

Original Articles

Estimates of the years-of-life-lost due to the top nine causes of death in rural areas of major states in India in 1995

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ABSTRACT

Background. Years-of-life-lost (YLL) contribute nearly two-thirds of the disability-adjusted life-years (DALYs) worldwide and are especially important for India where infant and child mortality is still high. These were estimated for India under the Global Burden of Disease study for the year 1990. No estimates are available for the different states of India. We aimed to prepare state-wise estimates of YLL for different causes of death in rural areas and to determine the causes responsible for a higher burden in different states.

Methods. Percentage deaths of the top 9 causes reported in the Registrar-General's *Survey of Causes of Deaths (Rural)—1995* in 13 major states of India and different age groups was applied to the expected number of total deaths. The life lost according to the standard life-table was age-weighted and discounted using the methodology of the Global Burden of Disease 1990 study. The causes of death were based on lay reporting which otherwise seem reliable.

Results. The all-cause YLL in rural India in 1995 were 207 per 1000 population. The minimum was 74 in Kerala and maximum 276 in Madhya Pradesh. Pneumonia was the top cause responsible for 15 YLL. The inter-state variation was high as Tamil Nadu had only 1.6 and Uttar Pradesh 30.5 YLL from this cause. Cancers were a uniform burden across the states. Heart attack, and bronchitis and asthma cut across the more and less developed states. Suicides were a heavy burden in Andhra Pradesh and vehicular accidents in Haryana and Rajasthan. Bihar, Gujarat, Madhya Pradesh, Orissa, Rajasthan and Uttar Pradesh had communicable and nutritional conditions as predominant causes while Kerala and Punjab had non-communicable diseases as the predominant cause of YLL due to premature mortality.

Conclusion. These results provide a new perspective about the causes of death that need more attention in rural areas of different states of India. These will also help prioritize areas which

require more inputs at the state-level and hence will be useful for health policymakers.

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INTRODUCTION

The World Development Report 1993¹ presented disability-adjusted life-years (DALYs) lost for different regions of the world as a measure of the global burden of disease.² We used the same methods to calculate DALYs lost for different causes in each state of India. DALYs contain two major components—the years-of-life-lost (YLL) due to premature mortality and the years-of-life-lost due to disability (YLD). Various diseases and conditions that cause disability of varying severity, for different durations, are weighted according to their severity and converted to 'loss of life'. The aim is to capture all conditions of ill-health into a single index. This allows comparison of, for example, one DALY lost in a child due to nutritional deficiencies with one lost due to a malignant neoplasm in an adult. There is considerable debate^{3–7} on the appropriateness of DALYs. However, DALYs have initiated a discussion on criteria for setting health priorities in different segments of the population. We feel that DALYs are currently the most comprehensive index of health needs, and for evaluating and monitoring different health interventions, though primarily restricted to the physical component of health. This could help in cost-effectiveness studies and health prioritization at the national level.

For rural areas, this exercise serves another important purpose. It delineates the problem in the less privileged, generally poor section of society. The disease structure in rural areas may be very different from that of urban areas. It would be useful to obtain these estimates for rural areas as the large majority of the Indian population lives in these areas.

METHODS

Data requirement for YLD

The data requirement for computation of DALYs is large and not available for many countries. In the absence of readily available data in some regions, the Global Burden of Disease (GBD) study² derived estimates by (i) reviewing the epidemiological literature; (ii) conducting small-scale surveys; (iii) using epidemiological models; and (iv) consulting experts. A series of exercises was undertaken for each group of diseases and a consensus arrived at. Despite inputs of enormous resources into these exercises, the estimates, though not fully accurate, are epidemiologically consis-

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tent. The stipulation is that these estimates can be modified as and when improved data are available.

Data requirement for YLL

The data requirement for YLL is relatively small. The only information required is the age and gender distribution of deaths by various causes. In India, where registration of deaths is far from complete and a large number of deaths not medically certified, even this information is not adequately available. The best source for this is the annual Survey of Causes of Death conducted in sample rural areas by the Registrar General of India. We refer to this as SCD(R). The latest report available is for the year 1995.⁸

Survey of Causes of Death (Rural)

A sample of 1731 (out of 21 536) primary health centres (PHCs) was covered by the SCD(R) in 1995. A complete sub-centre comprising villages with a combined population of nearly 5000, 3–6 km away from the PHC, was selected. Thus, this report is based on a survey of villages in 1731 sub-centres.⁸ These villages are distributed over 23 states and 2 union territories. The details of the method of selection of PHCs are not mentioned as the officer in charge of the survey informed us that the only consideration for selection was a regional representation. Therefore, no other bias is likely.

