CHILD MORTALITY AND INJURY IN ASIA: SURVEY METHODS
Michael Linnan, Le Vu Anh, Pham Viet Cuong, Fazlur Rahman, Aminur Rahman, Shumona Shafinaz, Chitr Sitti-Amorn, Orapin Chaipayom, Venus Udomprasertgul, Maria Consorcia Lim-Quizon, Guang Zeng, Jing Rui-Wei, Zhu Liping, Katrina Irvine and Thomas Dunn

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Survey Methods

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Summary: This paper presents a more detailed description of the survey methodology for technical specialists interested in understanding the major differences between the surveys and the methods used in making the previous estimates of child deaths.

A detailed description is provided for survey governance, sampling design, survey instruments, the classification scheme for mortality and morbidity measured in the surveys, the fieldwork procedure, the analytic framework, weighting and adjustments and survey costs.

Following this, a number of methodological lessons are addressed, such as: the need to count all children and not only those under five years of age; the need to count all clearly identifiable causes of death in those same groups; the need to count morbidity as well as mortality; and the need to count the deaths in the community where they occur to avoid the various biases associated with facility-based counting. A number of examples from the surveys are shown to illuminate the issues so that they are clear for non-technical readers.

Keywords: epidemiology, cross-sectional survey, complex sampling, cluster surveys, life table analysis, survival function, child mortality, cause of death, Asia, Bangladesh, China, Philippines, Thailand, Viet Nam, low- and middle-income countries (LMICs), injury, community survey, mortality estimates, under-five mortality, morbidity estimates, disability.

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The paper results from the work of a large number of technical contributors who are listed in detail in the annex. The authors acknowledge the enormous contributions made by those listed to this series of papers.
FOREWORD

There is strong and growing evidence that child injury is a major concern throughout the world, in developing as well as industrialized countries. Research carried out by The Alliance for Safe Children (TASC), UNICEF and local partners in East and South Asia compellingly demonstrates the importance of injury as a cause of child mortality and disability in this region.

The impacts of child injury in developing countries are typically many multiples of those seen in the rich world. For example, for every 100,000 children born in industrialized countries, fewer than 135 die from injuries before the age of 18. In the Asian countries participating in the research presented here, that figure is well over 1,000. The impacts of these rates, due to higher risks, are magnified by the greater numbers of children living in developing countries.

Over the past 50 years, child deaths due to injury have decreased substantially in industrialized countries. The risk of death by injury before the age of 18 to a child born today is less than half the level of 30 years ago. Yet the reduction in the number of deaths in these countries was not merely a natural outcome of economic development. It was the result of a concerted, collective effort that began with recognition of the problem, followed by political commitment and policy change. This long process of research, lobbying, legislation, environmental modifications, public education and improvements in emergency services has saved millions of lives. Fifty years of successfully reducing child injury rates in industrialized countries has taught us that the interaction of a child and a pond, a child and a car, or a child and an animal are as predictable, and as preventable, as the encounter of a child with a virus or bacteria.

We are nearing midway in the effort initiated at the historic Millennium Summit in 2000, where world leaders adopted a set of Millennium Development Goals for the year 2015. One goal calls for reducing the under-five mortality rate by two thirds from its 1990 level. To reach this ambitious goal we will need to work harder to do what we have always done for children’s survival – promoting safe motherhood, increasing immunization coverage, ensuring better nutrition, and improving the role and status of women.

To achieve sustainable reduction in child mortality we must also 'work smarter'. Focus must be given to two areas of child deaths that now make up the majority of preventable mortality, and that have not been sufficiently well addressed in the past. One area is the reduction of neonatal deaths, which has become the focus of much recent research and international public and policy attention. Another focus must be on child injury.

Almost three decades ago a child survival revolution was launched, aimed at combating infectious diseases and nutritional deficiencies as the leading killers of infants and children. The targets were a handful of diseases and conditions that were responsible for the vast majority of deaths of infants and children. Based on evidence, interventions were organized through focused, affordable and sustainable actions. Campaigns were launched for breastfeeding and growth monitoring, immunization and oral rehydration therapy. Millions of lives were saved, and the development of many millions more children was advanced.

We now need to take similarly bold steps to prevent drowning, transport injury, poisoning, and other injury-related causes of child death and disability. Experience tells us that accidents and injury are largely preventable with simple and effective interventions. Unless we include injury prevention in our programmes, we stand to lose the impact of the major investments that have been made in immunization, nutrition and maternal and child health care.
In addition, deaths due to injury are but the tip of the iceberg. For every injured child who dies, many more live on with varying degrees and duration of trauma and disability, often denied the right to be productive citizens and to live a life of dignity. Their families are burdened with expensive hospitalization or other costs of caring for them. Likewise, injury to parents may lead to a family losing its breadwinner or its caregiver, contributing to poverty and with a devastating impact on children. Society must invest in preventing injuries, to save lives but also to help ensure the quality of life for children and their families.

Child injury prevention need not compete for the same scarce resources as other actions for children. Initiatives against accidents and injuries must be made complementary to and supportive of our focus on infant and child health, early childhood care, girls' education, HIV/AIDS prevention, and other programmes for young children and adolescents.

This special Innocenti series on Child Injury, developed jointly by UNICEF and TASC, presents recently acquired evidence from surveys in five Asian countries: Bangladesh, China, Philippines, Thailand and Viet Nam. The surveys are large in scale, similar to a census. In total over half a million households and nearly 2.5 million people were surveyed. The scale of the research provides an in-depth view of child mortality from all causes, as well as of morbidity from injury throughout all the years of childhood. The results show in detail the leading contribution made by injury to child death and disability, a fact that has been insufficiently recognized to date.

The findings from this research are important to Asia, one of the most dynamic and rapidly developing regions and home to over half the world’s children. However, it is likely that patterns of increasingly significant injury-related child death and disability are occurring just as silently in other regions, difficult to detect by currently available measurement methods.

The work presented here clearly shows that in Asia the efforts for child survival carried out over the past three decades have been enormously successful. In the space of less than two generations the region has been transformed into one where the epidemiology of child and adult deaths is almost comparable to that in the rich world; the rates remain high, but the patterns have evolved. The epidemiological transition is clearly well underway in the region, from infectious diseases to injury and chronic disease as the leading causes of child death and disability. We must now rise to this new challenge.

The surveys and their results are made possible by, and build upon, the development that has occurred in health systems in the region. A strong and capable public health infrastructure now exists in most countries able to provide necessary information about death and illness. This provides policymakers with a firm basis on which to formulate the interventions that will most effectively continue the downward trend in the rates of child death and disability and extend protective benefits to all children.

The realization that almost half of all child deaths after infancy are due to injury gives great pause, but it is also a cause for hope. The revolution in child injury prevention in rich countries over the last 50 years demonstrates that injury is preventable. There is a clear way forward for policymakers in the region to make Asia ‘A Region Safe for Children’.

Pete Peterson
President
The Alliance for Safe Children

Kul C. Gautam
Assistant Secretary-General, United Nations
Deputy Executive Director, UNICEF
SYNOPSIS OF THE SERIES

The initial papers in this series present a comprehensive overview as well as an in-depth focus on the methodology, the detailed results and the policy and programmatic implications of the surveys that have been carried out on child injury in Asian countries. Papers are also presented on the association of poverty and injury, and on a community laboratory for developing effective injury interventions. A brief summary of these is as follows:

**Child mortality and injury in Asia: An overview.** An introduction to child injury and the issues that underlie the new data with a summary of results. The data show child injury to be far more prevalent than previously understood. Differences in these data and those gathered earlier are explored, and implications are addressed in a non-technical fashion.

**Survey methods.** An explanation of the methodology used for the surveys. It provides a detailed discussion of the methodology for readers with a technical background who desire more in-depth information on the surveys and how they differ from previous work.

**Survey results and evidence.** Detailed presentation of the results from the series of injury surveys, particularly for readers with specific country or category interests. This paper expands upon the description in the overview paper, including the presentation of further statistical analysis.

**Policy and programme implications.** Implications of the new findings are explored for child health programmes within the countries surveyed. The discussion has a practical orientation, to contribute to policy discussions on the measures needed for effective child injury prevention and response.

**The cost of injury and its association with poverty.** Using economic methods introduced for the Jiangxi Survey in China, data are presented on the cost of injury and its association with poverty. These costs and associations have implications for the wider Asian region.

**A community laboratory for child Injury prevention in Bangladesh.** An introduction to a new community laboratory in Bangladesh for child injury interventions. Covering over 170,000 rural and urban households, the initiative focuses on measurement of the efficacy of injury interventions and their cost-effectiveness.

Future papers in the series are planned to be devoted to key issues of child injury raised in this initial group, but which call for more detailed discussion. Additional surveys in the field, when completed, will provide coverage of additional settings. These include reports on:

1. Child injury survey findings in Cambodia, as one of the few remaining countries in East Asia with high child mortality.
3. Drowning, which accounts for the majority of all child deaths from injury. The phenomenon of drowning is unique in many respects, including epidemiology and prevention; the potential exists for elimination of a significant cause of child deaths.
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1 INTRODUCTION

The surveys presented in this series of papers show that for children in Asia, mortality and morbidity from injury is far more common than had been previously known. The first paper, IWP 2007-04, reviewed the methodology of the current estimates and limitations inherent in them. It also briefly described the alternative methodology used in the surveys presented in these papers, which is the direct measurement and classification method.

