

# Technical Report on Child Injury in Cambodia

**A final report to UNICEF Cambodia**

**on**

**The Cambodia Accident and Injury Survey, 2007**

**by**

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# Abbreviations

ADL	Activities of Daily Living
ASMR	Age Specific Mortality Rate
CAIS	Cambodia Accident and Injury Survey, 2007
CDHS	Cambodia Demographic and Health Survey, 2005
CDR	Crude Death Rate
CI	Confidence Interval
CMR	Child Mortality Rate
DDD	Digital Data Divide
EPI	Expanded Program on Immunization
GPC	General Population Census
HHL	Household listing
ICD	International Classification of Diseases
IMCI	Integrated Management of Childhood Illness
IMR	Infant Mortality Rate
LBW	Low Birth Weight
LMIC	Low and middle income country
NCD	Non-Communicable Disease
NIPH	National Institute of Public Health of the Ministry of Health, Cambodia
NIS	National Institute of Statistics of the Ministry of Planning, Cambodia
PSU	Primary Sampling Unit
PPS	Probability Proportional to Size
RTA	Road Traffic Accident
RTI	Respiratory Tract Infection
SES	Socio-economic status
SSU	Secondary Sampling Unit
TASC	The Alliance for Safe Children
TNS	Taylor, Nelson Sofres
U5MR	Under 5 Mortality Rate
UNICEF	United Nations Children's Fund
UTD	Unable To Determine
UXO	Unexploded Ordnance
WHO	World Health Organization

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# Chapter 1

## Key Findings

The Cambodia Accident and Injury Survey (CAIS) was the largest community-based survey on child mortality and morbidity ever conducted in Cambodia. It used 66,576 households containing 323,129 residents of whom 133,322 were children. The households were representative of the entire Cambodian population and the survey was done in February and March 2007. CAIS showed injury is a leading killer and disabler of Cambodian children.

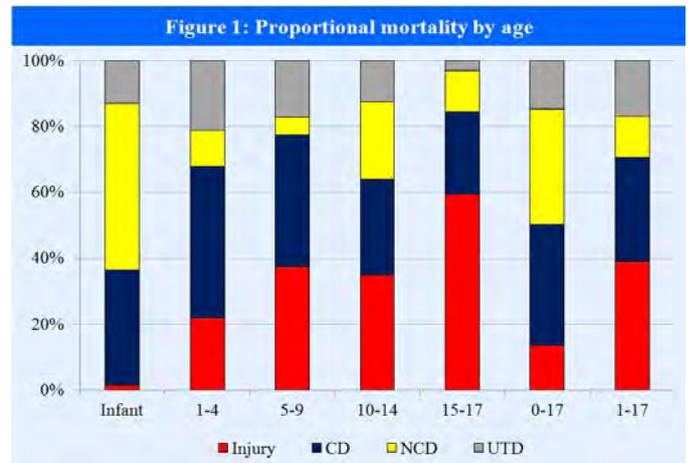
In each household, detailed interviews were conducted to examine deaths, illnesses and injuries in children and their parents. CAIS described the causes of child death and illness and then looked in detail at child injury. Causes of death were from medical certificates if available and verbal autopsy if not. Type of death was classified as non-communicable disease (NCD), communicable disease (CD), injury or unable to determine (UTD) if information was not sufficient to classify the death by a specific cause.

Injuries were characterized by age group and categorized by level of severity as moderate, major, serious, severe, or fatal in order to help determine the risk factors and some of the related social and economic costs. The survey did not include injury that was considered minor. To be counted, the injury required the patient to seek medical care, or miss at least one day of work or school.

Children have different patterns of disease and injury according to their stage of childhood. These patterns clearly stand out in the survey and provide policymakers with key information to tailor child health programs to best target the actual causes of child death and disability in Cambodia.

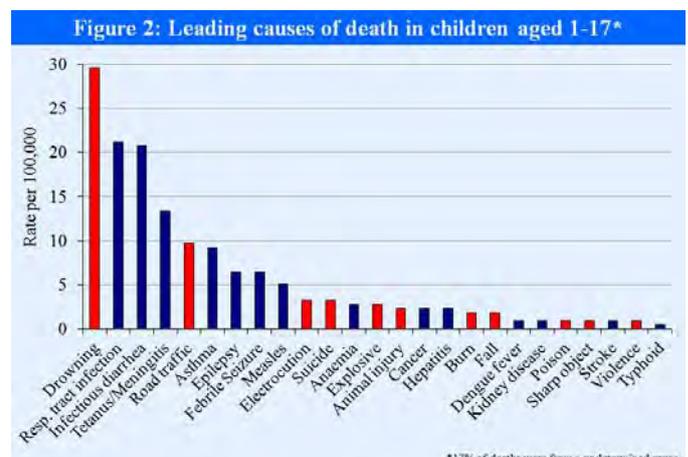
Figure 1 illustrates the differing patterns of cause of death by each stage of childhood. In infancy, NCD was the leading killer, mainly from birth related causes and congenital defects in first month of life (the neonatal period), and followed by CD in the rest of infancy. As children grow older, the proportion of injury deaths increased, while CD and NCD deaths decreased.

Most infant deaths are neonatal deaths, occurring in the first month of life. Most relate to factors during pregnancy, lack of proper care and delivery at birth or the period immediately after birth. Because of these causes are not present in further stages of life, infancy is a unique period of life that requires special consideration from the epidemiologic and demographic perspective.



As a result, the three following figures focus on the period of childhood after infancy, 1-17 years.

Figure 2 shows the leading causes of death for children aged 1-17. Overall, more children aged 1-17 in Cambodia die each year from drowning than from any other single cause of death. About 2,090 children were estimated to have died from drowning in the year preceding the survey. Road traffic was the second largest cause of injury and death and about 650 children were estimated to have died from road traffic in the year prior to the survey. In contrast to popular belief, only a relative small number of deaths were caused by explosive injury (landmine/UXO), which ranked as the 13th leading cause of all deaths in children aged 1-17. Overall, almost 4,020 children were estimated to have died from all causes of injury in the year surveyed.



There were large differences in the pattern of death according to gender. Figure 3 and 4 which follow illustrate that the patterns of death differed according to the gender of the child as well as whether the child lived in a rural area of an urban area.

Figure 3 shows for some types of fatal injury in the ages 1-17, especially drowning and road traffic accidents, males had higher rates of death than females. The patterns for gender difference was different in the different age groups of childhood.

Figure 3: Five leading causes of death in children aged 1-17 by sex\*

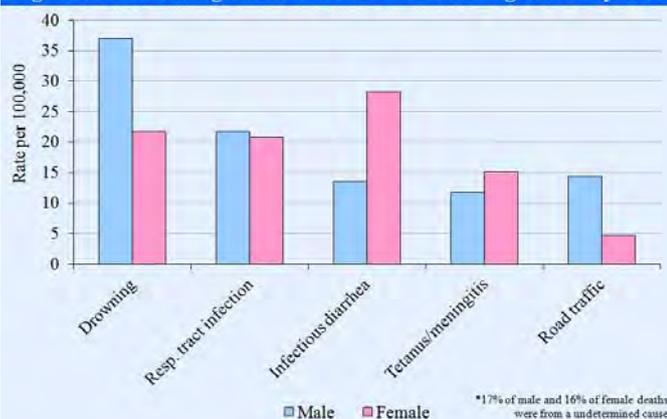


Figure 4 illustrates that the five leading causes of death have a correlation with whether children live in urban or rural areas. As most children in Cambodia live in rural areas, the patterns of death for children in Cambodia is predominantly the rural pattern. The different causes of death in urban and rural location are important to recognize.

Figure 4: Five leading causes of death in children aged 1-17 by place of residence\*

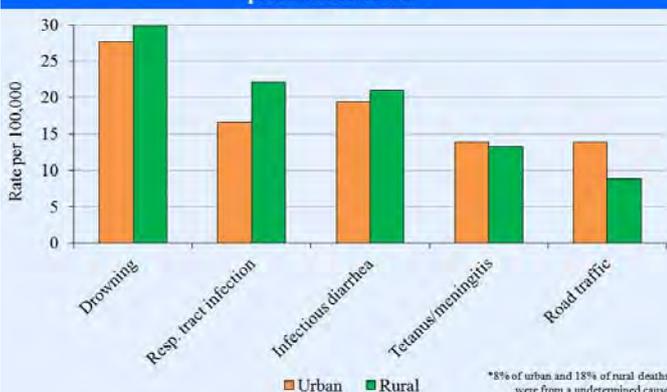
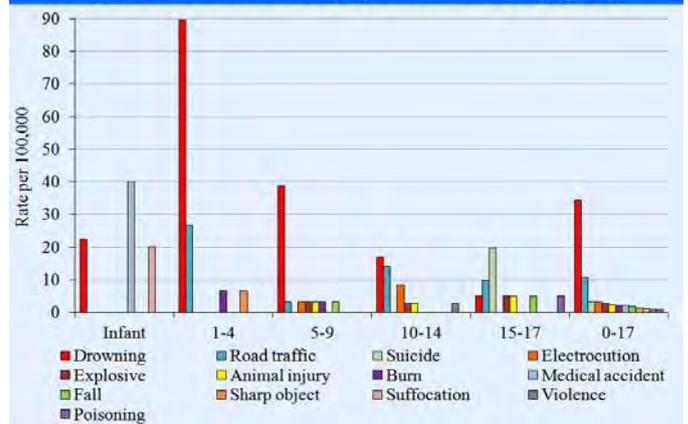


Figure 5 examines fatal injury in detail and clearly shows that each stage of childhood has a different pattern of fatal injury.

For infants the leading cause of injury death was medical accidents involving caesarean section births, followed by drowning and suffocation. For toddlers the overwhelming lead cause of injury death was drowning, which was the highest for all ages, this trend followed into school aged children (5-9). For children aged 10-14, drowning was still the leading cause of death, with road traffic accidents a very close second. Late adolescent (15-17) show a completely different pattern of injury with suicide being the leading cause followed by road traffic.

While injury that causes the death of a child is clearly a critical issue for child health in Cambodia, fatal in-

Figure 5: Causes of fatal injury in children by age group



jury is only the tip of the iceberg. There are significant costs associated with fatal injury, but in terms of the economic and social costs, it is serious injury—especially one which causes permanent disability—that outstrips fatal injuries.

Figure 6 illustrates that child drowning is not the only hidden epidemic in Cambodian children. Road traffic, animal injury and falls are at very high levels in all age groups of children after infancy. Overall, more than 58,000 children were estimated to have suffered an economically and medically significant animal related injury in the 12 months preceding the survey.

Figure 6: Causes of injury resulting in a missing a day of school/work in children by age group

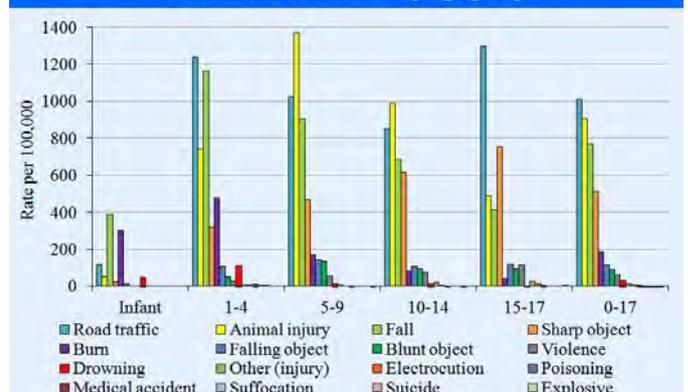
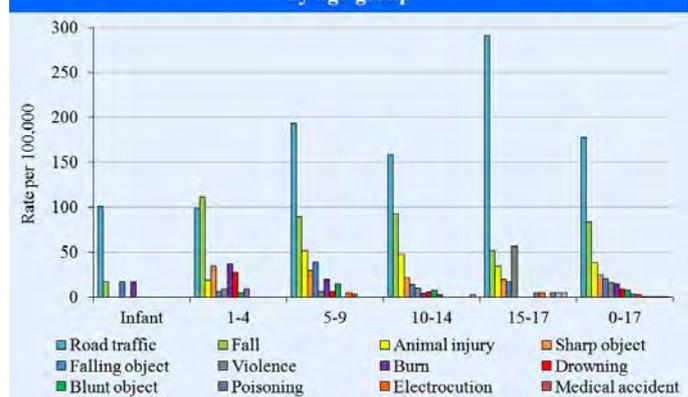


Figure 7 illustrates the pattern of injury that was serious enough to require hospitalization for an injured child. There is already recognition of the epidemic of injury from road traffic and the survey clearly validates

Figure 7: Causes of injury resulting in a hospital stay in children by age group



that it is an issue for concern and action in all age groups of children.

Figure 8 illustrates the patterns of injury which have the highest economic and social costs of all – those resulting in permanent disability. More than 7,100 children were estimated to have been permanently disabled from injury in the 12 months preceding the survey. This is almost 20 children every day. The leading causes of permanent disability from injury in children were from road traffic, estimated to cause more than 7 permanent disabilities every day; and falls, estimated to leave 4 children with a permanent disability every day.

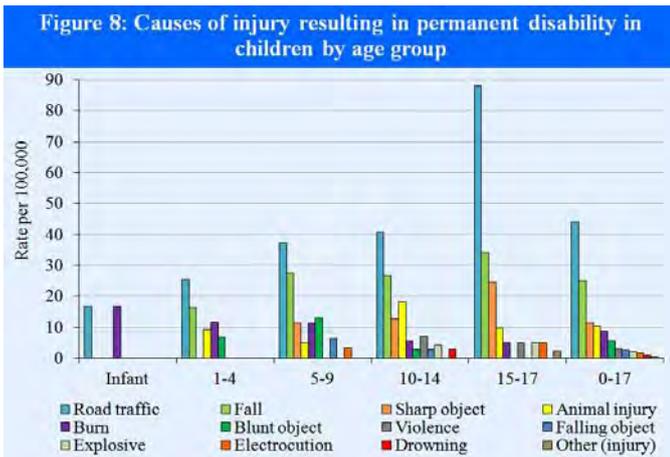
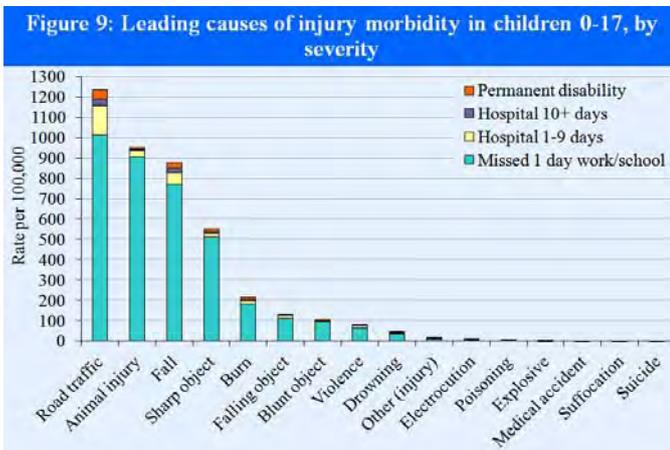


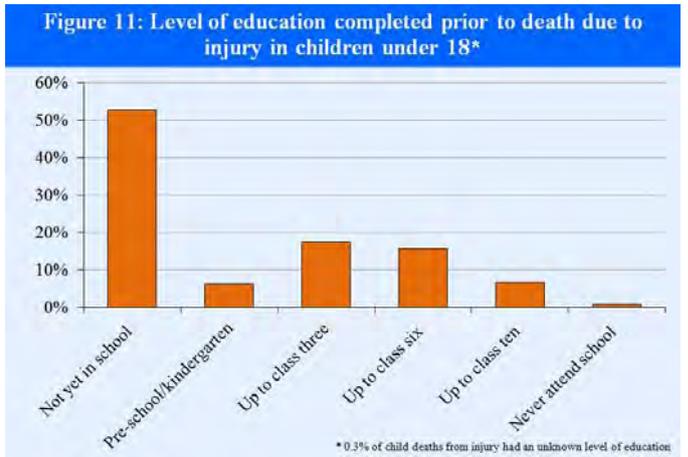
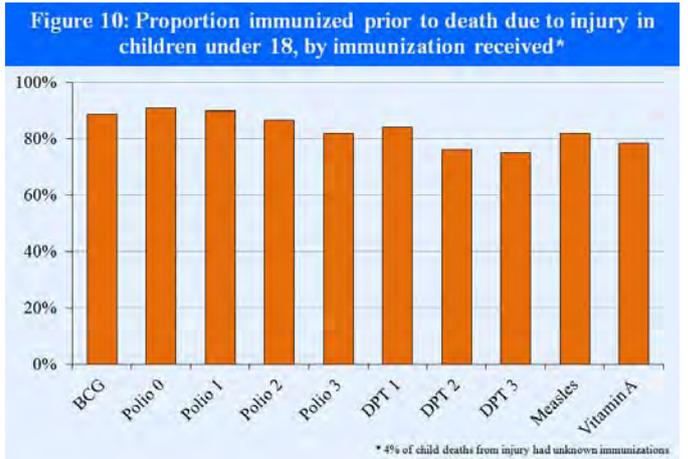
Figure 9 shows the leading causes of injury morbidity for all children (0-17), separated by severity levels. The high non-fatal road traffic injury rate in the 15 to 17 year olds skews the distribution of morbidity for all children aged 0 to 17, so road traffic became the leading cause of injury morbidity for all children. Animal injury and falls, which are prevalent in every age group, were second and third respectively. The fourth and fifth causes of injury morbidity in all children aged 0 to 17 were cuts from sharp objects and burns respectively.



There are other gains to be had beyond mortality reduction in preventing child injury. The survey showed that almost all children who had died from injury had received major health and social investments. These

can be seen in the immunization figures and educational attainment for children who died from injury as shown in Figures 10 and 11. These deaths represent a loss of the investments in the children made through immunizations and education (as well as the other child survival interventions).

The costs are not limited to fatal injury. Just counting children who were in school when injured, the average number of school days lost to each child was almost three weeks (12.5 days). Loss of this much schooling to such a large number of children likely affects overall school retention and graduation rates.



It is no victory to prevent deaths from measles or tetanus in children during infancy, only to have the same children die from drowning while still in early childhood; or to be successful in increasing gender equal school attendance rates, but have those same children later die from an injury. This is akin to “the operation was a success but the patient died”.

Child survival is not about surviving a particular cause of death – it is about a child surviving childhood to become an adult. In the larger context of health and development, addressing injury in children in each stage of childhood is necessary to lock in the gains made from all the other efforts thus ensuring a child grows to his or her full potential. Achieving this in Cambodia will require injury intervention programs becoming core components of child health programs.

## Chapter 2

# Methodology

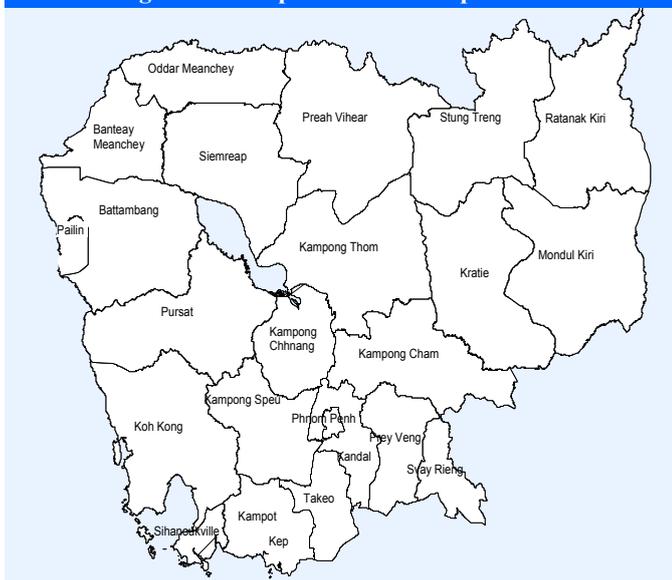
### Background

The 2007 Cambodia Accident and Injury Survey (CAIS) was a national cross-sectional survey conducted in February and March 2007 to describe, understand and measure accidents and injuries in Cambodia and to quantify the burden of injury in order to develop intervention and prevention programs. This research is a joint project between the National Institute of Statistics of The Ministry of Planning (NIS), the National Institute of Public Health of The Ministry of Health (NIPH), the United Nations Children's Fund in Cambodia (UNICEF), and The Alliance for Safe Children (TASC), with management assistance provided by Taylor, Nelson Sofres (TNS).

Specific objectives this report addresses were to:

- Determine the causes of child death and the leading causes of child injury morbidity in the population
- Estimate the proportion of child mortality and the incidence of child morbidity due to injury
- Describe the pattern and characteristics of child injury
- Explore risk factors associated with child injuries
- Gain an understanding of behavioral, attitudinal and other factors related to risks, hazards and care-seeking behaviors related to or resulting from child injury
- Identify environmental risks and hazards for child injury in and around the household and the community
- Establish baseline data for UNICEF Cambodia programming on accidents, injuries and disabilities.

Figure 2.1: Map of Cambodian provinces



### Survey Area

The sample was drawn from 23 provinces as shown in Figure 2.1. No households were included from Mondul Kiri Province.

### Survey Design

The CAIS used a two-stage survey design. The first stage consisted of drawing a representative sample, then visiting all selected households to count and list residents; determine births and deaths in the household and to construct maps for subsequent visits by interview teams (called a Household Listing – HHL). The demographic parameters of the homes comprising the sample were checked to ensure it was a representative sample.

The second stage was the household visit by teams of interviewers and supervisors to conduct the lengthy interviews that collected detailed information on deaths from all causes in the previous three years and injuries of all severities in the preceding year.

### Sample Design

The sample was a nationally representative sample, using probability proportional to size (PPS) sampling, with a sampling fraction of approximately 3.5 percent. Detailed calculations regarding sample size are in appendix B.

The sampling frame was the complete list of villages enumerated in the 1998 Cambodia General Population Census (GPC) plus 166 villages which were not enumerated during the 1998 GPC. It includes 23 of 24 provinces throughout the country and consists of 13,505 villages.

The sample was drawn by staff of NIS with technical assistance from TASC. The protocols and field manuals for the first stage household listing were developed by NIS with assistance from TASC and UNICEF. The actual training and field work was done by NIS in October 2006 with technical assistance from TASC. The data entry was done in November 2006 by NIS with technical assistance in data entry, forms design and output by TASC.