We examined the locations of the PHCs included in the survey and found that they were indeed evenly scattered in each state. A trained PHC-level health worker visits each house every month in the selected villages and files a report of deaths and their cause. A total of 37 831 deaths were investigated by the SCD(R) in 1995. The cause of death was based on verbal autopsy (lay reporting though certified by the medical officer of the PHC on the basis of the symptoms reported).⁸ Many of these causes cannot be classified according to the International Classification of Diseases (ICD) list. While state-wise tables for age distribution are available, these are not available for gender distribution. Thus our calculations are for both the genders combined. Adequate data were available for 13 major states, which together constitute 85% of the rural population of India. The SCD(R), 1995 included at least 900 deaths from each of these states, an adequate number to provide estimates. Some of the top 9 causes of death have been validated in Andhra Pradesh (unpublished report) to be a fairly accurate assessment of the major causes of death in rural areas. Bronchitis and asthma have different aetiologies and management but we had to club them together because the SCD data are available in this format only.

Calculation of YLL

For calculating YLL, we used the same methodology as that used for international estimates.² This involves age-weighting which assigns a greater value to a year lived in young or middle-aged adult life as compared to a year of life lived by a child or an elderly person. This also involves discounting of future years lost at the rate of 3% per annum relative to the current years lost. We also used the standard life-table as used for the international estimates. However, those calculations are separate for men and women but we took averages to come up with a pooled life-table for the two genders. YLL for deaths at different ages, pooled for men and women are given in Fig. 1. The formula is given below.²

$$YLL = \frac{0.1658 e^{-0.04a}}{(0.07)^2} [1 + 0.07 a - e^{-0.07L} \{1 + 0.07(L + a)\}],$$

where a is age at death and L is the life expectancy at age a .

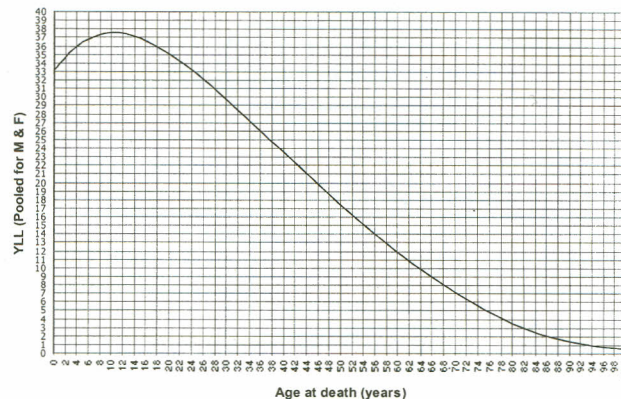


FIG 1. Years-of-life-lost (age-weighted and discounted) at different age of death (combined for both genders)

Average age at death in different age groups

The GBD study estimates² pool the age groups 0–1 with 1–4 years and give results for 0–4 years. But the age group 0–1 has special significance for India because of the high infant mortality rate. The SCD(R) tabulates causes of death for these two age groups separately. Hence, we did not merge these two groups. Since more than half of the infant deaths in rural India are in the neonatal period,⁹ we estimated that in the 0–1 years age group the average age at death is nearly 3 months. Similarly, in the 1–4 years age group the average age at death was taken as 2 years as they are also skewed towards a lower age. For other age groups except the last two, the average age at death was taken in the centre of the age group. For the age group 60+ years, the age distribution of deaths in rural India in the year 1995 was as follows.⁹

Age (years)	60–64	65–69	70–74	75–79	80–84	85+
Percentage of deaths	7.04	6.96	7.91	4.96	4.64	4.86

This gave an average of nearly 73 years when the mid-point of 85+ years was taken as 90 years. In the age group 45–59 years also, there was a slight shift towards the higher age and the average age at death was taken as 54 years.

The steps followed in the calculation of YLL are listed below.

Total YLL in rural areas

1. The annual population figures for rural areas in India are not available. Hence, the total population in the rural areas of each state in the year 1995 was obtained by using the natural growth rate (birth rate – death rate) in rural areas of each state from 1991 to 1995. The population figures are available from the 1991 Census.
2. This population in each state was divided into age groups 0–1, 1–4, 5–14, 15–24, 25–34, 35–44, 45–59 and 60+ based on the percentage distribution reported by the Sample Registration System (SRS)⁹ for rural areas of each state for the year 1995. These age groups are the same as those used by the SCD(R), 1995 report. While the percentage of deaths in India is available for 5-year intervals, the cause of death data are available only for the above-mentioned age groups. Thus, our calculations are for these relatively broad age groups only. The GBD study presented most results for 0–4, 5–14, 15–44, 45–59 and 60+ age groups.
3. The total number of deaths in each age group was obtained separately for each state by applying the state-wise age-specific death rate for rural areas⁹ to the population in different age groups.

