive prevalence from 1990 to 2015. Horizontal lines are 95% uncertainty intervals. States and union territories are ordered by decreasing lower bound of uncertainty interval. (B) Change in percentage of modern contraceptive prevalence from 1990 to 2015 versus the percentage of modern contraceptive prevalence in 1990, with 95% uncertainty intervals in estimates of the level in 1990, including a LOESS fit to the points (red line).

subnational estimates. Subnational estimates are constructed for a subpopulation by changing hierarchical models in the family planning model that refer to a subregion–country hierarchy to a country–subpopulation hierarchy (appendix pp 10–11). We developed the FPET (appendix pp 4–9), which implements the local family planning model.[13]

In this Article, we used FPET to obtain subnational estimates for India. To assess future trends, we constructed projections up to 2030 for all indicators and states and union territories. We compared these projections to a target of 75% of demand for family planning satisfied with modern contraceptive methods by 2030. The 75% target is based on Fabic and colleagues' proposal[14] that all countries attain the target of 75% of demand satisfied with modern methods by 2030. We assessed what increase in use of modern methods would be necessary to meet the target. All outputs we present were obtained directly from the tool output. In addition to point estimates, we present 95% UIs to reflect the uncertainty in estimates and projections.

Data sharing

The raw data for this study are available online.

Role of the funding source

The funder had no role in the study design, data collection or analysis; in the writing of the manuscript; and in the decision to submit the paper for publication. All authors had full access to all data in the study and had final responsibility for the decision to submit for publication.

Results

Modelled estimates and projections for all states and union territories are shown in the appendix (p 23) and presented for Assam in figure 1, focusing on three key indicators: modern contraceptive prevalence, unmet need for modern contraceptive methods, and demand satisfied with modern methods.

The modelled fit follows the level and trend of the DHS data closely (figure 1) but shows some discrepancies between the modelled estimates and other data. These discrepancies are due to FPEM assumptions and findings. First, for non-standard data (eg, women not aged 15–49 years), the model takes into account potential biases associated with the non-standard characteristics when producing the estimates. Second, when fitting the model, data for India are categorised into DHS, national survey data, or other survey data. Based on the global assessment of data of these different types of surveys, the random errors associated with non-DHS data are greater than those associated with DHS data, especially for measuring unmet need.[6] As a result of this assessment, error variances for non-DHS data are estimated to be higher than the error variance for DHS data, and the modelled estimates will be more informed by the DHS

data compared with data from other sources. This difference explains the discrepancy between the AHS data (black circles, figure 1) and the modelled estimates for unmet need.

There is a large amount of heterogeneity across the country in the current levels of modern contraceptive prevalence, unmet need for, and demand satisfied with modern methods (table; figure 2). According to the latest UN Population Division estimates,[8] India as a whole has a modern contraceptive prevalence rate of 52·2% (95% UI 37·8–66·1) in 2015. The modern contraceptive prevalence ranges from 14·7% (8·9–22·3) for Manipur to 69·8% (65·8–73·5) for Andhra Pradesh (table). In other words, Manipur has a level of modern contraceptive prevalence similar to the national level in 1975, whereas Andhra Pradesh has a level that India is not even projected to reach by 2035. This represents a difference of 55·1 (46·4–62·1) percentage points between the lowest and highest prevalence regions, pointing to large disparities. With the exception of Manipur, all regions have achieved a minimum of 10% of women using modern contraception, with 97·5% probability.

For unmet need for modern methods and demand satisfied with modern methods, the national levels stand at 20·4% (12·3–30·9) and 71·8% (55·6–84·1), respectively.[8] Andhra Pradesh performs the best among the 29 states and union territories for both of these indicators, with 5·5% (4·5–6·7) unmet need and a demand satisfied with modern methods of 92·7% (90·9–94·2). At the other end of the spectrum, Manipur consistently lags behind the other states and union territories; unmet need for modern methods is 40·3% (30·9–50·4) and demand satisfied with modern methods is 26·8% (16·7–38·5). In general, the best-performing states or union territories are in the central region of India and the worst performing are in the northeast (table and figure 2).