This paper presents the direct measurement and classification method in greater detail. The paper addresses various statistical and epidemiologic issues related to the surveys. Therefore it has a more technical orientation than other papers in the series. Every attempt has been made to keep the presentation and discussion sufficiently broad and accessible to generalists interested in this paper. Technical specialists in epidemiology and other readers interested in further detail are directed to the full reports on the individual surveys available through the UNICEF country offices concerned and at the TASC website at <www.tasc-gcipf.org>.

2 BACKGROUND

Present estimates

The standard method used to measure child mortality in low-and middle-income countries (LMICs) first determines the total number of children under five years old dying from all causes. Then, it allocates mortality shares of this total number based on the leading killers of young children in a given region. Typically, these leading causes have been determined by health facility data, statistical models, and expert opinions.1

In 2001, the World Health Organization (WHO) formalized this general process with the establishment of the Child Health Epidemiology Reference Group (CHERG). The group began a process to develop estimates of child mortality by determining the proportions of child deaths caused by the leading recognized killers of children under five years of age: pneumonia, diarrhoea, malaria, measles and the major causes of neonatal deaths (in the first month of life).

The group started with the WHO database of mortality-by-cause as reported by WHO member States. Acknowledging the serious quality issues inherent in the reported data, the group used the distribution by cause of child deaths in 72 countries where there was agreement on soundness of the data. These were from high- and middle-income countries. For countries without similar data, epidemiological studies and statistical modelling were used extensively to fit proportional mortality by cause to the numbers of child deaths in a two-step process. In the first step, a statistical model was used to assign deaths to one of three broad categories by cause: communicable diseases, non-communicable diseases and injuries or deaths from external causes. The second step used the proportional mortality estimates and various natural history models devised by the CHERG to assign the distribution of specific causes of death. These were then published as global, regional and country-level, cause-

specific child mortality estimates.\textsuperscript{2} The global level estimate is shown in figure 1 for illustrative purposes.

**Figure 1: Global mortality of under-fives and neonates (0–28 days) by cause, 2000–2003**

![Figure 1: Global mortality of under-fives and neonates (0–28 days) by cause, 2000–2003](image)


This global level figure includes injury and estimates that it was responsible for about 3 per cent of under-five deaths in 2005. The regional estimate for the WHO Western Pacific Region, which includes Viet Nam, does not contain estimates of injury contribution to under-five deaths. The official estimates available at the time of the initial Viet Nam survey in 2000 lumped them into a category labeled ‘other’, which accounted for 25 per cent of under-five deaths in the Western Pacific.\textsuperscript{3}

**Initial work on child injury in Viet Nam**

At the same time, work was underway at a new institution in Viet Nam, the Hanoi School of Public Health (HSPH). In developing the strategic research agenda for the school, one fundamental question was to ask what the major killers of children in Viet Nam were. Consultation with the country offices of UNICEF, WHO and others indicated that infectious and nutritional causes were the leading killers.


\textsuperscript{3} <www.who.int/child-adolescent-health/OVERVIEW/CHILD_HEALTH/map_00_region.jpg> accessed 8 December. 2006.
However, several community-level studies contradicted the information reported by UNICEF and WHO country offices. An assessment of child mortality in 20 villages comprising a demographic research site in northern Viet Nam showed injury, almost entirely drowning, as the leading cause of death in children after infancy. A similar study undertaken in southern regions of the country showed similar results, with injury, predominantly drowning, being the leading child killer after infancy. A study of the major urban areas throughout the country showed a similar pattern. Efforts to reconcile the different findings of the leading causes of death of children from the field studies to those reported by WHO and UNICEF led to an effort to understand the striking differences seen from the sample surveys.

For its part, UNICEF Viet Nam undertook to validate the numbers of deaths reported as due to diarrhoeal and respiratory diseases. Programme managers were asked to count the individual deaths for each cause. They reported the actual numbers counted rather than the sum predicted by the proportion-based models as deaths from that particular cause. When actual numbers were counted, they were substantially fewer. As a result of these findings, UNICEF Viet Nam, in collaboration with the US Embassy, the Centers for Disease Control and Prevention in the United States (CDC) and the HSPH, undertook a community-based survey with a nationally representative sample which was large enough to directly count deaths and establish cause of death for Vietnamese of all ages.

The HSPH created a collaborating network of public health institutions in eight regions of the country and undertook the Viet Nam Multi-Center Injury Survey (VMIS). While named an injury survey, VMIS actually looked at all causes of mortality in 27,000 households selected as a nationally representative sample from all areas of Viet Nam. When completed in 2001, the results confirmed that the epidemiologic transition had already occurred in Viet Nam. Injury was the leading cause of death after infancy, with drowning being the leading cause of death in the 1–4 age group, as well as in older age groups until late adolescence. While controversial in Viet Nam at the time, particularly because the findings differed greatly from the WHO estimates, the VMIS findings have since been validated in other studies.

The divergence of the findings in Viet Nam from those in the models and predictions by WHO and UNICEF at the global level led to a reassessment of the likely causes of child mortality elsewhere in Asia. In a region of the world with the longest and most rapid sustained decreases in under-five mortality, it seemed likely that in most of the countries in

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7 Personal communication, Dr P. Len, National Health Officer, UNICEF Viet Nam and Morten Giersing, former UNICEF Country Representative, Vietnam.
the region the leading causes of child death after infancy were no longer the classic infectious and nutritionally related causes.

The UNICEF East Asia and Pacific Regional Office recognized that an epidemiological shift would make achieving Millennium Development Goal 4 (MDG 4) more difficult. MDG 4 requires a reduction in the under-five mortality rate (U5MR) by two thirds from the 1990 rate. It was recognized that if injury was a leading cause of mortality in the under-five age group, it would be difficult to meet the Goal without interventions specifically targeting this cause.10

In order to answer the question of whether injury was a significant cause of early child mortality in other countries in Asia as well as Viet Nam, additional surveys were undertaken in Bangladesh, China, the Philippines and Thailand. The lessons learned in doing the survey in Viet Nam were used to extend the methodology to these countries. Each round of surveys provided new experience and lessons learned and these were incorporated in the next round. The goal of the changes was to extend the usefulness of the surveys for programme planners, for intervention design, and for developing a methodology for cost-effectiveness that would be used later in evaluation. The changes included nesting case-control studies into the larger survey to provide risk factor information, defining prevalence of risk factors at the household and individual level, and adding modules on economic costs and social burden.

While the methodology has evolved in response to lessons learned, the core components and definitions have remained consistent. One lesson identified early on during the literature review for the Viet Nam survey was that standard definitions of populations surveyed, their age groups, socio-economic descriptors, and deaths and morbidities measured was critical to any comparative use. Therefore, all the surveys use the same definitions of populations, ages, and classifications of fatal and non-fatal events. Virtually all of the evolution process has been the addition of modules rather than changes from the standard methodology developed for VMIS.

3 SURVEY GOVERNANCE

The work of the surveys was guided by a Technical Advisory Group (TAG). At the time of the surveys in this series of papers, the TAG had representatives from UNICEF, the World Health Organization, the US Centers for Disease Control and Prevention and universities in Australia, China, India, Thailand, USA, and Viet Nam. A list of the current TAG members is available on The Alliance for Safe Children (TASC) website at www.tasc-gcipf.org.

Within each country, surveys are governed by separately constituted Technical Advisory Groups. Primarily, these are comprised of academics from local research institutes, with support provided by TASC and the UNICEF country office. The country TAG will typically have representation from the Department or Ministry of Health, the national statistics office, and the agency responsible for the national census. The country TAG is asked to undertake a literature review aimed at identifying current estimates for injury and provides an indication of the quality, completeness and inherent biases in the national injury information. The TAG

10 Personal communication, Mehr Khan Williams, former UNICEF Regional Director, East Asia and Pacific.
then helps localize and refine the instruments for the particular country context. All protocols and instruments are then submitted to an ethical review board for approval prior to the commencement of fieldwork.

4 SAMPLE DESIGN AND METHOD

Sample size

The sample size for the first survey (VMIS) used the following formula and assumptions:

$$n = \frac{z^2_{1-\alpha/2} \cdot p(1-p)}{(\epsilon p)^2}$$

Assumptions:  
- Precision = 20%  
- Alpha = 0.05 (two-sided)  
- Response rate = 95%  
- Design effect = 1.1

The survey had a large sample. In 2001, the sample size of about 27,000 households made it the largest household injury survey ever carried out in a developing country. However, despite this, an early lesson was that it lacked the power to discriminate deaths by the narrow age groups required when they were stratified by sex and urban or rural residence.

In subsequent surveys the sample size was determined by the size of the least frequent age- and sex-specific injury type for which an estimate was required. As a result, the sample sizes increased to four or five times the size of the Viet Nam study. This is illustrated in table 1, which shows the average number of visited households required to find a death from any cause in each of the age categories shown. The numbers required are much larger than those listed in the table when differentiations are made by gender, location (urban or rural), injury causes, etc.