The final sampling dataset, distributed by PPS methods across 600 secondary sampling units (SSUs) required the inclusion of 63,000 households. This equalled an

average of 105 households in each of the 600 SSUs. In drawing the sample, a surplus of 10 households per SSU was provided to allow for refusals and wastage. This brought the total sample to 69,000 households (115 x 600). At the time of the household listing survey, an additional number of households were added for convenience of mapping when more than one segment was required to fill the SSU. Additionally, the enumerators for the HHL encountered various issues relating to households in the sampling frame having dissolved and disappeared, institutional households that did not fit the household criteria, and absent members at the time of visit. As a result, the final number of households mapped and entered for the second stage of the survey was 70,536.

Figure 2.2 shows the age-specific mortality rates (all causes of death) for the sample as calculated from the HHL survey. In addition, a life table was derived from the mortality functions in the sample and is provided in Appendix B. The life expectancy for the birth cohort in the year immediately preceding the survey (for infants born in 2006) was 63.9 years. The probability of dying at the end of the period from birth to exact age one (0q1) otherwise known as the IMR, is 52.9 infant deaths per 1,000 live births. These numbers are consistent with what would be expected from a national sam-

ple. As a separate validation step they were compared to the values of the 2005 CDHS survey and adjusting for the year and a half difference in time of the surveys, were found to be similar (CDHS IMR for 2006 = 59.5/1,000 live births; 95% CI: 52.7 – 66.4).

Figure 2.3 below shows the population pyramid derived from the sample. There were a total of 323,129 persons whose ages ranged from 0 - 109 years of age.

### Household description and key definitions

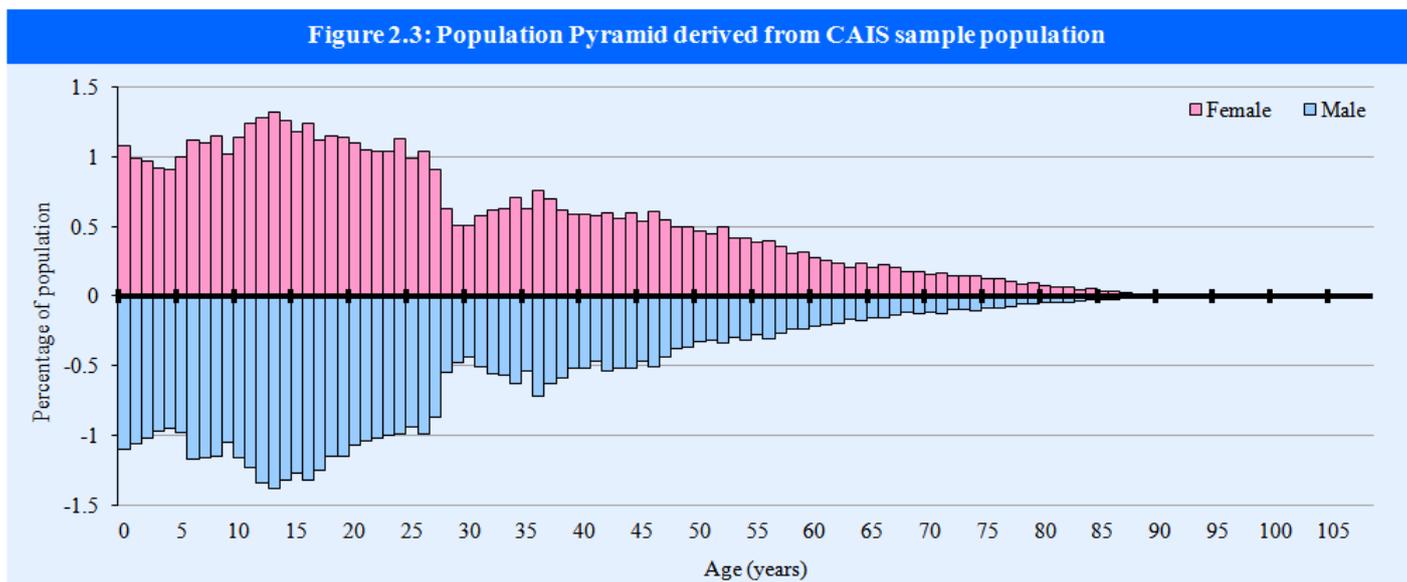
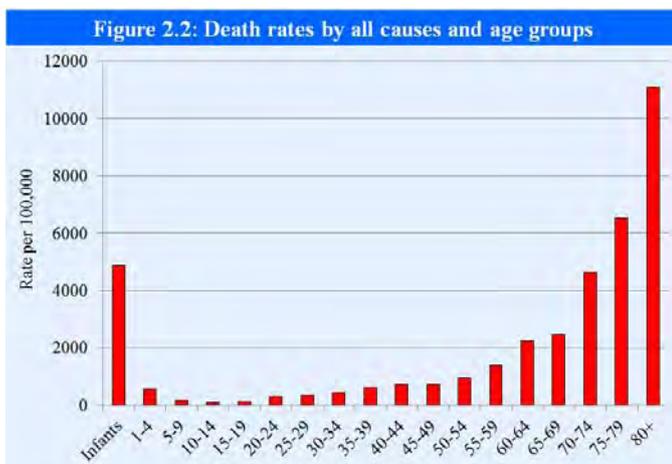
The household was the lowest unit of sampling, and the basic unit of interview. Households were defined as a dwelling where a group of members live together and use the same kitchen to cook.

**Household head:** The person in a household who makes the major decisions for the family. This was usually a male who was the major economic earner for the household, but varied according to household composition.

**Household members:** All persons permanently living in the household at the time of interview and sharing the same kitchen. The members in the household did not need to be related. Servants or hired staff were considered members. Guests or visitors were not members. University dormitories, military barracks, and construction sites were excluded from the sample. Further information is available in the glossary (Appendix A).

**Children:** Anyone within the period of birth to the end of the 17<sup>th</sup> year of life. Adulthood begins on the 18<sup>th</sup> birthday.

**Caretaker:** The person who spends the most time in a day (24 hours) with the responsibility of looking after the child. Different children could have different caretakers in the same household.



## Respondents

The survey had multiple respondents. For the household member list, associated socio-economic status (SES) and household role information, the respondent was usually the household head or the member regarded as the most knowledgeable about the household. For any questions that related to the children in the household, the respondent was usually the mother or usual caretaker of the child.

## Questionnaires

Mortality events from all causes (communicable, non-communicable, maternal, and injury) were investigated. Morbidity from injury was included, but morbidity from other causes was not. The recall period for mortality was 3 years, and one year for morbidity.

The questionnaire was the fourth iteration of the TASC standard questionnaire used in the other Asian countries. This was pre-tested in both rural and urban Cambodia and further revised to be suitable for Cambodia. In addition, a module was added on cost (direct and indirect) and measures of social burden for all injury mortality and morbidity events found in the survey.

**Form 1:** Household Member Listing and screening form, completed by all households and gathering demographic, occupational and SES information on all household members, injury morbidity events, roles and relationships within the household, and hazards and risk factors present in and around the household for various injuries.

**Form 2:** Injury Morbidity, completed for each injury to a member of a household in the last one year. It contained detailed information on the non-fatal injury event, including the type of injury, the outcome and economic and social costs information.

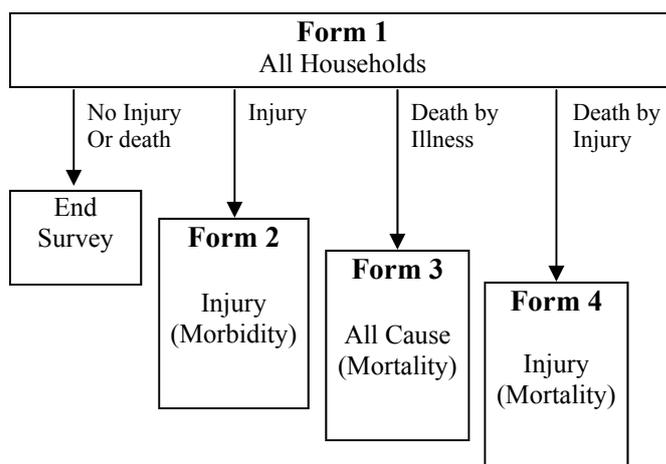
**Form 3:** Verbal Autopsy, completed for each death within the household in the last three years. It was based on the standard WHO Verbal Autopsy form, extended to include injury, and deaths over the age of five years old. It contained demographic and SES information of the deceased, detailed information on signs, symptoms and how the deceased died.

**Form 4:** Injury Mortality, completed for each death caused by injury from the household in the last 3 years with detailed information about the fatal injury event, including the type of injury, the outcome and economic and social costs information.

## Household visits and flow of forms

All households selected were visited by the survey teams during the field work period of February and

March 2007. Informed consent was obtained from all respondents as the first step in the interview process. The flow of forms is shown below.



The determination of occurrence of a mortality or morbidity event was done using a standardized process. The interviewer explained that for an infant to die, they had to have been born alive, thereby excluding still-born infants. Deaths of any cause were then investigated. Finally, deaths from injury were further asked for by showing the respondent a series of pictures of each of type of injury, and describing that type of injury using local terminology.

## Recall calendar and other visual aids

A three year recall calendar was used that plotted significant cultural and life events for the previous three years. The events were chosen to be as close to quarterly intervals for the three years as possible. The calendar was used when mortality and morbidity events were identified, in order to provide the best estimate of the actual month and year of occurrence.

Visual aids were developed that included drawings and pictures of each the different types of injury events as well as the risk factors being asked about. The pictures of each type of injury were shown to each respondent at the beginning of the interview and each type was discussed with the respondents in detail, in order for the respondent to understand what was being asked about. Similarly, the pictures of the various risk factors (e.g. pictures of typical insecticides, stair rails, ponds and ditches, etc) were shown to the respondent when those items were being asked about in order to facilitate precision in answers.

## Cause of death and morbidity determinations:

The definition of injury was: Damage to a person caused by an acute transfer of energy, or by sudden absence of heat (hypothermia) or oxygen (asphyxiation, drowning). Forms of energy are mechanical (kinetic), thermal, chemical, electrical and

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radiation. Intentional injuries are injuries that are purposefully inflicted, either by the victims themselves (suicide or suicide attempts), or by other persons (homicide, assault).

The analysis classified causes of death into five broad categories:

**Injury**, which was further sub-classified by type and mechanism: 1) Intentional, which included suicide and violence, and 2) Unintentional, which included drowning, transport, falls, burns, cuts, poisons, suffocation, electrocution, injury from blunt object, falling objects, animals, explosives and medical accidents.

**Non-communicable diseases (NCD)**, which included: chronic diseases, congenital conditions, birth defects, and neonatal causes that were not infections (such as birth asphyxia, birth injury, hemorrhage, etc).

**Communicable diseases (CD)**, which included infectious diseases that are sometimes classified as chronic diseases, such as tuberculosis. Neonatal conditions that are infectious are included here (neonatal tetanus, sepsis, meningitis, etc).

**Maternal** conditions related to childbirth.

**Undetermined (UTD)**. The classification was done by verbal autopsy and when information was not sufficient to determine one specific cause, it was classified as undetermined.

These five categories were used because of the verbal autopsy classification scheme. This system, based on the standard WHO verbal autopsy process does not use the International Classification of Disease (ICD) categories nor use death classifications such as “neonatal conditions”. The information obtained is usually insufficient to allow finer classifications of cause of death, and usually is the actual cause of death rather than the underlying cause of death. In this system, neonatal deaths are those which die in the first 28 days of life and can be neonatal deaths from injury, neonatal deaths from infection, neonatal deaths from non-communicable diseases or neonatal deaths of undetermined cause.

The criteria for inclusion in the survey was any disease, illness or incident that caused a household member to seek medical care, or caused them to miss one day or more of school or work. For those who were unemployed or of preschool age, the minimal criteria for inclusion was an event of sufficient magnitude to seek care, or prevent being able to perform activities of daily life (ADL) such as eating, bathing, and moving for one day.

Morbidity from injury was classified with the same sub-classifications and mechanisms as fatal injury. Mor-

bidities were also further categorized by severity levels:

**Moderate**: An injury serious enough to seek medical care, or to miss one day or more of school or work, but not to be hospitalized or cause permanent disability. For household members unemployed or preschool age, the minimal criteria for inclusion was an event of sufficient magnitude to prevent being able to perform activities of daily life (ADL) such as eating, bathing, and moving.

**Major**: An injury serious enough to require hospitalization of 1 to 9 days, but not resulting in permanent disability. This level usually excluded major surgery.

**Serious**: An injury requiring hospitalization for 10 days or more, but not resulting in permanent disability.

**Severe**: Any injury that caused permanent disability. Permanent disability was defined as the loss of a physical sense (sight, hearing, etc.), loss of mobility (loss of use of arm, hand, leg or foot) or loss of ability to speak. It did not include mental or emotional causes due to the difficulty of measuring these in a standardized way.

It is important to note that injuries not of sufficient severity to cause a visit to a medical facility for care or loss of at least one day’s work or school were not included in the survey. This excludes a large number of injuries, but these minor injuries are not of public health significance as they did not cause financial expenditure or loss of a day’s wages and productivity, or attendance at school for students. This is also the reason why the term “moderate” was used to describe the lowest level of severity in the survey. The injuries that did not result in social or economic costs, and thus excluded from the survey, were deemed to be minor.

## Quality control procedures

Quality control procedures were a key focus, due to the size of the survey. Five percent of all households were re-interviewed by supervisors and answers were compared to those of the original interview.

All questionnaires from a village were edited in the field by supervisors prior to the interview team leaving the village, in case rechecks were needed. Field editing for completeness and correctness was done before the questionnaires were sent for data entry.

The data was double-entered by a commercial data entry company (DDD Cambodia). TASC staff cleaned and edited the database for analysis with assistance from NIS, NIPH, TNS and UNICEF staff.

## Calculation of rates and weighting

The analysis was performed using SPSS version 12 software, by technical staff from TASC, UNICEF, NIS and NIPH. The total number of deaths was taken from the most recent year (the first of the 3 year recall period). The survey over-sampled urban households by a factor of 2, and therefore the urban rates have been weighted accordingly for all ages.

## Limitations of CAIS

Methodological issues related to surveys impose constraints on the findings. Major constraints relate to the issues of classification, enumeration, and sample size and power.

### Classification issues

While named an accident and injury survey, CAIS looked at all causes of death in order to determine the proportional contributions of injury, non-communicable disease and communicable disease to overall mortality and morbidity. This required all deaths to be classified by one of the three causes to determine what proportion of all deaths they represented. Classification error is a serious problem of community-based surveys where cause of death is established from verbal autopsy. In a verbal autopsy, laypeople will usually describe the final, ultimate cause of death, but often will not relate this to the underlying cause of death. Take for example, a death described as rapid breathing. It could be caused by heart failure with rapid breathing due to fluid in the lungs (pulmonary edema); by an infection of the lungs (pneumonia) that occurred by itself, or resulting from severe injury with subsequent respiratory complications. In each case of death, the final cause would be the same rapid breathing, but the underlying cause in each would be different. The first would be congestive heart failure, a non-communicable disease; the second would be a primary pneumonia, which is a communicable disease; and the third would be a complication of an injury, and classified as an injury death complicated by a secondary pneumonia. The source of information for this is a medically unsophisticated layperson, thus there is room for misclassifications as to the underlying cause of death. In many cases, (as many as twenty to thirty percent in some age groups) there was insufficient knowledge of the death by the respondent, to allow adequate classification. It was coded as undetermined if this were the case. Classification issues usually have a greater effect on causes other than injury. The signs and symptoms of many communicable and non-communicable causes of death may be too subtle to be remembered clearly. However, most people have a very clear idea of injury -- and know and can describe in detail a drowning, a dog bite, being hit by a car, or a fall from a height.

## Enumeration issues

At the community level, how the sample is obtained has a large effect on the completeness of the sample taken. Ideally, the sampling process allows the potential for each and every person from the area to be in the actual sample taken. In practice this is impossible to achieve, as at any one time, some resident households of an area are not there. Some are staying with relatives in other areas while the head of household is seeking work, visiting family members in other communities or are traveling for business or other reasons. Their deaths, or their knowledge of deaths of others cannot be determined, and these are lost to the survey. Additionally, in some areas, there are people who do not want to be counted, visited or interviewed by researchers, for a variety of reasons; lack of documentation, fleeing from family or authorities, etc. They are also lost to the survey. There are also lost deaths for other reasons. Perhaps most significant among them, if a death occurs to the head of the household, there is a possibility the household disbands with the remaining dependents joining families elsewhere. In the case of the death of a head of household, both the death and the health experience of all members of the disbanded household can be lost.

CAIS attempted to minimize these issues by using two separate contact points for each household. The first was to list the household at the time of village mapping, and the second was at the time of actual interview, several months later. Having two contact points helped to increase the likelihood that more complete information would be available concerning health events of household residents.

### Sample size and power issues

One of the most important issues that the reader must consider in interpreting the CAIS results relates to the sample size or the power of the survey. It is extremely important to understand the limitations of the data imposed by the sample size in order to correctly interpret the results.

Deaths are relatively rare events in the general population. To find a rare event at the community level means interviewing many households in order to find one household with a death in the previous year. This low rate of households with a death from any cause means that the sample size must be quite large to find a significant number of deaths. The costs of a community-based survey are directly related to sample size, and large sample sizes impose prohibitive costs on the survey. Thus, a national community-based survey requires a balance of size (numbers of houses screened for deaths found) with cost (dollars available for the survey). This balance means that only relatively frequent causes of death are able to be determined with reason-

able precision by the survey. Rare causes of death are not picked up by the survey. It is not that they do not exist, or are not important, but that they are too infrequent to be ascertained by a survey with a sample size that would be affordable.

The need to balance sample size with survey costs results in a relatively small number of deaths in the selected sample. This issue then compounds itself when the data is categorized and analyzed by smaller and finer groups. The decreasing numbers of illness and death when subdivided into smaller age groups has a major effect on the resolving power when looking at the childhood age groups. When classified by age group, the numbers of death in any one age group gets smaller; when sub-classified by sex, further sub-classified by cause, and then further sub-classified by urban/rural, the numbers of deaths get very small. When subdivided this many times, in many groups, they are often zero. This is apparent when looking at death rates for various causes of injury deaths when classified by age, sex and urban/rural. This is a normal problem of large, national surveys.

The same issue pertains to looking at special populations. The overall rates nationally reflect the true pattern of injury morbidity and mortality of all causes occurring in Cambodia in the three years prior to February and March 2007, within the limits of the precision allowed by the sample size. However, the rates obtained should not be applied to separate groups that do not reflect the overall composition of the population. For example, groups such as ethnic minorities, populations in special circumstances due to issues such as migration, or those living in areas associated with marginal conditions fall well under the resolving power of this survey. The rates obtained from the national sample cannot be assumed to be representative of these populations. These populations and groups very likely have markedly different rates and they require special dedicated surveys to look at rates and causes of morbidity and mortality within the group or area.

A related issue is that when sample sizes are small and are subdivided into even smaller groups, the confidence intervals are increased. Thus, the confidence intervals around the sub-classifications are large and with

each further sub-classification they get much larger. This means that there are problems to interpretation of the numbers. First, rare causes at the national level do not show up in the numbers, and second, less rare causes have very large confidence intervals, which make direct comparisons difficult because of problems with statistical significance. The overall resolution of the survey at the national level is high but it falls quickly when resolving causes of death by rural/urban, age, sex and cause.

While the issues of sample size and power, and the consequent problems with confidence intervals and statistical significance are impediments to detailed comparisons of different sub-groups it is important to recognize that the overall patterns of mortality, regionally and nationally, and the trends defined by the sample are internally consistent and validated by demographic techniques such as life table analysis (Appendix B). This consistency adds confidence to the findings at the national and regional levels.

The issue of small numbers (rare events) is the single greatest constraint for CAIS. There are others, particularly the difficulty in obtaining sufficient information after the fact, sometimes almost a year later, to allow complete and accurate classification of the cause of illness or death. This is a generic limitation of the epidemiologic method and not due to CAIS.

Table 2.4 shows the numbers and rate per 100,000 children in each group for the sample population, and for deaths and morbidities within the recall period (3 years for mortality and 1 year for morbidity).

Table 2.4: Number of events in the sample population and rate (per 100,000) over three years of recall											
Age	Sample population	Mortality events								Morbidity events	
		Injury		CD		NCD		UTD		Injury	
		number	rate	number	rate	number	rate	number	rate	number	rate
Infant	5,944	13	217.25	212	3570.42	323	5431.64	81	1370.16	68	1135.60
1-4 years	21,600	53	245.38	120	554.97	32	148.80	45	207.33	1017	4706.02
5-9 years	30,809	31	99.00	52	167.16	12	37.33	20	63.29	1500	4868.71
10-14 years	35,520	34	95.72	35	98.54	20	54.90	17	47.86	1438	4047.02
15-17 years	20,420	42	203.23	19	90.60	14	66.11	24	115.08	828	4052.50
0-17 years	114,293	172	150.42	437	382.44	399	349.54	186	162.94	4849	4242.62

## CAIS 2007 and CDHS 2005: Similarities and differences

The CAIS has a great deal in common with the Cambodia Demographic and Health Survey (CDHS 2005). The sampling frame for both was the same (1998 Cambodia General Population Census plus 166 villages which were not enumerated during the 1998 GPC) and the time of field work was about 1 to 1.5 years apart (CAIS February 2007 – March 2007; CDHS September 2005 – March 2006). Thus, it is natural for users of the data to compare findings. When doing so, it is necessary to understand the differences in the surveys in order to understand any differences in the results.

The first major difference relates to sample size:

- The CDHS sample size was 14,243 households
- The CAIS sample size was over four times larger, with 66,576 households.

The second major difference relates to the sampling scheme:

- The CDHS used a complex sampling scheme that defined 19 sampling domains and allocated the 14,243 households to the 19 sampling domains. Various combinations of these domains are used to construct estimates for all of Cambodia, for urban and for rural areas of the country.
- The CAIS used a sampling scheme that selected 66,576 households with the only differences being urban areas (14% of Cambodia) had more households allocated to them than rural areas (86% of Cambodia) in order to have sufficient ability to measure rare events in this smaller number of households.

The third major difference relates to the respondents:

- CDHS questions and respondents varied according to the schedule and module for each component part of CDHS. Questions specific to accidents were contained only in the Household Schedule where the respondent for an accident occurring to a child in the household may have been any adult member of the household and not the child's mother as was the case in CAIS.
- In addition, a special module of the CDHS Individual Woman Schedule elicited information on cause of death (including injury) among a 50% subset of mothers and limited to children born in the past three years. As a result, the sample size for these early childhood deaths is extremely small. Thus, the sample did not capture deaths occurring from age 3 onward and is also heavily focused on early child deaths, mainly in infancy.
- CAIS questions on all accidents for children whether fatal or non-fatal, were asked of all mothers regardless of when the child was born.