Nationally, the prevalence of use of modern contraceptives in India has increased by 15·4% (2·0–32·0).[8] Subnationally, the results are diverse (table, figure 3A). 13 states have shown a significant improvement in modern contraceptive prevalence from 1990 to 2015: Andhra Pradesh, Arunachal Pradesh, Assam, Haryana, Jharkhand, Maharashtra, Meghalaya, Nagaland, Odisha, Rajasthan, Tripura, Uttar Pradesh, and West Bengal, with Rajasthan registering the largest increase of 33·9% (20·1–46·4).

Across India, the states or union territories with the greatest changes in modern contraceptive prevalence from 1990 to 2015 generally had low modern contraceptive prevalence in 1990 (figure 3B), although there is considerable variation in the change in this indicator among states that had similar levels in 1990. Bihar, Goa, Manipur, and Meghalaya registered much lower changes than expected in modern contraceptive prevalence in this period compared with other states or union territories, considering their level in 1990.

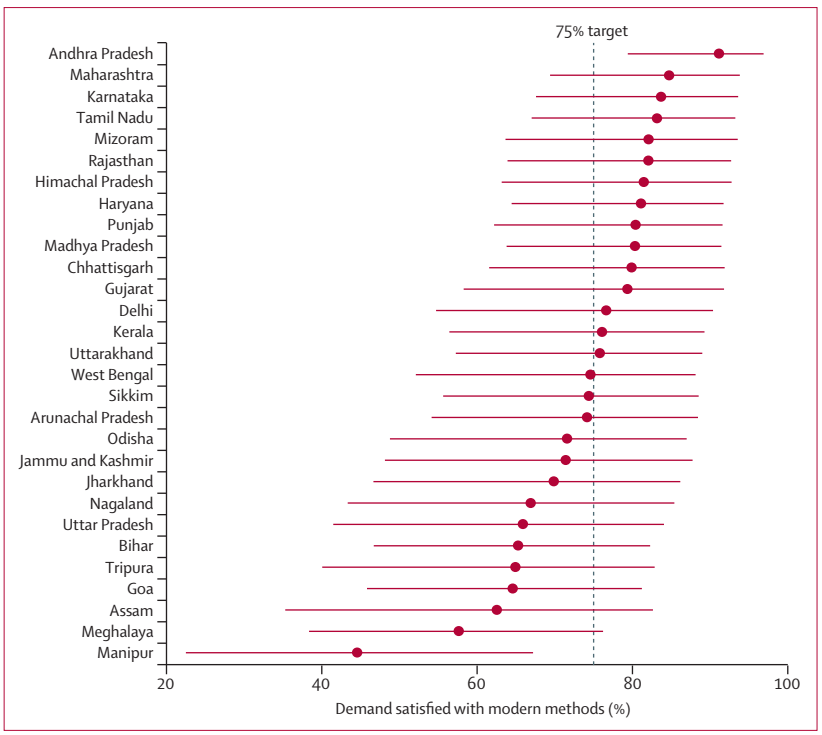

Figure 4: **Projections of demand satisfied with modern methods for 2030**
95% uncertainty intervals are displayed with horizontal lines. States and union territories are ordered by decreasing point estimate.

Andhra Pradesh is projected to be in the most positive position in 2030, with an unmet need for modern methods of 6·5% (2·7–13·9) and with 91·5% (79·4–96·9) of the demand satisfied with modern methods (table, figure 4). A similar positive scenario is projected for Maharashtra, Karnataka, and Tamil Nadu, where unmet need is projected to be less than 12% and the demand satisfied is projected to be more than 80% in 2030 (table). These projections contrast with Manipur, where unmet need is projected to be 35% and the demand satisfied is projected to be less than 50% in 2030 (table). Assam, Meghalaya, Tripura, and Uttar Pradesh will also have a relatively high unmet need for modern methods (with point estimates of greater than 25% in 2030). The demand satisfied for these states and union territories is projected to be less than two-thirds in 2030 (table).

Based on the point estimates, 15 states and union territories are projected to attain the target of 75% of demand satisfied with modern methods by 2030 (table, figure 4). In 12 of these states and union territories, the target was met already in 2015 (table). For those states that were not projected to meet the target, we calculated the additional percentage (and number) of women who would need to be provided with access to modern methods in order to meet the target. Among such states, the five with the largest gap were Manipur, Meghalaya, Goa, Uttar Pradesh, and Bihar (table). In terms of the absolute numbers rather than the percentage, Uttar Pradesh

For the **FPET** see http://fpet.track20.org

For the **raw data** see http://dx.doi.org/10.17632/hmhkdmv28y.1

presents the biggest challenge, needing more than 9 million additional women using modern contraceptive methods by 2030 to attain the 75% target. Bihar, Assam, Jharkhand, West Bengal, and Odisha need an increase of more than 1 million to meet the target (table).

