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**CHILD MORTALITY AND INJURY IN ASIA:
POLICY AND PROGRAMME IMPLICATIONS**

**Michael Linnan, Morten Giersing, Huan Linnan, Ross
Cox, Mehr Khan Williams, Christian Voumard and
Rodney Hatfield**

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Correspondence should be addressed to:

UNICEF Innocenti Research Centre
Piazza SS. Annunziata, 12
50122 Florence, Italy
Tel: (+39) 055 20 330
Fax: (+39) 055 2033 220
Email: florence@unicef.org

Policy and Programme Implications

Michael Linnan,^a Morten Giersing,^b Huan Linnan,^c Ross Cox,^a Mehr Khan Williams,^d
Christian Voumard^e and Rodney Hatfield^f

^a The Alliance for Safe Children

^b Former UNICEF Country Representative, Bangladesh and Viet Nam

^c Consultant, UNICEF East Asia and Pacific Region (EAPR)

^d Former Regional Director, UNICEF EAPR

^e Former UNICEF Country Representative, China

^f Former UNICEF Country Representative, Cambodia

Summary: This paper presents a summary of the findings of the national and subnational surveys on child injury in this series and discusses implications of the results for child health policy and programmes.

The principal finding is that injury has been largely unrecognized as a leading cause of child death. This is largely because the previous estimates of child mortality causality were unable to include injury due to technical issues. The surveys provide convincing evidence that injury is a leading cause of child death after infancy and that the types of injury vary with the age group of the child. Similar convincing evidence shows that injury is a leading cause of serious morbidity and permanent disability in children and that the types of injury with these outcomes also vary with the age of the child.

The implications discussed are (1) an effective measure of child mortality needs to be developed to include all ages of childhood; (2) prevention of mortality and serious morbidity from injury in children will require a life-cycle approach; (3) continued progress on child survival programming in children under five years of age will require injury reductions; (4) since drowning is the single injury cause responsible for about half of all injury deaths, targeting it for reduction would be an efficient strategy; and (5) there are efficient strategies for targeting other subtypes of child injury as well.

Keywords: children, demographic change, epidemiological transition, 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, drowning, 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.
2. The correlates of survival and death of children and their parents in the Asian tsunami of December 2004, and the lessons for preparation and response in relation to the annually occurring natural disasters involving water in Asia.
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.

Contents

1 Introduction	1
2 Summary of Results	3
3 Policy and Programme Issues	9
Annex: Contributors to the Series.....	16

1 INTRODUCTION

This paper examines the policy and programme implications of the surveys which have been presented in previous papers in this series.¹ The six surveys of the causes of death and disability of children and their parents, conducted in Viet Nam, Bangladesh, Thailand, the Philippines, and in Jiangxi Province and Beijing, China, were undertaken as a joint collaboration between UNICEF, The Alliance for Safe Children (TASC) and government partners in each country. The surveys have been conducted with a new methodology that takes advantage of the extensive technical capacity now available at the national and local levels in most countries in Asia. This national capacity has been harnessed to perform a standardized survey that counts deaths as they happen and classifies them by cause, including causes of infectious (communicable) diseases, non-communicable diseases, injury, and 'unable to determine'. The surveys also count serious and disabling injury events. The surveys have very large sample sizes on the order of 100,000 households, and are able to examine causes of death in the different age groups of childhood and parenthood.

The surveys have been undertaken to provide information where there was little or none before. Information on causes and numbers of child deaths is readily available in rich countries. Developed countries have both the funds and technical capacity to develop and maintain vital registries and information systems that draw on data from a variety of sectors (health, education, welfare, public safety, etc.). However, these sets of data are not available in countries classified as low-and middle-income countries (LMICs), including those discussed in this series. This paucity of data so vital for health policy and programmes was one of the fundamental reasons which led to the undertaking of these surveys. A second reason was the mismatch between the official estimates of causes of death in children in each country and what had been observed in smaller community studies within the countries. The final reason was a pressing need to respond to the dramatic increase in the need for clinical care for serious injury that has overburdened the clinics and hospitals in most of the countries in Asia.

Official estimates of child deaths are available at the global and regional levels, and the most authoritative estimate is maintained by the Child Health and Epidemiology Research Group (CHERG) of the World Health Organization (WHO). The latest estimates are for 2000–2003, but only include deaths in children under five years of age, do not include serious morbidity or permanent disability, and are limited in the categories of deaths included.² A comparison of the WHO estimates with the surveys in this series (Viet Nam in 2000, Bangladesh in 2003, Thailand in 2003, the Philippines in 2003, Beijing in 2004, and Jiangxi Province, China, in 2005) shows very significant differences. The surveys all found injury to be a leading cause of mortality and disability – among children under five as well as among children over five years of age. The significant differences between the WHO estimates and these estimates are related to three technical factors: different measurement methodologies, changing epidemiological patterns, and a more inclusive definition of childhood.

¹ UNICEF, *Innocenti Working Paper, Special Series on Child Injury*, IWP 2007-04,-05,-06, UNICEF Innocenti Research Centre, Florence, Italy.

² <www.who.int/child-adolescent-health/OVERVIEW/CHILD_HEALTH/map_00_region.jpg>

The measurement methodologies utilized for the present analysis differ from those used most frequently in previous efforts to address child injury. In those estimates, the process begins by making an estimate of the total number of children under five years of age who die annually in the South and East Asian regions. The proportions of the total number of children dying due to each principal cause, as considered by panel of experts, are then determined, and these proportions are applied to the total estimated numbers of under-five deaths.³ This produces estimates of the total numbers of children under five who die from each of the principal causes used by the expert panels. Injury is not among the principal causes currently estimated, but is generally included within an overall category called 'other'.⁴

In contrast, the methodology used in the surveys reported in this series of papers defines a large, representative sample of the country, city or province being surveyed, and uses household interviews to find all deaths, counting them one by one, and assigning a cause to each one. Injury is counted as one category, and broken down into subtypes (drowning, road traffic accidents, falls, burns, poisoning, etc.). When measured in this fashion, overall causes of child mortality in poor countries is shown to include much higher numbers of injury deaths before and after the age of five than has been believed in the past. The approach also provides an important measure of the bias found in hospital- or clinic-based health information systems, which miscount injury deaths because those already dead at the scene are rarely taken to hospital. For example, drowned children are almost never taken to the hospital or the local clinic, but instead are simply buried or cremated.

