Epidemiological transition in a rural community of northern India: 18-year mortality surveillance using verbal autopsy

Rajesh Kumar,1 Dinesh Kumar,1 J Jagnoor,2 Arun K Aggarwal,1 P V M Lakshmi1

ABSTRACT

Background Information on causes of death is vital for planning of health services. However, vital events registration systems are weak in developing countries. Therefore, verbal autopsy (VA) tools were incorporated in a community-based surveillance system to track causes of death.

Method and Findings Trained fieldworker identified all deaths and interviewed a living relative of those who had died during 1992–2009, using VA, in eight villages of Haryana (11,864 populations). These field reports detailing events preceding death were reviewed by two trained physicians, who independently assigned an International Classification of Disease-10 code to each death. Discrepancies were resolved through reconciliation and, if necessary, adjudication. Non-communicable conditions were the leading causes of death (47.6%) followed by communicable diseases including maternal, perinatal and nutritional conditions (34.0%), and injuries (11.4%). Cause of death could not be determined in 6.9% cases. Deaths due to cardiovascular diseases showed a significant rise, whereas deaths due to diarrhoeal diseases have declined (p<0.01). Majority (90.0%) of the deceased had contacted a healthcare provider during illness but only 11.5% were admitted in hospital before death.

Conclusion Rising trend of cardiovascular diseases observed in a rural community of Haryana in India calls for reorientation of rural healthcare delivery system for prevention and control of chronic diseases.

INTRODUCTION

Cause-of-death information is an important planning tool for health services. However, most low- and middle-income countries lack well-established vital events registration systems.1 In India, <25% of the deaths are registered.2 Over two-third of the deaths occur at home, hence, medical certification of cause of death cannot be ascertained for majority of the deaths in the population.3 Therefore, most developing countries have so far relied on modelling to estimate cause-specific mortality for health planning.4 5

Verbal autopsy (VA) is a reliable alternate tool for tracking causes of deaths in settings where coverage and quality of vital registration systems remain poor. Validity of VA has been shown to be satisfactory for generating population-level information on causes of death.6–9 Therefore, VA method has been implemented in several sentinel mortality surveillance systems.10 A nationally representative study, which used VA to determine causes of death during 2001–2005, has reported non-communicable diseases (NCDs) (42%) to be the leading cause of death in India.11 However, reliable time trends on causes of death are not yet available to understand the pace of epidemiological transition among demographically diverse communities in India.

As risk factors and disease rates can have substantial heterogeneity especially in a large middle-income country like India, analysis of causes of death in various communities are needed to characterise epidemiological transition for identifying relevant policy priorities. Therefore, this study was aimed at ascertainment of the time trends in distribution of causes of death using VA methods so as to characterise the pace of epidemiological transition in a rural community of northern India.
RESULTS
Over a period of 18 years (1992–2009), 1440 deaths were recorded; 59.2% were men and 47.0% belonged to low-social status families. Most (90.0%) of the deceased had availed healthcare during the illness; 54.0% had consulted allopathic and 31.0% had contacted indigenous (ayurvedic) medical practitioners. Twelve per cent deceased were admitted in hospital before death, predominantly in government hospitals.

Age and sex distribution of population was obtained from the health workers who conduct a complete family census of the villages every 5 years. Cause-specific mortality was calculated for three time periods, that is, 1992–1997, 1998–2005 and 2004–2009. Causes of deaths were categorised into three groups. Group II: NCD and group III: injuries - group II: NCD; and group III: injuries. Direct standardisation methods were used to take into account changes in age and sex composition of the population. 95% CIs were estimated for the directly standardised cause-specific mortality rates. Data were analysed using STATA software.

DISCUSSION
The global burden of disease and injury estimates had stated that India is undergoing health transition. This study confirms that rural communities in Haryana state are passing through demographic and epidemiological transition. Crude birth rate as well as death rate declined in the study community as is also the case in rest of Haryana state. The proportion of people aged less than 5 years has declined in the population over the last 18 years. Deaths due to infectious diseases especially diarrhoea disease have registered a decline, whereas cardiovascular diseases were found to be rising in the study population, indicating epidemiological transition. Other rural areas of India may also be passing through epidemiological transition. A study from a rural community of southern India had also reported chronic non-communicable as leading cause of mortality. The causes of death study in the sample registration system during 2001–2005 has reported about 40% of the deaths due to NCDs in rural areas of India. However, these studies did not provide time trends for causes of deaths.