TABLE I. Years-of-life-lost per 1000 population in 1995 for the top 9 causes of death in rural areas

State	Tuberculosis of the lungs	Pneumonia	Anaemia	Bronchitis and asthma	Heart attack	Cancer	Paralysis	Vehicular accidents	Suicides	Top 9 causes	Other causes	All causes
India	9.0	15.0	6.1	10.0	8.5	5.5	3.1	6.0	5.6	68.9	138.0	206.8
Madhya Pradesh	13.5	24.0	10.6	9.7	7.3	4.8	4.8	4.4	5.3	84.3	192.2	276.5
Bihar	8.4	21.3	9.8	5.0	5.9	4.6	3.3	7.4	4.0	69.8	174.8	244.6
Uttar Pradesh	14.3	30.5	11.4	11.0	6.5	5.5	2.2	6.0	2.7	90.0	153.7	243.7
Orissa	9.0	19.6	11.7	12.3	5.9	5.1	5.1	4.3	8.0	81.0	151.9	233.0
Rajasthan	13.0	27.3	8.4	13.4	6.2	4.5	2.1	10.7	3.1	88.7	131.7	220.5
Haryana	2.6	15.9	6.9	8.5	9.3	4.7	1.3	9.4	6.4	64.9	118.3	183.3
Andhra Pradesh	9.2	2.5	3.3	8.7	11.1	6.5	3.2	3.9	9.9	58.4	117.8	176.2
Gujarat	13.9	11.5	4.5	6.6	7.9	5.7	1.9	2.6	6.5	61.3	103.1	164.3
Karnataka	7.8	12.8	4.0	12.5	10.1	6.2	4.0	2.8	8.5	68.6	93.2	161.8
Maharashtra	6.6	8.9	2.3	10.9	5.5	4.8	2.7	6.9	3.9	52.5	108.8	161.3
Tamil Nadu	5.8	1.6	4.4	5.3	18.0	3.6	4.9	3.3	8.2	55.0	101.0	156.0
Punjab	2.2	5.1	1.5	4.4	17.1	6.3	2.5	6.7	2.0	47.7	93.6	141.2
Kerala	1.5	2.1	1.0	6.4	15.3	6.4	4.7	2.0	8.0	47.4	26.3	73.7
Others	3.2	3.9	0.4	15.3	8.8	7.3	2.7	8.6	7.7	57.9	158.6	216.4

NOTE: States grouped into four categories; the cut-off points are based on consensus among the three cluster methods.¹⁰

- The total YLL were calculated by multiplying the age-wise deaths with the YLL for the respective age as obtained from Fig. 1. For this purpose, the average age at death in different age intervals was taken as 0.25 (3 months), 2, 8, 20, 30, 40, 54 and 73 years, respectively. From Fig. 1, the values of YLL at these ages were 33.1, 34.8, 37.4, 35.1, 29.8, 23.5, 15.1 and 6 years. These are based on the same age-weighting and discounting as followed for international calculations.
- Since the total YLL in a small state like Haryana (rural population 13 million) are not comparable with a large state like Uttar Pradesh (rural population 121 million), conversion of YLL to per 1000 population was necessary for inter-state comparison. The total YLL were divided by the population (in thousands) to obtain the YLL per 1000 population.

Cause-wise YLL in rural areas

- The SCD(R), 1995 provides percentage age distribution of deaths in each state separately for each of the 9 causes. We used these percentages to calculate the total deaths in each age group from these 9 causes. All other deaths were assigned to 'other causes'. Total deaths in each age group from all causes were the same as obtained in Step 3 above.
- The YLL for each of the 9 causes were obtained by steps similar to those in Steps 4 and 5 above.
- YLL for 'other causes' was obtained by subtracting the 9-cause YLL from the total YLL. The source of data for total YLL was the age-specific mortality and age distribution as reported in the SRS⁹ and the source of data for cause-specific YLL was SCD(R).⁸

RESULTS

The YLL in 1995 per 1000 population from each of the top 9 causes of death in rural areas of different states of India are shown in Table I. The total YLL for all causes are also shown in the table. The states are grouped into four categories, the cut-off points of which are based on consensus among the three cluster methods.¹⁰ These 9 causes of death were responsible for nearly one-third of the total YLL (Fig. 2). This ratio was nearly same in each state except Kerala where the 9-cause YLL were nearly two-thirds of the total YLL. The following conclusions emerge from Table I. These are given first for