The fourth major difference relates to the way the questions were asked:

- CDHS injury questions were asked without visual aids or specific definitions about what an injury was.
- CAIS questions were asked in a specific, structured manner developed for the injury surveys. The process was that first the interviewer explained what injury was, using several common terms, and showed the respondent pictures of a child experiencing each type of injury, while simultaneously explaining the pictures with local terms and slang used for that type of injury. Each of the 14 different subtypes of injury was shown/explained this way to first orient the respondent on this unfamiliar subject, and then the respondent was asked whether any of those injuries had occurred.

Given these differences, it should be apparent that not all measures will be the same between the two, even when they are measurements of the same indicator. While both are sample surveys, the samples and the survey procedures were different as noted above. Some measured differences will relate to the size of the samples with variability due to sampling error. Some will be due to different definitions of questions and techniques of asking; some to the difference in respondents, some to the differences in recall period, etc. It should be apparent that despite seeming to share many similarities, in reality there are many differences and these differences will result in differing results.

For the most part, the differences are minor. Two key measures are very similar in both surveys: the infant mortality rate (IMR) and under-five mortality rate (U5MR) which are both bedrock indicators for child health. Allowing for the time differences in the two surveys, the expected CDHS IMR in 2006 would have been 59.5 with confidence intervals of 66.4 and 52.7. The CAIS IMR of 52.9 with confidence intervals of 58.6 and 47.6 is statistically indistinguishable. Similarly, the expected CDHS U5MR of 75.2 with confidence intervals of 82.8 and 67.6 is statistically indistinguishable from the CAIS U5MR of 74.4 with confidence intervals of 80.8 and 68.3. The close agreement of these key measures lends confidence to estimates derived by both.

However, for the issue of injury, there are very large differences. The CAIS had a key goal of measuring injury in great detail in children and their parents. The major measures are related to injury, so the questions and methodology have been repeatedly tested and validated in previous surveys in neighboring countries. The major measures in the CDHS survey are related to non-injury aspects of health outcomes, behaviors and knowledge in mothers and children; these appear in the Individual Women's Schedule and have been repeatedly tested and validated in other DHS surveys.

CDHS questions about injury are in the Household Schedule and are not asked or subject to validation with the same rigor as the questions in the Individual Women's Schedules. As mentioned, the respondent will in many instances not have been the child's mother and hence it is likely that many non-fatal accidents went unreported. In addition, although age and sex data is available in the Household Schedule, the ages are estimates provided by the respondent and not in any way validated or checked, unlike ages in the Individual Women's Schedule where ages are calculated from date of birth. Therefore errors are likely with respect to the reported ages of children with non-fatal accidents. No age or sex data is available in this schedule for fatal accidents, since the Household listing is limited to living members. Age and sex data for fatal accidents is available in the Individual Women's Schedule only for the 50% of the sample for which the Cause of Death Module was completed and only for children born in the past three years.

When comparing the two surveys on the domain of injury, there are large differences. For example, CDHS estimates about 1% of children 0-9 years of age were non-fatally injured in the previous year, and CAIS finds about four times this percentage (4.4%). CDHS found road traffic to be the most common cause of injury in this same age group of children and CAIS found falls to be most common.

On closer inspection of the reasons for these large differences, it appears that the measurement of age is a key factor. As mentioned, ages for victims of nonfatal accidents are subject to considerable error in the CDHS. In addition, the fact that some of the CDHS data will have come from respondents other than the child's mother is likely to have contributed to under-reporting. As a result, the injury information in CAIS appears to be the more accurate with respect to non-fatal injuries.

With regard to fatal child injuries, the CAIS is the only dataset which collected this information in a manner that captured ages of all children. The CDHS Household Schedule did not record ages for victims of fatal accidents and the Individual Women's Schedule recorded this information for only a small subset of children who died in the first years of life. Hence no conclusions can be drawn with respect to fatal accidents in children from the CDHS, whereas the CAIS provides detailed information.

# Chapter 3

# Mortality Overview

## Introduction

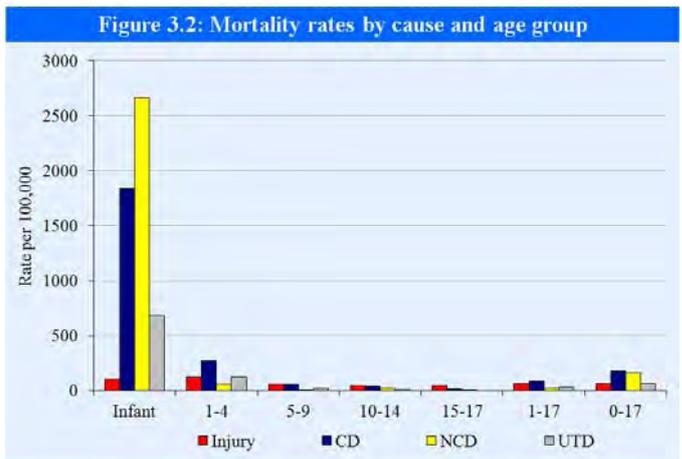
The 2007 Cambodia Accident and Injury Survey (CAIS 2007) represented a remarkable achievement, as it was the largest community-based study of child mortality and morbidity ever conducted in Cambodia. It used over 66,500 households containing 323,129 residents with 133,322 children. The very large sample size was necessitated by the rarity of child deaths. While child deaths are spoken of as being at very high levels, this is in a comparative sense, when they are compared to high income countries. In a purely statistical sense, any child death is a rare event: in this survey, to find a child death from any cause in the preceding year required visiting almost 200 households. To find a child death from injury required visiting over 1,200 households.

It was necessary to visit the households to find these deaths because in Cambodia, just as in other low and middle income countries, deaths rarely occur in hospitals. This is especially true for injury, as these are sudden, unexpected deaths and virtually all of them occur in the community. For children, they often are near or in the home. Since a dead child is rarely if ever brought to the hospital, the child injury death is unknown in the medical reporting system. Hospitals and clinics see only a very select type of injured child; the non-fatally injured child, and most commonly, a child with bloody injuries or with broken bones from trauma.

To get a true picture of child injury, it is necessary to measure it where it occurs, in homes and the community. Relying on hospital reports presents a very biased picture of injury in other low and middle income countries, and the CAIS shows this to be the case in Cambodia as well. The following sections describe the pattern of fatal child injury found in the survey.

Injury in infancy is low in proportion when compared to the other causes because the overwhelming numbers of infant deaths are due to issues in pregnancy, child-birth and the first month of life. After infancy, the proportional contribution of injury increases in each age group as non-communicable (NCD) and communicable (CD) causes decrease. After infancy, injury accounted for nearly one-third of all child deaths (Figure 3.1).

Figure 3.2 uses rates rather than proportions. It shows the overwhelming contributions of CD and NCD related to pregnancy, the birth and the first month of life. Because these are so large, when compared to these injury accounted for just 2% of infant mortality.



In the verbal autopsy classification system, low birth weight and birth injury, two major causes are classified as NCD deaths; and others in the first month of life are due to infectious causes. These proportionally overwhelm injury in infancy, but are absent throughout the rest of childhood. Because they are so large, they dwarf the contribution of injury to infant deaths. However, the graph also illustrates that actual injury deaths in infancy are among the highest for any period of childhood.

## Leading causes of child deaths

Most infant deaths were due to non-injury causes (Figure 3.3). Low birth weight, respiratory tract infections and infectious diarrhea were the three leading causes.

Figure 3.4 illustrates that drowning was the leading cause of death in toddlers by injury and the second leading cause of death in this age group overall. Road traffic, burns, and sharp objects were the other leading causes of injury death for children in this age group.

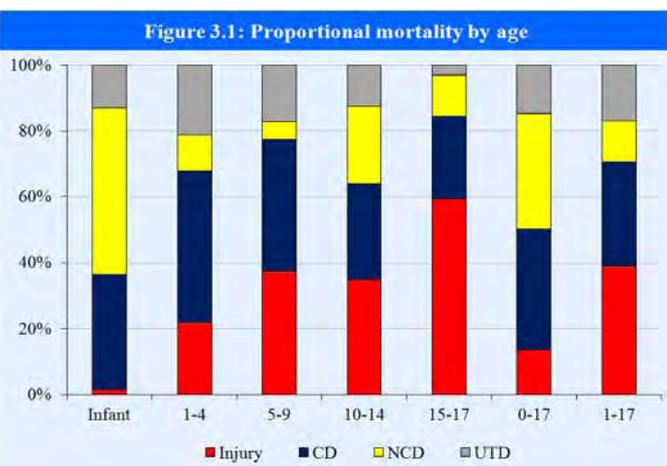


Figure 3.3: Leading causes of death in infants\*

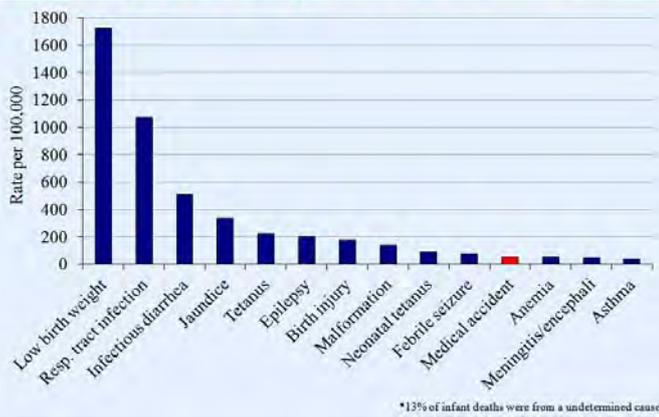
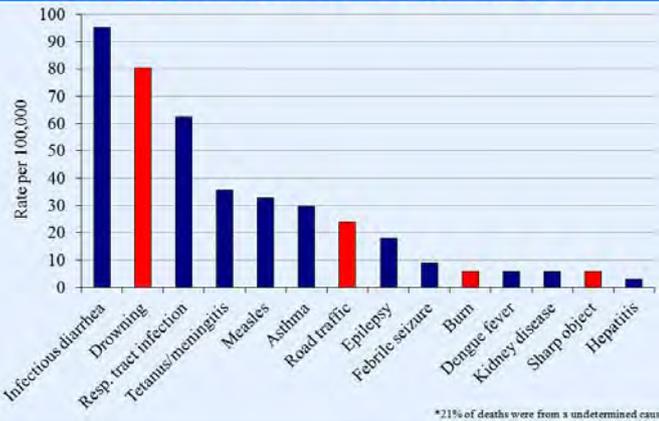


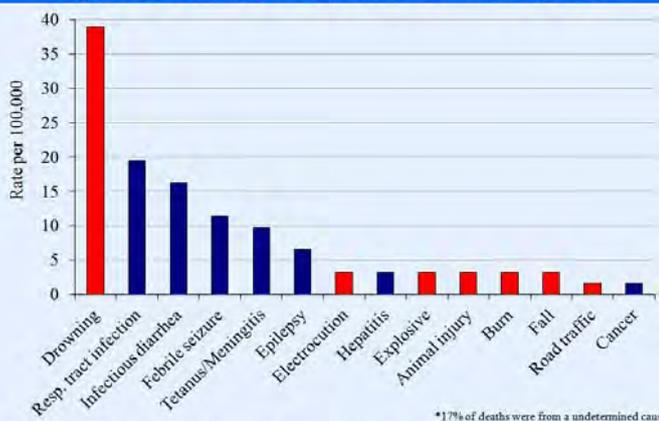
Figure 3.4: Leading causes of death in children aged 1-4\*



Infectious diarrhea was the leading cause of death amongst toddlers, accounting for 95.2 deaths per 100,000 children. Overall communicable disease (CD) caused 272.6 deaths per 100,000 and NCD caused 63.2 deaths per 100,000. Cause of death information was largely determined by verbal autopsy, as a result the cause of 21% of deaths in this group were unable to be determined.

Figure 3.5 illustrates that drowning was by far the leading cause of death in children aged 5 to 9, responsible for the deaths of 39.0 per 100,000 children in this age group. Drowning caused over twice as many deaths in children this age as the next leading cause, respiratory tract infections, with a rate of 19.5 deaths per 100,000 children. Electrocutions, explosive injuries (including

Figure 3.5: Leading causes of death in children aged 5-9\*



unexploded ordnances), animal injury, burns and falls were all significant causes of death in this age group, with each category accounting for 3.3 deaths per 100,000 children. Road traffic accounted for 1.6 deaths per 100,000 children.

Injury accounted for two of the four leading causes of death in children in the age group 10-14. Figure 3.6 illustrates that, in children aged 10 to 14, drowning and tetanus/meningitis shared the leading cause of death (15.5/100,000). Respiratory tract infections and road traffic shared the third leading cause of death. Both accounted for 12.7 deaths per 100,000 children. Asthma and anaemia tied as the fifth cause of death (8.5/100,000 each) and electrocution deaths were seventh (7.0/100,000), while explosive injury, animal injury and violence were also leading causes of death in this age group (2.8/100,000 each).

Figure 3.6: Leading causes of death in children aged 10-14\*

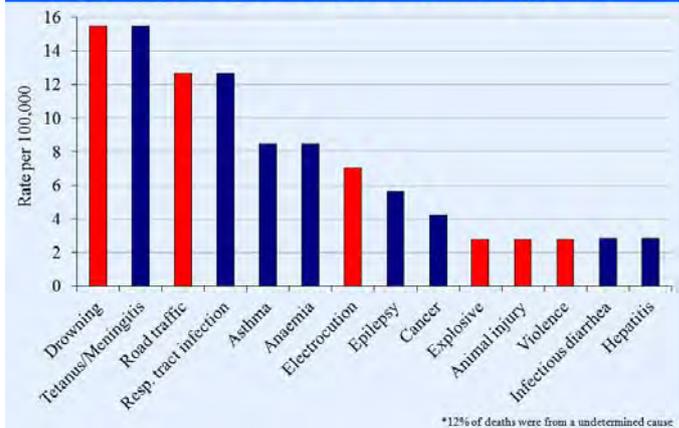


Figure 3.7 illustrates that the leading cause of death in the 15 to 17 year old age group was suicide (17.1/100,000). Respiratory tract infections and asthma shared the second leading cause of death, with each category accounting for 9.8 deaths per 100,000 children. Road traffic was the fourth leading cause of death in this age group (7.4/100,000). Drowning, explosive injury, falls, poisons and injuries inflicted by animals were the other causes of injury death for this age group.

Figure 3.7: Leading causes of death in children aged 15-17\*

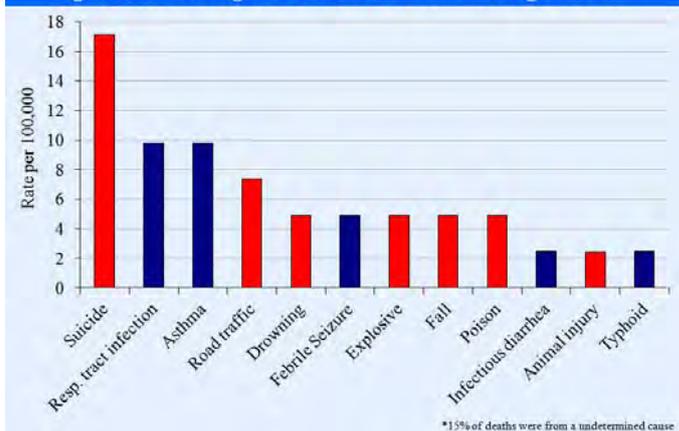
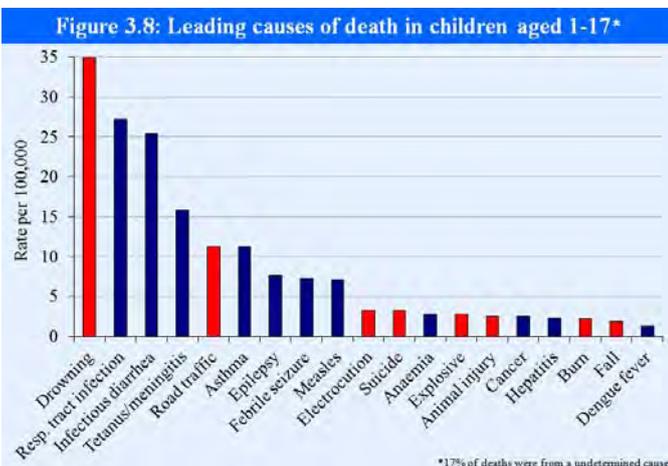


Figure 3.8 illustrates that overall more children aged 1 to 17 in Cambodia die each year from drowning than from any other single cause – 35.0 per 100,000. The second, third and fourth leading causes of death were all disease related. Road traffic was the fifth leading cause of death, killing 11.3 per 100,000 children. Other leading causes of injury death were electrocution, suicide, explosive injury, injuries inflicted by animals, burns and falls, all at levels well below that of drowning and road traffic.



Gender differences are also visible in child death rates. Figure 3.9 illustrates the 19 leading causes of all child deaths. In addition to the male predominance in drowning, males were also killed more frequently from road traffic, burns, falls, suicide, electrocution and animals. Females predominate in injury deaths from explosive injuries.

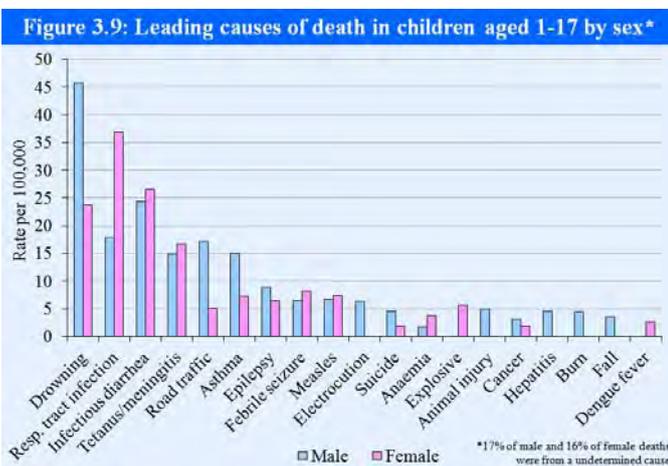


Table 3.10 illustrates the estimated frequency of child deaths from injury in Cambodia. The calculation for time between each death ignores the fact that most child injury occurs during the daylight hours and simply divides the 24 hours in a day by the number of fatal injuries in that time period. It is perhaps simplistic, but it helps to understand the urgency of the injury epidemic that is occurring in Cambodian children. Every 4 hours and 12 minutes a child dies from drowning; every 13 hours and 29 minutes a child dies in a road traffic accident, and every 2 hours and 11 minutes a child dies from some cause of injury.

**Table 3.10: Estimated numbers of child deaths from injury (0-17)\***

Injury Type	Per Year	Time between each death
Drowning	2,090	4 hours
Road traffic	650	13 hours
Electrocution	190	1.9 days
Suicide	190	1.9 days
Medical accident	160	2.3 days
Explosive injury	130	2.8 days
Animal injury	130	2.8 days
Burn	130	2.8 days
Fall	110	3.3 days
Suffocation	80	4.6 days
Poison	60	6.1 days
Cuts and sharp objects	50	7.3 days
Violence	50	7.3 days
<b>Total</b>	<b>4,020</b>	<b>2 hours</b>

\* These estimates are made by projecting the age-specific mortality rates from the sample to the national population, and rounded to the nearest 10.

## Chapter 4

# Morbidity Overview

### Introduction

Mortality is easy to measure because of its dichotomous outcomes, i.e. being alive or dead. Morbidity is more difficult to measure because of large variations in severity. It has a continuous distribution of severity from insignificant bumps or bruises that only require self-treatment, through increasing severity when needing medical care, then minor surgery done in the casualty department, then hospitalization for major surgery, and the most severe level, which is permanent disability. This spectrum renders injury morbidity difficult to define and measure in a standardized way across populations. This is the primary reason why indicators of child health available at the regional and global levels have traditionally utilized mortality measures.

While nonfatal injury may be difficult to measure, it is very important to do as it represents the majority of the economic and social costs of injury. A fatally injured child is a tragedy for the child's family and friends, but it is a time-limited one that usually does not have a severe recurrent set of costs. A seriously injured child that requires multiple surgeries with the attendant months of acute rehabilitative care can place an unbearable economic burden on even a middle class family and often jeopardizes the integrity of low and lower middle class families. The severe social costs and economic consequences that result from a permanently disabled child almost always result in a downward trajectory for the child and the family as well.

### How minor is moderate injury?

The survey only counted morbidities that were significant. "Moderate" level injuries were the lowest level included, which required the child to visit a medical provider, miss one day of school or work, or restrict daily activities for one day or more. This excluded the injuries so minor they involved no financial or other cost (such as a minor bruise or a scraped knee). More than 5,600 incidents of non-fatal injury in children aged 0 to 17 were available for analysis from the survey sample. Of these, 99% occurred post infancy.

### External causes of childhood injury morbidity

Figure 4.1 illustrates that falls were the leading cause of injury morbidity among infants, followed closely by burns. At a rate of 403.8/100,000, fall injuries serious enough to require medical care occurred in about one out of every 250 infants in the year prior to the survey.

Figure 4.1: Leading causes of injury morbidity in infants

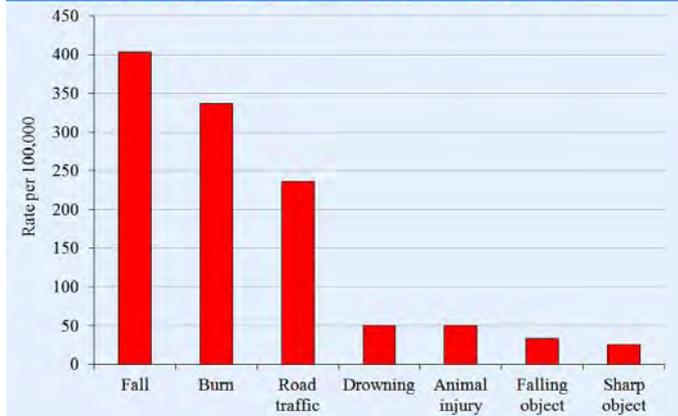
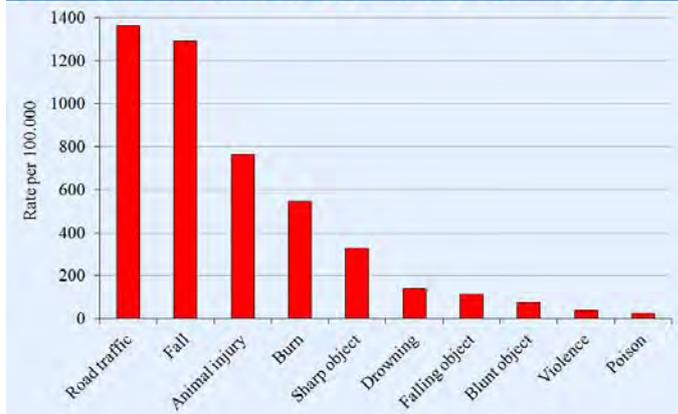


Figure 4.2 illustrates that road traffic surpasses falls to be the leading cause of injury morbidity in the 1 to 4 age group. One out of 75 children 1-4 years old was injured by road traffic. In this age group, road traffic and falls account for over half (56%) of all injury. Animal injury and burns were the third and fourth leading cause of injury respectively.