Table 1: Average number of households visited to find one child death, by age and survey

<table>
<thead>
<tr>
<th>Households visited to find once child death from any cause</th>
<th>Age</th>
<th>Viet Nam</th>
<th>Bangladesh</th>
<th>Thailand</th>
<th>Philippines</th>
<th>Jiangxi</th>
<th>Beijing</th>
</tr>
</thead>
<tbody>
<tr>
<td>0–17</td>
<td>386</td>
<td>118</td>
<td>254</td>
<td>188</td>
<td>1,177</td>
<td>4,012</td>
<td></td>
</tr>
<tr>
<td>0–1</td>
<td>2,077</td>
<td>179</td>
<td>344</td>
<td>395</td>
<td>7,693</td>
<td>14,042</td>
<td></td>
</tr>
<tr>
<td>1–4</td>
<td>2,250</td>
<td>619</td>
<td>3,298</td>
<td>766</td>
<td>3,031</td>
<td>28,084</td>
<td></td>
</tr>
<tr>
<td>5–9</td>
<td>1,227</td>
<td>1,462</td>
<td>3,853</td>
<td>1,773</td>
<td>4,546</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10–14</td>
<td>1,688</td>
<td>3,090</td>
<td>4,770</td>
<td>2,153</td>
<td>11,112</td>
<td>28,084</td>
<td></td>
</tr>
<tr>
<td>15–17</td>
<td>3,857</td>
<td>4,132</td>
<td>3,853</td>
<td>2,206</td>
<td>12,501</td>
<td>9,361</td>
<td></td>
</tr>
</tbody>
</table>

Source: Authors’ calculations based on the individual survey reports.

Sample design

In general, the surveys use stratified, multi-stage, cluster-sample designs. The specific design features vary and are summarized in table 2. Typically, the strata are administrative regions and/or rural and urban areas for which prevalence estimates are required. Efficiency gains were expected from stratification due to anticipated regional variability in injury prevalence. Within strata, typically two- or three-stage cluster sampling was performed. UN Mega-cities (Bangkok, Beijing, Dhaka) were always included (selection probabilities of 1). Simple random sampling (SRS) or probability proportional to size (PPS) sampling was used to distribute sampling units. The primary, secondary, and tertiary sampling units (PSU, SSU, TSU respectively) for each survey are shown in the table. Cluster sampling was used to
minimize field costs associated with face-to-face interviewing and overcome limitations of available sampling frames. The sampling unit for all surveys was households, and all household members were included. The definition of household was typically that used in doing the national census. This allowed use of existing enumeration areas, facilitating survey logistics. It also provided a common basis for demographic and socio-economic status (SES) data comparisons with the previous census, and permitted direct comparisons of life tables from the census with the surveys.

Table 2: Sample size, design and method of the surveys

<table>
<thead>
<tr>
<th>Year of fieldwork</th>
<th>Viet Nam</th>
<th>Bangladesh</th>
<th>Thailand</th>
<th>Philippines</th>
<th>Beijing, China</th>
<th>Jiangxi, China</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Household</td>
<td>26,733</td>
<td>171,366</td>
<td>100,179</td>
<td>90,446</td>
<td>28,084</td>
<td>100,010</td>
<td>516,818</td>
</tr>
<tr>
<td>Members</td>
<td>128,662</td>
<td>819,429</td>
<td>389,531</td>
<td>418,522</td>
<td>81,604</td>
<td>319,543</td>
<td>2,157,291</td>
</tr>
<tr>
<td>Children</td>
<td>46,858</td>
<td>351,651</td>
<td>98,904</td>
<td>178,938</td>
<td>13,508</td>
<td>98,335</td>
<td>788,194</td>
</tr>
<tr>
<td>Strata</td>
<td>8 regions</td>
<td>Urban/rural</td>
<td>5 regions</td>
<td>National</td>
<td>18 districts</td>
<td>Urban/rural</td>
<td></td>
</tr>
<tr>
<td>Allocation method</td>
<td>Proportional to sq. root allocation</td>
<td>Proportional to size in last census</td>
<td>Proportional to size</td>
<td>Proportional to size</td>
<td>Proportional to size</td>
<td>Proportional to size</td>
<td></td>
</tr>
<tr>
<td>PSU</td>
<td>Provinces</td>
<td>Districts</td>
<td>Provinces</td>
<td>Regions</td>
<td>District committee</td>
<td>Street committee and townships</td>
<td></td>
</tr>
<tr>
<td>Method</td>
<td>SRS</td>
<td>SRS</td>
<td>PPS</td>
<td>SRS</td>
<td>PPS</td>
<td>PPS</td>
<td></td>
</tr>
<tr>
<td>SSU</td>
<td>Districts</td>
<td>Upazilla-rural</td>
<td>Census blocks (urban)</td>
<td>Census blocks</td>
<td>Street committee</td>
<td>Neighbourhood committee, village</td>
<td></td>
</tr>
<tr>
<td>Method</td>
<td>SRS</td>
<td>SRS (rural)</td>
<td>Systematic (urban)</td>
<td>Systematic</td>
<td>PPS</td>
<td>PPS</td>
<td></td>
</tr>
<tr>
<td>TSU</td>
<td>Blocks of 90 households</td>
<td>Union (rural)</td>
<td>Households (urban)</td>
<td>Barangay</td>
<td>Neighbourhood committees</td>
<td>200-household block</td>
<td></td>
</tr>
<tr>
<td>Method</td>
<td>SRS</td>
<td>SRS (rural)</td>
<td>Systematic (urban)</td>
<td>Systematic</td>
<td>PPS</td>
<td>PPS</td>
<td></td>
</tr>
<tr>
<td>Sampling unit</td>
<td>Household</td>
<td>Household</td>
<td>Household</td>
<td>Household</td>
<td>Household</td>
<td>Household</td>
<td></td>
</tr>
<tr>
<td>Observation unit</td>
<td>All members</td>
<td>All members</td>
<td>All members</td>
<td>All members</td>
<td>All members</td>
<td>All members</td>
<td></td>
</tr>
</tbody>
</table>

SRS = simple random sampling.
PSS = probability proportional to size with measure of size being the number of households.
Source: Author summaries of national injury surveys.

In countries where the surveys included a UN defined mega-city, a separate sample was taken to allow ascertainment of injury in these cities in comparison with other urban areas in the same country. In these cases the sample was stratified by slum versus non-slum. Dhaka, Bangladesh, Bangkok, Thailand and Manila, Philippines are in this category. Beijing, China was surveyed separately even though it has no slums, and was stratified into urban districts and rural counties.
5 SURVEY INSTRUMENTS

The survey questionnaires consist of modules that were first developed and piloted in 1999/2000 as part of the Viet Nam Multi-Center Injury Survey. A brief description of each module is provided in table 3. The modules are designed to collect demographic information on household members, causes of mortality and morbidity, and causes, circumstances and consequences of injury events, and to provide a description of household injury hazards. The first four modules – screening forms, injury mechanism, and verbal diagnosis and autopsy – were initially developed for the Viet Nam survey. Modules Five and Six – control forms for nested case-control studies of drowning for both children and adults – were first developed in 2002 for use in Bangladesh and in subsequent surveys.

Table 3: Summary description of survey modules

<table>
<thead>
<tr>
<th>Module</th>
<th>Description</th>
</tr>
</thead>
</table>
| Screening form       | All surveys: Basic demographic information (age, sex, marital status, household roles), mortality and morbidity (illnesses and injury) of household members. Additional items are collected for women of reproductive age to enable calculation of indirect measures of infant and child mortality such as preceding birth estimates and sibling survivorship.  

In Beijing and Jiangxi Province, China, the Philippines and Thailand: Injury hazards at the household level were included (risk factors for fire, poisoning, falls, and sharp object exposure; sleeping position and place of infants and children under five; children’s swimming ability).  

The most recent surveys have incorporated detailed SES questions on the screening form as well as additional risk factors.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| Verbal autopsy form  | All surveys: Age-specific forms to allow determination of cause of death (separate verbal autopsy forms for infant deaths in the first month of life, in the post-neonatal period to end of infancy (29 days through 11 months), deaths in years 1–4, deaths in years 5–17, and deaths in adults (18 years and above).  

The forms were adapted from the WHO standard for verbal autopsies for infants and children under five. For infants and children 1–4 years of age the forms are unmodified except for the addition of a detailed typology of injury deaths. Forms were developed for 5–17 year olds, based closely on the forms for 1–4 year olds. A truncated version was developed for adults, for whom the purpose was to resolve specific injury causes, and other causes only as non-communicable, communicable and other.  

In Bangladesh the same forms were used after comparison with verbal autopsy forms from Matlab and additions made to ensure comparability. These were field tested and validated with urban and rural populations where the cause of death was known and show high levels of agreement, particularly for children. The forms have remained largely unchanged since then for surveys in China, Indonesia, the Philippines, and Thailand. |
| Verbal diagnosis form| Surveys in Bangladesh, Beijing (China), the Philippines, Thailand, and Viet Nam include proportional morbidity, and these age-specific forms to allow determination of the cause of morbidity. The forms were adapted from the verbal autopsy forms, and use a similar structure, elicit information about the same symptoms, and record the diagnosis from any available health records rather than the cause of death. In subsequent surveys (Cambodia and Jiangxi, China) morbidity has been measured from injury and the form is not included in these surveys.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Injury mechanism form| All surveys: For each injury recorded, a separate form was administered to examine the circumstances leading to the injury as well as the actual injury event and its outcome. Temporary and permanent disability are included in outcome issues, as well as social and economic cost data that pertain to the injury and subsequent treatment and rehabilitation.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
| Control form          | Control group questionnaire for case-control drowning study. Used in Bangladesh, China and Thailand. Subsequent surveys have added nested case-control studies for suffocation, animal bites, burns, poisoning and cuts as well as drowning and these are now incorporated into the screening form and a separate control form is no longer used.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
Added as a specific form in late surveys, with congregation of various SES data elements from the other forms. In the most recent surveys (Cambodia and Jiangxi, China) the SES data has been moved to the screening form to allow SES factors to be included in risk ratios for households without injury as well as those with injury. This allows ascertainment of SES associations with mortality from all causes, and specific types of fatal and non-fatal injury.