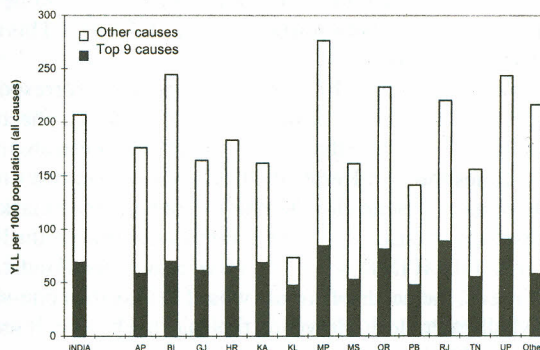


Fig 2. Distribution of years-of-life-lost by the top 9 causes and other causes in the rural areas of major states in 1995

overall YLL and then categorized into (i) communicable and nutritional conditions; (ii) non-communicable diseases; and (iii) injuries. These categories are the same as those used in the 1990 GBD study² and thus amenable to international comparison. However, our data are based on only the top 9 causes of death.

Overall YLL

The total years lost due to premature mortality (all causes) in 1995 in rural parts of India was 207 per 1000 population. Because of age-weighting, discounting and use of standard life-table, YLL provide a new dimension to the age pattern in mortality (Table II). While

TABLE II. Contribution of different age groups to mortality indicators in rural areas of India in 1995

Item	Age group (years)								All age groups
	0-1	1-4	5-14	15-24	25-34	35-44	45-59	60+	
Population (%)	3.1	9.2	25.6	18.1	15.3	11.1	10.5	7.1	100
Deaths (%)	24.2	8.9	5.6	4.2	4.7	4.8	11.1	36.4	100
YLL (%)	38.0	14.7	10.0	7.0	6.7	5.4	8.0	10.3	100
Age-specific death rate/1000	76.1	9.5	2.1	2.3	3.0	4.2	10.3	50.0	9.8
Age-specific YLL/1000	2574	332	80	80	91	100	156	300	207

YLL years-of-life-lost

infant deaths remain at the top no matter what indicator is used, the contribution of the age group 60+ years is 36.4% to deaths but only 10.3% to YLL. The death rate in the age group 15–24 years was less than one-fourth of the rate in the age group 45–59 years but the YLL per 1000 population were more than one-half. Age-specific death rate was highest in infancy (76.1 per 1000 live-births) followed by the 60+ age group (50 per 1000 population).⁹ If based on age-specific death rates alone, these two are the priority age groups (Table II), but based on the YLL, after infancy, it is 1–4 years in rural India.

Overall state-wise YLL

The YLL due to premature mortality in rural areas were least in Kerala (74 per 1000 population) and highest in Madhya Pradesh (276 per 1000 population) and indicate a wide disparity between states. The state next to Kerala was Punjab with 141 YLL per 1000 population, clearly marking out Kerala as an exceptional state for YLL just as it is for many other health indicators. In Bihar, Madhya Pradesh, Orissa, Rajasthan and Uttar Pradesh the YLL were >200 per 1000 population.

The total YLL are heavily dependent on the infant mortality rate (IMR) and expectation of life at birth (ELB). The reason for the low YLL in Kerala and high YLL in Madhya Pradesh could be the large difference in IMR between these states (Table III). This also is reflected in the ELB.

The rank of states by YLL per 1000 population corresponds fairly well with the crude death rate (CDR) though the ratio changes (Table III). While the YLL in Madhya Pradesh are more than three times those in Kerala the CDR is less than two times. The ELB values are quite close to one another and may mask the glaring disparity in YLL. The same is more or less true for the IMR except for Kerala. If IMR is to be believed as an overall indicator of health needs, the needs of Kerala would be less than one-sixth those of Madhya Pradesh. However, this may not be true. It seems that YLL are able to capture the disparities in health needs much better than ELB, IMR or CDR.

Group I: Communicable and nutritional conditions

The real value of YLL is in their calculation for each cause of mortality. The highest burden (based on YLL) in rural India was pneumonia. It was responsible for a loss of 15 years per 1000 population (Table I). However, there were large variations between

states. The lowest loss from this cause was 1.6 years in Tamil Nadu and the highest was 30.5 years in Uttar Pradesh. While the YLL due to pneumonia were low (<6 per 1000 population) in Andhra Pradesh, Kerala, Punjab and Tamil Nadu they were high (≥ 20) in Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh. These four states are the heartland of the country but economically the least developed. An acronym *BIMARU* is often ascribed to these states which in Hindi means 'sick'. These are also the most populous states, comprising 44% of India's population.