Figure 4.2: Leading causes of injury morbidity in children aged 1-4



Animal injury is the leading cause of injury morbidity in the 5 to 9 age group, where one in 70 children were injured by animals (Figure 4.3). This was followed closely by road traffic. In this age group, the third and fourth leading causes of injury were falls and cuts from knives and other sharp objects.

Figure 4.4 illustrates that road traffic and injury caused by animals are essentially tied for first place, and about one out of every 48 children were injured by one of these two causes. The top four causes of injury morbidity (animal injury, road traffic, falls, and sharp object injury) account for nearly 9 out of 10 non-fatal injuries in this age group.

In the 15 to 17 year old age group, road traffic was, by

Figure 4.3: Leading causes of injury morbidity in children aged 5-9

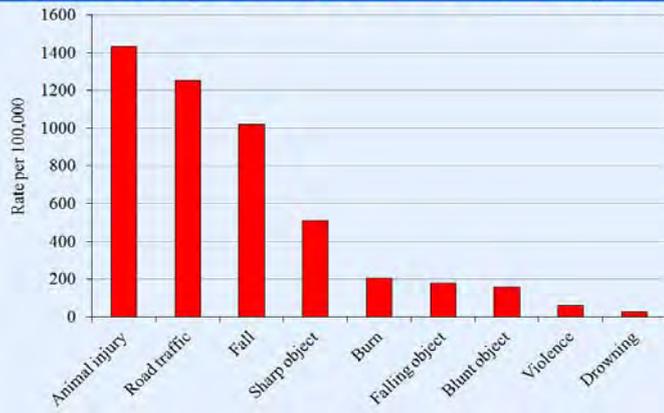
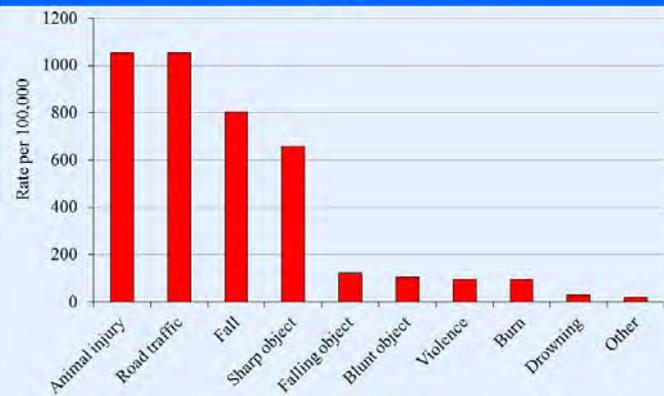
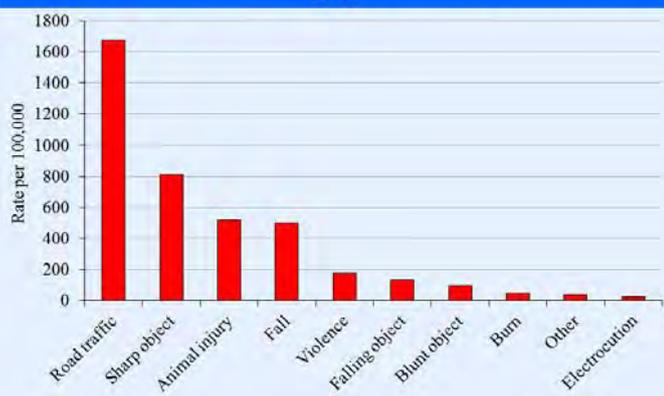


Figure 4.4: Leading causes of injury morbidity in children aged 10-14



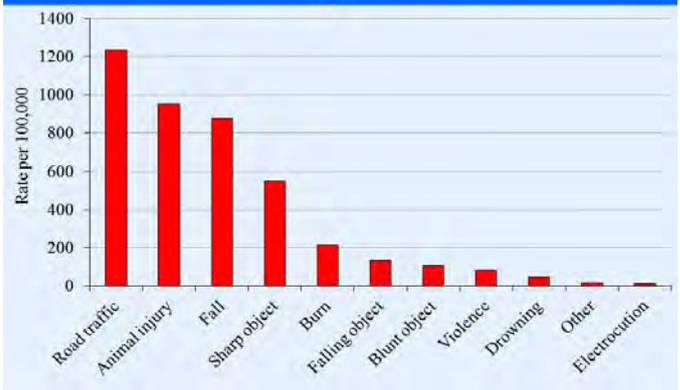
a large margin, the leading cause of injury morbidity. It affected about one in every 60 children in the age group (1674.9/100,000). Road traffic was double the rate of the second leading cause of injury morbidity, sharp object injury (Figure 4.5).

Figure 4.5: Leading causes of injury morbidity in children aged 15-17



The high non-fatal road traffic injury rate in the 15 to 17 year olds skews the distribution of morbidity for all children aged 0 to 17. This can be seen in Figure 4.6, (top of next column) and so road traffic became the leading cause of injury for all children. Animal injury and falls, which are prevalent in every age group, were second and third respectively. The fourth and fifth causes of injury morbidity in all children aged 0 to 17 were cuts from sharp objects and burns respectively.

Figure 4.6: Leading causes of injury morbidity in children aged 0-17

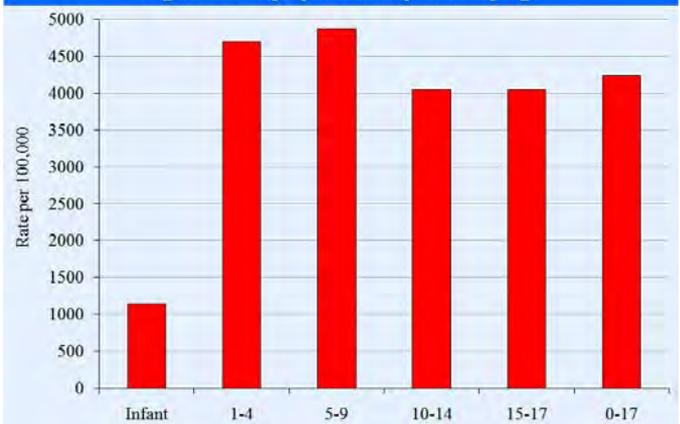


### Age specific causes of injury morbidity

Injury morbidity rates were similar across all age groups with the exception of infants, whose rates were about one quarter that of children after infancy (Figure 4.7). Injury rates were 4,242.6 per 100,000 for children aged 0 to 17, which means about one child out of every 24 was injured in the year prior to the survey.

All types of injuries combined were frequent enough that more than one in every 88 infants was injured in the year prior to the survey and about one out of every 21 children 1-17 years old was injured in the year before the survey.

Figure 4.7: Injury morbidity rates by age



Similar to mortality, there was strong gender predominance for non-fatal injury in males. Figure 4.8 illustrates this male predominance in all age groups. Males also experienced greater morbidity rates than females in every specific injury type, except suffocation and medical accidents (Figure 4.9).

Figure 4.10 illustrates that there was no significant difference in morbidity rates between urban and rural children across all age groups, although in children under 5 there was a trend towards higher morbidity rates in rural children.

Figure 4.11 shows that in the two leading causes of injury morbidity, road traffic and animal injury, urban children had slightly higher rates than those of rural

Figure 4.8: Injury morbidity rates by sex and age group

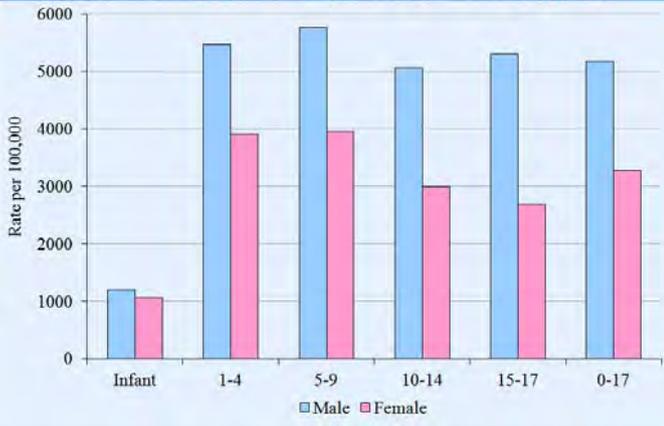


Figure 4.9: Specific non-fatal injury rates by sex in children aged 0-17

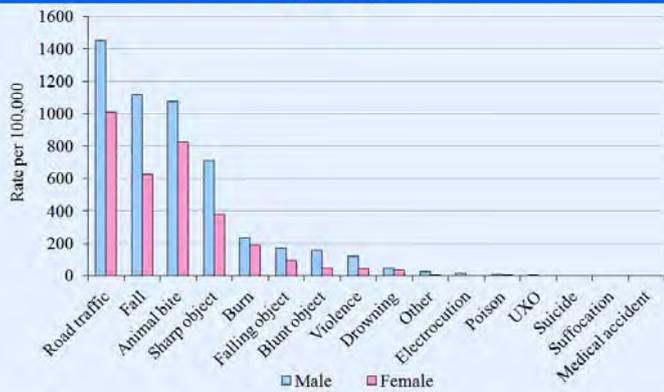


Figure 4.10: Injury morbidity rates by place of residence and age group

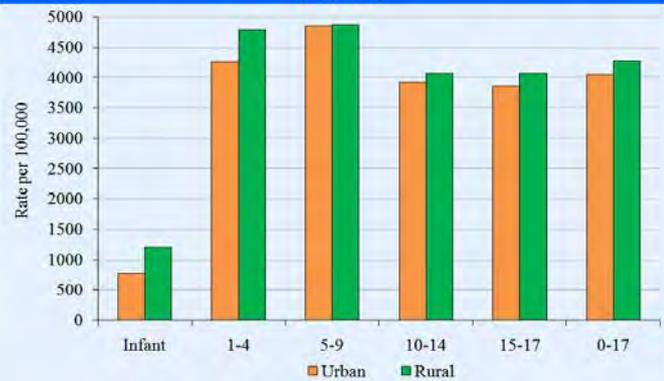
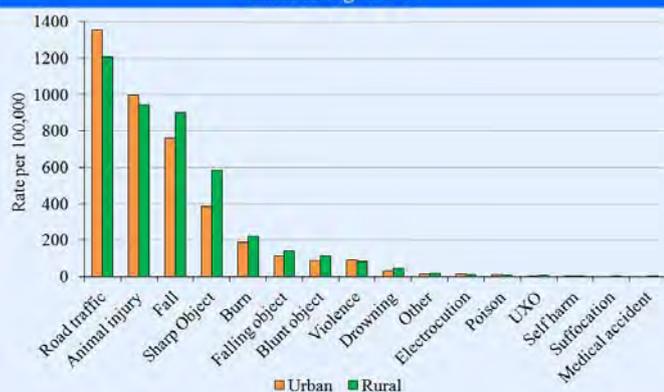


Figure 4.11: Specific non-fatal injury rates by place of residence in children aged 0-17



children, while rural children had higher rates of morbidity due to falls, cuts from sharp objects, and most other injury categories.

## Injury Severity

Non-fatal injuries were categorized with four severity levels: moderate, major, serious and severe.

- **Moderate injuries** were those that either generated a visit to a care provider or caused the individual to miss one or more days of school or work.
- **Major injuries** required one to nine hospital days and normally did not involve major surgery.
- **Serious injuries** required hospitalization for 10 or more days and generally required major surgery.
- **Severe injuries** resulted in permanent disability, such as the loss of a limb or a sense (sight, hearing, etc).

It is important to note that the classification scheme of severity of injury is made as a practical compromise. There are many ways to assign increasing values of severity, but most are either impractical or difficult to use in comparisons. Using hospitalization as one measure of severity and secondarily the number of days hospitalized provides a practical system that allows comparison. It does, however, require access to a hospital, and this varies by venue (more hospitals in urban areas) and by income (most hospital admissions are on a 'pay as you go' basis). Thus, there are differences in actual access that make the classification scheme imperfect. The same issues of access (proximity and cost) apply in wealthy countries as well, but are considered issues of equity, rather than issues of the classification system itself.

The largest proportion of injuries for every age group is moderate, followed by major, and serious and severe interchanged depending on age group (Figure 4.12).

Figure 4.12: Injury severity rates by age group

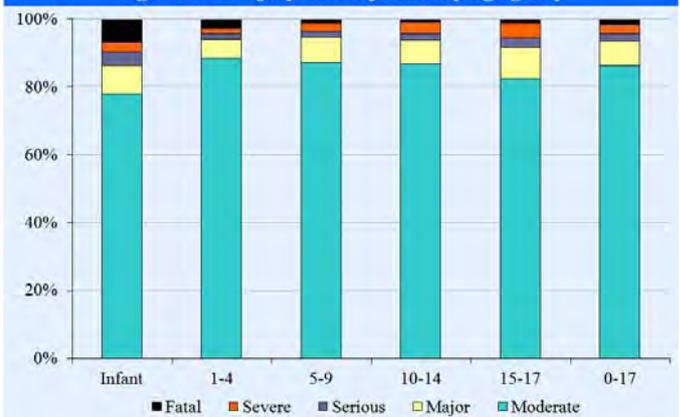


Figure 4.13 illustrates a pattern of male predominance in every severity level, while Figure 4.14 illustrates rural predominance in every severity level.

## Permanent disability from injury

Permanent disability is the most severe outcome from non-fatal injury. Because the impact is permanent, it is

Figure 4.13: Injury severity rates by sex in children aged 0-17

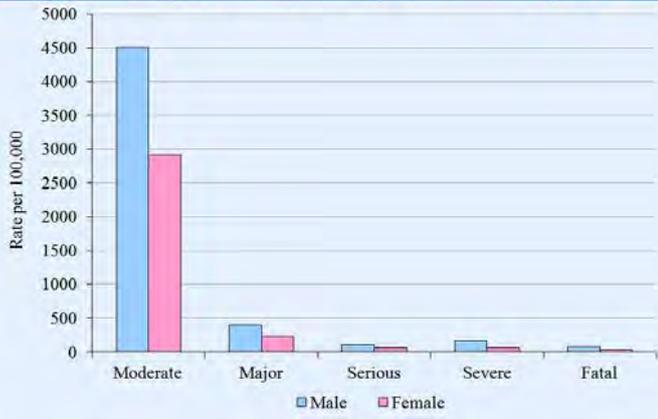
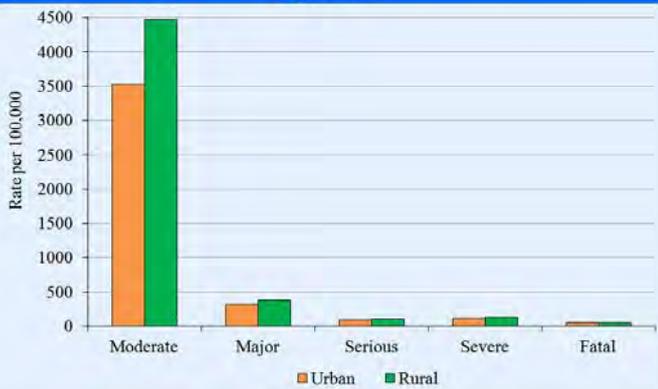


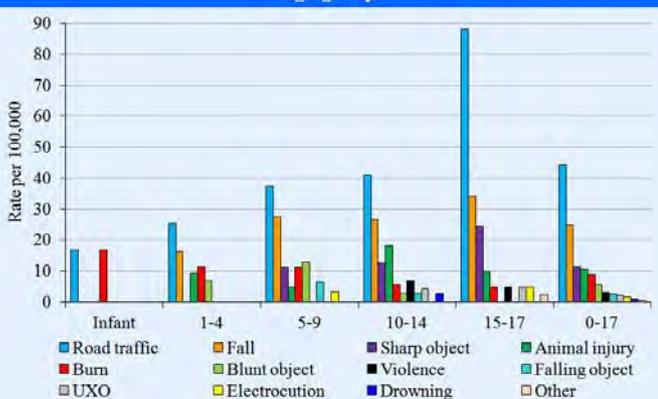
Figure 4.14: Injury severity rates by place of residence in children aged 0-17



considered separately. Permanent disability usually has higher costs and larger social burdens than fatal injury.

Figure 4.15 illustrates that the rate of permanent disability in children increased as the child's age increased. Road traffic injury was the leading cause of permanent disability in every age group, followed by falls in all age groups (except infants where the second leading cause of permanent disability was burns). In toddlers (1-4 years old) burns, animal injury and blunt objects were other causes of permanent disability.

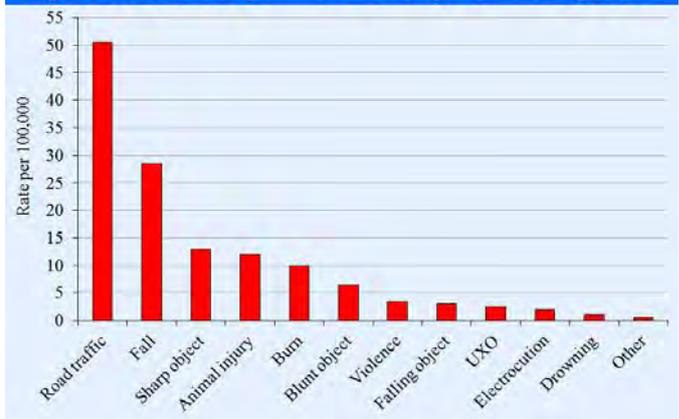
Figure 4.15: Causes of permanent disability in children by age group



As children increased in age the variety of types of injuries resulting in permanent injury also increased. Children aged 15-17 had the highest rate of permanent disability at a rate of 178.8 per 100,000.

Overall, road traffic, falls and sharp objects accounted for over two thirds (69%) of all permanent disability in children aged 0 to 17 as seen in Figure 4.16.

Figure 4.16: Causes of permanent disability in children aged 0-17



There is a clear predominance of males in permanent disability, except in infants where there is no difference between the sexes. Males show an increase in permanent disability as age increases while females show no clear trend across age groups. There is no clear difference between rural and urban children in regard to permanent disability, except in infants where only rural infants were found to have suffered a injury resulting in permanent disability.

### The impact of injury morbidity

Figure 4.17 illustrates the full extent of morbidity caused by non-fatal injury. Fatal injury is the ‘tip of the iceberg’ and the majority of the economic cost and social burden of injury is due to non-fatal injuries. Each morbidity classified as “moderate” equals at least one day of school or work time lost, or a visit to a medical provider. Each morbidity classified as “major” implies a financial cost to the individual’s family of at least one day in a hospital, and each morbidity classified as “serious” includes a cost of at least 10 days in a hospital. Thus for every child that died from an injury, 1.8 suffered a permanent disability, 1.3 spent at least ten days hospitalized, 4.7 spent between one and nine days hospitalized, and 56.5 missed at least one major day of school or work.

Figure 4.17: Ratio of Severity of injury in children aged 0-17

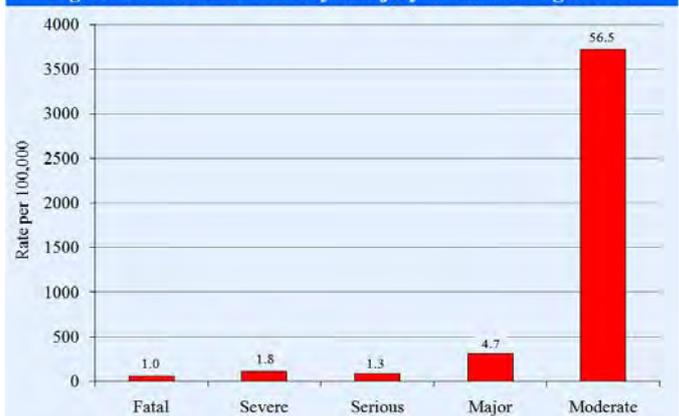


Table 4.18 provides estimates of the total number of children permanently disabled in 2007, the year the survey was conducted.

Table 4.18: Estimated number of children permanently disabled from injury (0-17)*		
Injury Type	Per Year	Time between injuries
Road traffic	2,700	3 hours
Fall	1,520	6 hours
Sharp object	690	13 hours
Animal injury	640	14 hours
Burn	530	17 hours
Blunt object	350	1.0 days
Violence	190	1.9 days
Falling object	160	2.3 days
Explosive injury	130	2.8 days
Electrocution	110	3.3 days
Drowning	50	7.3 days
Other**	30	12.2 days
<b>Total</b>	<b>7,100</b>	<b>1.2 hours</b>

Table 4.19 estimates the total number of children injured in 2007, the year the survey was conducted.

Table 4.19: Estimated number of child morbidities from injury (0-17)*		
Injury Type	Per Year	Time between injuries
Road traffic	75,340	7 minutes
Animal injury	58,170	9 minutes
Fall	53,630	10 minutes
Sharp object	33,570	16 minutes
Burn	13,030	40 minutes
Falling object	8,120	1 hour
Blunt object	6,490	1 hour
Violence	5,130	2 hours
Drowning	2,780	3 hours
Other**	1,010	9 hours
Electrocution	610	14 hours
Poison	480	18 hours
Explosive injury	290	1.3 days
Suicide	130	2.8 days
Suffocation	110	3.3 days
Medical accident	110	3.3 days
<b>Total</b>	<b>259,000</b>	<b>2 minutes</b>

\* These estimates are made by projecting the age-specific rates from the sample to the national population, rounded to the nearest 10.

\*\* Other refers to sprains, strains and other injuries that were difficult to classify using the CAIS functional injury classification system

## Chapter 5

# Drowning and Suffocation

### Introduction

Drowning is simple to define as submergence in water, but classifying it as an injury is not simple. For example, drowning when swimming for pleasure can easily be classified as drowning. However, if the swimming was to escape a natural disaster, for example a flash flood or the sinking of a ship, it could also be classified as a death due to a natural disaster or as a transportation fatality which are two entirely different classifications.

In CAIS, fatal drowning was defined as death resulting from submersion in water; non-fatal drowning victims were submerged but did not die. It did not matter what the circumstances were, whether from sinking of a ship or from a flood, if the injury resulted from submersion in water it was considered a drowning.

