**India: Health of the Nation's States** – The India State-Level Disease Burden Initiative. New Delhi: ICMR, PHFI, and IHME; 2017. ISBN 978-0-9976462-1-4.

# Executive Summary

## Introduction

With almost one-fifth of the world's population living in India, the health status and the drivers of health loss are expected to vary between different parts of the country and between the states. Accordingly, effective efforts to improve population health in each state require systematic knowledge of the local health status and trends. While state-level trends for some important health indicators have been available in India, a comprehensive assessment of the diseases causing the most premature deaths and disability in each state, the risk factors responsible for this burden, and their time trends have not been available in a single standardised framework. The India State-Level Disease Burden Initiative was launched in October 2015 to address this crucial knowledge gap with support from the Ministry of Health and Family Welfare of the Government of India. This is a collaborative effort between the Indian Council of Medical Research, Public Health Foundation of India, Institute for Health Metrics and Evaluation, and experts and stakeholders from about 100 institutions across India. The work of this Initiative is overseen by an Advisory Board consisting of eminent policymakers and involves extensive engagement of 14 domain expert groups with the estimation process. Based on intense work over two years, this report describes the distribution and trends of diseases and risk factors for every state of India from 1990 to 2016.

## Methods and data

The estimates were produced as part of the Global Burden of Disease Study 2016. The analytical methods of this study have been standardised over two decades of scientific work, which has been reported in over 16,000 peer-reviewed publications, making it the most widely used approach globally for disease burden estimation. These methods enable standardised comparisons of health loss caused by different diseases and risk factors, between geographic units, sexes, and age groups, and over time in a unified framework. The key metric used for this comparison is disability-adjusted life years (DALYs), which is the sum of the number of years of life lost due to premature death and a weighted measure of the years lived with disability due to a disease or injury. The use of DALYs to track disease burden is recommended by India's National Health Policy of 2017.

Through an elaborate process, all data sources and inputs available to estimate disease burden in every state and union territory of India were identified and attempts were made to access these data. These included censuses, vital registration, Sample Registration System, large-scale national household surveys, other population-level surveys and cohort studies, disease surveillance data, disease programme-level data, administrative records of health services, disease registries, and a wide range of other studies conducted across India. Access to several important datasets was facilitated by senior government officials. Data were included in the analysis if they met quality and inclusion criteria.

## Health status improving, but major inequalities between states

Life expectancy at birth improved in India from 59.7 years in 1990 to 70.3 years in 2016 for females, and from 58.3 years to 66.9 years for males. There were, however, continuing inequalities between states, with a range of 66.8 years in Uttar Pradesh to 78.7 years in Kerala for females, and from 63.6 years in Assam to 73.8 years in Kerala for males in 2016. The per person disease burden measured as DALY rate dropped by 36% from 1990 to 2016 in India, after adjusting for the changes in the population age structure during this period. But there was an almost two-fold difference in this disease burden rate between the states in 2016, with Assam, Uttar Pradesh, and Chhattisgarh having the highest rates, and Kerala and Goa the lowest rates. While the disease burden rate in India has improved since 1990, it was 72% higher per person than in Sri Lanka or China in 2016. The under-5 mortality rate has reduced substantially from 1990 in all states, but there was a 4-fold difference in this rate between the highest in Assam and Uttar Pradesh as compared with the lowest in Kerala in 2016, highlighting the vast health inequalities between the states.

## Large differences between states in the changing disease profile

Of the total disease burden in India measured as DALYs, 61% was due to communicable, maternal, neonatal, and nutritional diseases (termed infectious and associated diseases in this summary for simplicity) in 1990, which dropped to 33% in 2016. There was a corresponding increase in the contribution of non-communicable diseases from 30% of the total disease burden in 1990 to 55% in 2016, and of injuries

from 9% to 12%. Infectious and associated diseases made up the majority of disease burden in most of the states in 1990, but this was less than half in all states in 2016. However, the year when infectious and associated diseases transitioned to less than half of the total disease burden ranged from 1986 to 2010 for the various state groups in different stages of this transition. The wide variations between the states in this epidemiological transition are reflected in the range of the contribution of major disease groups to the total disease burden in 2016: 48% to 75% for non-communicable diseases, 14% to 43% for infectious and associated diseases, and 9% to 14% for injuries. Kerala, Goa, and Tamil Nadu have the largest dominance of non-communicable diseases and injuries over infectious and associated diseases, whereas this dominance is present but relatively the lowest in Bihar, Jharkhand, Uttar Pradesh, and Rajasthan.