Discussion

In this paper, we presented estimates and projections of rates and trends in modern contraceptive prevalence, unmet need for, and demand satisfied with modern methods in 29 states and union territories in India. The estimates illustrate subnational differences both in terms of current levels and past progress from 1990 to 2015 that are masked by national averages. Subnational projections to 2030 also highlighted great differences between states and union territories, and we identified which states or union territories should be prioritised if they are to meet the 75% target of demand for family planning satisfied with modern contraceptive methods by 2030. Region-specific policy recommendations are necessary to address these different situations.

The heterogeneity in subnational performance and progress (in particular, the finding that the 75% target had already been met by 12 states and union territories in 2015 but is not projected to be met under present conditions for many others by 2030) lends further credence to the argument that a single global or even a country-specific target might not be appropriate if targets are meant to be ambitious yet achievable for the population they refer to. One proposal would be targets for each state and union territory that has a 10% probability of achievement based on our probabilistic projection model that takes into account historical levels and rates of changes.[15] Using probabilities of achievement will enable targets to be set on the basis of a metric that is both comparable across states and union territories, and that accounts for the differing baselines and historical progress of each state or union territory.[15]

We constructed the estimates and projections using a local implementation of the FPEM. The global and local FPEMs have been instrumental in providing institutions such as UNFPA and WHO, and donors such as USAID and the Bill & Melinda Gates Foundation, with a means to monitor progress of family planning at global and national levels. Limitations of the models include that the uncertainty in the projections includes only the uncertainty in the projected family planning indicators (prevalences), not the uncertainty in the number of women, and that the focus is on married women only.

Although validation exercises suggested that the global model's projections are reasonably well calibrated (appendix p 14),[6] true monitoring of current levels and trends is possible only through data collection. There is considerable uncertainty in the current estimates for states and union territories without recent data. Most states have data up to 2013, although Delhi and Jammu and Kashmir have data up to only 2007, and Nagaland only up to 2005. As the demand for estimates grows, the importance of high-quality disaggregated data available in a timely manner will only increase. For the FPEM, we need observations of the prevalence of contraceptive use and unmet need for family planning, as well as estimates of the number of women in the base population at the subnational level of interest. Most countries have surveys that are powered to provide reliable estimates of family planning indicators at the least granular subnational level (ie, region or province). A few, such as Kenya, have even conducted surveys meant to give estimates at a finer (ie, county) level. We repeat the call for such data, but at the same time are conducting further research into supplementing our analysis for some indicators (eg, modern contraceptive prevalence) with non-conventional types of data, such as service statistics, which would require additional modelling of the biases and errors associated with such data.

The local model fitting was done with FPET. FPET implements the local family planning model that enables users to generate national or subnational estimates and projections of relevant indicators of access to reproductive health with little external support. The provision of FPET means that our results can be easily reproduced and more importantly the analysis can be readily extended by any user at the local level to further in-country planning, monitoring, and evaluation. Thus, our analysis can be generalised to subnational analyses, focusing on geographical regions in other countries. Potentially, other types of population subgroups (eg, groups defined by urban or rural residence, or wealth quintiles) can also be considered, although some caution is needed if such alternative (non-geographical) disaggregations are used or if subpopulations become very small (appendix p 12). FPET serves the twin goals of facilitating national and subnational monitoring and decision making, and increasing the agency of the local stakeholders. More generally, we believe that developing simple monitoring tools for non-technical users should, insofar as possible, be the way forward for all global health indicators that have direct relevance at a local level.

Contributors

JRN and LA developed FPET, building onto the global FPEM. JS, YPG, and JRN constructed input datasets. JRN and NC analysed the data. JRN and LA prepared the first draft of the Article. NC and LA revised the Article. All authors reviewed results and provided inputs and comments to the Article.

Declaration of interests

We declare no competing interests.

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