The other communicable condition figuring in the top 9 causes of death in rural parts of the country is pulmonary tuberculosis. This problem was particularly severe (YLL ≥ 12) in Gujarat, Madhya Pradesh, Rajasthan and Uttar Pradesh. The YLL due to tuberculosis of lungs is low (<3) in Haryana, Kerala and Punjab.

The only nutritional condition in the top 9 killers was anaemia. The YLL due to this condition in rural areas ranges from 1 (Kerala) to 11.7 years (Orissa) per 1000 population, a wide variation.

These three conditions together were responsible for the loss of 30.1 years per 1000 population in 1995. This is 14.5% of the total YLL (all causes) in the rural parts of the country.

Group II: Non-communicable diseases

Three non-communicable diseases appear in the top 9 causes of death in rural India. These are cancer, heart attack and paralysis. The YLL due to cancer were relatively stable across the states at nearly 5 per 1000 population (Table I). However, the YLL due to heart attack varied from a low of 5.5 years in rural areas of Maharashtra to a high of 18 years in Tamil Nadu. Bihar, Maharashtra, Orissa, Rajasthan and Uttar Pradesh had a low (YLL <7) burden from this cause.

The YLL due to paralysis were the least (1.3 years) in Haryana and highest (5.1 years) in Orissa. Considerable variation existed between states in the burden of premature mortality due to this condition as well.

The most important non-communicable condition causing premature mortality was bronchitis and asthma. At the all-India level in rural areas, it was responsible for a loss of 10 years per 1000 population. The loss was low (YLL <6) in Bihar, Punjab and Tamil Nadu, and high (YLL ≥ 10) in Karnataka, Maharashtra, Orissa, Rajasthan and Uttar Pradesh. This cause cuts across the conventional labels of more developed and less developed states. The four non-communicable conditions together caused a loss of 27.1 years per 1000 population in rural India. This accounts for 13.1% of the total YLL (all causes).

Group III: Injuries

Vehicular accidents and suicides were among the top 9 causes of mortality in rural India. Each caused a loss of nearly 6 years of life per 1000 population (Table I). Vehicular accidents took a particularly heavy toll in Rajasthan (YLL=10.7), followed by Haryana (YLL=9.4) but was <3 years in Gujarat, Karnataka and Kerala.

The burden of premature mortality due to suicides was least in Punjab (YLL=2) followed closely by Uttar Pradesh (YLL=2.7) and was the highest in Andhra Pradesh (YLL=9.9). Karnataka, Kerala, Orissa and Tamil Nadu also had a high (YLL ≥ 8) burden from this cause.

Vehicular accidents and suicides together were responsible for a loss of 11.6 years of life in 1995 in rural parts of India. This comprised 5.6% of the total YLL from all causes. This cause also cuts across the conventional labels of economically more developed and less developed states.

TABLE III. Different mortality indicators in rural areas of various states, 1995 (states ranked by years-of-life-lost)

State	Years-of-life-lost/1000 population	Expectation of life at birth*	Infant mortality rate†	Crude death rate‡
Kerala	74	71.8	16	6.0
Punjab	141	65.5	58	7.8
Tamil Nadu	156	60.5	61	8.8
Maharashtra	161	62.0	66	8.9
Karnataka	162	60.1	69	8.5
Gujarat	164	59.1	68	8.3
Andhra Pradesh	176	59.7	74	9.2
Haryana	183	62.1	70	8.5
Rajasthan	220	55.6	90	9.6
Orissa	233	54.9	107	11.2
Uttar Pradesh	244	55.0	89	10.8
Bihar	245	57.7	74	10.9
Madhya Pradesh	276	52.3	104	11.9

* in years (1989–93) † per 1000 live-births (1995) ‡ per 1000 population (1995)