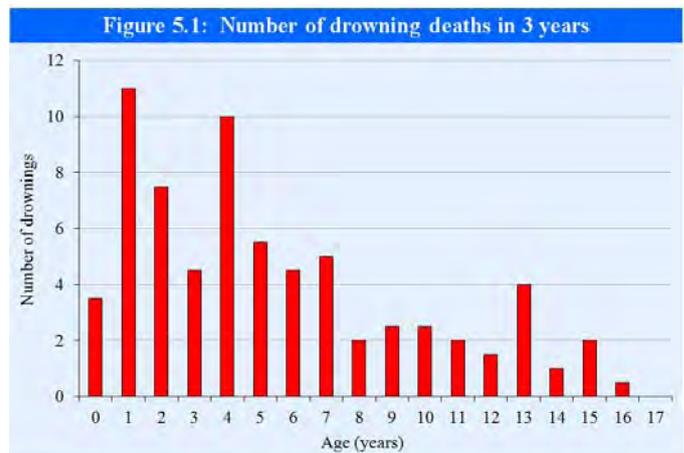
Drowning occurs because of the exposure of a child to water. This occurs with very high frequency in low and middle income countries (LMICs). These countries usually have high birth rates, and this means that the second or third child in a family is often being supervised by a sibling only two or three years older. LMICs are mainly rural, and there are many ponds, ditches and streams nearby houses to facilitate cooking, washing of clothes, sanitation and providing water for animals. Thus, the large number of very young children who often lack adult supervision, but spend much of their time in close proximity to water hazards, leads to very high drowning rates. Cambodia is no exception to this, and all of the above-mentioned factors are present.

Like almost all other LMICs, the magnitude of child drowning is invisible to child health policymakers in Cambodia. This is due to the speed at which death occurs in drowning. Because the time required to fatally drown is only a few minutes and the very young child is most often alone, the drowned child is rarely still alive when discovered. Even when discovered in time, few laypersons in LMICs know CPR so the child is not resuscitated. With the child already dead, there is no reason to take it to a hospital or clinic, so it is given death rites and for others life goes on.

Therefore, most drowned children are not seen at hospitals and other health facilities. This makes the epidemic of child drowning deaths invisible. The only way to make it visible is through community surveys and that was one objective of CAIS.

### Fatal drowning

Figure 5.1 illustrates the number of drowning deaths recorded during the entire three year recall period of the survey. Drowning deaths peaked when children were toddlers and decreased as children became older. The median age for drowning deaths was 5 years, which means that half of all drowning deaths occurred below that age and half above it.



Most drowning deaths occurred in children 1-4 years at a rate of 89.7 deaths per 100,000 annually (Figure 5.2). Most children in this age group cannot swim. They are highly mobile and independent of their mothers, thus increasing their exposure to water hazards such as open wells, rivers, and ponds.

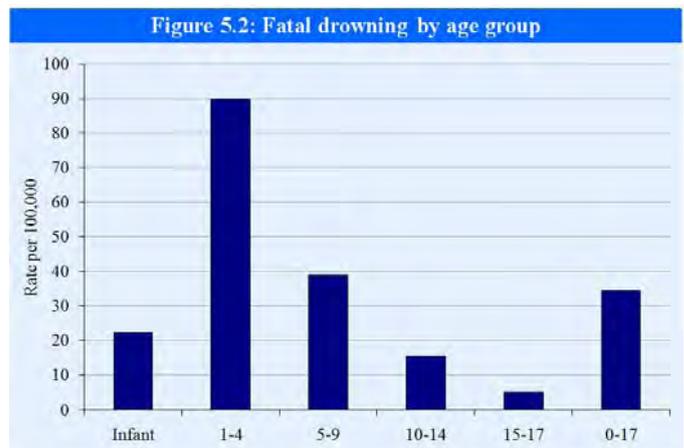


Figure 5.3 illustrates the fatal drowning rates for the year preceding the survey for each specific age group. The drowning rate was highest for two-year-olds (142.9 per 100,000), and rapidly decreased after the age of six.

Figure 5.3: Fatal drowning rate by year of age

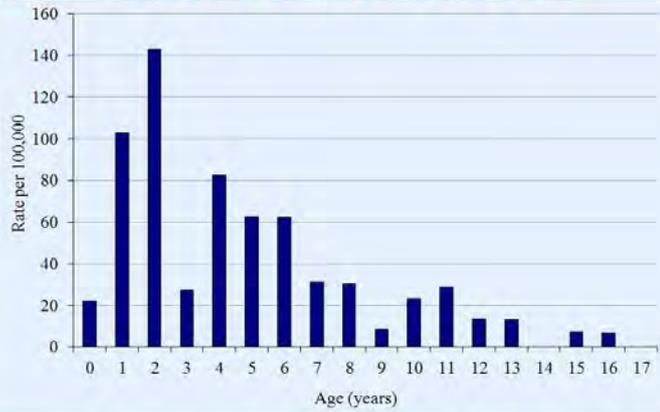


Figure 5.4 illustrates that for children 1 to 4 years old, males were more than four times as likely as females to drown. Across most age groups and in both sexes, drowning deaths occurred at high rates, thus drowning is a hazard throughout childhood.

Figure 5.4: Fatal drowning by sex and age group

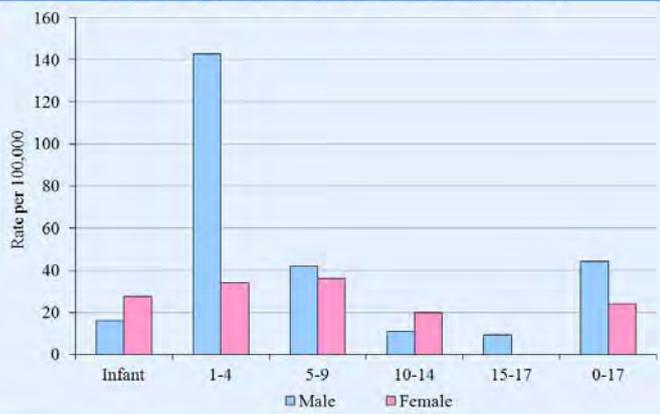
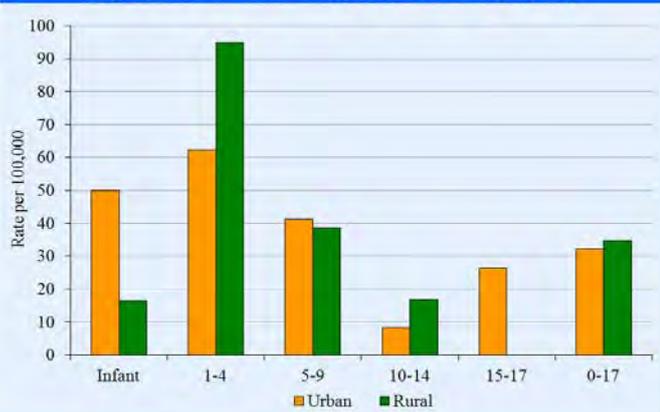


Figure 5.5 illustrates that overall (0-17) drowning occurred in both urban and rural settings almost equally (32.3/100,000 and 34.7/100,000, respectively). There were large differences in two age categories: young children, with urban infants drowning at three times the rate of rural infants (50.0/100,000 and 16.4/100,000, respectively); and children 1-4, with rural children drowning at a higher rate of 95.0 per 100,000 children, compared to urban children (62.3/100,000). No rural drownings occurred in the 15 to 17 age group. The highest drowning rates were seen in rural males aged 1 to 4.

Figure 5.5: Fatal drowning by place and age group



## Non-fatal drowning

The highest rate of non-fatal drowning occurred in the 1 to 4 year old age group, with the second highest occurring in infants. The older age groups had lower rates of non-fatal drowning, although still at a substantial number (Figure 5.6).

Figure 5.6: Non-fatal drowning by age group

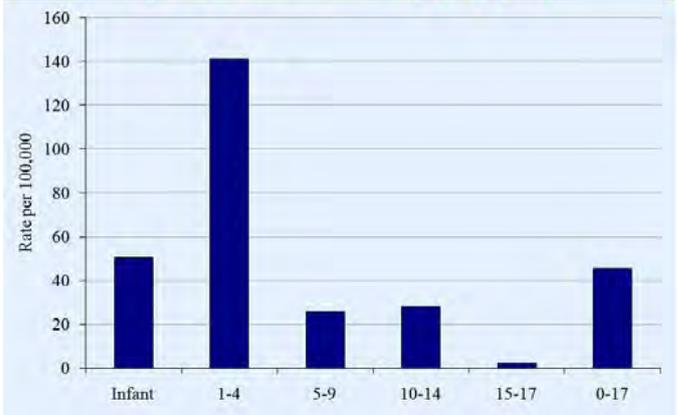
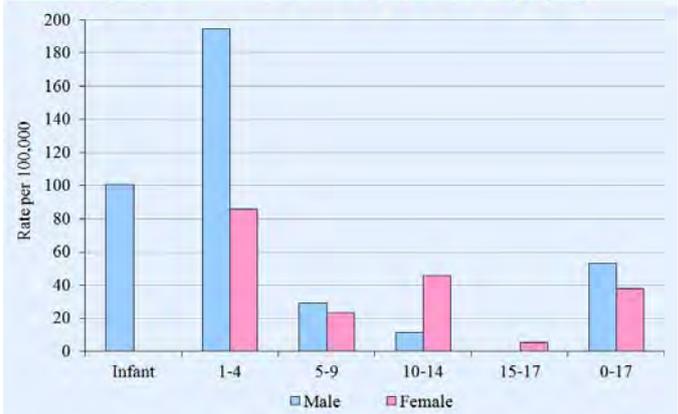


Figure 5.7 illustrates the same pattern in non-fatal drowning as in fatal drowning. Males predominated in the 1-4 age group and overall (0-17) had higher non-fatal drowning rates.

Figure 5.7: Non-fatal drowning by sex and age group



When considered by place of residence, rural children had higher non-fatal drowning rates than their urban counterparts (Figure 5.8). This held true for all age groups except the 15-17 year-olds.

Figure 5.9 illustrates that almost half (49%) of non-fatal drowning events among children were moderate in severity and did not require a hospital stay; 9% were major in severity and required between one and nine days of hospitalization, and 2% were serious enough to require an extended hospital stay of at least 10 days. Non-fatal drowning resulted in permanent disability in children 0-17 years, about 2% of non-fatal drownings resulted in permanent disability.

Figure 5.8: Non-fatal drowning by place and age group

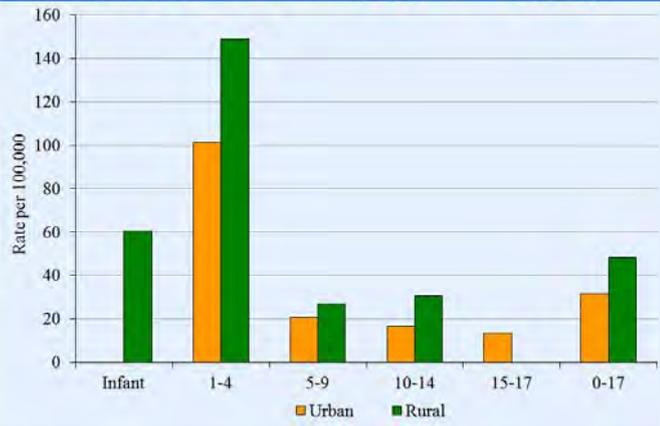
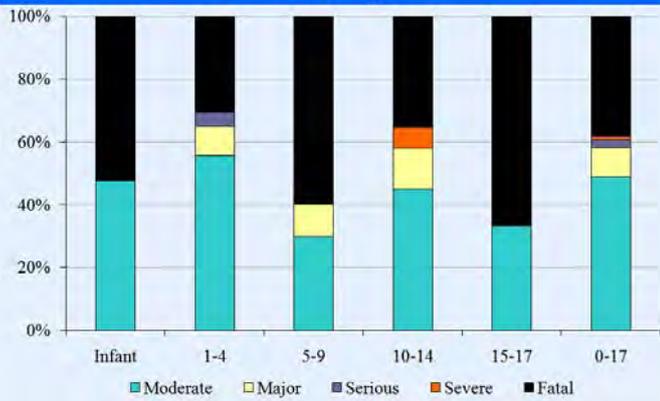


Figure 5.9: Proportion of injury by severity and age group for drowning



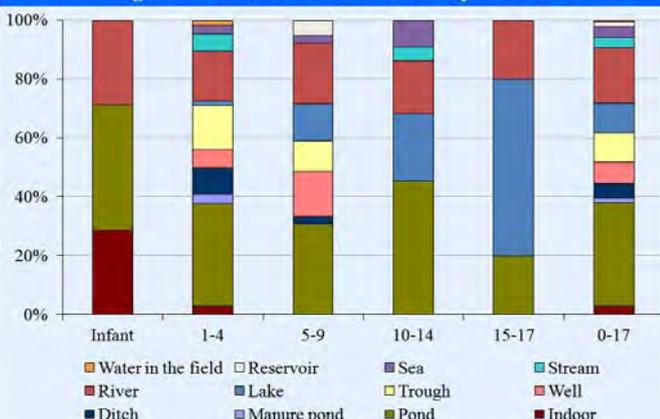
**Factors associated with fatal drowning**

The graphs that follow illustrate various environmental factors connected to drowning deaths. Unless otherwise noted all statistics presented are for children between the ages of 0 and 17.

Swimming ability in CAIS is defined as the ability to cross 25 meters of open water using any stroke or form of movement. Ninety-five percent of children over the age of four who died from drowning did not know how to swim.

Figure 5.10 shows most fatal drownings occurred in natural water bodies. Only children under 10 drowned in man-made water bodies, such as wells, troughs, reservoirs and ditches. Wells accounted for 6% of the

Figure 5.10: Place where child fatally drowned



drowning deaths in children aged 1-4 and 15% in children aged 5 to 9. Ponds were the leading place of drowning in children 0-17 years, accounting for well over a third of all fatal drownings (infant, 43%; 1-4, 35%; 5-9, 31% and 10-14, 46%), while lakes were the leading location in children aged 15 to 17 (60%). Overall (0-17) only three percent of children drowned indoors and these were primarily infants, for whom indoors accounted for one-third of all drownings (29%).

Figure 5.11 illustrates that over half (58%) of all drowning deaths occurred within 100 meters of the child’s home. In the older age categories, the locations of the water bodies were further from the house (more likely to be on routes to and from school, or around peer’s homes).

Fatal drowning events that took place in close proximity to the home were even more striking for infants and toddlers. All water bodies were within 100 meters of an infant’s home and four out of 10 were within 10 meters (40%), while three-quarters (78%) occurred within 100 meters of toddlers (1-4) homes and over half (55%) were within 10 meters of the home.

Figure 5.11: Distance from house to water body where fatal drowning took place

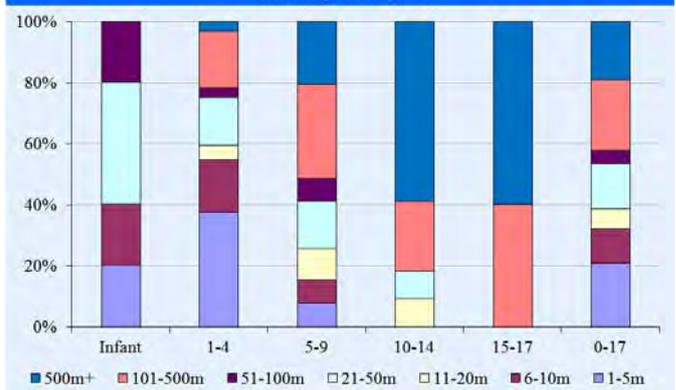


Figure 5.12 illustrates the ways in which water sources where fatal drownings took place were used. Most drownings occurred in bodies of water connected with the household. Water bodies used for “bathing/washing”, “storage” and “cooking/drinking” combined accounted for nearly half (47%) of the reported drowning locations. The single largest category was a catch all “other” grouping, which accounted for 28%. “No regular household use”, swimming” and “raising fish” accounted for the remaining locations (11%, 11% and 3%, respectively).

Figure 5.13 illustrates that while there was no dramatically evident temporal pattern to fatal drowning, there was a relationship to the rains and the flood cycle of the Mekong. Drowning deaths were consistent across the year, with the three months with the most deaths, September, October and November, corresponding to the end of the Cambodian rainy season. This corresponds to the flood cycle of the Mekong as well as

Figure 5.12: Use of water source where fatal drowning occurred

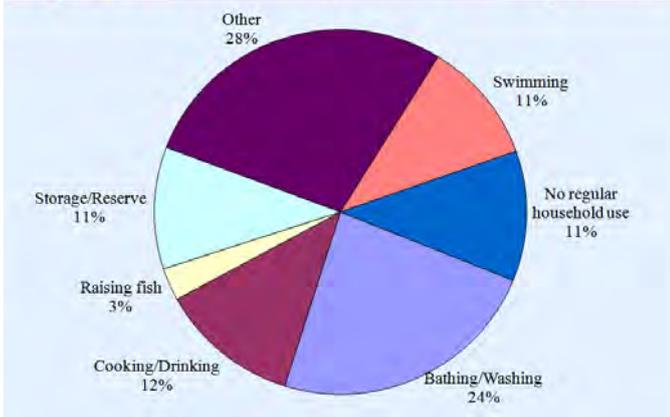
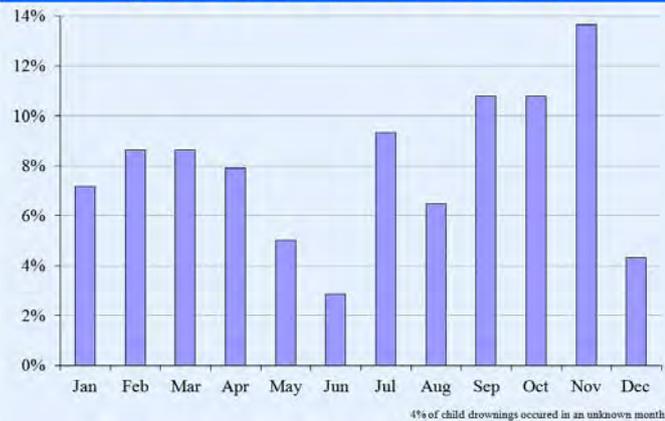


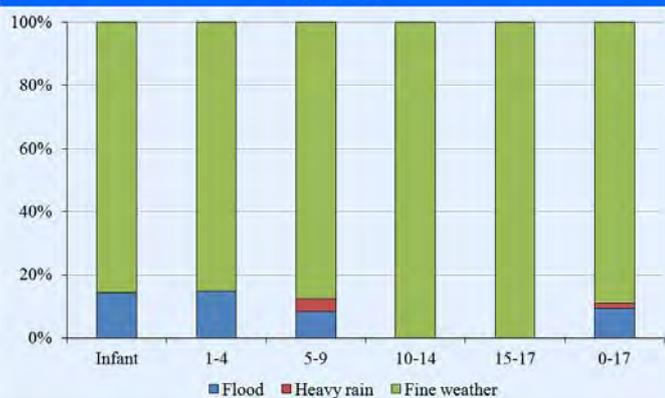
Figure 5.13: Known\* months of fatal drowning



higher levels of water in reservoirs and on farm lands. During the dry season of May/June and the Mekong is at its lowest point, drowning deaths are at their least.

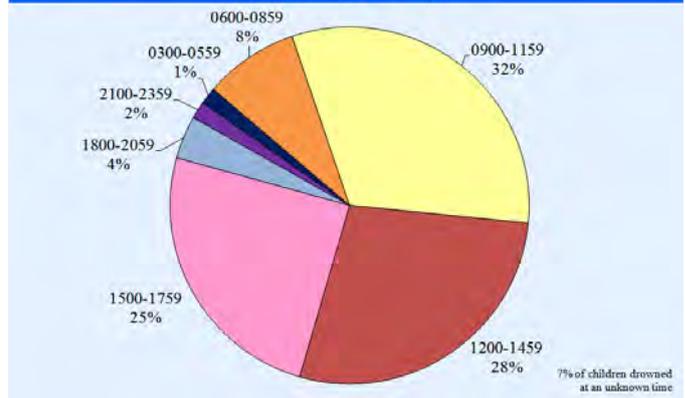
Weather conditions did not play a significant part in fatal drowning in Cambodia. Although 11% of all drowning occurred during climate conditions such as heavy rains and floods, Figure 5.14 illustrates that the majority of fatal drownings happened during normal daily exposure to water hazards.

Figure 5.14: Proportion of drowning deaths related to weather conditions



For those cases where the time of day was noted (93% of all fatal drownings), Figure 5.15 illustrates the hour the drowning victim was first noticed missing. Fatal drowning was essentially a daylight phenomenon. The vast majority of children (93%) were first noticed missing during daylight hours (between 6am and 6pm). No children were noted to be missing before 3am, and only

Figure 5.15: Known\* time of day when fatally drowned child is determined missing



6% were noticed missing after 6pm.

Figure 5.16 illustrates the activity that children were doing prior to the fatal drowning event, for the cases where the activity is known (89%). Over one-third (34%) were playing *in* the water, while just under a third (31%) were washing clothes. Fetching water accounted for the largest proportion of the remaining activities (17%).

Figure 5.16: Known\* activity of children prior to death from drowning

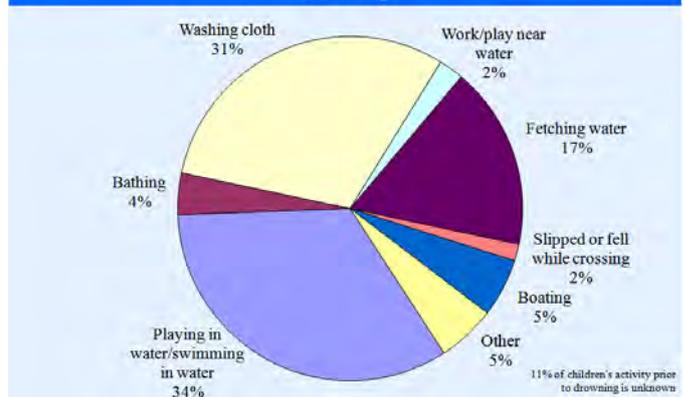


Figure 5.17 illustrates the relationship to the person accompanying the victim when fatally drowned.

Across all age groups, only 10% of drowned children were accompanied by their mother or father at the time they drowned. While it may be normal for children older than 5 to venture out without their parents, for infants and children aged 1 to 4, only 14% and 15%, respectively, were accompanied by parents.