Source: Compiled from original survey forms, administered 2000-2005.

The survey instruments for Viet Nam Multi-Center Injury Survey (VMIS) were initially developed in English. They were translated into Vietnamese in 2000 following pre-testing with English-speaking members of the Viet Nam Public Health Research Network. The questionnaire was further developed and tested through repeated small-scale studies in rural, peri-urban, and urban areas in Viet Nam in the year leading up to the national survey.

In subsequent surveys, the instrument was adapted for each country: the English language version was pre-tested with English-speakers from local research institutes, modified and translated into the local language, and then pre-tested again with approximately 50 households. The language was modified as necessary, and the revised instrument was given a full pilot test under field conditions with a minimum of 250 households each in urban, peri-urban and rural areas, plus slums if a city defined as a UN mega-city was included in the survey. The full pilot test was used to test the data collection process in the field and finalize the Standard Operating Procedures Manual and the Interviewer and Supervisor Guidebooks, and work out efficient logistic procedures.

In general, the instruments were translated into the main national language spoken by all the interviewers. The training programme for interviewers included local dialect terms to facilitate on-the-spot translation; where large population groups did not speak the main language, interviewers from that area were chosen. This allowed on-the-spot translation for local or minority languages as necessary. This was considered preferable to specifically excluding certain language groups or treating it as a sampling error.

Although the survey instrument was localized for each country, the adaptations are for language only and incorporate locally appropriate idiomatic responses to each question. The definitions of injury type were held constant in all surveys. Injury severity definitions were also held constant, except for the least severe level.

The common data elements obtained in the surveys are as follows:

**Demographic**: name, age, sex, marital status, relationship within family for consanguineous members, ethnic group, religion. These were obtained for all surveys.

**Socio-economic**: occupation, education (years completed), role in household for non-consanguineous members, household income and/or expenditures, size (square metres) and construction of house (floor and roof materials), type of toilet, presence of running water and electricity. Ownership questions included the house and common household assets (such as refrigerator, air conditioner, car, motorbike, bicycle, television, cell phone, etc.). These were obtained for all surveys with the exception of Viet Nam. In Viet Nam, the major economic variables were home ownership and household income.
**Epidemiologic**: household-level risks for drowning (large water vessels inside, presence of bodies of water outside, wells, troughs, etc.), for road traffic accidents (RTA)**11** (proximity to road, whether door kept closed, etc.), for asphyxiation (type of heater used), for suffocation (infant sleeping position, bed-sharing practices), for poisons (type of poison, storage container and place of storage), for falls (balconies or porches, stair rails in multistorey dwellings), for burns (type of cooking appliance, types of hot water boiler and hot water storage vessel), for cuts (types of sharp objects and storage practices), and for dog bites (presence of dog at household, whether dog is vaccinated against rabies, and its sleeping location).

**Personal risks**: drowning (ability to swim for parents, for children four years and older, for primary caretaker of children under five) and suffocation (bed-sharing practices and sleeping positions for infants).

6 **CLASSIFICATION OF MORTALITY AND MORBIDITY CAUSES**

All reported episodes of mortality and morbidity are classified as a single, mutually exclusive type – maternal causes; non-communicable diseases (NCD); infectious or communicable diseases (CD); injury; or undetermined (UTD) – and are assigned a specific cause, e.g., pneumonia, meningitis, malnutrition, drowning, and so forth.

The classification of injury is made in the field by the interviewer so that immediate follow-up questions can be asked according to injury type. The classification for injury requires a detailed history of antecedent events and a detailed description of the injury incident itself to prevent misclassification.

Classification of non-injury causes is made by medical staff after fieldwork is complete. The information used to make the classification is contained in the verbal autopsy and verbal diagnosis, and is extracted from medical records, where available. A single classification is required for the type of cause (maternal, NCD, infectious, injury, undetermined) to avoid causes summing to more than 100 per cent of deaths.

The classification forms are based on standard WHO verbal autopsy forms for deaths of children under five. The forms are modified to include specific causes of injury, and to cover children older than four years (5–17 years). A separate classification form is used for adult deaths and is based on a short description of the circumstances involved prior to and at the time of death.

**Case definition for injury and illness**

The case definition of injury and illness for Viet Nam was: any injury/illness serious enough to cause death or permanent disability, require trained medical care to be sought, or result in missing one day of work or school. An injury or illness not meeting this minimal criterion

---

**11** ‘Road traffic accidents’ (RTA) is the term used in the countries surveyed to refer to injuries due to road transport, sometimes referred to as ‘road transport injuries’. For the purposes of this definition, ‘accident’ indicates a lack of intent.
(seeking care or missing one day of work or school) was deemed insignificant in terms of health care and economic or social costs and was not counted.

This same definition was also used in Beijing. The lowest level of severity was modified for Bangladesh, the Philippines, and Thailand to reflect three days’ rather than one day’s absence from school or work. The modification was suggested in pre-testing, and adopted after extensive discussions with social scientists and epidemiologists familiar with cultural norms in each country.

Classification of injury severity

All surveys classify injury severity in five categories: fatal, severe, serious, major, moderate.

**Fatal injury (death):** injury resulting in death, whether immediately or later, but as a direct result of the injury. This is the same for all surveys.

**Severe injury (permanent disability):** injury resulting in permanent disability from blindness, deafness, loss of an extremity (arm or leg) or loss of the ability to use the hands or walk, or the loss of mental abilities. Emotional and psychiatric causes were not included because of the difficulty of diagnosis and classification. This is the same for all surveys.

**Serious injury (10+ hospital days):** injury requiring hospitalization for 10 days or more. This is designed to capture injuries requiring a major surgical procedure. It is the same for all surveys.

**Major injury (1–9 hospital days):** injury requiring hospitalization for nine days or less. This definition is designed to capture injuries requiring significant medical care and hospitalization, but not major surgical intervention. This is the same for all surveys.

**Moderate injury (missing school or work, seeking care from health practitioner but not being hospitalized):** injury requiring medical care, or missing either one or three days of school or work, or being unable to carry out activities of daily living for the same time period, but without hospitalization. The definition used one day for Viet Nam, Beijing, and Jiangxi Province, and three days for Bangladesh, Thailand and Philippines.

Classification of injury type

All injuries are classified according to their physical cause and are maintained in that form in a database. For reporting purposes, they are then classified according to what policymakers and intervention programme designers feel is the most useful categorization scheme. For example, all deaths from submersion in water are coded as drowning, together with the circumstances surrounding the event. This approach allows the estimation of a crude drowning rate that incorporates all deaths from submersion and also facilitates the customary distinctions, for instance, classifying some drownings in the transport injury category, as when they relate to ship or ferry sinkings, etc. The separation of physical cause from categorization in the database allows the generation of International Classification of Disease
(ICD) format reports, if desired (within the limitations of the classification methods used in the survey).

The classification of injury used in the Viet Nam Multi-Center Injury Survey was a functional classification that included 11 types of injury:

1. Transport accidents
2. Injury caused by sharp objects
3. Drowning
4. Poisoning (including food poisoning from toxic plants)
5. Falls
6. Animal injury (injury caused by an animal)
7. Electric shock
8. Burn/Fire
9. Suffocation
10. Injury caused by falling objects
11. Injury caused by machines

Subsequent modifications of this classification in later surveys include the addition of assault, suicide and 'other' injuries.

Recall periods

A one-year recall period for all mortality and morbidity events was used in the Viet Nam Multi-Center Injury Survey. For subsequent surveys, respondents were asked to recall morbidity and mortality events over successive month and quarter time periods, as shown in table 4.

Table 4: Recall periods for morbidity and mortality events

<table>
<thead>
<tr>
<th></th>
<th>Viet Nam</th>
<th>Bangladesh</th>
<th>Thailand/Philippines</th>
<th>Beijing/Jianguo, China</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morbidity</td>
<td>1 year</td>
<td>1, 3, 6, 12 months</td>
<td>1, 3, 6, 12 months</td>
<td>1, 3, 6, 9, 12 months</td>
</tr>
<tr>
<td>Mortality</td>
<td>1 year</td>
<td>1, 3, 6, 12 months, 2, 3 years Dhaka mega-city</td>
<td>1, 3, 6, 12 months</td>
<td>1, 3, 6, 12 months</td>
</tr>
</tbody>
</table>

Source: Individual injury surveys.

7 FIELDWORK PROCEDURES

Recruitment and training of field staff

For each survey, interviewers and supervisors were recruited by the local research institutes implementing the survey. The ratio of supervisors to interviewers varied, ranging between 1:5 and 1:7.

Field staff training was conducted by the local research institutes, incorporating standardized role-playing scenarios and covering standardized interview techniques and record keeping.
As a general rule, the surveys are done as quickly as possible, in order to minimize problems from changing seasonal patterns of injury, as well as trying to minimize inherent risks to field staff given their continuous exposure to hazards associated with fieldwork (transport injury, dog bites and snake bites, falls, etc.). The time needed to complete the fieldwork varied according to the sample size and the number of interviewer/supervisor teams. The fastest survey was done in Beijing, where only three weeks were needed to interview all 28,000 households. The longest was in Thailand, where fieldwork was interrupted by the SARS epidemic midway through. As a result, it lasted over eight months and recall calendars were changed to allow for the passage of time.