The second factor, changing epidemiologic patterns, also accounts for some of the large differences between this research and earlier findings. The surveys presented here have all been done after 2000. However, the research on under-five deaths used in the typical child mortality estimations was carried out primarily in the mid and late 1980s. Since then, overall under-five mortality rates in the surveyed countries have fallen by almost 50 per cent.⁵ In rich countries, a similarly rapid decrease in child mortality was accompanied by a change in the pattern of deaths, shifting from predominantly infectious diseases to non-communicable diseases and injury, often referred to as 'the epidemiologic transition'.⁶ This is the pattern that has appeared in the surveys summarized here.

The third reason for the large difference relates to differing definitions of childhood. Previous child mortality estimates have focused on children under five; this was due both to difficulties experienced in estimating causes of death among older children, and to the fact that under-five mortality was seen as the best overall indicator of child health and of the effectiveness of measures to improve it. The surveys reported here measure mortality over childhood in its entirety, from infancy through 17 years of age, as defined by the Convention on the Rights of

³ Mathers, C.D., et al., 'Counting the Dead and What They Died From: An assessment of the global status of cause of death data', *Bulletin of the World Health Organization*, vol. 83, no. 3, March 2005, pp. 171–177.

⁴ Bryce, J., et al. and the WHO Child Health Epidemiology Research Group, 'WHO Estimates of the Causes of Death in Children', *The Lancet*, vol. 365, no. 9465, March 2005, pp. 1147–1152.

⁵ UNICEF, 'Progress since the World Summit for Children: A statistical review', UNICEF, New York, 2001, < http://www.unicef.org/publications/index_6440.html>.

⁶ Gribble, J.N. and S.H. Preston (eds.), *The Epidemiologic Transition: Policy and planning implications for developing countries*, National Academy Press, Washington, D.C., 1993.

the Child.⁷ However, the surveys show that about one-half of all child deaths after infancy occur after the child has graduated from the ‘under-five’ age group. These previously uncounted child deaths are counted in the surveys and the majority of them are caused by injury.

2 SUMMARY OF RESULTS

To frame the discussion on the policy implications, the composite results of the six surveys are presented below. The key points are first summarized and then followed by graphical figures to illustrate these key issues:

- Injury is overshadowed as a cause of mortality and serious morbidity in infants by the extremely high rates of communicable, non-communicable and birth-related causes of death and illness. However, the rates of injury in infants were shown to be among the highest compared to those experienced in the rest of childhood. Suffocation, falls and drowning are significant causes of deaths during infancy and have been shown to be easily preventable.
- Infancy is the only time in childhood when the environment is totally controlled by the caretaker, rather than the child. This fact has been an advantage for other child health interventions and needs to be a key consideration in injury prevention for children.
- After infancy, injury is a leading cause of death in all child age groups and increases in proportion as the age of the child increases.
- Drowning, unrecognized as a major cause of child death in the previous estimates, accounts for about half of all child injury deaths in each country surveyed. It is particularly significant in children aged one to four, where it makes up over eighty percent of injury deaths.
- Injury both increases in prominence and changes in type with age group: suffocation, drowning, and falls predominate in infancy; drowning predominates in early and middle childhood; and road traffic accidents and suicide predominate in adolescence.
- Fatal injury is important, but there is a larger burden of non-fatal injuries that cause lengthy hospitalization and permanent disability. Injury is a leading cause of permanent disability. The numbers of permanently disabled children are larger than those fatally injured. Permanent disability imposes a lifelong burden on the child and the family, as well as on the society.
- Falls, traffic accidents, cuts and burns are leading causes of non-fatal injury in children in the surveys, similar to the pattern in rich countries.

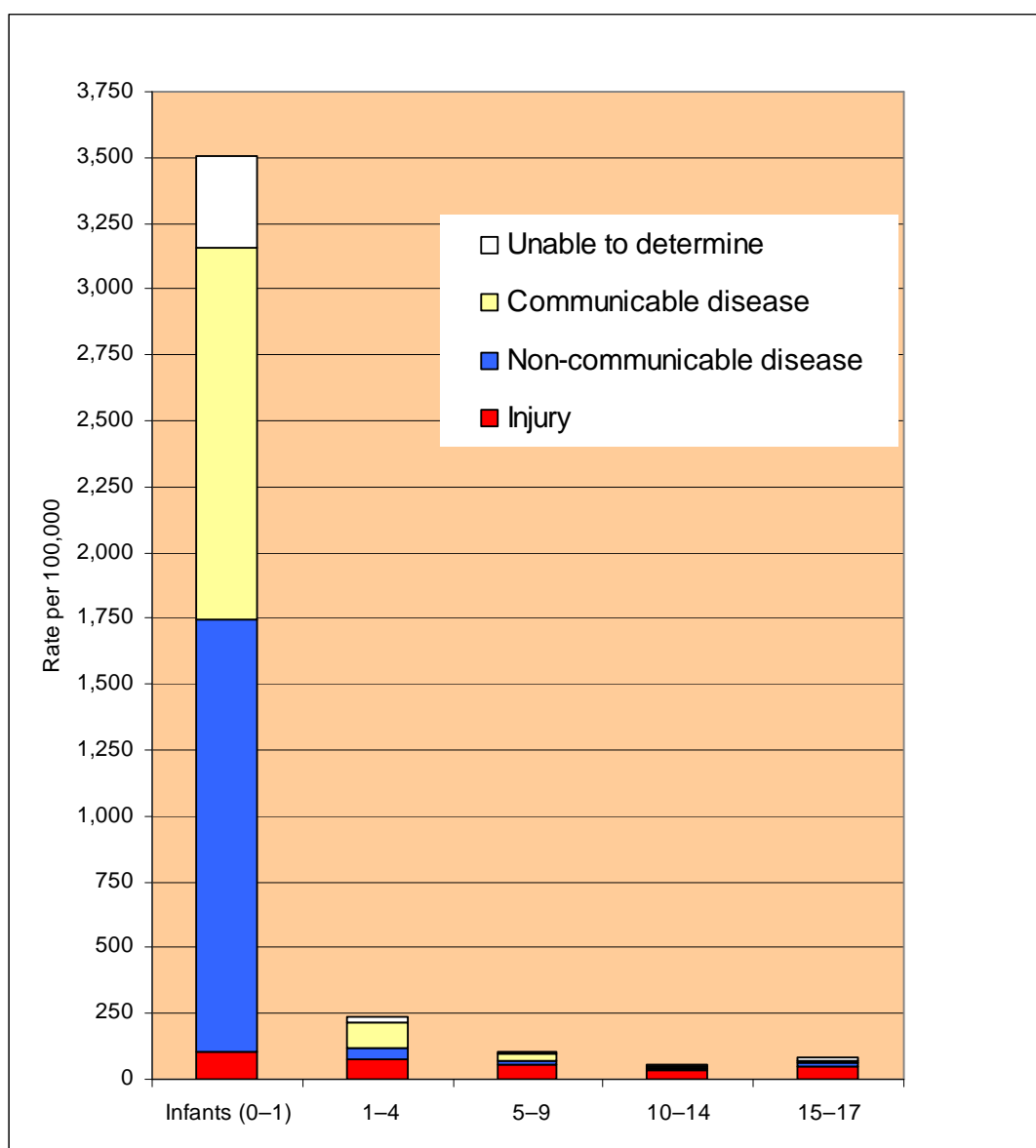
⁷ The United Nations General Assembly adopted the Convention into international law on 20 November 1989; it came into force on 2 September 1990. The Convention defines a child as any person under the age of 18.