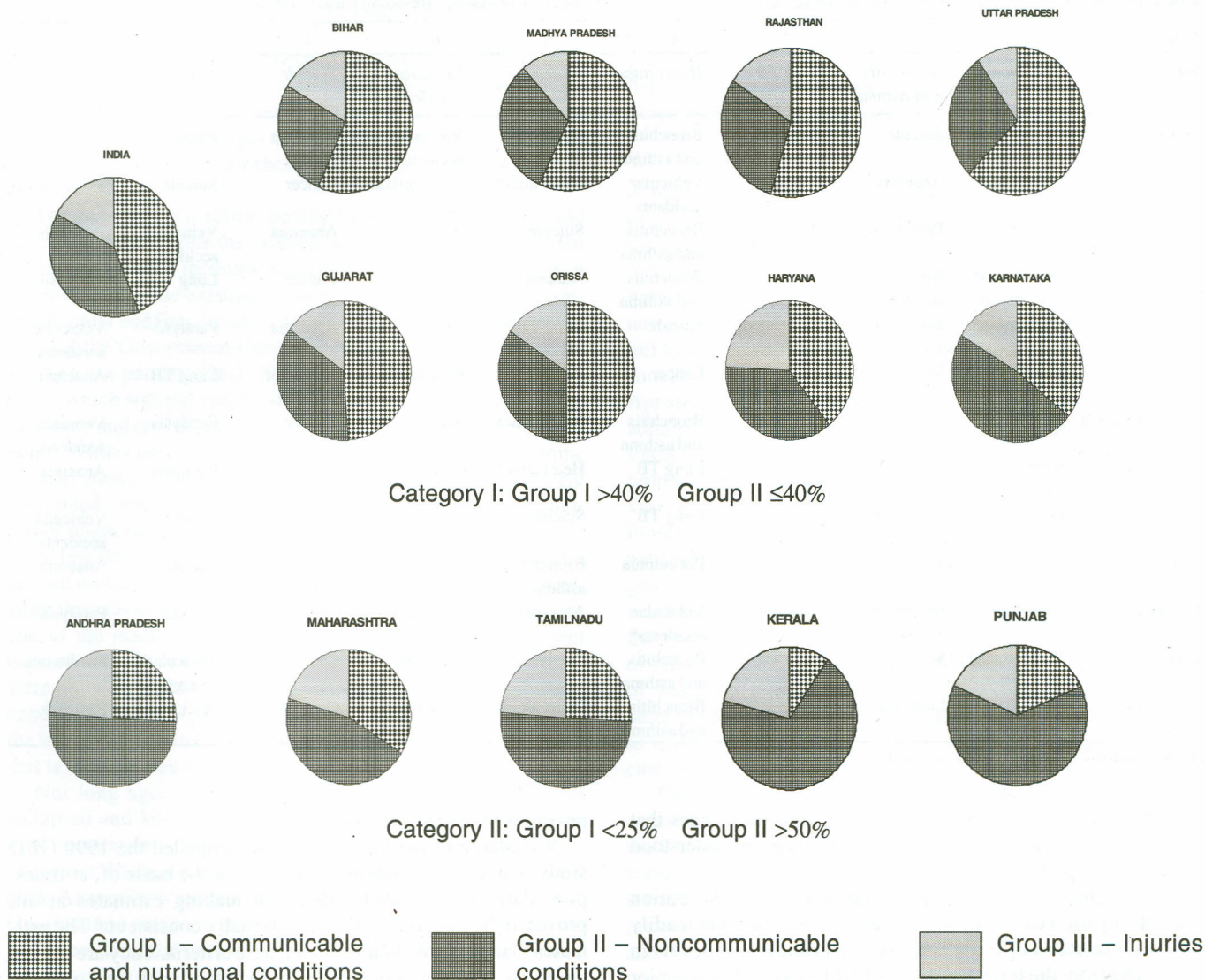


FIG. 3 Share of communicable/nutritional conditions, non-communicable conditions and injuries in the top 9-cause years-of-life-lost (YLL) in rural parts of India divided into two categories based on the proportion of predominant group of conditions. (Size of pie represents 9-cause YLL per 1000 population)

Differences between states

Figure 3 indicates that the states of India can be divided into two broad categories with respect to contribution to YLL by Group I, II and III causes. We arbitrarily consider causes with YLL ≥10 as major. Andhra Pradesh, Kerala, Punjab and Tamil Nadu had the same cause (heart attack) with the highest YLL >10; pneumonia was a major cause in 7 of the 13 states (Table IV).

DISCUSSION

Limitations of the present work

Because of the lack of data, even workable estimation of various parameters in the spectrum of 107 diseases (as in the GBD study²) requires enormous inputs in terms of extensive review of the literature, working with a large variety of epidemiological models, and reconciling exercises to come up with a consensus. In the absence of such resources, we restricted the present exercise to only estimates of the YLL component of DALYs.

When resources become available, a more comprehensive exercise would be undertaken for computation of DALYs for each state of India. In our opinion, the YLL component is extremely important for India where the infant and child mortality are still high. According to the 1990 estimates of the GBD study, nearly 70% of DALYs in India are YLL.² The disability component measured by YLD is more important for developed countries where the expectation of life is already high. Even in areas with a high life expectancy, mortality is of concern. For example, the state of Victoria in Australia produced a separate report on YLL based on premature mortality.¹¹ Such mortality is rare in that state. All this shows that mortality deserves attention by itself, and the present exercise on YLL can be meaningful even without the YLD component.