In the present study, CVDs were found to be the leading cause of deaths. Previous studies conducted in the study area showed increasing prevalence of hypertension with rising prevalence of overweight. A study from urban slums of Kolkata has also reported cardiovascular mortality as a top cause of death followed by malignancies and respiratory ailments. The social gradient in NCDs’ risk factors seems to be changing in northern India. It was interesting to find a significant decline in deaths due to genito-urinary diseases. Most of these conditions are related to benign enlargement of prostate in men. This could be due to a combination of decline in incidence of these conditions or

Table 1 Age and sex wise death rate per 1000 population per year in a rural community of Haryana, India

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>0–4</td>
<td>Male</td>
<td>936</td>
<td>15.0</td>
<td>1029</td>
<td>11.7</td>
<td>809</td>
<td>11.5</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>896</td>
<td>15.8</td>
<td>785</td>
<td>13.2</td>
<td>655</td>
<td>8.4</td>
</tr>
<tr>
<td>5–14</td>
<td>Male</td>
<td>1195</td>
<td>1.1</td>
<td>1313</td>
<td>0.9</td>
<td>1422</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>1030</td>
<td>1.0</td>
<td>1132</td>
<td>0.9</td>
<td>1243</td>
<td>0.7</td>
</tr>
<tr>
<td>15–59</td>
<td>Male</td>
<td>3152</td>
<td>3.7</td>
<td>3462</td>
<td>3.4</td>
<td>3802</td>
<td>4.0</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>3113</td>
<td>1.9</td>
<td>3419</td>
<td>1.9</td>
<td>3755</td>
<td>2.0</td>
</tr>
<tr>
<td>60+</td>
<td>Male</td>
<td>331</td>
<td>67.0</td>
<td>364</td>
<td>60.4</td>
<td>400</td>
<td>54.2</td>
</tr>
<tr>
<td></td>
<td>Female</td>
<td>440</td>
<td>32.6</td>
<td>483</td>
<td>29.7</td>
<td>530</td>
<td>29.6</td>
</tr>
<tr>
<td>All</td>
<td></td>
<td>11693</td>
<td>7.6</td>
<td>11987</td>
<td>6.6</td>
<td>12636</td>
<td>6.0</td>
</tr>
</tbody>
</table>
improved survival due to availability of safer transurethral resection procedure compared with the traditional prostate surgery.

Diarrhoeal diseases have shown a remarkable decline, but perinatal conditions still continue to be the leading cause of mortality among children younger than 5 years. Hence, specific health initiatives such as skilled care at the time of childbirth are needed. Respiratory infections still figure as a prominent cause of death. Overall, among all ages, more than one-third of deaths continue to be due to communicable conditions diseases, perinatal/maternal and nutritional conditions. It indicates that rural communities now face dual burden of communicable as well as NCDs.

The care-seeking pattern shows that although most of the deceased had consulted medical practitioners, but only a small proportion of them were admitted in hospitals (11.5%). Primary healthcare utilisation from public facilities improved from 17% to 27% in the last 10 years in rural area of the state.19 However, in view of the rising burden of CVDs, healthcare availability will pose more challenges in future. Hence, now is the right time for investing resources in reorientation of the healthcare delivery system for prevention and control of CVDs. So far rural health services were geared to tackle communicable diseases, nutritional, perinatal and maternal conditions. A field trial has demonstrated the feasibility of implementing CVDs prevention

Table 2  Top 10 cause-specific mortality rates per 1000 population per year by age and sex in a rural community of Haryana, India, 1992–2009