- Injury caused by animals is a major unrecognized cause of death and serious morbidity in children. It was one of the three leading causes of morbidity in every country surveyed. As the fifth leading cause of child death in all the surveys, it was a significant cause of mortality in children, unrecognized in previous child mortality estimates.

Fatal injury of course occurs not only among children. The surveys also captured the significant number of parents who died from injury, leaving behind one or more children with only one or no parents to support them. The vulnerability of orphans, which has been brought to global attention in the context of HIV/AIDS, is also an important dimension of the injury pandemic. This area of findings will be addressed more fully in later analysis.

The most important findings of the surveys are summarized in the following figures.

Figure 1: Proportional mortality by age

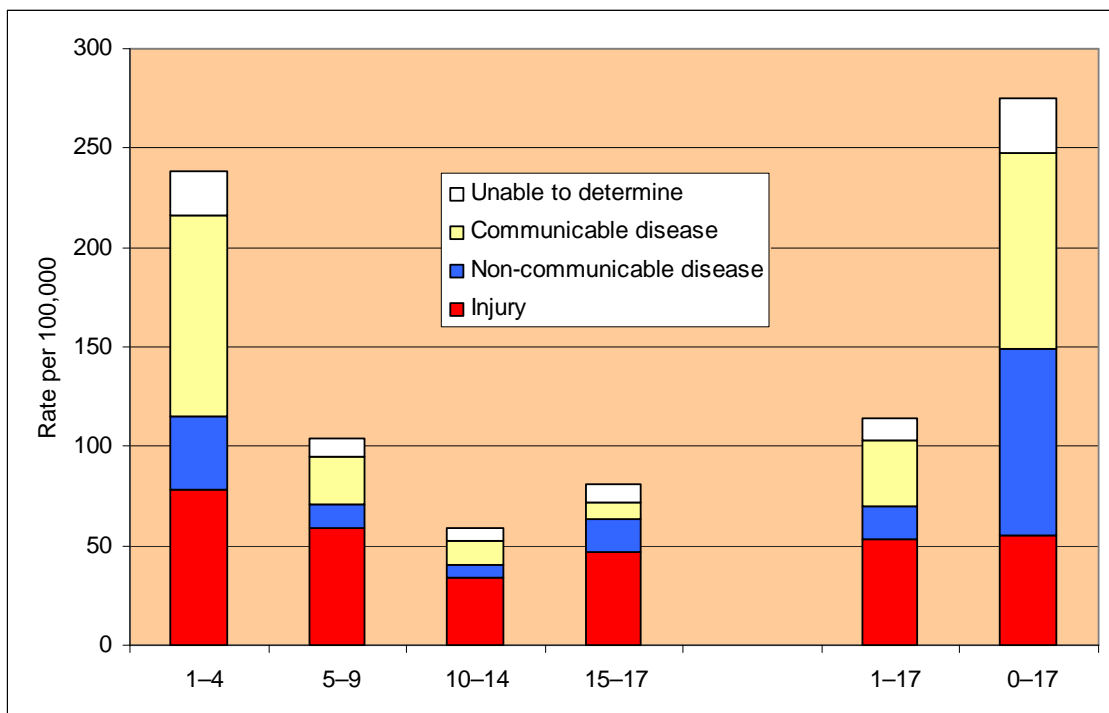


Source: Authors' calculations from individual surveys (2000-2005); composite is population-weighted.

The dramatic mortality rates in infancy in comparison to the rest of childhood are evident in figure 1. While overshadowed by communicable and non-communicable diseases, fatal injury in infancy is actually at or near its peak rate during the full span of childhood. After infancy, mortality rates from causes other than injury decline radically while injury remains relatively constant. Proportionally, it becomes a much larger share; for example, it accounts for about 37 per cent of all deaths in the 1–4 age group.

This epidemiologic shift occurs for two reasons. One is that about two thirds of all infant deaths occur in the first month of life, the neonatal period. This is the highest mortality period in life, with most earliest deaths due to problems of pregnancy or the birth process. Once beyond this pregnancy and birth-related period, mortality falls dramatically. The second reason is the changing environment of the child. Born helpless and unable even to lift its head, infants are totally dependent on the mother and are carried everywhere, thus protected from danger. There is little exposure to hazard, other than accidental falls, burns, or suffocation during sleep. At age one, when the child begins to walk, the situation changes dramatically. The child explores the world on very unstable legs, does not understand danger, and often escapes from the close supervision of a busy mother. This combination makes injury (particularly drowning) a leading cause of death in the 1–4 age group.