**Fieldwork**

Informed consent was obtained from all respondents before data were collected. The respondent was chosen as the most knowledgeable adult member of the household among those present at the time of the interview. Where possible, the head of household plus as many household members as possible were present to corroborate answers or add detail. For a child death or serious morbidity, the respondent was the child’s caretaker, usually the mother.

Local governments engaged in intensive awareness-raising campaigns several weeks prior to the survey. Interview times were scheduled to maximize the number of household members available. The household revisit policy required at least two revisits before a substitution was allowed.

The reinterview rate was 5 per cent of randomly selected households; and when a child death was found, an attempt was made by the supervisor to revisit the house to validate the information obtained.

**Data entry**

Data entry was carried out locally with double entry, except in Thailand, where single entry method was used.

**8 ANALYTICAL FRAMEWORK**

A standard framework was used for all analyses. The rates, ratios, and proportions of various events were determined by sex and location (urban/rural, slum/non-slum), together with specific groupings (e.g., role in family, occupation, level of education, household income, and other SES measures). Additional standardized analyses included:

**Injury orphanhood:** injury orphans are defined using the WHO standard for HIV orphans but adapted to injury; that is, children who have lost a primary caregiver (mother) from injury, lost a primary economic provider (father) from injury, or lost both.

**Economic burden:** a number of SES-related parameters were collected in the survey to define economic groups within each population (e.g., standardization by quintile using the wealth asset index calculated from household responses to questions about ownership of assets, type of construction materials for walls, floor and roof of dwelling, type of toilet
facilities, etc.). Various analyses were done for direct and indirect economic costs from injury.

**Social burden:** a number of elements related to the social impact of injury were collected in the survey (e.g., the number of days of schooling or employment lost, the effect on household income, effect on family roles, extended care requirements for serious and disabling injury, etc.). Since one level of severity for non-fatal injury is permanent disability, a series of burden/impact analyses were done on this subgroup.

9 WEIGHTING AND ADJUSTMENTS

In Viet Nam, a self-weighting PPS sample was obtained, with probability of selection proportional to the square root of the population size. Viet Nam has a very large range in population density among its eight geographic regions. The square root proportionality scheme was designed by the census bureau to ensure that enough sampling units were present in the very sparsely populated regions to allow meaningful comparisons at the regional level. Capture-recapture methods were used for the adjustment of regional numbers of deaths.

In Bangladesh, sampling was done in 12 randomly selected districts, with sample weights distributed according to the urban/rural proportions of the populations as denoted in the previous census. A separate sample scheme was used for Dhaka, because its status as a UN mega-city required a separate sample large enough to ensure sufficient power for comparisons between slum and non-slum areas.

In China, a self-weighting, stratified PPS sampling scheme was used in both Beijing (city) and Jiangxi Province. Beijing is a UN mega-city, but there are no slums and therefore no need for a more complex sampling scheme.

In Thailand, a stratified PPS scheme was provided by the national census bureau for the initial sample design, weighted to reflect the provincial and regional urban/rural distribution of households. Following this, five additional provinces were added to allow direct comparisons between the community-based sample and hospitals participating in the national sentinel injury surveillance system. Additionally, Bangkok is a UN mega-city and a quota sample of slum households was obtained to give sufficient power for slum/non-slum comparisons. In Thailand, mortality rates for infants and children under five were adjusted using census-derived age-specific mortality rates.

The Philippines sample used a non-standard cluster survey frame because of UNICEF country office’s need for data on iodized salt use in each province. As a result, one cluster was sited in each province, and all data refer to the national sample of 90,446 households (418,522 household members), which is not weighted.

The software used for data analysis varied by country. Local analysts used STATA SE 8.0 and SPSS 12, for the most part. Both account for complex survey design and use the Taylor series linearization method for variance estimation where complex samples were obtained.
10    SURVEY COSTS

Although the surveys were very large, the costs have been relatively modest. Table 5 shows
the approximate field cost of each survey, including training, printing of instruments,
transport, and data entry. The average cost per household was approximately two US dollars,
and the average survey cost was about US$200,000. The costs in any country were mainly
related to transport and labour, meaning that geography and macroeconomic factors were the
most important determinants. All figures are in unadjusted dollars, spent in the years
indicated. The costs of the surveys were shared between TASC and the UNICEF country
office for the survey in question.

Table 5   Field costs of each survey

<table>
<thead>
<tr>
<th>Country/Province</th>
<th>Year of fieldwork</th>
<th>Households in sample</th>
<th>US dollars</th>
<th>Cost per household</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viet Nam</td>
<td>2000</td>
<td>26,733</td>
<td>85,000</td>
<td>3.18</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>2003</td>
<td>171,366</td>
<td>125,000</td>
<td>0.73</td>
</tr>
<tr>
<td>Thailand</td>
<td>2003</td>
<td>100,179</td>
<td>175,000</td>
<td>1.75</td>
</tr>
<tr>
<td>Philippines</td>
<td>2003</td>
<td>90,466</td>
<td>150,000</td>
<td>1.66</td>
</tr>
<tr>
<td>Beijing, China</td>
<td>2004</td>
<td>28,084</td>
<td>225,000</td>
<td>8.01</td>
</tr>
<tr>
<td>Jiangxi, China</td>
<td>2005</td>
<td>100,010</td>
<td>400,000</td>
<td>4.00</td>
</tr>
</tbody>
</table>

Source: Authors’ calculations based on individual survey reports.

Validity and accuracy

The issue arises in the use of large survey datasets as to how valid the conclusions from the
survey are for the population group covered and whether the findings are accurate. The
survey methodology described here has built-in mechanisms to provide quantitative
information on this. The surveys are large enough to contain sufficient numbers to construct a
life table with the same radix (reference population) as is generated from the most recent
census or intercensus of the country or province surveyed.

The sample populations in the surveys are quite large and are drawn using equal probability
of selection methods (e.g. probability proportional to size, PPS) or are based on census
sampling schemes. In most cases, the survey populations approximate the statistical samples
taken from the national census (usually 2 or 3 per cent of the households in the census).
These statistical samples are what are used to create life tables and other demographic
summary measures from the census.

The life table derived from the survey population can be used for a detailed comparison with
each of the major social, economic and demographic indices as derived from the most recent
census, to measure whether the survey population is representative of the national population.
These measures of representativeness provide evidence for whether the measures are valid for
their stated use. Additionally, it allows direct comparison of the crude mortality functions
over all age intervals between the life table derived from the survey population and the most
recent census life table. The goodness-of-fit for the mortality function expressed in the
population life table with that of the latest census life table provides a measure of overall
goodness.
11  CAPACITY FOR EXTENSION

Once the sample is shown to be nationally representative, the ability to derive a representative life table from it provides a number of potential opportunities for it to be used for further public health purposes by itself or in combination with a national census or intercensus:

- The surveys demonstrate the potential for extending a census or intercensus into five-year serial surveys that provide much more detailed information on the trends of various causes of death in specific age groups. This is somewhat similar to what is done in typical national household health surveys, but with larger populations and thus better estimates in each stage of childhood and directly linked to other social, epidemiologic and demographic analyses from the census.

- Once the crude mortality function from the survey is shown to closely approximate the crude mortality function in the latest census, the cause-specific mortality functions from the survey can be applied to a statistical sample of the national census population. This provides cause-specific mortality estimates from the census and, with it, all the epidemiologic information on ages and causes of death. This may provide a more useful technique of proportional mortality estimation that covers all of the population, as well as all ages, overcoming major limitations of the current proportional mortality estimation process.

- Using multiple decrement methods provides an opportunity for other analyses of particular interest for child health, such as deriving the childhood risk of a particular cause of death and comparing it with other age- and cause-specific risks. An example of this would be deriving the risk of drowning over the length of childhood as well as the rest of life and comparing it to other causes. This is illustrated in figure 2.

Figure 2  Cause-specific survival functions by multiple decrement life table (MDLT) group

The figure is a multiple decrement life table derivation (MDLT) of the life table constructed using the survey dataset from the Jiangxi Injury Survey. This statistical technique uses proportional hazards models to construct a survival function for each cause of death. The survival functions depict the proportion surviving at each year of life by cause of death.

It is seen that drowning is uniquely concentrated in early, middle and late childhood and young adulthood. In this perspective, prevention of a single drowning death would provide a larger number of years of life gained than from targeting interventions on other causes of injury.

Analyses using a combination of demographic and epidemiologic techniques have great potential in providing policymakers with information on the most efficient approaches to child health programming.

12 METHODOLOGICAL LESSONS FROM THE SURVEYS

Six large surveys in five countries with a combined sample size of over half a million households and nearly 2.5 million respondents provide an extraordinary opportunity for learning. Much of the experience has resulted in refinements to the surveys themselves, but lessons were also learned that are pertinent to other community-based injury research. Some indicate the potential reasons why the current body of evidence regarding child injury has not been as informative as had been expected. In particular, a number of key issues stand out as having particular relevance to existing research on child injury in LMICs. These can be summed up in five assertions:

1. Count all children, not just a particular group.
2. Count all causes, not just particular ones.
3. Count all outcomes, not just fatal ones.
4. Count the events where they occur, in the community, not where some seek care, in facilities.

And – when counting is done in this fashion, it becomes clear that

5. The pattern of childhood injury in LMICs has fundamental differences in comparison to its pattern in rich countries.

These are illustrated below with figures from the surveys and discussion of relevant technical points.