More than one-third (38%) of all fatal drownings occurred when the child was alone. Over half the time (57%) when an infant drowned they were accompanied by a sibling, most often an older sibling acting as the supervisor of the child in absence of the mother. Younger children were significantly more likely not to have anyone to accompany them. In the 1 to 4 age group over half of the time (54%) a toddler drowned they were alone, while in children aged 10 to 14 this decreased to 9%.

Figure 5.17: Person accompanying child prior to fatal drowning

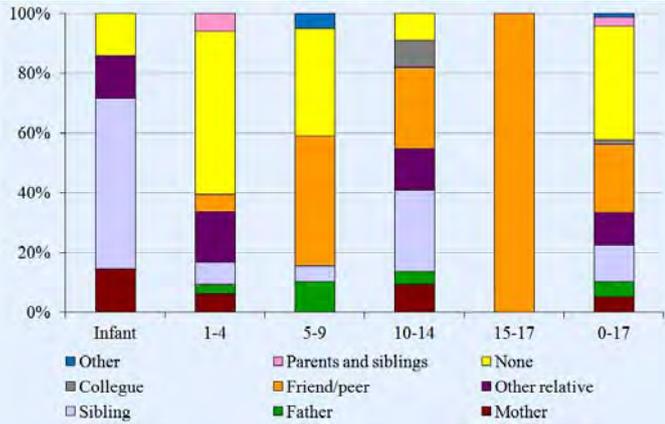
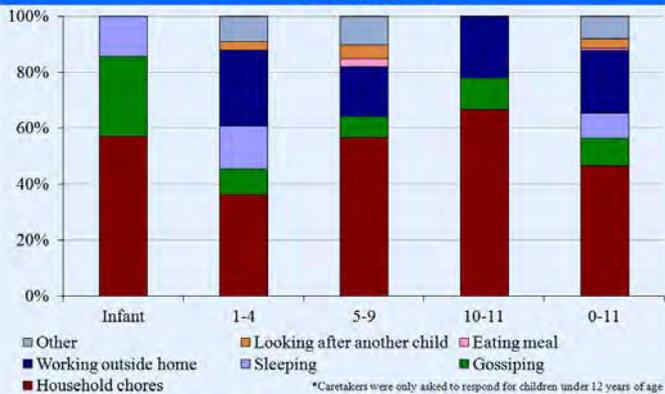


Figure 5.18 illustrates the activity the mother of the drowned child (aged 0-11 yrs) was engaged in at the time of the drowning. The two most common activities were doing household chores (46%) and working outside of the house (22%).

Figure 5.18: Activity of mother/caregiver at time of fatal child drowning by age group\*

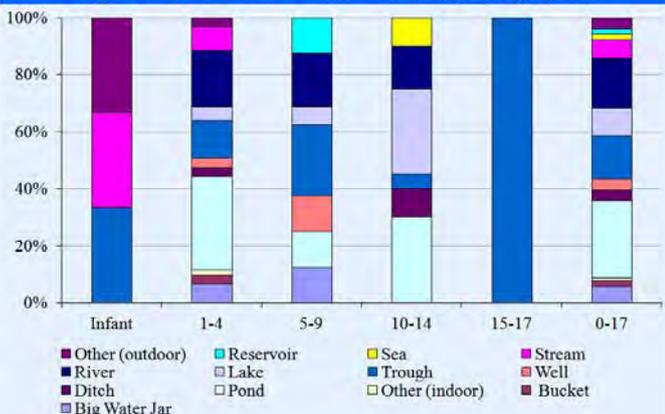


**Factors associated with non-fatal drowning**

As with fatal drownings, non-fatal drowning victims were unlikely to know how to swim. None of the non-fatal drowning victims aged over 4-years-old could swim.

Non-fatal drowning events happened in many locations (Figure 5.19). Similar to fatal drownings, the majority being natural bodies of water, with ponds being the most common (27%). The second most common loca-

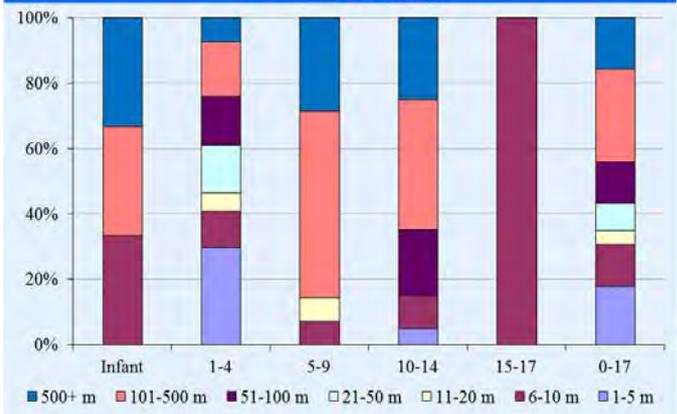
Figure 5.19: Place of non-fatal drowning by age group



tion for all children was rivers (17%). All the non-fatal drownings among 15 to 17 year-olds were in troughs.

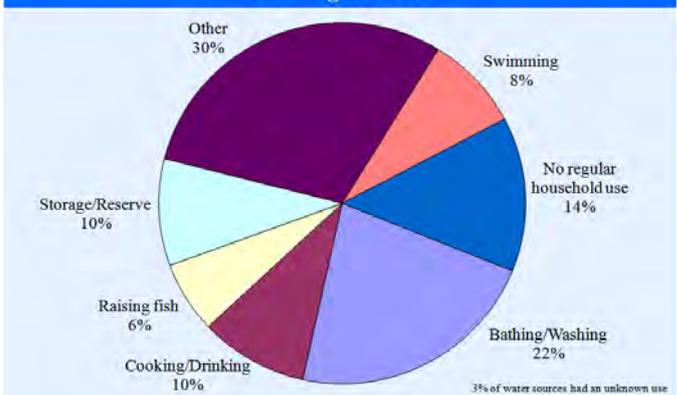
Overall most non-fatal drownings occurred close to the child’s home (Figure 5.20) with over half (56%) occurring within 100 meters and nearly one-fifth (18%) within five meters. For children aged 5 to 9 and 10 to 14 the majority of non-fatal drowning occurred at least 100 meters away from their home (86% and 65%, respectively).

Figure 5.20: Distance to water body where non-fatal drowning occurred, by age group



Many non-fatal drownings occurred in water sources that were used for bathing or washing (22%) or did not have a regular household use (14%). The catch-all category “other” contained the highest proportion of non-fatal drowning (30%). Water bodies that were used for swimming only accounted for 8% of non-fatal drownings (Figure 5.21).

Figure 5.21: Known\* use of the water source where non-fatal drowning occurred



Similar to fatal drowning, non-fatal drowning occurred in a pattern that peaks during the months at the end of the rainy season as seen in Figure 5.22.

Figure 5.23 illustrates the proportion of non-fatal drowning events related to weather conditions. For 10 to 14 year-olds, there was a higher proportion of non-fatal drowning events that were related to flooding (25%) than any other age group, although the majority of all non-fatal drowning events occurred during normal daily exposure to water hazards (81%) when measured over all of childhood.

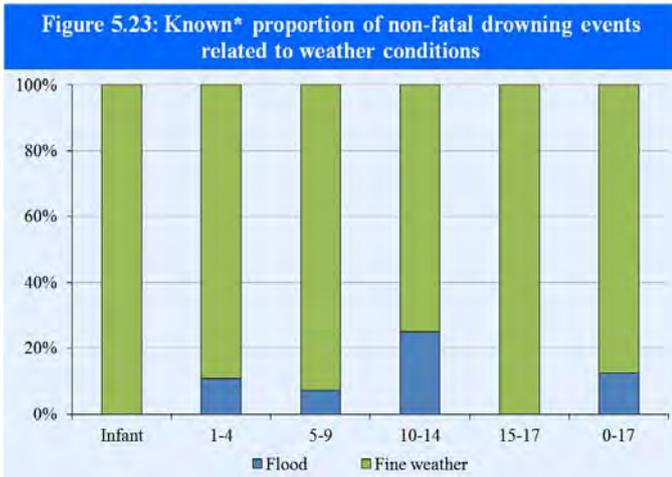


Figure 5.24 illustrates the activity of the child prior to the non-fatal drowning. One-third of all children (33%) were playing in the water, while 21% were working or playing near the water and a further 21% had a non-fatal drowning incident due to slipping or falling into water while crossing.

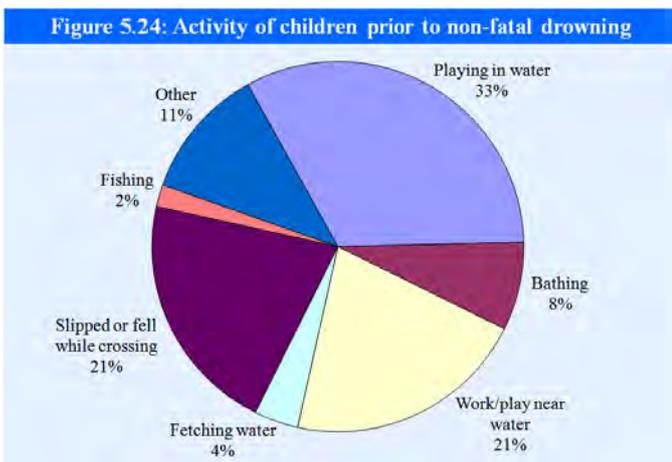


Figure 5.25 illustrates that infants who experienced a non-fatal drowning were accompanied by their sibling in two-thirds of cases (67%), while toddlers who experienced non-fatal drowning events were accompanied by their mother, father or sibling most of the time (71%). In older children, peers were usually accompanying children at the time of a non-fatal drowning event.

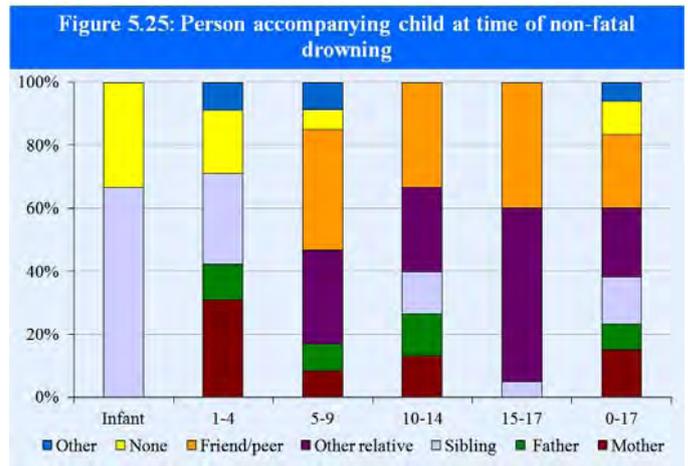


Figure 5.26 illustrates the age of the individuals accompanying the non-fatal drowning victim at the time of the incident. Across all age groups, 44% of non-fatal drowning victims were accompanied by an adult aged 20 years of age or older, while over one-third (38%) of children were accompanied by a child under 11-years-old. Infants that nearly drowned were predominately (66%) accompanied by a child under 11-years-old, and were never reported to be accompanied by an adult over 20 years old. (The average age of mothers of infants in the CAIS was 27.2). Non-fatal drowning victims aged 15 to 17 years-old were always accompanied by a peer aged 11-15 years.

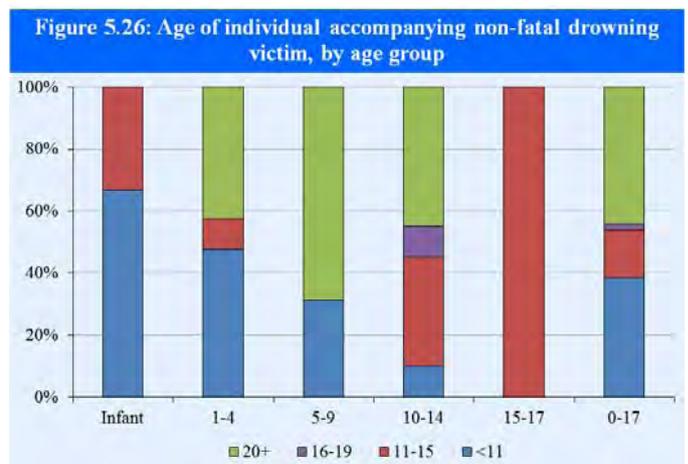


Figure 5.27 illustrates the activity the mother or caretaker of the non-fatal drowning victim child (aged 0-11 years) was engaged in at the time. The most common activity across all age groups was household chores (45%), followed by working outside the house (19%). While for infants, the mother or caretaker was working outside of the home 67% of the time.

For those cases where the time of day was noted (84% of all non-fatal drownings), Figure 5.28 illustrates the hour the non-fatal drowning victim was first noticed missing. The majority of children in all age groups were first noticed missing in the afternoon, between midday and 6 pm. Children aged 5 to 9 were also frequently first noticed missing pre-dawn, between midnight and 6am. All 10 to 11-year old and infant non-fatal drowning victims were first noticed missing dur-

Figure 5.27: Activity of mother/caregiver at time of child non-fatal drowning by age group\*

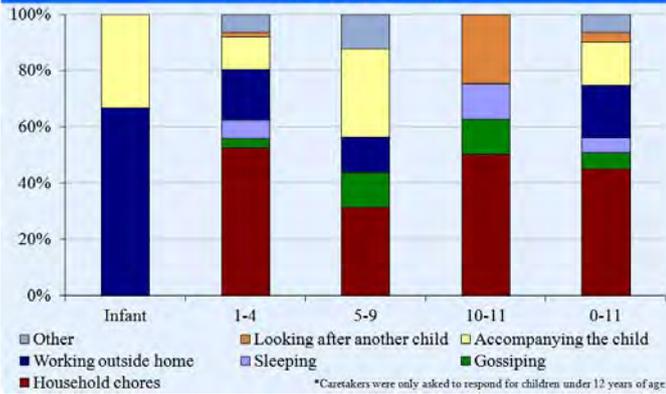
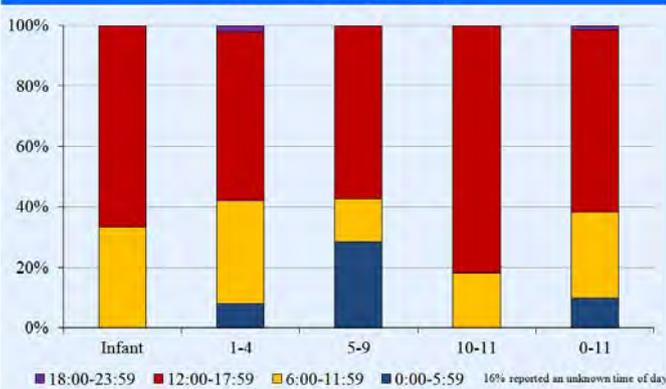


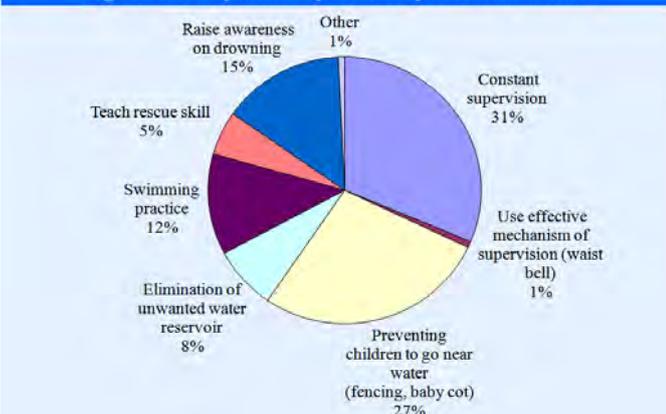
Figure 5.28: Known\* time of day non-fatal drowned child is determined to be missing



ing daylight hours. Toddlers were the only age group which had cases that were first noticed missing after 6pm.

When caretakers with a child, who was a victim of a non-fatal drowning incident, were asked their opinion on methods to prevent these events, one-third felt the best prevention method was to maintain constant supervision of their child (Figure 5.29). Another 27% felt a drowning safety plan to prevent children from going near water, by using fencing or cots, was the most effective way to prevent non-fatal drowning events. About 12% of respondents felt improving swimming skills was the preferred prevention method.

Figure 5.29: Opinion of preferred prevention method



## Risk factors for drowning and prevention

Drowning in Cambodia, like drownings in other LMICs, usually results from incidental exposure to water hazards. The exposure to water is generally not planned, unlike a recreational activity in rich countries at a pool, or the beach or boating, where parents and caretakers can be aware of the risk in advance, know a lifeguard is present, or prepare for it by increasing supervision or providing floatation devices, etc.

In Cambodia, the exposure to water occurs as part of the child's daily routine. In many cases, the water entry is often unexpected, due to a fall or a slip. Even when a child or a group of children decide to play or swim in a pond or other body of water, it is on the spur of the moment and there are almost never adults present to supervise. Children usually play in similar age groups and since swimming ability is rare in early and middle childhood where most drownings occur, when a child is in trouble, no one nearby has the skills or ability to rescue the drowning child.

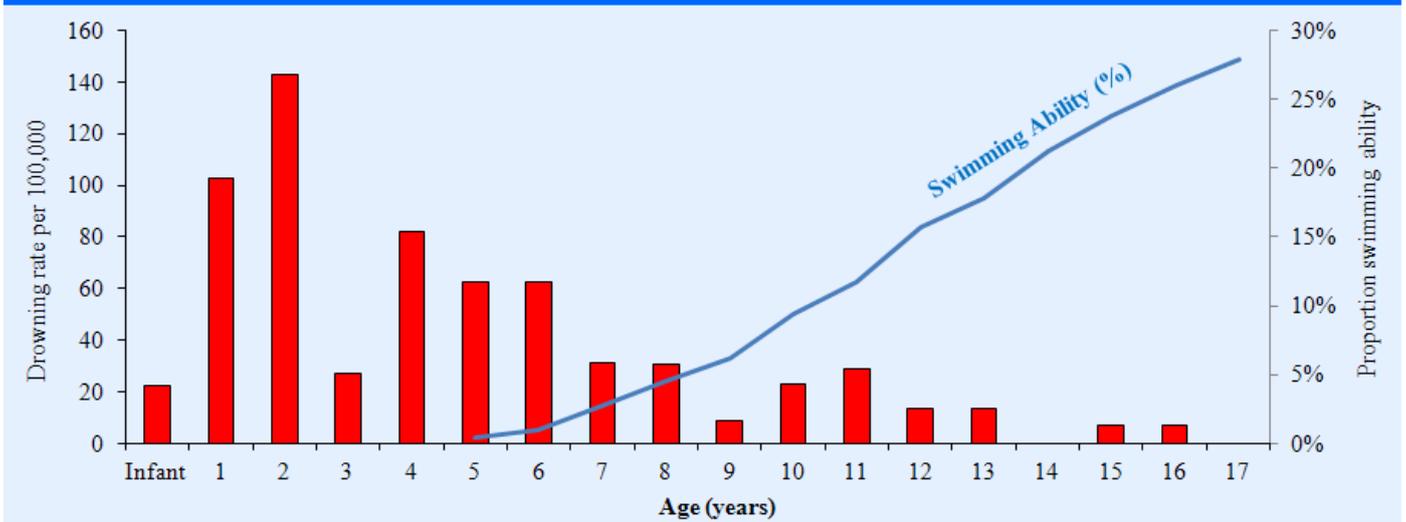
Given the risk factors for child drownings illustrated in the survey, prevention efforts will need to counter these. Since most child drownings occur under five, most of these children are too young to learn to swim. Prevention will require increased supervision, especially as infants develop into toddlers and outstrip a busy mother's ability to supervise them. Fences and other barriers will need to be placed between the home and nearby water hazards. Playpens and baby cots for infants and very young children would help create safe havens from water hazards.

In Bangladesh learning survival swimming skills specifically adapted for the environment has been shown to be effective against child drowning for children four years and older. This could be introduced in Cambodia, where swimming ability was quite low overall as shown in Figure 5.30. When compared to the drowning rates of Cambodian children, there was a decrease in drowning mortality as the proportion of children that can swim increased. Less than a third (28%) of Cambodian children ever learn how to swim. Swimming ability was particularly low in children aged 5 to 9 where drowning is the leading cause of death in that age group.

## An unrecognized epidemic of child drowning

Child drowning is largely an unrecognized issue in Cambodia. The finding that drowning is the leading cause of child death after infancy in Cambodia will likely surprise many people. The health information system (HIS) does not rank drowning as a leading cause of child death, and HIS statistics are the main source of information for most people. It is easy to understand why child drownings do not appear at high

**Figure 5.30: Swimming ability of Cambodian children against drowning rates by age**



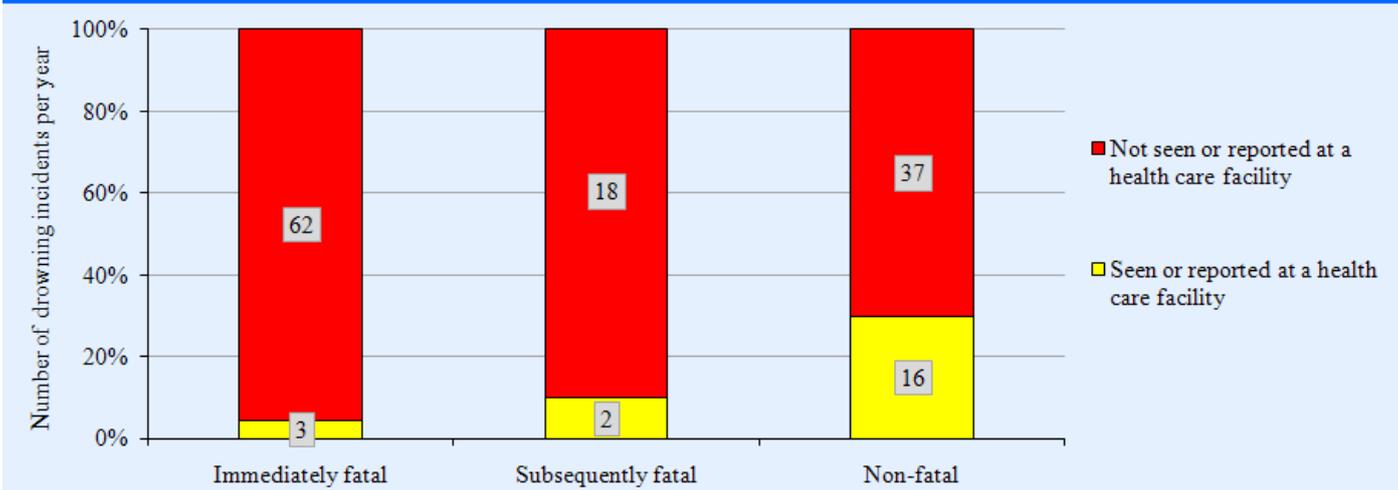
levels in the HIS. For each drowning noted in the survey, interviewers asked whether the death was reported to a hospital, health facility or other government institution. Only 6% of fatal drownings were reported, and less than a sixth (15%) of all drownings—fatal and non-fatal combined—were seen at, or reported to, one of these facilities (Figure 5.31). Thus, relying on facility reports introduces such a significant reporting bias that drowning, the leading cause of child death after infancy is rendered essentially invisible.