Figure 2: Proportional mortality by age

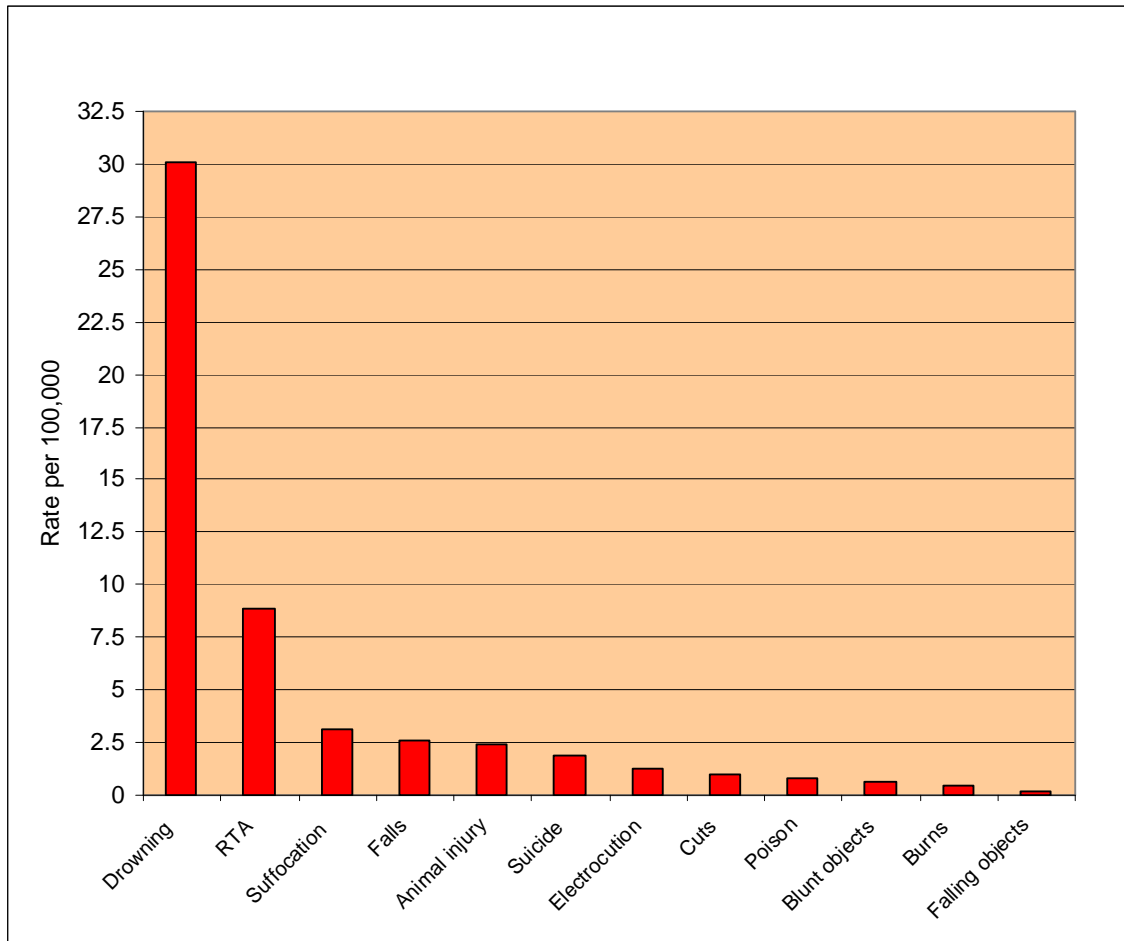


Source: Authors' calculations from individual surveys (2000-2005); composite is population-weighted.

Figure 2 excludes a bar dedicated to infancy to better show the pattern of proportional mortality in the rest of childhood. Seen on this scale, injury is a leading killer for all post-infancy child age groups. Injury accounts for about half of all child deaths after infancy (1–17) and for about a fifth of all mortality when infants are included (0–17). Injury kills an increasing proportion of children as they grow in age. Overall mortality declines and then

rises again in the late adolescent age group (15–17) due to large increases in intentional injury (suicide and homicide) as well as road traffic accidents.⁸

Figure 3: Fatal injury rates in children 0–17 years, by cause

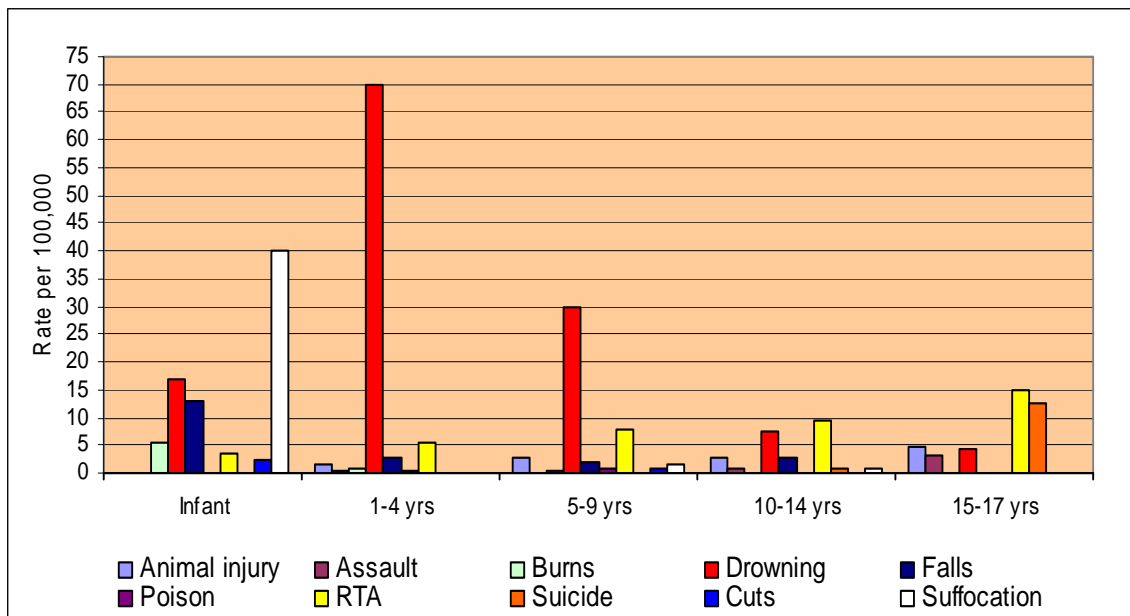


Source: Authors' calculations from individual surveys (2000-2005); composite is population-weighted.

Drowning was by far the leading injury cause of death in childhood (see figure 3), accounting for over three times as many deaths as road traffic accidents (RTA), the second leading cause. Drowning was highest in early and middle childhood, and traffic accidents were highest in adolescence. Suffocation primarily occurred in infants, and falls were common in all age groups. Fatal animal injury was caused by the bites of rabid dogs or poisonous snakes, usually in younger children. Suicides were found mainly during adolescence.

⁸ '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.

Figure 4: Fatal injury rates in children, by age group and cause



Source: Authors' calculations from individual surveys (2000-2005); composite is population-weighted.

Figure 4 shows that different patterns of injury occur in different childhood age groups:

