Cause of Death among Infants in Rural Western China: A Community-Based Study Using Verbal Autopsy

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Objectives To determine the causes of death among infants in high-mortality areas of western China with the use of globally recognized methods.

Study design A survey of all infant deaths identified over 1 year in 4 counties in Yunnan and Xinjiang in which combined verbal autopsy was combined with a physician's diagnosis of the cause to calculate the local infant mortality rate.

Results Among 470 completed investigations, a cause of death was assigned to 423 cases (90%). Overall, pneumonia (34.5%), preterm birth complications (16.5%), diarrhea (10.4%), birth asphyxia (10.3%), and congenital abnormalities (8.5%) were the main causes, with 56.6% of deaths occurring in the neonatal period. Deaths were attributable predominantly to prematurity or birth asphyxia in the early neonatal period, whereas infection accounted for more than 60% and 80% of deaths in the late and postneonatal periods, respectively. Calculated infant mortality was 21.9 in 1000 live births.

Conclusions The pattern of infant mortality observed in the surveyed counties differs markedly from that reported previously at the national level, with a high proportion the result of causes that may be preventable with globally recommended interventions. Financial and political support is needed to promote improved cause of death surveillance and newborn and infant health care in China's western region. *(J Pediatr 2014;165:577-84).*

U nderstanding the biological causes and contextual antecedents of death is important for health programming and related policies, but in 2010 medically certified vital registration data were only available from 61 mostly developed countries, accounting for only 2.7% of all deaths among children aged <5 years.[1] Some developing countries are introducing such vital registration systems, which record key life events, including births or deaths and ideally the circumstances of these events. However, vital registration data often are incomplete or of poor quality, and usually the subgroups not covered are at the greatest risk. The causes of deaths among such communities can only be extrapolated from other communities, which is potentially misleading where socioeconomic disparities exist.

Cause-specific mortality fractions among child populations therefore usually are determined by research,[2] surveillance, investigation of deaths by verbal autopsy, various local records, or a combination thereof.[1] Verbal autopsy is a structured interview with family members and/or caregivers of the deceased enabling assignment of a probable cause of death.[3] It has been validated for the most frequent etiologies, including those among children[4] and newborns,[5] although practices vary substantially.[6] The World Health Organization recently updated its standards for verbal autopsy to improve validity,[7] and newer methods to investigate antecedent and immediate associations with/determinants of death (social autopsy) are now available.[8,9] However, in developing countries the application of verbal and social autopsies is uncommon, and major gaps remain in community-level mortality surveillance, especially for young infants.[10]

With approximately 249 000 deaths among children aged <5 years in 2011, China is a significant contributor to the global burden of young child mortality; 215 000 of those deaths of children aged <5 years occurred during infancy.[11] Although the mortality rate of children aged <5 years in China is much lower than in other high-burden nations,[11] significant differences and disparities in the etiology of child death have been reported across its vast geographic areas and socioeconomic groups.[12-14] There also has been concern about the plausibility of Chinese data,[15] including the annual birth cohort.[16] Moreover, good-quality data to guide child health programs in China are scant, as is the case globally.[1] Government reports do not profile child deaths by etiology at national or subnational level, and no recently published studies use globally recommended methods to determine the cause of child deaths.

Information on this subject is currently gathered through China's semi-independent Maternal and Child Mortality Surveillance (MCMS) Network,[13,17]

ICD-10	International Classification of Diseases, 10th Revision
MCMS	Maternal and Child Mortality Surveillance
PHMRC	Population Health Metrics Research Consortium

which now covers 126 urban districts and 210 rural counties housing around 140 million people. Some other localities conduct similar surveillance,[18] but only these 336 follow a national standard and report to a centralized database. Although a vital registration system, national notifiable disease reporting system, and other reporting schemes exist, the MCMS is the China Ministry of Health's official source of information on maternal and child mortality. Most related reports in the Chinese literature use MCMS data or data from its subnational elements or variants. However, the MCMS uses no standard verbal autopsy instrument, and causes of death are attributed to its own classification of 35 diseases, making it impossible to compare its output internationally. Moreover, because of the limited number of surveillance sites, the MCMS is not representative subnationally below the level of China's 3 regions (eastern, central, and west), each of which is home to several hundred million people. Authors using 2008 MCMS data reported that the proportion of child deaths due to pneumonia varied up to 5-fold across China's regions and varied even more for diarrhea.[13] This disparity is not captured in official MCMS reports, and conclusions based on national data are misleading at subnational levels.