There are three major ingredients that separate YLL from other mortality measures. These are age-weighting, discounting of future years lost and use of standard life-table for every death. Thus

TABLE IV. Rank of different causes of death in different states with respect to years-of-life-lost (rural), 1995

State	1	2	3	4	5	6	7	8	9
<i>India</i>	<i>Pneumonia</i>	<i>Bronchitis and asthma</i>	<i>Lung TB</i>	<i>Heart attack</i>	<i>Anaemia</i>	<i>Vehicular accidents</i>	<i>Suicide</i>	<i>Cancer</i>	<i>Paralysis</i>
Andhra Pradesh	Heart attack*	Suicide	Lung TB	Bronchitis and asthma	Cancer	Vehicular accidents	Anaemia	Paralysis	Pneumonia
Bihar	Pneumonia*	Anaemia	Lung TB	Vehicular accidents	Heart attack	Bronchitis and asthma	Cancer	Suicide	Paralysis
Gujarat	Lung TB*	Pneumonia*	Heart attack	Bronchitis and asthma	Suicide	Cancer	Anaemia	Vehicular accidents	Paralysis
Haryana	Pneumonia*	Vehicular accidents	Heart attack	Bronchitis and asthma	Anaemia	Suicide	Cancer	Lung TB	Paralysis
Karnataka	Pneumonia*	Bronchitis and asthma*	Heart attack*	Suicide	Lung TB	Cancer	Anaemia	Paralysis	Vehicular accidents
Kerala	Heart attack*	Suicide	Bronchitis and asthma	Cancer	Paralysis	Pneumonia	Vehicular accidents	Lung TB	Anaemia
Madhya Pradesh	Pneumonia*	Lung TB*	Anaemia*	Bronchitis and asthma	Heart attack	Suicide	Cancer	Paralysis	Vehicular accidents
Maharashtra	Bronchitis and asthma*	Pneumonia	Vehicular accidents	Lung TB	Heart attack	Cancer	Suicide	Paralysis	Anaemia
Orissa	Pneumonia*	Bronchitis and asthma*	Anaemia*	Lung TB	Suicide	Heart attack	Paralysis	Cancer	Vehicular accidents
Punjab	Heart attack*	Vehicular accidents	Cancer	Pneumonia	Bronchitis and asthma	Paralysis	Lung TB	Suicide	Anaemia
Rajasthan	Pneumonia*	Bronchitis and asthma*	Lung TB*	Vehicular accidents*	Anaemia	Heart attack	Cancer	Suicide	Paralysis
Tamil Nadu	Heart attack*	Suicide	Lung TB	Bronchitis and asthma	Paralysis	Anaemia	Cancer	Vehicular accidents	Pneumonia
Uttar Pradesh	Pneumonia*	Lung TB*	Anaemia*	Bronchitis and asthma*	Heart attack	Vehicular accidents	Cancer	Suicide	Paralysis

TB tuberculosis * years-of-life-lost >10

YLL provide a new perspective to deaths at different ages that other mortality measures do not capture. YLL can be understood as a burden of premature mortality.

The computation of YLL requires age and gender distribution of deaths by each cause. However, the only information readily available for states of India is the age distribution of deaths in rural areas from the top 9 causes and that too for only the major states. These causes of death are top in terms of percentage share of deaths. The data from SCD(R) for the top 9 causes are in usable format and seem sufficiently good to prepare reasonable estimates. Other causes are grouped in one category and the total mortality is the same as otherwise known. It cannot exceed the sum total of mortality from individual causes in our case as feared by Murray and Lopez² for some epidemiological estimates.

There are at least two deficiencies in the SCD data. First, some deaths are assigned to 'senility'. While the state-wise break-up is not available, at the all-India level they account for 14.8% of the total deaths investigated in SCD, 1995.⁸ Senility cannot be considered as a cause of death. Lack of resources did not allow us to carry out a re-survey and re-distribute these deaths. We have put them under the category 'others' which includes causes other than the 9 most common ones. This means that the estimates we obtain for the 9 most common causes could be slightly higher than what we have obtained. Second is the absence of gender categorization in the SCD data. Deaths due to conditions such as stroke or anaemia could be very different in women and men. The mortality in the two genders differs in India just as it does anywhere in the world. In the absence of segregated data we were forced to pool the data. Because of the same limitation, the World Bank¹² also did such a pooling while preparing a comprehensive list of disease control

priorities in developing countries.