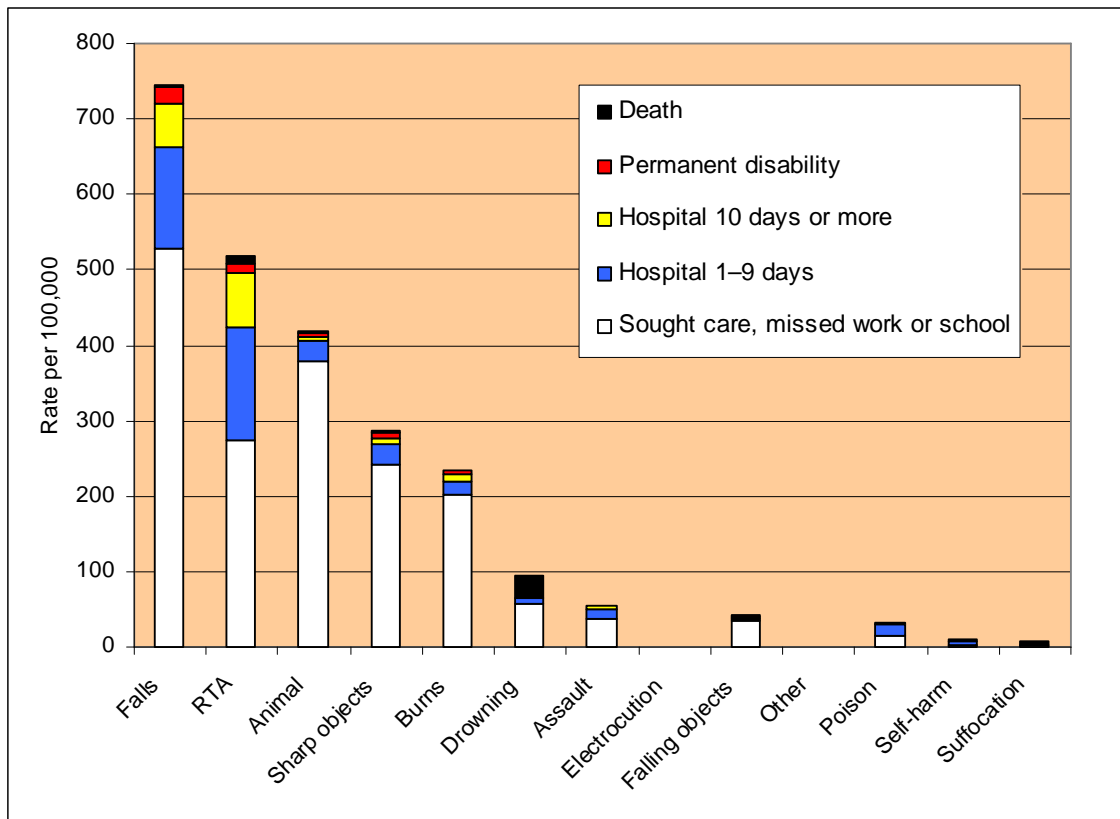
- In infancy, suffocation, drowning, falls and burns are the leading causes of injury death. For prevention, all efforts will have to focus directly on parents and caregivers, as they are the ones who determine the risks and hazards the infant faces.
- For toddlers in the 1–4 year age group, drowning is the overwhelming cause of injury death, responsible for over 90 per cent of all injury deaths. For prevention, the main strategies are supervision and decreasing exposure to hazard (e.g. fencing a pond, covering a well). Toddlers stay close to the home, and the water hazards near the home are fixed in location and can be individually identified and rendered less hazardous. Falls are the second leading cause and RTA is the third. Supervision and decreasing exposure to hazards is also the primary prevention strategy for these two causes but, with much of the exposure on a mobile and changing basis, it is much more difficult to control or lower risks from falls or RTA than from drowning.
- For children in the primary school years, drowning remains the leading cause, responsible for over half of all injury deaths. Since these children are mainly with peers rather than adults, and are far from home, swimming ability is the major factor in prevention of drownings. RTA is the second leading cause, with almost all of these deaths among pedestrians and bicyclists. This exposure is incurred at least twice a day (on the journey to and from school), and as the nature of the hazard changes with high traffic densities near schools, prevention needs to focus on these somewhat predictable factors.
- For children in the secondary school years, RTA becomes a leading cause of injury death after drowning. Drowning declines and intentional injury (suicide and homicide) begins to rise, mainly during and after the post-pubertal ages of 12–14 years. Most of this period of childhood precedes puberty, with its attendant changes in children's physical and emotional context. Injury rates are lowest in this age group, a time when children's mental

development allows them to understand the risks, but they are not yet under the influence of pubertal factors that lead to increased interpersonal violence and risk-taking.

- In late adolescence, RTA is the single leading cause of injury death, followed by suicide. Intentional injury, taking suicide and homicide together, is the leading killer of children aged 15–17. Adolescence is classically described as a time of turbulence and risk-taking and the upturn in injury rates in this age group is consistent with that. Efforts for injury prevention will have to deal with these primary factors in order to be effective.

Figure 5 shows how the causes of non-fatal injury differ from those of fatal injury. Fatal injury is the most severe outcome on a spectrum of severity. The comparison shows that non-fatal injury actually causes a larger health burden. This key public health concept is lost in relying on child mortality estimates alone. Note that minor injury (injury not resulting in seeking care, or missing work or school) was not counted in the surveys and so is not seen on the graph.

Figure 5: Fatal and non-fatal injury rates by severity for age group 0–17

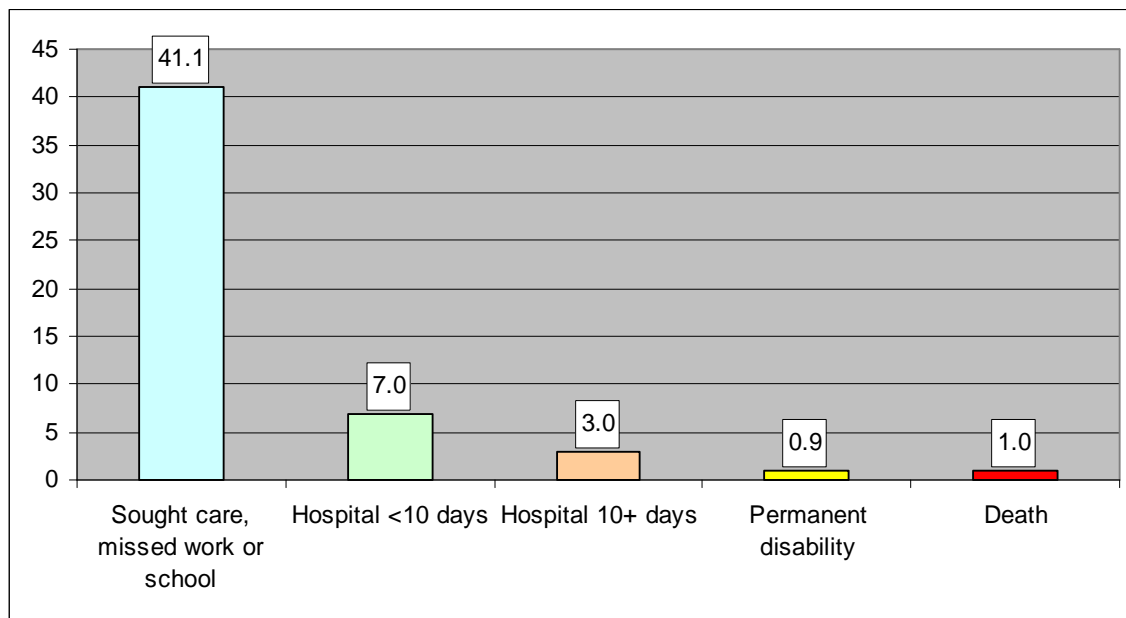


Source: Authors' calculations from individual surveys (2000-2005); composite is population-weighted.