Recent publications attempted to provide cause-specific child mortality rates for China[1,12-14] but data were extrapolated from imperfect information sources, including the MCMS and publications based on local resources of uncertain quality.[12,18] Moreover, programs to prevent mortality of children aged <5 years in China lack several key interventions widely recommended by global authorities, possibly because of the lack of reliable data on causes of death. To inform future global reports on child mortality and surveillance practices and local-level child health interventions in China, we assessed the causes of death among infants in rural western areas.

Methods

The study was conducted in rural areas of Yunnan and Xinjiang in western China, where socioeconomic development lags considerably behind the center and east, urbanization is relatively low, and minority ethnicity is high.[19,20] In each province, we selected 2 MCMS counties with a high reported number and rate of infant mortality; minority ethnicity ranged from 80% to 93%. In September 2011 we requested information from the county health departments on all deaths among infants (0-11 months) from October 1, 2010, to September 30, 2011. Lists of recorded deaths were shared with the investigation team by mid-October, followed by fieldwork completed in December 2011. To identify cases not recorded by the MCMS, county health departments asked local hospitals and health centers to recheck obstetric, pediatric, emergency, and administration department records. The investigation team also convened community health workers and village officials in each township to confirm all deaths, visit households if needed and identify unreported deaths.

We used the verbal autopsy questionnaire developed by the Population Health Metrics Research Consortium (PHMRC), itself based on the World Health Organization–standardized verbal autopsy instrument,[21] with separate questions for neonatal and postneonatal deaths. We used the PHMRC questionnaire because it includes both verbal and social autopsy tools, and will report separately on our social autopsy of the infant deaths. The PHMRC tool has been validated by several studies[9,22-25] and was first translated into Mandarin and piloted with selected assumed informants near Beijing before finalization. Ethical approval of this study was obtained from the institutional review board at the Chinese Center for Disease Control and Prevention. Informed verbal consent was sought from all interviewees, and confidentiality and anonymity were ensured. Refusal to participate was respected.

Medically trained personnel familiar with Mandarin and local languages conducted the interviews. Pre-hoc training assured interviewers' ability to communicate clearly and sensitively. A group leader from China's National Center for Women's and Children's Health was assigned to each of 2-3 investigation groups of 4-6 locally-based staff per county to coordinate activities and check completed questionnaires.

After obtaining verbal informed consent, interviewers surveyed the main caregiver during the fatal illness (preferably the mother) using the Consortium questionnaire. The infants' and parents' names, ethnicity, address, duration of residence, and dates of infants' birth and death were recorded. Cases were excluded if the caregiver/infant had resided <6 months in the county, was absent, refused to participate, or answered <70% of the questions.

Specific clinical questions focused on coughing and fever (duration and severity), consciousness, lethargy, dyspnea/tachypnea (<2 months: ≥60 breaths; 2-12 months: ≥50 breaths), chest in-drawing, stridor, grunting, wheezing, cyanosis, purulent skin lesions and ulcers, and breastfeeding problems. Narratives on certain symptoms or signs also were collected via open-ended questions, such as on the production/expectoration of sputum. Clinic records were sought but rarely were available (<10%), so record-based validation of the cause of death was not possible.

An expert opinion was sought to assign a final cause of death. Particular attention was paid to differentiating infectious and noninfectious causes of respiratory distress in the early postnatal period.[26] Three experienced pediatricians from tertiary hospitals in Beijing independently reviewed completed questionnaires; each death was reviewed by 2 of them. For discordant diagnoses, the pediatricians and an expert on the *International Classification of Diseases, 10th Revision* (ICD-10) convened to agree on a final ICD-10 diagnosis.

Statistical Analyses

Data from the completed questionnaires were double-entered into Epidata 3.1 (Epidata Software, Odense, Denmark). Deaths were divided into early-neonatal (0-7 days), late-neonatal (8-27 days), and postneonatal (28-364 days). Causes of death were stratified by age, sex, and other variables to be reported elsewhere. To compare specific causes across age groups, the χ^2 and Fisher exact tests were