COUNT ALL CHILDREN, NOT JUST A PARTICULAR GROUP

Measures of child deaths and serious morbidity need to include all children in the measure. The net effect of limiting mortality estimates to only the first five years of childhood is to
exclude a large number of child deaths and these deaths are predominantly injury. The deaths in the older child age groups – those from age five through 17 – account for about half of all childhood injury deaths, as seen in figure 3.

**Figure 3  Proportional mortality in childhood by age group and cause, Bangladesh**

A corollary is that when measuring all ages, it is necessary to use a standard grouping of the age groups to enable comparison. All UN Member States have agreed to a standard definition of childhood in the Convention on the Rights of the Child. It defines it as 0–17 years. Using different ages for childhood (0–14 or 0–19), as in most global-level estimates, makes comparisons difficult, as well as raising serious technical issues about correct denominators. The total number of children defined by ages 0–14 or 0–19 is different from that grouped by 0–17 because the denominators are not the same. Additionally, since the proportions of causes of death differ in the two groups, using different age groups introduces different epidemiologic patterns, as seen below.

**Changing the ages changes the epidemiology**

Using 0–14 underestimates intentional injury and RTA, and 0–19 overestimates both, in comparison to 0–17. Both of these injury types have rapidly changing age distributions between 14 and 19 years. Interpolation from present datasets with 14 or 19 as the endpoint is not a solution. As seen in figures 4 and 5 below, depending on the relative distribution of types of injury, the rates can increase or decrease. This renders interpolation unworkable.

Figure 4 shows the age-specific rates of fatal injury in Viet Nam and Thailand calculated for two different age groups: 0–14 years and 0–17 years. The rates differ, and in differing directions depending on the relative proportion of drowning and RTA.
The same effect is seen in figure 5 comparing morbidity in the age groups in Viet Nam and China. The relative proportions of falls and animal bites, the two leading causes of injury morbidity determine the direction of change when three additional years are added to the 0–14 age group.

**Figure 5: Causes of non-fatal child morbidity, by age group, Viet Nam and Jianxi, China**

*Source: Authors' calculations from Viet Nam (2000) and Jiangxi, China (2005) datasets.*
**COUNT ALL CAUSES, NOT JUST SELECTED ONES**

When proportional childhood mortality is analyzed by age group and the three broad categories of injury, communicable diseases (CD) and non-communicable diseases (NCD), it becomes clear that injury claims an increasing proportion as age increases.

**There is no intervention called ‘other’**

Measurements of child deaths and serious morbidity need to include all causes of death. Excluding injury or lumping it within ‘other’ results in an incomplete picture of causality, often seriously distorted from the true picture. Unless linked to an identified cause, an intervention cannot be delivered.

Measurements of child deaths and serious morbidity need to be based on sufficiently large samples to provide adequate numbers of events within each of the age groups of childhood. The patterns of mortality and serious morbidity change for each age group, and without this fine-grained information, it is not possible to design effective interventions since these depend on changing the risk environment characteristic of each stage of childhood.

As seen in figure 6, suffocation, drowning, falls and burns characterize infancy. The toddler years (1–4 years) are almost entirely characterized by drowning. As school-aged children roam the community, RTA becomes a leading cause of fatal injury, and as children progress through adolescence, intentional injury (suicide and homicide) becomes a leading cause of injury deaths.

**Figure 6: Causes of fatal child injury, by age group, Bangladesh**

![Figure 6: Causes of fatal child injury, by age group, Bangladesh](image)

*Source: Authors’ calculations based on Bangladesh Health and Injury Survey (2003).*
To be effective, interventions for these different causes would need to focus on different changes to behaviours and environments. For example, drowning and suffocation interventions in infants and very young children are most effective when mediated through caregivers; but for older, school-aged children, interventions must be targeted at the children themselves. However, unless the survey is able to clearly discriminate the different rates of drowning and suffocation in the different age groups, the key information is lost.

**A corollary to the maxim of counting all causes is that sample sizes need to have sufficient power to find injury deaths at the different stages of childhood**

If sample size is not sufficient, estimates are incomplete and potentially misleading. Lacking sufficient power leads to two different and important potentials for distortion. The first relates to the fact that the end-users of the data are policymakers who are generalists and do not have a technical background in epidemiology or statistics. The absence of deaths from a particular cause in the survey data leads the users of the data to wrongly conclude that a particular cause of death is not present. This results in both a failure to take action and the erroneous impression that the cause is not an issue of concern.

The second potential for distortion occurs if the power calculation for the minimal sample size uses the overall child age group. This eliminates the ability to find key differences within the individual age groups that constitute childhood. The result is to obscure causes that are significant to a particular developmental stage, such as suffocation in infancy and suicide in adolescence. This is clearly shown in figure 6 above. It has large consequences since the causes of child injury are very different across the major stages of childhood.

**COUNT ALL OUTCOMES, NOT ONLY FATALITIES**

Measuring child deaths is necessary but not sufficient. Mortality tells only part of the story, often the part with the lowest social and economic costs. The picture is incomplete without measuring morbidity, especially that causing permanent disability and lengthy hospitalization.

As one concrete example, the cost and social burden module of the Jiangxi survey showed that the majority of economic costs and the lifelong social burden accompany the more severe, non-fatal injuries. The cost of injury in Jiangxi was 4.3 per cent of provincial GDP.

While infectious and non-communicable diseases also generate disability and large costs (as with HIV/AIDS and diabetes), injury has a unique impact for children because it is at far higher rates among all child age groups.

Figure 7 shows the ratios of non-fatal injury of all types by severity level compared to one death. It is clear that the total burden of injury is much more than that incurred by fatal injury alone.
Injury outcome is a continuous variable. Fatal injury is only the most severe outcome among the various other levels which begin at the least severe measured in the surveys (missing school), through hospitalization, to permanent disability and, finally, to death. When different levels of severity are categorized, as in figure 8, it becomes evident that non-fatal injury causes greater social and economic burden than fatal injury.

When presented as different categories of severity from least severe to fatal, the predominance of non-fatal outcomes is visually striking. When seen in this light, policymakers can understand that just making mortality estimates looks at only a part of the overall picture. It also limits examination of other linked factors such as economic costs, social burden and the overall priority for interventions.
Figure 8: Severity of childhood injury by cause (all countries except Philippines)

Source: Authors’ calculations based on all surveys except Philippines (2000–2005); composite is population weighted.

COUNT THE EVENTS WHERE THEY OCCUR, IN THE COMMUNITY, NOT JUST WHERE SOME SEEK CARE, IN FACILITIES

Measuring child deaths and serious morbidity in developing countries is most complete when measurements are made where the deaths and morbidity events occur – in the home and community.

Developing countries are characterized by unequal social stratifications that place large portions of the population below the poverty line. This results in major barriers for access to health facilities. Most commonly three-quarters or more of the populations are rural, with poor access to health facilities because of the lack of infrastructure in rural areas. Finally, very often, if not most often, health-seeking behaviours in these countries involve non-formal health care providers, such as traditional healers, who fall outside the standard health statistics and reporting systems. Because the users of hospitals and health facilities are not representative of the entire population, relying on data from these facilities yields a distorted picture of morbidity and mortality, compared to that emerging from measurements made at the community level.
What people believe regarding injury determines where they seek care

The formative research in each country clearly showed that people usually defined injury as having occurred when there was blood or an open wound (trauma). Atraumatic injury (drowning, poisoning, etc) was usually not considered ‘injury’. This different belief or categorization system has a great impact on where care is sought. Figure 9 clearly illustrates this from Bangladesh.

**Figure 9:** Place of treatment by type and frequency of fatal injury and length of survival, children 0–17, Bangladesh

![Bar chart showing place of treatment by type and frequency of fatal injury and length of survival.](image)

*Source: Authors' calculations based on Bangladesh Health and Injury Survey data (2003).*

Most traumatic injury (e.g. road traffic accident) was seen at a clinic or hospital if the person survived to reach the facility. In contrast, almost half of atraumatic injuries (e.g. drowning) was not seen at a facility, even when surviving to arrival is factored in. Traditional and informal doctors see a large proportion of injury, mostly atraumatic, and are not part of the health information systems. These injuries are lost to the information system.

**You can’t count it unless people understand what 'it' is**

The questions asked in order to count deaths and non-fatal events has an important effect on what the answer is, since injury means different things to different people. There are different cultural viewpoints that determine what constitutes injury, as well as health-seeking behaviours when it occurs.

The pilot studies carried out in each country for questionnaire development showed very large differences in the responses to questions about injury depending on how they were asked. Asking whether an accident or injury had occurred, even using different local names and terms, resulted in relatively low response rates. Giving the respondent a complete definition of what constituted injury, with a concrete example of each type of injury (suffocation, drowning, fall, poison, etc.), resulted in higher recall rates, often two or more times higher. Using a flash card with an artist's drawing of an event happening (child drowning, falling down stairs, hit crossing a road, etc.) further increased recall rates.
There were wide cultural differences apparent in the different countries as to what constitutes injury in the average respondent's mind. The standard classification system of intentional and unintentional, with various types defined as resulting from energy transfer, lack of oxygen, etc., was found to be extremely confusing in most of the formative pilot research. The most reliable manner of asking was to start by defining what was being asked using the native languages and including local idioms or slang, while covering every category of injury, and showing a pictorial example of each while it was being explained. Finally, at every subsequent question regarding whether a particular injury had occurred, the question was asked using the flash card with repetition. The experience of piloting the questionnaires in the six different surveys was a very clear validation of the old saying, “what answer you get depends on how you ask the question.”