Figure 5 also shows the extremely high case fatality rates associated with drowning and clearly demonstrates how it is the leading cause of death. Seen in the larger spectrum of child injury which includes all severity levels, drowning is the sixth leading cause of injury.

Figure 6 details the ratios of non-fatal injury by severity level compared to one death. It underscores the public health issue that the total burden of injury is much more than that incurred by fatal injury alone. Most of the deaths occur pre-hospital, leading to no hospitalization and few direct medical costs; hence they generate a minor share of the direct economic costs of injury. Almost all the medical costs for hospital and for rehabilitative care following hospitalization are accrued by children who are not fatally injured. The majority of economic costs and the lifelong social burden accompany the more severe, non-fatal injuries. While infectious and non-communicable diseases also generate disability and large costs (as with HIV/AIDS and diabetes), injury has a significantly higher incidence across each stage of childhood.

Figure 6: Ratio of injury frequency to death by severity level for age group 0–17



Source: Authors' calculations from individual surveys (2000-2005); composite is population-weighted.

3 POLICY AND PROGRAMME ISSUES

With health histories from a sampling of more than 500,000 households, or nearly 2.5 million people in five countries in East, South, and Southeast Asia, the surveys form a unique injury evidence base for the world's most populous region. The surveys confirm the limitations of present knowledge regarding cause-specific mortality and morbidity in this region, and highlight many programmatic considerations and issues of child health policy.

Understanding child mortality requires counting all children

About one-half of all child deaths (0–17 years) occur after infancy (0–1), and about one-half of these occur after the age of five years. Yet, the under-five mortality rate (U5MR) remains the single most important yardstick of child health in global discussions of development. As shown by the surveys, however, the under-five mortality rate masks several important issues. The high mortality in infancy, age 0 to 1, colours the rates for the full 0–5 age group but omits all detail for the 1–4 age group. And it self-evidently contains no information about 5–

17 year olds. Most critically, when the priority given to the under-five mortality rate influences programme design and may lead to a cut-off for interventions affecting the older age group, then two thirds of all children are excluded. Equal priority should apply to six year olds as to four year olds.

Increased visibility of deaths and adverse health events in children older than five years is needed. This mandates mortality measurements for children over five and the creation of suitable indicators. Given the linkage between rates of death in specific age groups, as demonstrated by U5MR, and child survival programmes, it is necessary to have indicators that measure these same events in older children: Deaths of those children should be registered when they are due to diarrhoea, pneumonia, or drowning, comparably to how they are registered for children under five years of age.

Policymakers and programme implementers clearly need a new indicator that applies to all children. These surveys show that proportional estimates are no longer the only option since it is feasible to count deaths (and serious non-fatal events as well) as they occur. In doing this, a wealth of additional information, including serious non-fatal health events, becomes available to health policymakers. Of course, counting all children is beneficial for more than injury prevention and control alone; while injury causes about half of all deaths of children after the age of five, communicable and non-communicable causes are responsible for the other half. Without counting these deaths (and serious morbidities as well), it will not be possible to address child injury and its impact in the most effective manner.

Prevention requires a life-course approach

Since the leading causes of injury death and serious morbidity differ by age group, standard age groupings are needed to obtain an accurate picture of child injury and recognize the different characteristics of the different age groups. To clarify the salient patterns, childhood could be divided into five age groups, such as those developed for the TASC survey methodology: (1) infancy; (2) early childhood, 1–4 years of age; (3) childhood, 5–9 years of age; (4) early adolescence, 10–14 years of age; and (5) late adolescence, 15–17 years of age. These groupings correspond to the major periods of socialization in childhood: infancy and 1–4 years as preschool; 5–9 years as primary school; 10–14 years as secondary school; and 15–17 as late adolescence, often with entrance into the workforce. These groupings are appropriate because there are different risk and health hazard exposure patterns in each group, and, consequently, different patterns of injury and disease. Without such a breakdown, it will be difficult to design adequate interventions and, as importantly, monitor and evaluate their effectiveness.

Children progress through stages of childhood in the same way as adults progress through the stages of adult life. Preventive medicine and public health programmes have long recognized this and have for the last several decades been organized on a life-course basis. It is important for the same efficient approach to be taken to childhood.

Policymakers need proper data on child mortality and morbidity

Injury was responsible for around 10 per cent of all mortality in the countries surveyed. Most policymakers initially believed it was not a significant health policy issue, for a variety of reasons including that the other nine tenths of total mortality may have been considered more pressing. This might be a strategically valid response if injuries were evenly distributed across all ages of the whole population, but injuries are in fact mainly concentrated in childhood and early adulthood. Policymakers have clearly lacked information separating infancy from the rest of childhood, and childhood from adulthood. With the full epidemiological picture it would have been clear that injury has been the leading cause of death for young children, adolescents and young adults for at least a decade or longer.

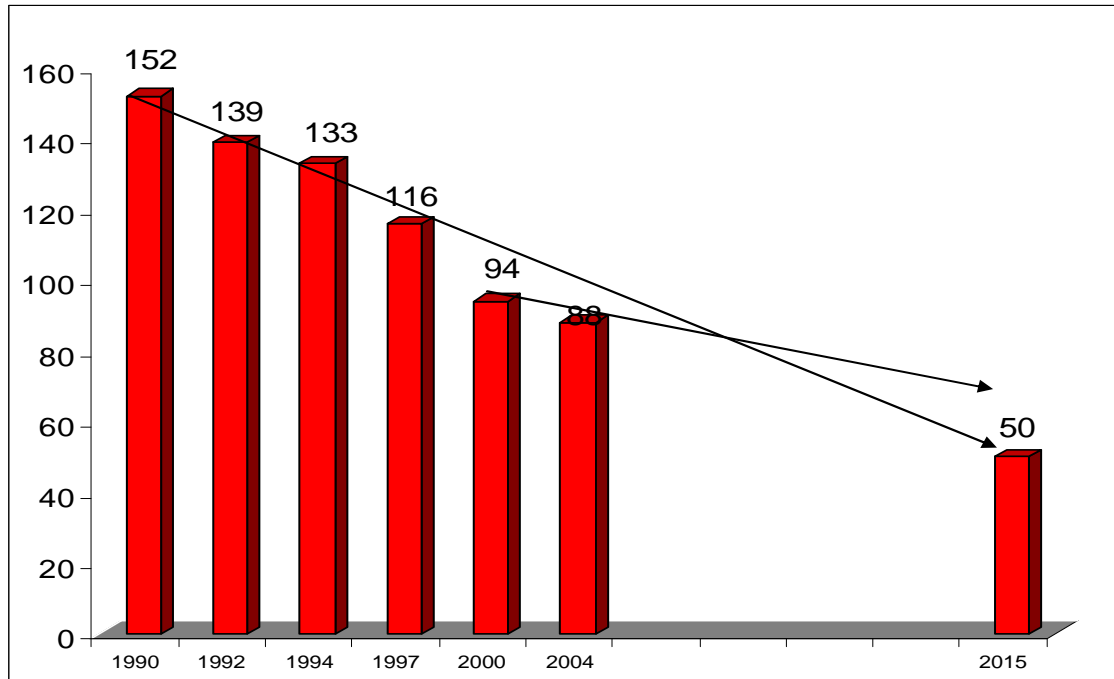
Measuring injury deaths in age groups and communicating the basic facts of epidemiology to health and development policymakers is a primary and necessary step to change this misperception. Indeed, in each country where the surveys have been conducted the government has subsequently made a significant commitment to injury reduction, especially among children. While the policy histories differ among countries, a common feature has been the use of evidence to mobilize partners within health and across other sectors, generating a momentum that has led to national policy changes.