Compare this to road traffic accidents, which have their own, dedicated reporting system, the Road Traffic Accident and Victim Information System (RTAVIS). RTAVIS collects data from public health facilities, private clinics and traffic police. While road traffic is actually the fifth leading cause of death in Cambodian children after infancy, it has great visibility among policy-makers and donors and as a result, both awareness and interventions have resulted. There is no such data collection system for drowning and it is invisible to policy-makers and there are no interventions. There is a clear lesson here.

Injury surveillance systems that rely on health care facility reporting greatly underestimate drownings. Without an effective community-based surveillance system for injury, child drownings will continue to be greatly under-reported and policy-makers will continue to miss this leading cause of child death after infancy. An RTAVIS-like system for drownings would not work unless it was based upon community-level reporting structures. Between the traffic police, private clinics and public health facilities most of the road traffic deaths and injuries are covered. The immediately fatal road traffic deaths not seen at health facilities are usually known to the traffic police. The serious non-fatal road traffic injuries usually require surgery or because of bleeding and broken bones, the victims present to health facilities.

However, this is not the case with drowning, which is not traumatic, and does not involve cuts, bleeding or broken bones. A fatally drowned child is rarely taken to a health facility as there is essentially nothing that can be done by the health facility. They are simply buried or cremated. Non-fatally drowned children also rarely are seen at a health facility as they usually re-

**Figure 5.31: Drowning as recorded in the CAIS, by whether they were reported to a health facility and type of drowning**



ceive care based on family knowledge or through non-formal or traditional healers. In order to count fatal and non-fatal drowning, a community-based system is required.

## Discussion

Prevention begins with acknowledging the problem, measuring it and monitoring it. For child drowning, this will require a surveillance system that operates at the community level. The survey shows that parents do not bring drowned children who immediately died to a health center or hospital. Therefore, the facility-based method of drowning surveillance needs to be supplemented by information from existing institutions in the community that are aware of mortality in children.

The survey shows that drowning was the leading single cause of death in children older than one-year-old. Drowning deaths peak in toddlers (aged 1 to 4). This is an age where the child is actively exploring their environment and this requires increased supervision. However given the average of over 2 children per family, many mothers are unable to meet the supervisory needs of the crawling infant or exploring toddler. Mothers will need to adopt techniques to increase the safety of the child's environment.

Prevention will require putting barriers between the exploring infant or toddler and the water hazards. This requires both that parents recognize the need to do this and are also encouraged to act. In many cases, the most effective barrier methods for infants is a playpen or infant cot, but these require parents to change existing behaviors, as they are rarely used. This is an opportunity for existing maternal and child health programs to incorporate these issues. Clearly there are potential gains to be had from incorporating drowning prevention into existing antenatal care programs. But there are other, ongoing child health programs that have great potential as well.

Monthly outreach by health centre staff is an excellent opportunity to make contact with parents of young children to educate them on injury prevention. Health outreach includes immunization, with the 9 month measles immunization a particularly good opportunity to tell parents their child will soon be walking and that a simple door gate or improvised playpen can help prevent accidents in the home. The last immunization is at the age when drowning reaches its peak and parents could at that stage be encouraged to fence ponds and cover all water receptacles. Health outreach is done in close collaboration with volunteer Village Health Support Groups (VHSG) whose ongoing advocacy and home visits represent a chance to reinforce the messages of the health centre staff on a more regular basis.

Drowning prevention for school-aged children is more

complex as they are outside the home, usually with peers and not supervised by an adult. Fencing or barriers are not effective as older children often ignore or defeat them to play in the water-body. Since children usually cannot be isolated from the water hazard, it becomes necessary to remove the risk of drowning when they are in the water.

This means ensuring that the child learns to swim at the earliest possible age, since the highest drowning rates occur in the earlier age groups. Teaching a basic form of swimming, called survival swimming, has been shown to be an effective means of drowning prevention in Bangladesh and this could be done in Cambodia. It not only provides protection from drowning in daily life exposures of children to water, but it also protects them during the floods that may occur in the monsoon season.

Teaching survival swimming is only one component of a broader water safety program. The child also learns how to safely rescue others. Since the data indicates that most often the person accompanying the drowning victim was a peer or family member (Figure 5.17 and 5.25), these skills allow the person to potentially save the endangered child, if they are trained in safe rescue in such a program. This provides prevention coverage similar to the "herd immunity effect" that has been a major factor in effectiveness of immunization programs.

Herd immunity is where a weak, vulnerable animal is protected from predators when in the center of a herd of strong, protective animals. Using the example of whooping cough, it can be seen that not every child needs to be immunized to be protected. If most children in a population have been immunized, the germ that causes it can not circulate and children who lack the whooping cough immunization are never exposed. The few unimmunized children are protected from exposure by a herd of immunized others surrounding them. For drowning, if most people know survival swimming, and how to safely rescue a drowning person, then those children at risk of drowning are protected by their accompanying peers or family members.

The international community has worked with low and middle income countries to combat communicable and non-communicable disease and to raise literacy rates, with success. However, the financial investment has also been significant. It is only a relatively small additional investment to take the next step and provide them and their families with the skills to protect their children from drowning. About 85 per cent of 1 to 4 year olds who drowned had been immunized. This shows two important facts: First, it illustrates how effective using an immunization program for drowning prevention could be. Secondly, it shows a major source of 'wasted' resources for the immunization program. Im-

plementing a prevention strategy using the existing immunization programs would reach a large number of families with children who are the most at risk from drowning. One-quarter of children who drowned had already had at least one year of schooling. Teaching a child to swim or providing mothers with the knowledge to keep their toddler safe is a means of protecting other, non-health investments such as education in children's well-being.

## Accidental Infant Suffocation

### Introduction

Suffocation is a significant cause of death in infants, in part due to the near universal practice of mothers and fathers sleeping with the infant in the same bed. Usually the entire family sleeps together in the same bed. Young infants are unable to sit up or roll over until about the sixth month of infancy, when motor development has progressed. Before this, they are relatively defenceless and unable to react if anything obstructs their breathing, whether bed clothes, covers or an unaware, sleeping adult who has rolled over on the infant, or placed an arm over the infants face. After the sixth month, the child can defend him/herself by kicking and thrashing, which often clears the obstructing bed cover or wakes the intruding adult. Thus, infant suffocations usually occur in the first half of infancy.

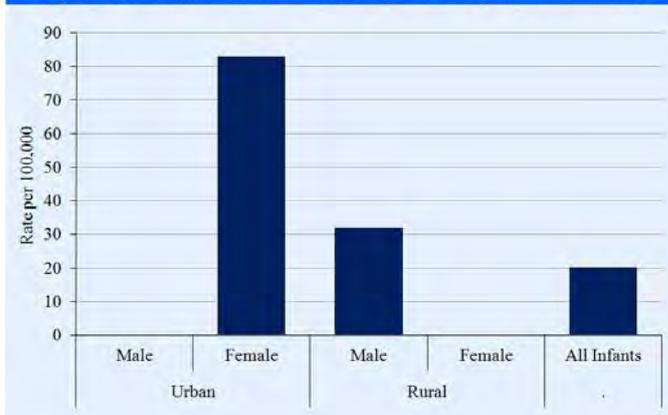
In developed countries there is a distinction made between adult overlayment deaths and sudden infant death syndrome (SIDS, cot or crib death). But a SIDS diagnosis usually is made based on autopsy findings and forensic information which is unavailable in a survey such as CAIS. Infant deaths were recalled retrospectively by laypersons, and the response "accidentally smothered the baby while sleeping" was most commonly used. It is possible that some of the infant deaths occurring are SIDS deaths, but it is likely to be a small percentage. If so, the interventions are the same as for overlayment.

In older children, suffocation is associated with inhaling foreign objects, being trapped in airtight spaces, or in cave-ins when digging wells or deep ditches. Suffocation can also occur from carbon monoxide, especially when homes are being heated by poorly ventilated heaters. Finally, children are often exposed to the risk of suffocation in occupational settings in cleaning out containers which had chemicals stored in them, such as railroad tank cars, silos or bilges. Children are preferentially used as they are small and able to get into tight places that larger adults could not.

### CAIS Findings

Accidental infant suffocation was the second leading injury-related cause of death for infants, following medical accidents. Infants died from accidental suffocation at a rate of 20.0 per 100,000 which is estimated to be nearly two infant deaths a week (Figure 5.32).

Figure 5.32: Suffocation in infants by sex and place of residence



Risk factors for accidental infant suffocation are:

- placing an infant to sleep in a non-supine position (other than on the back);
- sharing a bed (co-sleeping) with the infant when there are multiple bed-sharers; or
- one or more of the co-sleeping parents uses tobacco or alcohol.

Figure 5.33 illustrates more than one in ten infants is put to sleep in risky positions (3% prone and 8% sideways).

Figure 5.33: Known\* position infant is put to sleep in

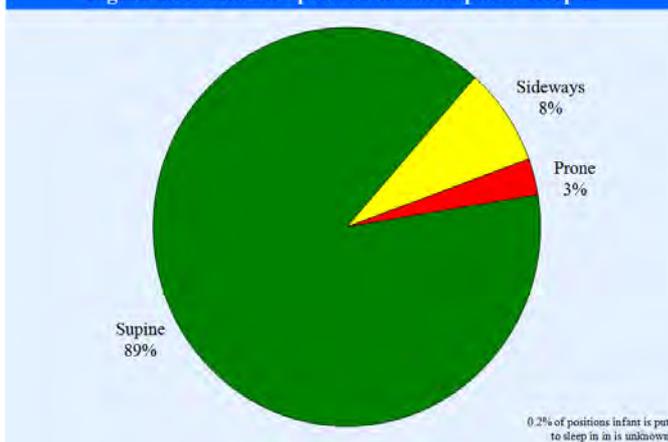
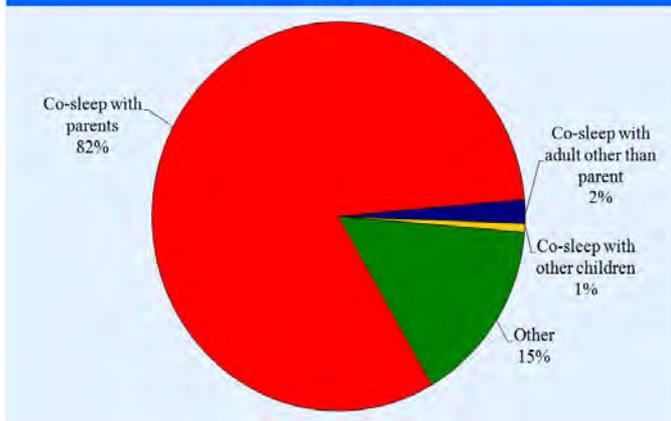


Figure 5.34 shows 82% of infants sleep in the same bed with parents. The average family size is 4.8 with often one bed for all members including the infant. Thus, most infants share a bed with two parents and an older sibling, and some with two older siblings, leading to a very crowded sleeping environment for that infant.

According to the Smoking Behaviour Survey in Cambodia (NIS, 2004), the prevalence of males or females of parenting age that currently smoke is over 25%. Alcohol is commonly consumed with meals, especially

Figure 5.34 Location where infants regularly sleep in Cambodian households



dinner. Many infants are exposed to increased risk of suffocation in these homes.

There are many benefits to infants sharing a bed with their mother — it increases breast feeding and leads to increased bonding to name only two. However, to fully reap the positive health benefits, parents need to be aware of how to safely share a bed with an infant.

Antenatal care programs (ANC) provide a means of working with individual mothers and fathers to plan safe ways to share the bed with the infant and the others who also are in the same bed.

ANC programs should educate expectant mothers and fathers to place infants to sleep on their backs, for mothers to stop smoking and drinking while breastfeeding and fathers to stop smoking and drinking while sharing the bed with the infant. Failing to do this represents a missed opportunity for prevention.

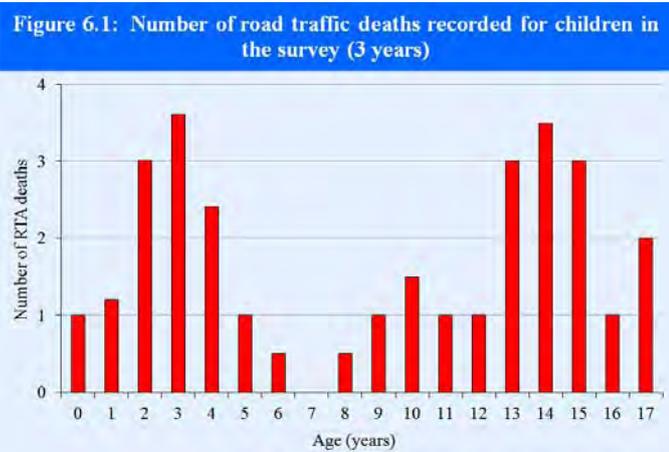
# Chapter 6

# Transport Injury

## Introduction

While there are many different types of transport (water, air, train and other forms) in Cambodia, the majority of mortality and morbidity incidents from transport were attributable to road traffic. One cannot conclude that other forms of transport are safer than road transport. Since the vast majority of trips taken by ordinary Cambodians are by road, this is where the survey found events to occur. While injuries occur with other modes of transport, because most transportation occurs on roads or in vehicles associated with roads, the numbers of events occurring with these other forms of transport are below the power of the survey to detect. In CAIS there were 30 child road traffic fatalities, but only two non-fatal transport injuries that were not road traffic related (occurred in boats).

The terminology for injury caused by road transport can be confusing. The acronym RTA is used in this report as a descriptive term for the clearest communication. Most readers of the survey are not familiar with the technical jargon of injury prevention. The term accident is used to communicate with this group as this is commonly understood by all. The use of the term 'accident' connotes lack of intention and has no connection to predictability or preventability. The term RTI is not used in this report as within the broad child health community, it normally means Respiratory Tract Infection and could be confused with Reproductive Tract Infection as well.



## Fatal transport injury

In Cambodia, road traffic was the second leading cause of injury death and the fifth leading cause of death overall, in children after infancy. Figure 6.1 illustrates

the number of child fatalities from road traffic in the three years prior to the date of the survey. There are two very distinct age ranges for fatal injuries, pre-schoolers and adolescents. The cause of these fatalities are just as distinct, the toddlers are almost entirely killed as pedestrians while the adolescents are involved in accidents while either a driver or passenger of a vehicle (usually a motorcycle or bicycle).

Figure 6.2 illustrates road traffic death rates were highest in children aged 1 to 4, and decreased as the child gets older. No fatalities in the year preceding the survey were found in infants, but about 26.6/100,000 children aged 1 to 4; 1.6/100,000 aged 5 to 9; 12.7/100,000 aged 10 to 14; and 7.4/100,000 aged 15-17 are killed by road traffic annually. Overall 10.7/100,000 children aged 0 to 17 were killed by road traffic every year.

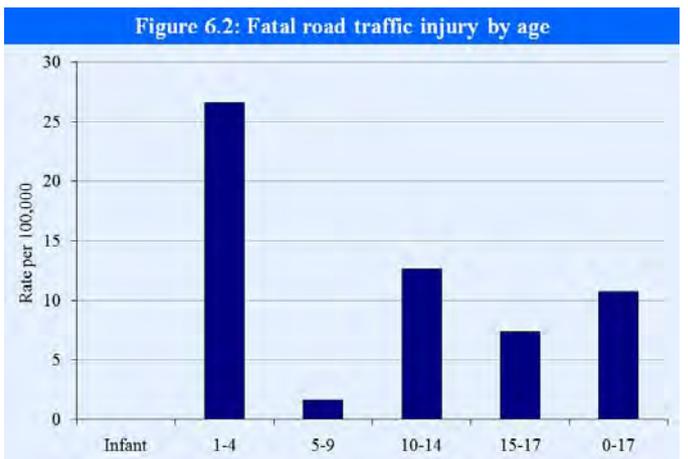
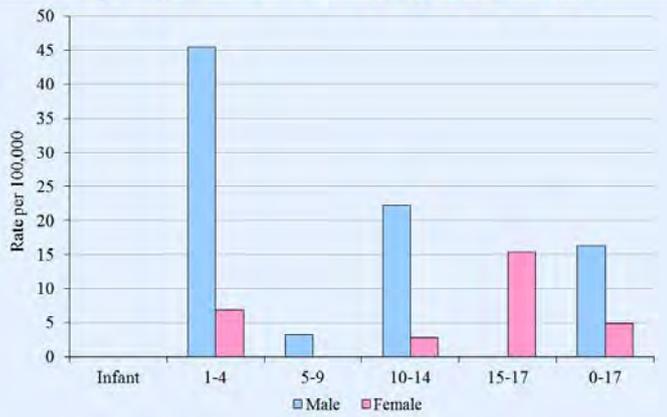


Figure 6.3 illustrates fatal road traffic rates by one-year age intervals. It is clear that road traffic fatality peaks in two different age groups: younger children aged 2 to 6 years old and older children aged 10 to 17 years old.



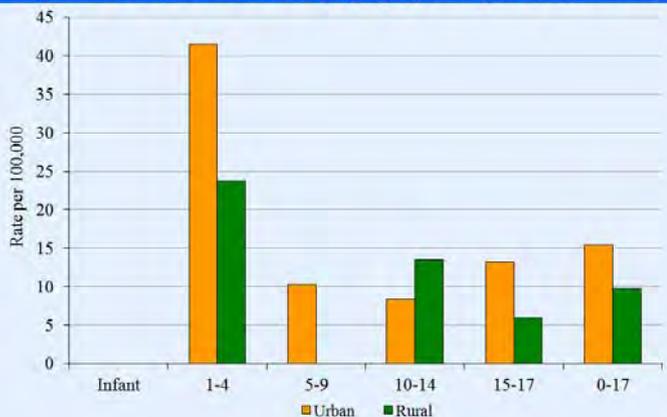
There was a strong male predominance in road traffic deaths for children under 15 years old (Figure 6.4). Only females were recorded to have died in the 15 to 17 age group, with a rate of 15.4/100,000. Overall, males and females aged 0 to 17 died from road traffic at 16.3/100,000 and 4.9/100,000 respectively.

Figure 6.4: Fatal road traffic injury by age and sex



In children aged 0 to 17 there was a predominance of fatal road traffic amongst children in urban areas, except children aged 10 to 14 (Figure 6.5). Overall children from urban areas died from road traffic at a rate of 15.4/100,000 and children from rural areas at 9.8/100,000.

Figure 6.5: Fatal road traffic injury by age and place of residence



### Non-fatal transport injury

Non-fatal road traffic rates show high rates for every age group. Figure 6.6 illustrates that rates are lowest in infants, while the highest rate of road traffic morbidity occurred in the 15 to 17 year age group.

Figure 6.7 illustrates the road traffic morbidity rate by yearly age intervals. It shows the same trend as was seen with fatal road traffic with two distinct age groups, one peaking at 4 years and then a sharp upturn starting as children enter puberty.

Figure 6.8 illustrates that morbidity was higher for males in all age groups. In the older age groups this disparity was quite striking; the 15–17 year old males have a rate (2,153.3/100,000) that was almost twice the female rate (1,150.1/100,000).

Figure 6.6: Non-fatal road traffic injury by age group

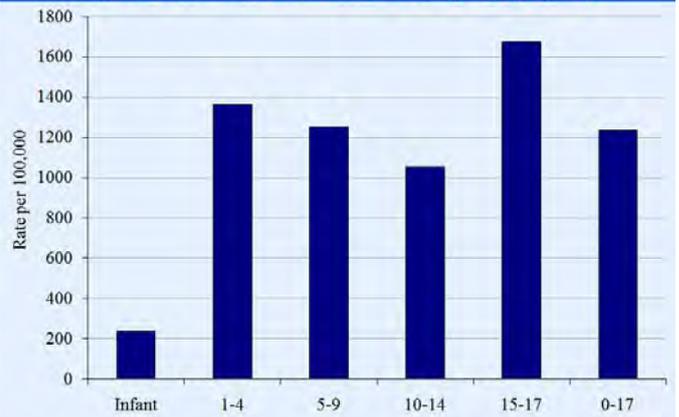


Figure 6.7: Non-fatal road traffic injury among children by age - detail

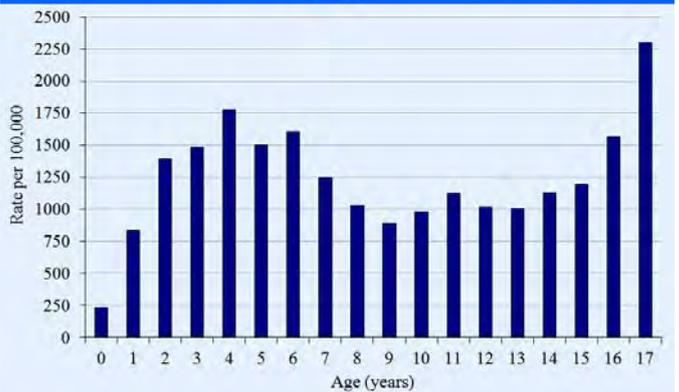


Figure 6.8: Non-fatal road traffic injury by sex and age group

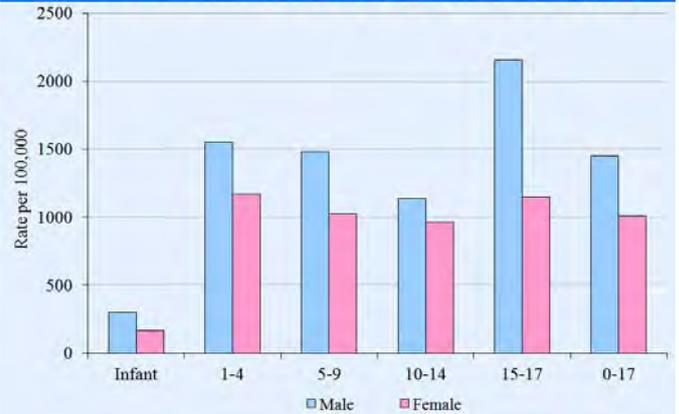
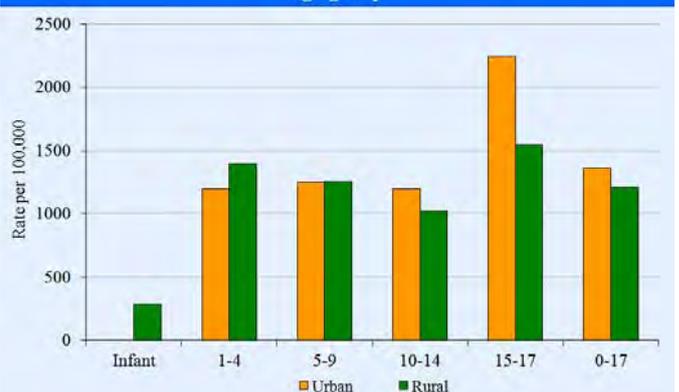


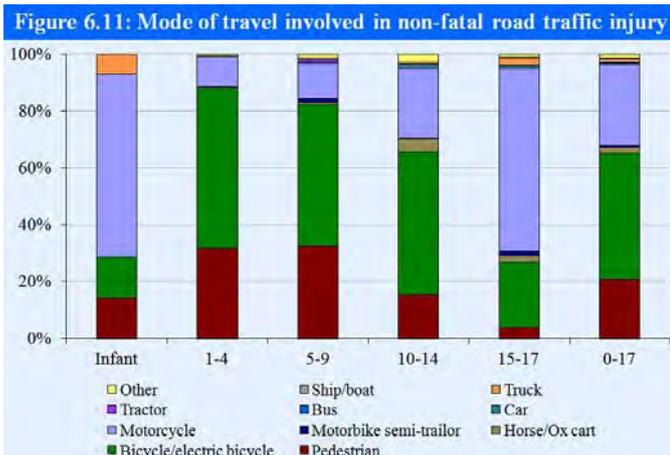
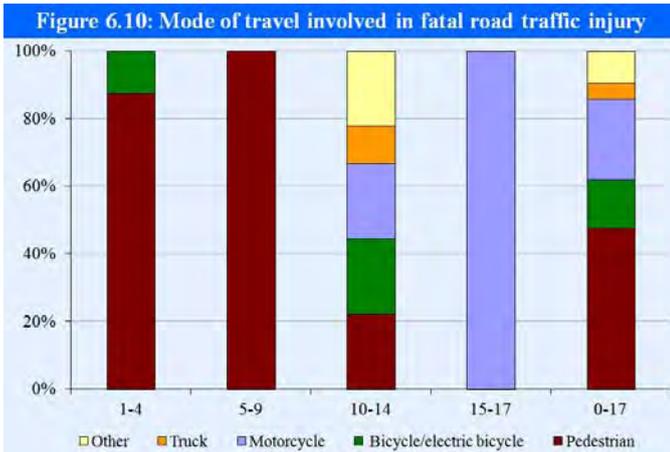
Figure 6.9 illustrates that there appears to be no predominance in non-fatal road traffic events in rural or urban areas. The only exception was in 15 to 17 year olds, where there were many more non-fatal road traffic events in urban areas.