## Infectious and associated diseases reducing, but still high in many states

The burden of most infectious and associated diseases reduced in India from 1990 to 2016, but five of the ten individual leading causes of disease burden in India in 2016 still belonged to this group: diarrhoeal diseases, lower respiratory infections, iron-deficiency anaemia, preterm birth complications, and tuberculosis. The burden caused by these conditions generally continues to be much higher in the Empowered Action Group (EAG) and North-East state groups than in the other states, but there were notable variations between the states within these groups as well. The range of disease burden or DALY rate among the states of India was 9-fold for diarrhoeal disease, 7-fold for lower respiratory infections, and 9-fold for tuberculosis in 2016, highlighting the need for targeted efforts based on the specific trends in each state. The burden also differed between the sexes, with diarrhoeal disease, iron-deficiency anaemia, and lower respiratory infections higher among females, and tuberculosis higher among males. The proportion of total disease burden caused by infectious and associated diseases was highest among children, which contributed to the disproportionately higher overall disease burden suffered by the under-5 years age group. For India as whole, the disease burden or DALY rate for diarrhoeal diseases, iron-deficiency anaemia, and tuberculosis was 2.5 to 3.5 times higher than the average globally for other geographies at a similar level of development, indicating that this burden can be brought down substantially.

## Rising burden of non-communicable diseases in all states

The contribution of most of the major non-communicable disease groups to the total disease burden has increased all over India since 1990, including cardiovascular diseases, diabetes, chronic respiratory diseases, mental health and neurological disorders, cancers, musculoskeletal disorders, and chronic kidney disease. Among the leading non-communicable diseases, the largest disease burden or DALY rate increase from 1990 to 2016 was observed for diabetes, at 80%, and ischaemic heart disease, at 34%. In 2016, three of the five leading individual causes of disease burden in India were non-communicable, with ischaemic heart disease and chronic obstructive pulmonary disease as the top two causes and stroke as the fifth leading cause. The range of disease burden or DALY rate among the states in 2016 was 9-fold for ischaemic heart disease, 4-fold for chronic obstructive pulmonary disease, and 6-fold for stroke, and 4-fold for diabetes across India. While ischaemic heart disease and diabetes generally had higher DALY rates in states that are at a more advanced epidemiological transition stage toward non-communicable diseases, the DALY rates of chronic obstructive pulmonary disease were generally higher in the EAG states that are at a relatively less advanced epidemiological transition stage. On the other hand, the DALY rates of stroke varied across the states without any consistent pattern in relation to the stage of epidemiological transition. This variety of trends of the different major non-communicable diseases indicates that policy and health system interventions to tackle their increasing burden have to be informed by the specific trends in each state.

## Increasing but variable burden of injuries among states

The contribution of injuries to the total disease burden has increased in most states since 1990. The highest proportion of disease burden due to injuries is in young adults. Road injuries and self-harm, which includes suicides and non-fatal outcomes of self-harm, are the leading contributors to the injury burden in India. The range of disease burden or DALY rate varied 3-fold for road injuries and 6-fold for self-harm among the states of India in 2016. There was no consistent relationship between the DALY rates of road injuries or self-harm versus the stage of epidemiological transition of the states. The burden due to road injuries was much higher in males than in females. The DALY rate for self-harm for India as a whole was 1.8 times higher than the average globally for other geographies at a similar level of development in 2016.

## Unacceptably high risk of child and maternal malnutrition

While the disease burden due to child and maternal malnutrition has dropped in India substantially since 1990, this is still the single largest risk factor, responsible for 15% of the total disease burden in India in 2016. This burden is highest in the major EAG states and Assam, and is higher in females than in males. Child and maternal malnutrition contributes to disease burden mainly through increasing the risk of neonatal disorders, nutritional deficiencies, diarrhoeal diseases, lower respiratory infections, and other common infections. As a stark contrast, the disease burden due to child and maternal malnutrition in India was 12 times higher per person than in China in 2016. Kerala had the lowest burden due to this risk among the Indian states, but even this was 2.7 times higher per person than in China. This situation after decades of nutritional interventions in the country must be rectified as one of the highest priorities for health improvement in India.

## Unsafe water and sanitation improving, but not enough yet

Unsafe water and sanitation was the second leading risk responsible for disease burden in India in 1990, but dropped to the seventh leading risk in 2016, contributing 5% of the total disease burden, mainly through diarrhoeal diseases and other infections. The burden due to this risk is also highest in several EAG states and Assam, and higher in females than in males. The improvement in exposure to this risk from 1990 to 2016 was least in the EAG states, indicating that higher focus is needed in these states for more rapid improvements. Remarkably, the per person disease burden due to unsafe water and sanitation was 40 times higher in India than in China in 2016. The massive effort of the ongoing Swachh Bharat Abhiyan in India has the potential to improve this situation.

## Household air pollution improving, outdoor air pollution worsening

The contribution of air pollution to disease burden remained high in India between 1990 and 2016, with levels of exposure among the highest in the world. It causes burden through a mix of non-communicable and infectious diseases, mainly cardiovascular diseases, chronic respiratory diseases, and lower respiratory infections. The burden of household air pollution decreased during this period due to decreasing use of solid fuels for cooking, and that of outdoor air pollution increased due to a variety of pollutants from power production, industry, vehicles, construction, and waste burning. Household air pollution was responsible for 5% of the total disease burden in India in 2016, and outdoor air pollution for 6%. The burden due to household air pollution is highest in the EAG states, where its improvement since 1990 has also been the slowest. On the other hand, the burden due to outdoor air pollution is highest in a mix of northern states, including Haryana, Uttar Pradesh, Punjab, Rajasthan, Bihar, and West Bengal. Control of air pollution has to be ramped up through inter-sectoral collaborations based on the specific situation of each state.