Progress in child survival needs injury prevention

In all the countries surveyed, injury has become a significant cause of death in children under five years of age. As mortality has become increasingly compressed into the neonatal period, suffocation, falls and drownings have become proportionally larger causes of infant deaths, both because other causes are being addressed and because more children are surviving to the ages where injury is a major killer. For children aged 1–4, injury is now a leading cause of death

To drive down under-five mortality, which remains the focus in internationally agreed goals such as the Millennium Development Goals (MDG), these injury deaths must be prevented. Bangladesh serves as an example. The current under-five mortality rate (U5MR) is 72 deaths of children under five per 1,000 live births and the MDG target requires a reduction to 50 deaths. Until the mid-1990s, the rate of decline in U5MR (as measured by two rounds of the Demographic and Health Survey (DHS)) was sufficient to meet the 2015 goal. However, as the majority of infectious and other causes have been significantly addressed through the successes of child survival, this leaves injury as the predominant remaining cause of death. It is arguable that the limited focus to date on addressing injury within policy agendas may have contributed to a slowing down the rate of decline in U5MR, as seen in figure 7.

Figure 7: Rate of decline of under-five mortality rate in Bangladesh 1990–1994, and 2015 prediction



Source: Bangladesh Demographic and Health Surveys, and UNICEF Bangladesh Country Office.

Priority in preventing child injury: drowning

Given the broad mixture of injury causes in adulthood, no single strategy will significantly reduce serious and fatal injuries. However, the picture is very different for children. After infancy and through early adolescence, more than half of all injury deaths result from a single cause of injury: drowning. Targeting drowning provides an efficient injury prevention strategy, which has proved successful in the rich world. Evidence has now accumulated from Bangladesh that prevention of drowning in children is feasible as well in the low-resource setting of LMICs,

There are public health aspects of child injury prevention that apply particularly to drowning in a way that mirrors immunization, one of the bedrocks of child survival, as a basis for potential lessons to address drowning.

- Just as a vaccination provides lifelong protection against the targeted disease, a child taught to swim gains the same lifelong protection against drowning.
- Just as immunizing most children against a disease prevents other children who are not yet immunized from being exposed, so preventing infection (the concept of herd immunity), teaching most children to swim provides a herd of protective peers who can rescue unprotected children who cannot swim if they are exposed to water and at risk of drowning.
- Just as the group of vaccine-preventable diseases represented a large proportion of diseases causing early child deaths and was susceptible to an efficient and cost-effective

intervention, prevention of drowning removes the leading cause of child deaths after infancy and through the end of childhood.

As discussed also in the Survey Results and Evidence Paper in this series (IWP 2007-06), evidence from a large-scale injury intervention programme in rural villages in Bangladesh demonstrates that drowning before the age of five can be prevented by increasing supervision and decreasing exposure to water, and after five by teaching children to swim.⁹

It is also clear that there are many established mechanisms within existing programmes relating to child survival, maternal health and early childhood education that could be utilized for infant and early childhood drowning prevention programmes. Similarly, many programmes in primary education already include ‘life skills’, and drowning prevention could easily be associated with these. Given that this one cause – drowning – is responsible for over half of all child deaths after the age of one, this provides an amazing opportunity to dramatically reduce child death at low cost.

Other early opportunities

Significant injury reductions are possible simply by changing existing policies, which often miss opportunities for prevention, or even inadvertently increase injury risk. As a first step, changing policies and improving practices is a significant intervention in and of itself.

Poisoning The surveys show poisoning to be a significant cause of mortality and morbidity. The leading agents are household and agricultural chemicals, but a significant source is medicine from maternal and child health programmes and infection control programmes such as for tuberculosis. Hundreds of millions of doses are dispensed every year, including iron pills, vitamins, fever medicines and tuberculosis medicines. These are distributed to households in containers that are not child resistant, and in quantities sufficient for multiple lethal child doses. Parents are often unaware of the hazard this presents to the children in the home and leave the pill containers lying about. Since virtually all of these medications are procured through global supply chains, the opportunity is there to require child-resistant packaging for all distributed medicines.

This is also an opportunity for the various health programmes to educate parents about poisons in general, and the need to store common poisons like kerosene, bleach, insecticides and rat poisons on high shelves or in cabinets out of the reach of children.

Suffocation All the surveys show that suffocation in early infancy is a significant cause of infant death. They show a high prevalence of multiple risk factors for infant suffocation, including (1) non-supine sleeping position; (2) parental smoking; (3) parental alcohol use (except Bangladesh) and (4) multiple bed sharers. In all the surveys, almost universally there was only one bed for the entire family, shared by all members, and in most families at least

⁹ See ‘Midterm Review of PRECISE (Prevention of Child Injuries through Social-intervention and Education) Project’, July 2007, conducted jointly by The Alliance for Safe Children (TASC), the Center for Injury Prevention and Research, Bangladesh (CPIRB), and UNICEF Bangladesh Country Office.

one parent smoked. Given the known risks of suffocation in these circumstances, antenatal care programmes should educate expectant mothers about proper sleep positions and the suffocation hazards to the infant from parental smoking and/or drinking. Programmes should also work with mothers to plan a safe way to share the adult bed with vulnerable infants. This is the norm with antenatal care programs in wealthy countries; expectant parents in LMICs deserve the same education, given the known risks to infants of these factors and their high frequencies.