We adhere to the same belief that propelled the 1990 GBD study, namely, that making estimates on the basis of, at times, poor data is more useful than not making estimates at all, provided they are plausible and internally consistent.² The estimates that we have obtained meet these criteria. They are at least workable to initiate a debate on the health priority methodology in India and to initiate a burden of disease study at the state level. Many states in India are of the size of a country and such disaggregation is important. Also, health is a state subject in India and hence these data would be useful for policymakers at the state level.

Verbal autopsy is an established method of assessing cause of deaths in areas where the cause cannot be medically certified. However, the reliability is variable.^{13,14} It has been found to be a 'reliable substitute' in Jordan.¹⁵ In Kenya, it was reported to have a positive predictive value of 85%.¹⁶ In the rural areas of the state of Haryana, the agreement between the verbal autopsy causes reported by field assistants and professionally qualified investigators was 83%.¹⁷ An indirect evidence of reasonable validity of SCD data comes from deaths attributed to 'tuberculosis of the lungs'. According to the SCD data, 5.24% of total deaths in 1995 were attributable to 'tuberculosis of the lungs'. According to the government report,¹⁸ there were nearly 500 000 deaths from all kinds of tuberculosis. If approximately 90% of these were due to tuberculosis of lungs then this would be 450 000; approximately 5.56% of the estimated total deaths in 1995. Thus, the SCD percentage is not far from the percentage arrived at from other sources. This provides independent confirmation and increases confidence in the SCD data.

Even in those regions of the world where deaths are registered

and causes assigned by medically qualified staff, the quality of the causes of death is still of concern.² The reasons that adequate confidence can be placed on the verbal autopsy reports in India are: (i) the health workers were trained and had a manual of instructions to fall upon; (ii) there was inbuilt supervision; (iii) the cause of death reporting is in lay terms so that errors are not likely; (iv) a medical officer regularly reviewed and certified these reports; and (v) the results seem consistent with whatever is otherwise generally believed to be occurring in different segments of the population. However, the SCD(R) must be regarded only as a workable alternative since medically certified causes are not available.

Salient features of the results

The total YLL for rural India were 207 per 1000 population. The GBD study² found this to be 235 per 1000 population in the rural and urban areas combined. The reason our estimate is low, despite being restricted to rural areas, is not clear. Both studies have used nearly the same data and are based on almost the same methodology. It is unlikely that mortality in rural areas has decreased so much in 5 years as to make such a big impact. However, the IMR in some rural areas has shown a fast decline. The other reason could be that we considered 0–1 and 1–4 years age groups separately while the GBD study combined these two age groups. This could cause some difference in the estimate though not as marked as observed.

While communicable and nutritional conditions followed the expected pattern of high burden in economically less developed states, this was not true for several other conditions. The burden of premature mortality due to cancers was uniform in all the states. The variation in burden due to pneumonia was unexpectedly large and merits a closer look. Heart attack caused less loss in Maharashtra, a more developed state. Bronchitis and asthma inflicted a relatively high loss in Karnataka and Maharashtra but less in Punjab and Kerala. All the four are relatively more developed states. All these issues need a deeper and intensive analysis. The reason why vehicular accidents took a heavy toll in Rajasthan and Haryana also needs investigation as the number of vehicles in these states is not as high as in some other states. Suicides seem to be a heavy burden in Andhra Pradesh and less in Punjab and Uttar Pradesh. This also needs a further probe.

One of the purposes of computing DALYs is to re-prioritize health conditions on the basis of age at death and the disability they cause in different segments of the population. Table IV gives the rank of the 9 commonest causes of death with respect to YLL in rural areas of India and different states. The 9 causes discussed by us are top in terms of percentage share of total deaths and not in terms of YLL. A cause of death lower down the order can get a higher rank in terms of YLL if it is afflicting young adults with greater frequency. Thus, a careful interpretation of the results obtained by us is required.

The wide disparities among states strengthen the argument that the health policy should be state-specific so that it could take care of local problems. Figure 3 also illustrates that in different states, health policymakers would need to plan different strategies depending upon the predominant causes (communicable or non-communicable) of YLL.

After publication of the World Bank report,¹ several countries

started to investigate the possibility of calculating DALYs for their population. The computations presented in that report were for various regions of the world and not for individual countries except for India and China. Among the individual countries who could complete their work are Indonesia¹⁹ and Mexico.²⁰

Following publication of the World Bank report and a number of other articles,^{21–28} a debate has been initiated on measuring health and its consequences.^{3–7,29} A common feature of this debate is the concern with the YLL component of DALYs rather than with the YLD. The debate concentrates mostly on causes of death and not so much on causes of disability.

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