<table>
<thead>
<tr>
<th>Causes (ICD codes)</th>
<th>Age (years)</th>
<th>Sex</th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0–4</td>
<td>5–14</td>
<td>15–39</td>
<td>40–59</td>
<td>60+</td>
</tr>
<tr>
<td>Cardiovascular diseases (I00–I69, I60–I69, I70–I99, G81–G83)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Diallode diseases (A00, A01, A03, A04, A06–A09)</td>
<td>2.4 (73)</td>
<td>0.1 (4)</td>
<td>0.04 (4)</td>
<td>0.1 (2)</td>
<td>3.3 (51)</td>
</tr>
<tr>
<td>Chronic respiratory diseases (J30–J99)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malignant neoplasm (C00–C97, D00–D48)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Perinatal conditions (P00–P08, P10–P15, P20–P29, P35–P39, P66)</td>
<td>3.6 (113)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respiratory infections (J00–J06, J10–J18, J20–J22, H65–H67)</td>
<td>2.1 (65)</td>
<td>0.02 (1)</td>
<td>0.1 (6)</td>
<td>0.04 (1)</td>
<td>1.1 (16)</td>
</tr>
<tr>
<td>Genito-urinary conditions (N00–N99)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor vehicular injuries (V01–V89)</td>
<td>0.1 (4)</td>
<td>0.05 (2)</td>
<td>0.2 (24)</td>
<td>0.6 (14)</td>
<td>0.6 (9)</td>
</tr>
<tr>
<td>Tuberculosis (A15–A19, B90)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Digestive system diseases (K20–K23, K25–K31, K35–K38, K40–K67, K70–K93)</td>
<td>0.2 (5)</td>
<td>0.1 (4)</td>
<td>0.04 (4)</td>
<td>0.5 (12)</td>
<td>2.4 (38)</td>
</tr>
<tr>
<td>Others*</td>
<td>0.7 (21)</td>
<td>0.1 (5)</td>
<td>0.8 (77)</td>
<td>3.5 (81)</td>
<td>13.2 (201)</td>
</tr>
<tr>
<td>All</td>
<td>9.2 (281)</td>
<td>0.4 (16)</td>
<td>1.6 (159)</td>
<td>10.2 (239)</td>
<td>48.7 (745)</td>
</tr>
</tbody>
</table>

Dash (—) in cell means no death. Figure in parenthesis are number of deaths from 1992 to 2009.


ICD, International Classification of Disease.
Eighteen-year surveillance using verbal autopsy revealed significant change in mortality pattern in a rural community of north India.

Deaths due to infectious diseases like diarrhoea have declined, while cardiovascular disease mortality has risen.

Epidemiological transition is underway in rural communities of north India.

Acknowledgements We thank Drs Kamlesh P Joshi, B Thirumala Rao, Tanzin Dikid, Suraj Senjam Singh, Jeyashree K, Hemant D Shewade, Rashmi Kashyap, Jay Prasad Tripathy and Khumukcham Trusty for their assistance in coding the causes of deaths.

Funding Post Graduate Institute of Medical Education and Research Chandigarh (India) had provided resources for conducting this study.

Competing interests None.

Patient consent Obtained.

What is already known on this subject

- Indirect estimates suggest that mortality patterns are changing in low- and middle-income countries.
- Trends on causes of death have not been reliably measured in these countries as vital events registration systems are weak. Verbal autopsy is a reliable alternate method to ascertain cause of death.

What this study adds

- Eighteen-year surveillance using verbal autopsy revealed significant change in mortality pattern in a rural community of north India.
- Deaths due to infectious diseases like diarrhoea have declined, while cardiovascular disease mortality has risen.
- Epidemiological transition is underway in rural communities of north India.

and treatment model through non-physician health workers in rural primary healthcare setting.

To conclude, a mortality surveillance system that incorporates VA methods revealed a rising trend of deaths due to cardiovascular diseases and a decline in deaths due to diarrhoeal diseases in a rural community of northern India. These results imply that these rural communities are undergoing epidemiological transition that calls for reorientation of healthcare priorities.

Acknowledgements We thank Drs Kamlesh P Joshi, B Thirumala Rao, Tanzin Dikid, Suraj Senjam Singh, Jeyashree K, Hemant D Shewade, Rashmi Kashyap, Jay Prasad Tripathy and Khumukcham Trusty for their assistance in coding the causes of deaths.

Funding Post Graduate Institute of Medical Education and Research Chandigarh (India) had provided resources for conducting this study.

Competing interests None.

Patient consent Obtained.

Ethics approval This study was conducted with the approval of the Institute Ethics Committee.

Provenance and peer review Not commissioned; externally peer reviewed.

REFERENCES