## Rising risks for cardiovascular diseases and diabetes

Of the total disease burden in India in 1990, a tenth was caused by a group of risks including unhealthy diet, high blood pressure, high blood sugar, high cholesterol, and overweight, which mainly contribute to ischaemic heart disease, stroke, and diabetes. The contribution of this group of risks increased massively to a quarter of the total disease burden in India in 2016. The combination of these risks was highest in Punjab, Tamil Nadu, Kerala, Andhra Pradesh, and Maharashtra in 2016, but importantly, the contribution of these risks has increased in every state of the country since 1990. The other significant contributor to cardiovascular diseases and diabetes, as well as to cancers and some other diseases, is tobacco use, which was responsible for 6% of the total disease burden in India in 2016. All of these risks are generally higher in males than in females. The sweeping increase of the burden due to this combination of risks in every part of the country indicates emphatically that major efforts need to be put in place to control their impact in every state before the situation gets totally out of control.

## Importance of understanding the specific health situation of each state

Understanding the health and disease trends in groups of states at a similar level of development or epidemiological transition is an important intermediate step in teasing apart the heterogeneity of disease and risk factor epidemiology in India. However, effective action to improve health must finally be based on the specific health situation of each state. This point is elucidated by significant variations in the burden from leading diseases and risk factors in 2016 between the following pairs of states that have physical proximity and are at similar levels of development and epidemiological transition.

The major EAG states of Madhya Pradesh and Uttar Pradesh both have a relatively lower level of development indicators and are at a similar less advanced epidemiological transition stage. However, Uttar Pradesh had 50% higher disease burden per person from chronic obstructive pulmonary disease, 54% higher burden from tuberculosis, and 30% higher burden from diarrhoeal diseases, whereas Madhya Pradesh had 76% higher disease burden per person from stroke. The cardiovascular risks were generally higher in Madhya Pradesh, and the unsafe water and sanitation risk was relatively higher in Uttar Pradesh.

The two North-East states of Manipur and Tripura are both at a lower-middle stage of epidemiological transition but have quite different disease burden rates from specific leading diseases. Tripura had 49% higher per person burden from ischaemic heart disease, 52% higher from stroke, 64% higher from chronic obstructive pulmonary disease, 159% higher from iron-deficiency anaemia, 59% higher from lower respiratory infections, and 56% higher from neonatal disorders. Manipur, on the other hand, had 88% higher per person burden from tuberculosis and 38% higher from road injuries. Regarding the level of risks, child and maternal malnutrition, air pollution, and several of the cardiovascular risks were higher in Tripura.

The two adjoining north Indian states of Himachal Pradesh and Punjab both have a relatively higher level of development indicators and are at a similar more advanced epidemiological transition stage. However, there were striking differences between them in the level of burden from specific leading diseases. Punjab had 157% higher per person burden from diabetes, 134% higher burden from ischaemic heart disease, 49% higher burden from stroke, and 56% higher burden from road injuries. On the other hand, Himachal Pradesh had 63% higher per person burden from chronic obstructive pulmonary disease. Consistent with these findings, Punjab had substantially higher levels of cardiovascular risks than Himachal Pradesh.

These examples highlight why it is necessary to understand the specific disease burden trends in each state, over and above the useful broad insights provided by trends common for groups of states at similar levels of epidemiological transition, if health action has to be planned for the specific context of each state. The chances of achieving the overall health targets set by India would be much higher if the biggest health problems and risks in each state are tackled on priority than with a more generic approach that does not take into account the specific disease burden trends in each state.

## Application of the state-level disease burden findings and future work

The findings in this report of the India State-Level Disease Burden Initiative can be used for planning of state health budgets, prioritisation of interventions relevant to each state, informing the government's Health Assurance Mission in each state, monitoring of health-related Sustainable Development Goals targets in each state, assessing impact of large-scale interventions based on time trends of disease burden, and forecasting population health under various scenarios in each state. The findings are also available in easily understandable visual graphics in an online open-access interactive visualisation tool at https://vizhub.healthdata.org/gbd-compare/india.

Future plans of the India State-Level Disease Burden Initiative include annual updates of the estimates based on newly available data, and more disaggregated findings such as the rural-urban estimates planned for next year and sub-state level estimates subsequently when adequate data become available.

## Conclusion

The disease burden and risk factor estimates for every state of India from 1990 to 2016 in this report are the most comprehensive description of disease epidemiology attempted so far in a single standardised framework for every part of the country. These included all available data and inputs from a large network of highly skilled collaborators. This knowledge base can be a crucial aid for more informed policy and interventions to improve population health in every state and union territory of India and in reducing health inequalities between the states. These findings and the ongoing work of the India State-Level Disease Burden Initiative could provide important inputs for the data-driven and decentralised health planning and monitoring recommended by the National Health Policy 2017 and the NITI Aayog Action Agenda 2017–2020.