Most antenatal care programmes stress the known benefits of breastfeeding and strongly encourage expectant mothers to breastfeed exclusively for the first six months of life. There are many proven health benefits to infants and children from breastfeeding, and co-sleeping of mothers and infants has been shown to lead to higher rates of successful breastfeeding. Educating mothers about the benefits of breastfeeding and skin-to-skin contact should also include ways to reduce the risks of suffocation for their infants. The increased emphasis on the advantages of breastfeeding should also increase breastfeeding rates as well.

Falls The surveys show that falls are a significant cause of serious morbidity and mortality for infants as a group. This results in large part from the virtually universal practice of infants sharing the bed with the parents. Although infants tend to be well-protected by their mothers and other caregivers while they are awake, they become especially vulnerable when the caregivers fall asleep and do not watch over them. Their inability to raise their head or roll over until the sixth month of life leaves them vulnerable to suffocation. In turn, normal motor development means that by seven months, infants are crawling: they are quite active and crawl about the bed, sometimes falling from it, while the parents are sleeping. The resulting falls can cause serious or fatal injury to the infant. (Infants have soft, unclosed skulls with an open fontanelle and their heads are large in proportion to their body. Thus, when falling after crawling to the edge of a bed, they usually fall directly on the top of their skulls.) This important point regarding co-sleeping for infants should be emphasized for injury prevention in settings such as those covered by the surveys and in other LMICs. Antenatal care programmes have the opportunity to educate mothers about this hazard and to suggest ways to prevent the falls.

Animal bites The surveys show poisonous snake bites and rabies from dog bites as substantial causes of mortality in all the countries. Most facilities stock only the therapeutics on WHO's Essential Drugs List, which does not contain snake anti-venom, hyper-immune rabies globulin, or rabies vaccine. The problem is compounded by the fact that some of the materials need cold storage, and that often the only available storage is the EPI (Expanded Programme of Immunization) cold chain, where current policy forbids non-EPI products. This represents a missed opportunity to make the life-saving medication more widely available at the local service delivery point, where they would be most effectively used.

The problem of dog bites exists year round at high rates regardless of season. Snake bites occur at a lower rate in the dry season, and increase in the rainy season when there are frequent floods. The rising waters force families and snakes to congregate on higher ground. When bites occur, the flooding usually prevents access to health facilities. This is also a

missed opportunity for pre-positioning as part of disaster response systems since the drugs are needed but not currently included as part of the emergency response system.

Beyond Asia

The countries surveyed have all made the epidemiologic transition. A clear lesson from the rich countries has been that the changed epidemiology of child death due to the epidemiologic transition requires a change in prevention strategy in order to continue to drive down child mortality. In the region surveyed, further improvements to child health will similarly require broad injury reduction and control programmes for children up to age 18.

These needed policy and programme changes are however not limited to the countries surveyed, nor to other rapidly developing countries in East, South and Southeast Asia. Inspection of health indices (such as life expectancy at birth, infant mortality rate and under-five mortality rate) strongly suggests that similar patterns of child mortality and morbidity exist in Latin America and the Caribbean and in most of the Middle East and North Africa, Eastern Europe, and Central Asia. It is in fact likely that the pattern reported here is occurring in almost every region except Sub-Saharan Africa, and even there injury can be predicted to be a significant cause of child death and disability. Determining this will require that large, community-based surveys are conducted, such as those described here.

Child survival has been a remarkably successful endeavour. At the beginning of the 'child survival revolution', more than 75 per cent of the world's children lived in countries where child mortality was high (with U5MR over 90). Only 30 years later, less than 20 per cent do. The world before us is no longer a world best served by a focus on survival of children under five. Further progress for the region's children will require protecting children throughout childhood, and this is equally true elsewhere in the developing world.

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.

Members of the Bangkok Working Group on Child Mortality Estimates:

Michael Linnan, Ross Cox and Thomas Dunn (The Alliance for Safe Children)

Guang Zeng and Jing Rui-wei (China Field Epidemiology Training Program, CFETP)

Fazlur Rahman and Aminur Rahman (Center for Injury Prevention Research, Bangladesh, CIPRB)

Iyorkun Uhaa (UNICEF Bangladesh)

Le Vu Anh, Pham Viet Cuong and Le Cu Linh (Hanoi School of Public Health, Viet Nam; HSPH)

Christine Branche, Laurie Beck and Fang Xiangming (US Centers for Disease Control and Prevention, CDC)

Maria Consorcía Lim-Quizon (Philippines Field Epidemiology Training Program Alumni Foundation, FETPAF)

Guru Gururaj (National Institute for Mental Health and Neuro Sciences, NIMHANS, India)

Chitr Sitti-Amorn (Institute for Health Research, Chulalongkorn University, Thailand)

Soewarta Kosen (National Institute for Health Technology Research, Ministry of Health, Indonesia)

Huan Linnan (UNICEF East Asia and Pacific Regional Office)

Principal Investigators for the national and subnational surveys:

Viet Nam – Le Vu Anh, Pham Viet Cuong and Le Cu Linh (Hanoi School of Public Health, Viet Nam)

Bangladesh – Fazlur Rahman, Aminur Rahman (CIPRB) and Shumona Shafinaz (UNICEF Bangladesh)

Thailand – Chitr Sitti-Amorn, Orapin Chaipayom and Venus Udomprasertgul (Chulalongkorn University, Thailand)

Philippines – Maria Consorcía Lim-Quizon (FETPAF, Manila, Philippines)

Beijing, China – Guang Zeng, Jing Rui-wei (CFETP, Beijing, China)

Jiangxi, China – Guang Zeng, Jing Rui-wei (CFETP, Beijing, China) and Zhu Liping (CDC, Jiangxi Province, China)

Technical Advisory Group members not listed above:

Charles Mock (Harborview Injury Prevention and Research Center, Seattle, USA)

Mark Stevenson (The George Institute for International Health, Sydney, Australia)

Curtiss Swezy (George Mason University, Virginia, USA)

Joan Ozanne-Smith (Monash University Accident Research Centre, Victoria, Australia)

Ian Scott (Department of Violence and Injury Prevention, World Health Organization, Geneva)

Morten Giersing (Former UNICEF Representative, Bangladesh and Viet Nam)

Mark Webster (JWT, Tokyo, Japan)

UNICEF technical contributors not listed above:

Isabelle Bardem, Richard Bridle, Andrew Claypole, Rodney Hatfield, Kayode Oyegbite,

David Parker, Pham Ngoc Len, Marissa Ricardo, Koenraad Vanormelingen, Bastiaan Van't

Hoff, Christian Voumard, Mehr Khan Williams, Yuan Min

Editorial assistance: Yoko Akachi, Allyson Alert, Pamela Ann Bone, Jesse Bump, Jonathan Ehsani, Belinda Lawton, Tracie Reiten.