Recognize that laypeople – not health care providers – principally determine health-seeking behaviour following occurrence of an injury

It is the sum of people's knowledge, customs and beliefs that result in where they seek care for an injury and this is the predominant factor influencing the types of injury that are seen at various institutions – some of which report the event to the health system, and some of which do not. The Bangladesh survey serves as a clear example: The quantitative module in the survey examined knowledge, attitudes and beliefs of caregivers. The survey showed that what mainly determined whether a child was taken to a hospital after injury was the presence of bleeding or other open wound. The care-seeking behaviour of medically unsophisticated caretakers preferentially channels traumatic injury to facilities that report as part of the health information system (clinics and hospitals). Non-traumatic injury is channelled to providers that do not (traditional healers, etc.). These tend to be associated with rural residence (usually 75–80 per cent of national populations) and, combined with the other issues seen with rural locations (access issues, higher rates of injury, etc.), this operates to increase the bias for hospitals to see traumatic injury more than atraumatic injury. This is seen in figure 9 above, where almost half of fatal drownings were seen by traditional healers and informal doctors – with the result that these fatal drownings were unreported in the health system. The traditional healers and informal doctors mainly saw atraumatic injury, with none of those affected by trauma from RTA seeking their care.

Recognize that to be counted at a facility requires surviving to reach the facility

Survival bias is clearly an issue with facility-based systems. Injury that kills quickly is often not seen at facilities, and if not seen, cannot be reported.

Drowning is fatal within minutes of submersion. There is no time for seeking care while the victim is still alive, and there are economic and cultural disincentives to taking a dead child to a hospital. Thus drowned children are rarely brought to a clinic or hospital. Accordingly, drownings are greatly under-represented by facility-based surveillance. Similarly, when traumatic injury such as RTA is immediately fatal, the same disincentives are present, but the survivable trauma then becomes preferentially represented in information systems that have case-finding based on facility data.
The surveys are designed to allow a comparison of the community events with presentation of cases to hospitals and clinics to precisely define many of the biases. In the case of the Thai survey, the sampling plan deliberately directly overlaid community samples with catchment areas from hospitals participating in the national injury sentinel surveillance system. This was done to allow measurements of incidence rates when measured in the community as compared to incidence as measured in the sentinel hospital where the injury was treated or reported. The data shown in figures 10 and 11 illustrate a variety of facility biases (severity, trauma, survival, access, etc.) using the Thai survey dataset.

**Figure 10: Child drowning, severity and report, Thailand**

![Bar chart showing child drowning severity and report in Thailand](chart.png)

Source: Authors’ calculations based on Thailand dataset (2003).

Within the Thai survey (100,179 households, 389,531 respondents, 98,904 children), there were a total of 45 child drownings (27 fatal and 18 non-fatal) recalled over the previous three years. Less than one quarter of the fatal drownings (6 subsequently fatal, 22.2 per cent) were reported to a hospital. Of the immediately fatal drownings, none were reported to a hospital. These represented over two thirds of the total sample (19 of 27; 70.3 per cent). One quarter (2 of 8; 25 per cent) of drownings that were fatal but not immediately so were never reported to a hospital. In addition, less than half (8 of 18; 44.4 per cent) of non-fatal drownings were reported to a hospital.

The lesson repeated here is that when measured at the community level, child drownings occur at much higher rates (in some cases by entire orders of magnitude) than are reported through information systems centred on health facilities. This is not unexpected given the known limitations of facility-based data. However, the magnitude of the bias is sufficient to make drowning, the leading cause of child death after infancy, almost invisible within the formal health information reporting systems.

Furthermore, one aspect of a sentinel hospital reporting system is the goal of looking beyond the hospital itself in order to gain a better understanding of the epidemiology of specific causes within the community. The system does not appear to overcome this surveillance
disconnection and raises some fundamental issues regarding whether injury surveillance can be done through systems such as these, at least in the countries where the surveys were done.

**Figure 11: Child RTA, severity and report, children 0–17, Thailand**

![Bar chart showing road traffic injuries severity and report](image)

*Source: Authors’ calculation from Thailand dataset (2003).*

The RTA data reflect the same survival bias evident in drowning. To be seen at the hospital requires survival of the initial crash and survival long enough to be admitted to the hospital. Victims of immediately fatal crashes were rarely seen at hospital, and neither were those injured so severely that they expired prior to admission (‘dead on arrival’, or DOA). The most serious (immediately fatal) injuries were reported to hospitals less than 5 per cent of the time (7 of 147, 4.8 per cent). Very serious injuries that were subsequently fatal were reported to a hospital at the highest rate, about three quarters of the time (201 of 268, 75 per cent). Less serious injuries that did not produce a fatality were reported to a hospital just less than three fifths of the time (1,419 of 2,430, 58.4 per cent). The data demonstrate that injury surveillance for road traffic injury which relies on hospital reporting underestimates fatal RTA, and the data that are reported are biased towards serious injuries that are not immediately fatal.

However, immediate deaths from RTA are not lost because they are routinely reported by the traffic police and the Ministry of Transport. This is not the case with drowning deaths, since they are not captured by other systems reporting centrally and are completely lost. This results in the loss of visibility of drowning in the Ministry of Health information systems and a distortion of the pattern of child injury causality.

Virtually all relevant global, regional and national level databases appear to show fatal RTA predominating as the leading cause of fatal child injury. This may be a result of the issues demonstrated in the survey data. The proportional mortality for drowning versus RTA in every survey showed drowning predominating. The aggregate of the surveys is shown in Figure 12. The age pattern noted was seen in each individual survey.
Figure 12: Proportion of child deaths attributable to road traffic accidents and drowning

Source: Authors' calculations based on all surveys (2000–2005); composite is population weighted.

This pattern was independent of level of development or motorization. It was also independent of location, whether urban or rural. Whether measured separately in the megacity survey components of the surveys or in the standard urban/rural national or provincial strata of the surveys, drowning was the leading cause of child death after infancy.

In addition to a survival bias, facility-based injury data have a trauma bias. Trauma requires surgery, and people know that such care is usually only available at hospitals. Atraumatic injury such as drowning, suffocation and poisoning is often left untreated, since without blood or other signs of trauma, people do not recognize the need to take the victim to a hospital. This was previously shown in the Bangladesh data (figure 9 above) and can be seen as well in the Thailand data set. Combining the Thai RTA and drowning data (one-year recall) shows this clearly in figure 13.

For atraumatic fatal injury (the 27 fatal drownings), less than one quarter (6, 22.2 per cent) were seen at a hospital. For traumatic fatal injury (the 78 fatal RTA events), the proportion seen at hospital was over a third (29, 37.2 per cent).
Figure 13: Child drowning and RTA events in first year of recall, children 0–17, Thailand

The cumulative effect of each of the biases (survival and trauma) is that facility reporting significantly misrepresents two leading causes of fatal child injury, drowning and RTA. Since drowning is atraumatic, more frequently immediately fatal, and is less often survived per potentially fatal exposure, it is seen less frequently than RTA in hospitals and other health facilities. Many of the global-level reporting systems such as the WHO Global Burden of Disease database mirror at a macro level what appears to be an artefact of the biases inherent in reporting mechanisms. The primary source of data for these databases is from the compiled national reports of members of the WHO World Health Assembly, and these primarily reflect facility reports. Additional evidence can be seen in the recent WHO publication on child injury in LMICs, which uses the Global Burden of Disease Database, and reports that RTA deaths are the leading cause of fatal child injury, attributing 182,833 deaths in children under 15 to RTA and 144,926 deaths to drowning.13

To avoid misinterpretation, measurements need to use standard recall periods, standard definitions of cause and standard age groupings

The recall period chosen in a community-based survey greatly affects the injury rates found. It is almost impossible to achieve valid comparison of injury rates from different surveys unless identical recall periods have been used.

Source: Authors’ calculations based on Thailand National Injury Survey (2003).

A technical goal of the surveys was to examine the relationship between severity and recollection of events, in order to better understand biases introduced by varying periods of recall for fatal versus non-fatal injury, and in particular, for the least serious levels of non-fatal injury. The method for recalling injury morbidities in the surveys uses a special recall calendar that has identifying events for the household in the year prior to the survey (holidays, natural disasters, cultural events, household members' birthdays, etc.). These are used as time period prompts by the interviewers and the respondents are asked about the occurrence of injuries that qualify over the course of the year. The questions start with the previous month, and then ask about the two months prior to that, then the three months prior to that, etc. In this manner, the one-year recall period is asked about in months and quarters. This allows an examination of the effect of the severity of injuries recalled on the length of recall. The method was validated in the Beijing survey where it was possible to check official records of injury events by level of severity and compare them to those recalled at the household level.

Figure 14: Non-fatal injury in children 1–17, by two methods of recall, Beijing China

![Graph showing non-fatal injury in children by severity level and recall method.](image)

Source: Authors' calculation from Beijing survey data (2004).

Figure 14 shows rates of non-fatal injury recalled in children (1–17 years) by level of severity, from the Beijing survey. The figure shows the severity-specific non-fatal injury rates graphed by two different methods of recall. The first, monthly method (‘1 month annualized’) refers to the number of injuries at each level of severity that occurred in the month prior to the survey; it is annualized by multiplying by 12, and expressed as an annual rate. The second, quarterly (‘1 year by quarters’) refers to the total number of injuries at each level of severity that occurred within each three months in the previous one year. They sum to provide the total number by severity level in one year. The figure shows that a one-month recall period resulted in non-fatal injury rates about one-half as large as those yielded by longer recall periods; the underestimate was greatest at the level of permanent disability (severe).
A one-month recall period, common in surveys, underestimates injury at most levels of severity. This happens for two main reasons. First, a one-month recall period doesn’t allow for the occurrence of multiple episodes of moderate severity over the course of a year, common with active children. (This is analogous to infectious disease surveys where children have several respiratory and diarrhoeal disease episodes per year.) Since the most frequent injuries are those of low severity, these make up the majority of all injury, and when under-reported on a one-month basis, this results in a substantial underestimate of non-fatal injury as a whole.

The second reason of the degree of underestimation is related to the increasing severity level. The more severe injuries occur much less frequently, and even in this large population of children in the Beijing survey (13,508 children) severe injuries (defined as causing permanent disability) occur rarely. If a severe injury did not occur once in the first month, the annualized severe injury rate measured using the short recall period is zero. However, when measured using a 12-month recall period the rate is 23/100,000. This recall brevity bias has significant implications for rates available through most of the community-acquired datasets which include non-fatal injury. It appears to be operative regardless of whether the non-fatal injuries are classified by some level of severity, or simply counted as all non-fatal injury. The recall brevity bias shown here mainly applies to community surveys, with retrospective case finding done from a single point in time.

Many injury morbidity surveys use one-month recall or at most, three months. The largest standardized surveys in the region, the Demographic and Health Surveys (DHS) have used a one-month morbidity recall. Additionally, DHS survey instruments do not use pictographic methods for injury recall. It is very likely that DHS surveys that include injury morbidity underestimate injury and particularly, the more severe classifications.

**WHEN CHILDHOOD INJURY IS COUNTED IN THIS MANNER IT BECOMES CLEAR THAT ITS PATTERN IS FUNDAMENTALLY DISTINCT IN THE COUNTRIES SURVEYED, AS COMPARED TO RICH COUNTRIES**

**How injury is categorized has implications in these countries**

Another categorization issue that makes it difficult for comparison between the surveys and other datasets relates to the functional categorization of injury in the surveys as compared to other methods used (e.g., International Classification of Disease (ICD) 9 or 10 in WHO datasets). A good example of this is animal injury (injury caused by an animal), which is rarely identified as a major cause of morbidity or mortality in most datasets describing child injury in LMICs. However, in each survey, animal injury was one of the leading causes of morbidity, and a significant cause of mortality.

The surveys used a functional classification scheme, which is most suitable for intervention development. Child injury related to animals was classified in this fashion (e.g. animal injury: bite: cat, dog, snake, etc.; and animal injury: envenomations: snake, bee/wasp, scorpion, etc.).
Most fatal animal injury was due to rabies (an infectious sequel of a bite, usually from a dog) and snake bites (a toxic envenomation). While these can be classified using ICD 9 or 10, the coding skills necessary are usually not found in these countries outside specific research institutions, and these are few in number. Most hospitals and clinics lack the ability to code these diagnoses other than as 'rabies' or 'snake bite', a functional classification in itself. However, when they are reported to higher levels, these often drop out, as they are not translated into the ICD codes of the national reports. It is unusual for large, national-scale datasets on injury to be reported using functional classifications. As a result, animal injury, as a single category, does not appear. This has the effect of obscuring one of the leading causes of child injury in the countries surveyed. When classified functionally and reported in the same way as we do in the surveys, they can be seen to be the third leading cause of morbidity and fifth leading cause of mortality in children in the countries surveyed.

The ICD scheme works well for wealthy countries, where the intervention infrastructure is already in place and a detailed ICD scheme allows for precise monitoring. It is less useful for LMICs where the interventions haven’t yet been implemented. Exposure to animals is very different for children in LMICs compared to rich countries. Pets and insects are overwhelmingly the leading animal exposure in most rich countries. However, most LMICs are predominantly rural, and children are tasked with grooming, feeding and caring for most farm and work animals in these countries. Dogs are frequently a part of this, either as working animals (herding, guarding, etc.) or as strays. In either case, they are usually not immunized for rabies. Exposure to snakes is similarly great due to the rural nature of most of the countries. Exposure increases with frequent flooding, an annual cyclical issue in large areas of most of these countries.

**Child injury patterns show real differences between LMICs and rich countries**

A global map of the distribution of rabies provides a visual demonstration of the boundaries between the rich countries and the rest of the world. Were the uncounted drownings or poisonings to be included, it would only reinforce this picture. That picture exists because rich countries have almost completely removed many of the injury risks from children’s environments. Whether through vaccination of dogs, child-resistant packaging of toxic drugs and substances, or limiting water exposure to recreational settings, they have fundamentally changed their risk environments for children – of all social strata, not only the rich or urban. Primary prevention of injury is a luxury afforded by the wealth and regulatory and enforcement infrastructure of these countries operating on educated populations who have safety awareness as part of their cultural norms. This has taken the better part of a century of social and economic development to achieve.

Child injury in countries such as the ones in these surveys occurs at high rates because hazard and risk of injury are ubiquitous in all child environments in these countries. Simply adopting some of the proven interventions of rich countries and trying to localize them may not work without a fundamental understanding of the differences in risk environments between the two. Many primary prevention strategies may not be feasible in these cultural settings at current levels of development and much will depend on secondary prevention. Surveys such as these clearly delineate the risk environments and point out which injuries have the highest
population attributable risk (PAR), who can be most effectively targeted by interventions, and which interventions would tackle the injuries with the largest social and economic burdens.

13 DISCUSSION

This set of surveys is unique among mortality and morbidity surveys in LMICs. It uses very large, representative samples, a common set of definitions, has a common methodology for interviewing and analysis, and looks at mortality and morbidity as it occurs at the household level. The power of the surveys enables fine discrimination of patterns of mortality of all causes at the different stages of childhood and adulthood. They provide information previously unavailable on morbidity from injury, and with standard categories of severity to make comparisons possible between surveys. They also provide comparative information on risk factors for injury, on the association of injury with socio-economic status, and on the economic costs and social burden of injury.

Directly counting all deaths in the community where they occurred and assigning cause to them was previously considered too difficult and/or expensive to do. However, these surveys show that within countries in Asia there now exists sufficient local capacity to carry out direct measurement surveys. This makes it possible to count each child death in all age groups from 0 to 17 years and to classify the cause of each death.

These health and injury surveys have been conducted in five East and South Asian countries: Bangladesh, China, the Philippines, Thailand, and Viet Nam. There is ongoing work in Cambodia and Indonesia which will be communicated in future working papers in this series. Together, these countries provide a cross-section of the Asian region, including various economic and social development stages, differing geographies, and different cultures, political systems, and religions. Applying the standardized survey methodology with a common set of definitions across these countries permits comparison of injury rates. It allows the exploration of commonality of cause and proportional mortality across multiple child and parent age groups.

A number of the findings are of potentially great public health importance:

- Injury is the leading killer of children after infancy in all the locations surveyed. Accordingly, it may be inferred to be a leading cause of child death throughout the entire Asian region and in other regions with similar or better IMR/U5MR indices, including as Latin America, North Africa, the Middle East, Eastern Europe and the former Soviet Union.

- Drowning, previously greatly undercounted, accounts for about half of all child injury deaths in the surveys.

- Injury due to animals has not been widely recognized as a leading cause of child mortality and morbidity, although it was found to be the first or the second leading cause of child morbidity in the surveys, and a significant cause of mortality as well.

- Finally, the surveys show that, at least in the countries surveyed, which are representative of Asia, the pattern of child mortality and morbidity now closely resembles that in developed countries. The epidemiologic transition is far advanced in this region, but the design of child health programmes has not caught up with it.
Other important lessons from the surveys are that the methodological problems they were designed to avoid, such as small sample sizes, lack of power, short recall periods and facility-based case finding, remain very serious issues which fundamentally distort the picture of child and adult health. A review of the available literature on child injury mortality and morbidity in LMICs shows that a large proportion of studies are affected by the issues just mentioned. In addition, studies dealing with morbidity apply inconsistent definitions of severity. These factors may explain, in part, why the available literature has not provided sufficient evidence to allow injury deaths to be included in most current child death estimates.

The surveys go well beyond epidemiology and include economic and social costs, risk factors and dimensions of behaviour, knowledge and attitudes. The fundamental reason for conducting the surveys was to provide timely, accurate information to stimulate public health interventions against the leading causes of child injury. The surveys also establish a baseline by which these interventions can be assessed. In each country where a survey has been carried out the results have stimulated needed action on child injury interventions. They may thus be identified as effective interventions in and of themselves.
ANNEX: Contributors to the Series

This series of papers grew out of a meeting of the Technical Advisory Group (TAG) for The Alliance for Safe Children (TASC), held in Bangkok, Thailand in August 2005. At the meeting, the group considered the results of the six national and subnational surveys that form the basis of these papers. These were done in Bangladesh, China, Philippines, Thailand and Viet Nam, with an additional sentinel survey on drowning carried out in Indonesia in 2004. This resulted in the formation of the Bangkok Working Group on Child Mortality Estimates (BWG-CME).

During 2005-2007 Dr. Michael Linnan, the Technical Director for TASC, worked with BWG-CME members, the Principal Investigators for the surveys and UNICEF regional and country staff to jointly author the first seven papers in the series. The individual contributors are listed in each paper. Others who contributed to the series as authors, editors or reviewers, including members of the TAG and the Bangkok Working Group, survey Principal Investigators and UNICEF staff, are listed below along with their institutional affiliations.

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