Figure 6.9: Non-fatal road traffic injury by place of residence and age group



## Particulars of the road traffic events

Almost half (48%) of all road traffic deaths in children aged 0 to 17 occurred when the child was a pedestrian (Figure 6.10). The next largest single cause proportion was when the child was on a motorcycle (24%). Trucks, bicycles and other motor vehicles combined, accounted for the remaining third of road traffic deaths (29%). Bicycle/electric bicycles were responsible for nearly half (45%) of all non-fatal road traffic events, followed by motorcycles at 28%, as is seen in Figure 6.11.



The age pattern becomes apparent when the individual age groups of fatal road traffic events are examined (Figure 6.10). Almost 9 out of 10 (88%) toddlers and all children aged 5 to 9 killed by road traffic were struck as pedestrians. As the children grow older, they begin riding bicycles or are passengers in motor vehicles, and pedestrian deaths become a smaller proportion of total road traffic mortality. In late adolescence, children were killed exclusively on or by motorcycles.

Non-fatal road traffic events involving bicycles accounted for nearly half (45%) of all injuries for 0 to 17 year olds and motorcycles came in second at 28% (Figure 6.11). In infants and 15 to 17 year olds, motorcycles accounted for nearly two-thirds (64%) of non-fatal road traffic injury. Pedestrian and bicycle accidents were the cause of at least 8 out of 10 (1 to 4 year olds, 88%; 5 to 9 year olds, 82%) non-fatal road traffic

injuries in children aged between 1 and 9 years old.

Figure 6.12 illustrates almost half (48%) of the child road traffic fatalities were as a pedestrian, while a further third (33%) were as a passenger, and the remaining 19% were as drivers or operators of a vehicle.

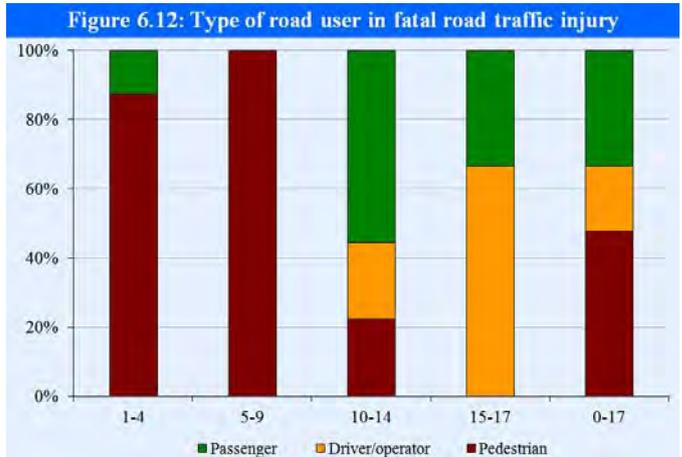
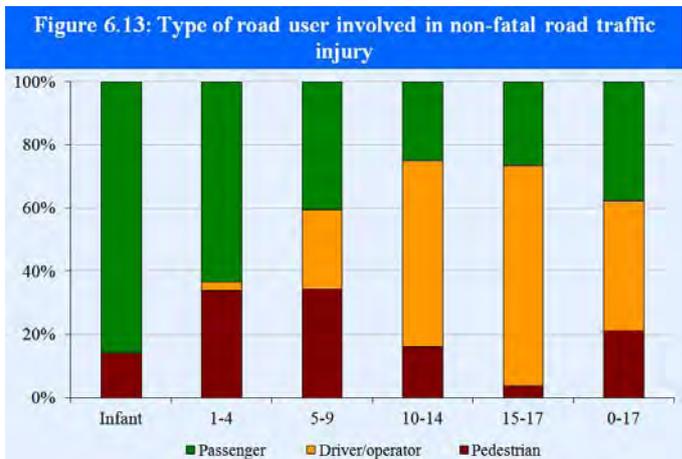


Figure 6.13 illustrates that the distribution of types of road users in non-fatal road traffic events was similar to that of fatal road traffic events, with an increased proportion of passengers involved in non-fatal road traffic events, particularly in younger age groups. Infants were involved in non-fatal road traffic events as a passenger 86% of the time.



As can be seen in figure 6.14, most fatal road traffic events for all children (aged 0 to 17) occur in the afternoon (52%) while the second most common time is in the morning (33%). This pattern is duplicated for 1 to 4 year olds. For children aged 5 to 9 and 15 to 17, fatal road traffic events occurred exclusively in the afternoon, while in 10 to 14 year olds, the majority of events occurred in the morning (44%), followed by the evening (33%). The times of involvement correlate with the fact that most young children are going to and from primary school in the morning and afternoon.

Figure 6.15 illustrates the relationship between time of the event and the role of victim. Pedestrians and driver operators were killed during daylight hours, but 43% of passengers were killed at night.

Figure 6.14: Time of accident in fatal road traffic injury by age

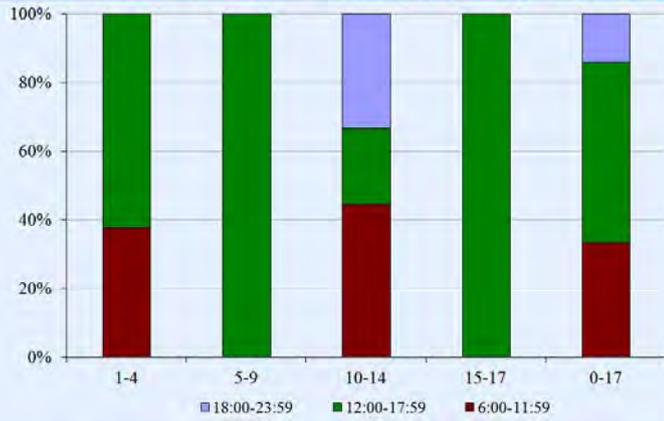
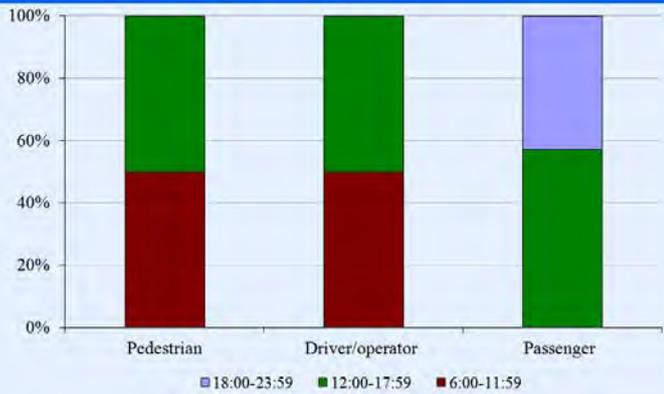


Figure 6.15: Known time of accident in fatal road traffic injury by role



For non-fatal road traffic events (Figure 6.16), the afternoon continued to be the time when most accidents occur, followed by the morning as the second most likely time for an event (46% and 40% respectively). Events between the hours of midnight and 6am occurred in only 2% of non-fatal road traffic events.

Figure 6.16: Known\* time of accident in non-fatal road traffic injury

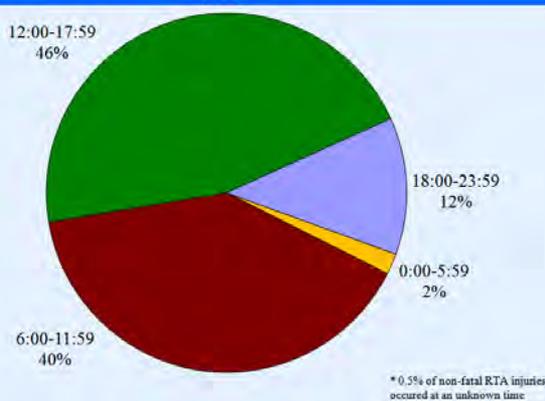
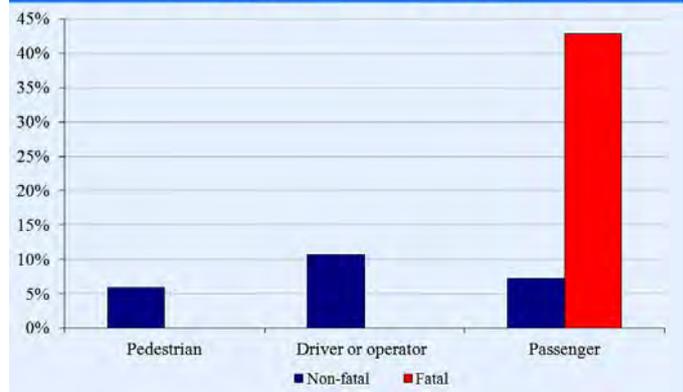


Figure 6.17 shows the degree to which poor driving conditions (either road or weather) was cited as contributing to a fatal road traffic accident. Almost half of the fatal events where the child involved was a passenger (43%) resulted from poor conditions. Between 6% and 11% of non-fatal events were due to poor conditions.

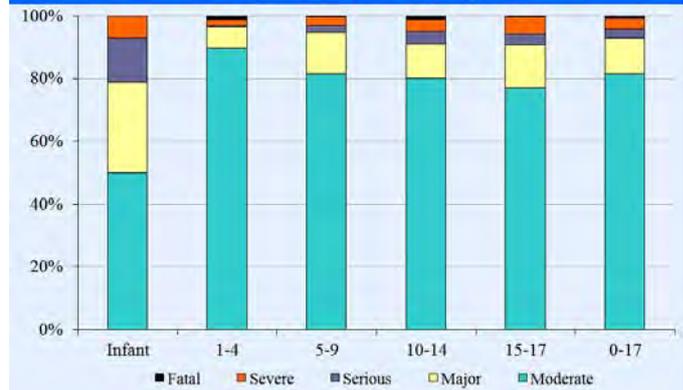
Figure 6.17: Percent of non-fatal road traffic injury in which weather or road conditions were a factor



### Hospitalization and severity

One in five of 0 to 17 year olds and half of infant road traffic morbidity were of a severity level that required a hospital stay of at least one day (Figure 6.18). The relatively large proportion of major and serious injuries is not unusual as road traffic causes traumatic injuries that require surgery, which requires hospitalization.

Figure 6.18: Proportion of injury by severity and age group in non-fatal road traffic injury

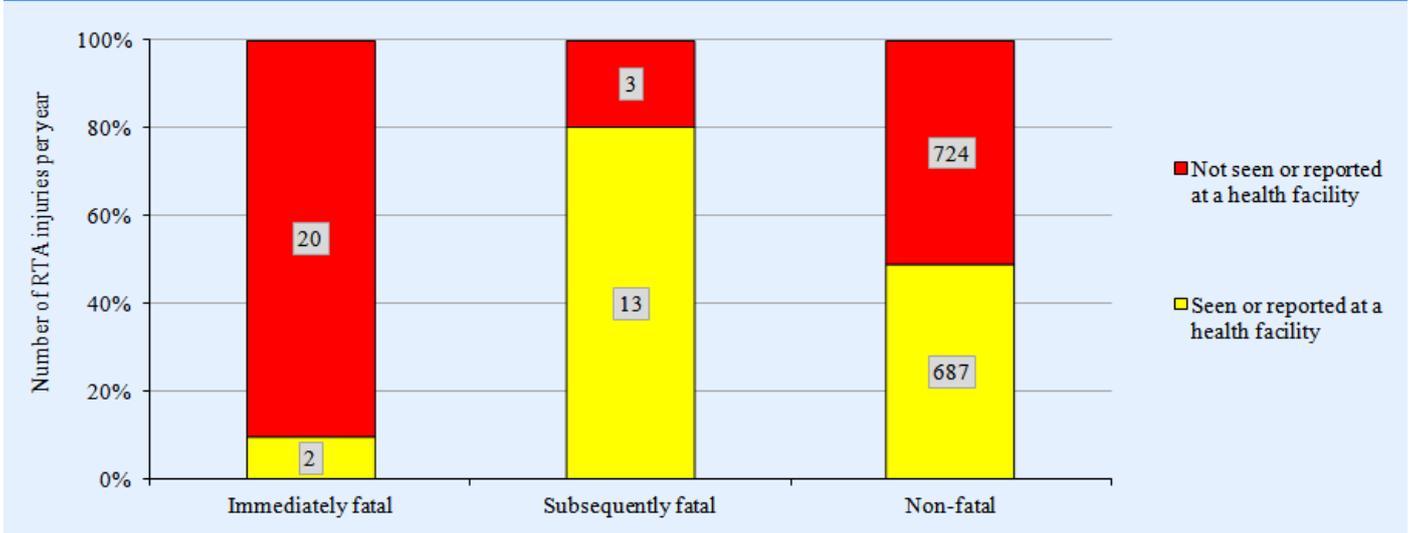


### Discussion

Injury from road traffic has already been recognized as a major child health issue, in large part due to the availability of data. In March 2004 three government departments in collaboration with Handicap International Belgium established the Road Traffic Accident and Victim Information System (RTAVIS). Using data collected from public health facilities, private clinics and traffic police, RTAVIS publicly disseminates traffic accident data via its website [www.roadsafetycambodia.info](http://www.roadsafetycambodia.info).

While such a facility-based system may not capture all road traffic-related deaths, permanent disabilities and serious injuries, it does mean that Cambodia has a more complete picture of the impact of road traffic injuries. From the data collected from the CAIS, it can be surmised that since children involved in road traffic events who die immediately are rarely seen at a health care facility (Figure 6.19), that systems only using facility based reporting for road traffic injuries will un-

Figure 6.19 road traffic injuries as recorded in the CAIS, by whether they were reported to a health facility and type of injury.



derestimate the extent of the problem. From the information already collected in Cambodia on road traffic there has been an influx of support from international donors, with the development of interventions focused at the policy level, at the infrastructure level and at the individual level. The real challenge is to find the most effective mix of these efforts to rapidly reduce the impact of road traffic. As the second leading injury-related killer of children after infancy and the leading nonfatal cause of injury in all children it clearly needs to be addressed as one of the highest priority issues in child health in Cambodia.

The epidemiology makes it clear that the interventions with the greatest potential will focus on increasing safety for children as pedestrians and in reducing crash rates in adolescent (aged 10-17) motorcyclists and bicyclists. Reduction of pedestrian injury may be the more achievable in the short term, as the reduction of injury rates in motorcyclists will likely require greatly increased enforcement capacity to deal with issues of proper licensing, driver training, helmet use, reckless driving, alcohol use and other key factors for this group. These issues are not amenable to approaches that do not include increasing enforcement. The reality is any significant increase in enforcement capacity will be possible only in the medium and long term. Thus, a practical approach will be to focus on the interventions that are most achievable in the short term, while the government and donors continue the investments and training necessary to enable significant increases in enforcement and engineering approaches for safer roads.

Pre-school and primary school children are most at risk from road traffic as pedestrians and urban children are at a higher risk of injury than children in rural areas. Prevention programs for this age group therefore need to focus on basic road safety for young children, for example walking facing traffic, looking both ways before crossing a road, not playing next to a road, etc.

Table 6.20: CAIS estimated number of child road traffic casualties (0-17 years)

Type	Per year	1 child every...
Injuries	75,340	7 minutes
Permanent disabilities	2,700	3.2 hours
Fatalities	650	13.5 hours

These should be core components of interventions directed at both children and their parents as parts of Safe Home and Safe School programs. Concurrent measures to increase separation of traffic streams and pedestrians will be needed and this can be achieved at the local level without major road engineering efforts, if undertaken as part of a Safe Community effort.

When compared to neighboring countries of Thailand and Vietnam, road traffic accident rates are lower in Cambodia, especially for adolescents on motorcycles. This is likely due to the economic barriers to owning a motorcycle, rather than other factors. Since it is very likely that Cambodia will continue to experience high economic growth rates, which will increase motorcycle ownership in adolescents and young adults, road traffic accident rates will only increase over time unless there is a national commitment to increased prevention efforts.

### CAIS and RTAVIS: Similarities and differences

Cambodia has a national road traffic surveillance system, the Road Traffic Accident Victim Information System (RTAVIS) which covers all of Cambodia's 24 provinces. RTAVIS is a multi-sectoral system which aggregates reports of road traffic crashes and casualties from the Ministry of Interior (traffic police database), the Ministry of Health Injury Surveillance System (Public health facility reporting) and private clinics.

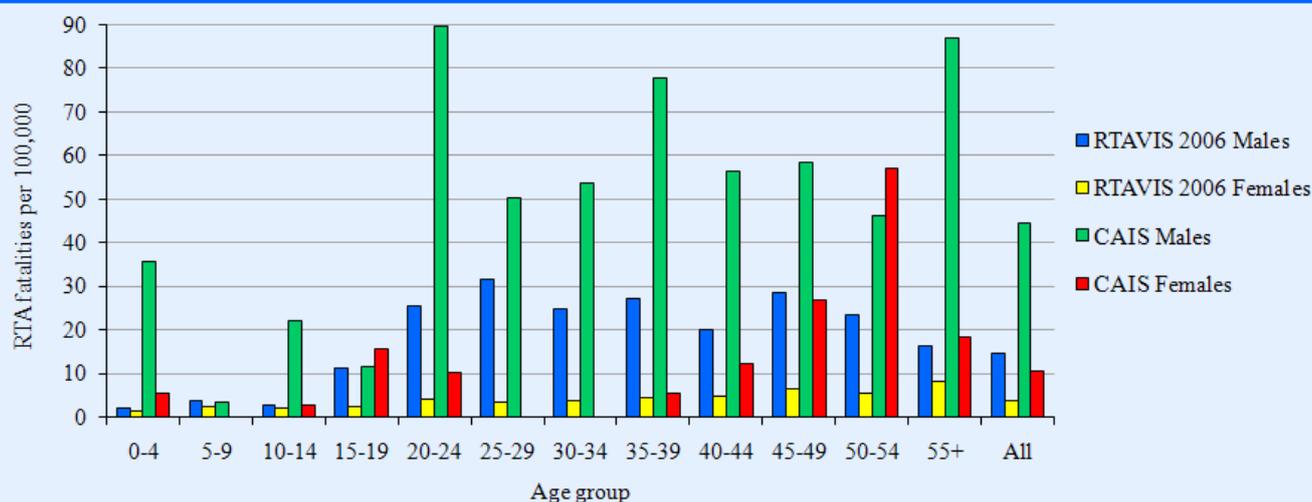
Since the Cambodia Accident and Injury Survey (CAIS) used a nationally representative sample of the entire population, it is possible to compare the findings from CAIS and RTAVIS by using the first year of mortality recall in CAIS and the 2006 RTAVIS reports. This overlaps essentially the same time periods for both, allowing a direct comparison of the findings.

Figure 6.21 illustrates the direct comparison for the fatal accident rates in similar age groups for males and females. There were two major differences that are immediately apparent:

- The RTAVIS data was more complete, with fatalities in all age groups, while the CAIS dataset has no fatalities in females in several age groups (5-9; 25-29 and 30-34).
- The CAIS data showed much higher rates in most age groups. Overall, the difference in rates was about three-fold, with RTAVIS rates approximately one-third of CAIS rates.

These differences are attributable to the differing data collection systems. CAIS was a sample of known size from the entire national population. As a sample, whether events were detected was a matter of the frequency of occurrence. Fatal road traffic events in females were relatively rare in these age groups and thus the rate was too low to be found in several of these narrow age groups. In essence, CAIS takes a large sample of Cambodians of all ages and counts all the fatal crashes that occur in that population. RTAVIS aggregates all road traffic fatalities where they were recorded by health facilities or police, with the system assuming that all such deaths are being formally reported. The differences in methods were apparent in the data. The CAIS data has occasional gaps in it (due to sampling error) and the RTAVIS data has a systematically low estimate of fatalities due to a lack of some fatal crash reports. Furthermore, for non-fatal road traffic crashes and the injuries occurring in them, the definitions between the two may differ. Therefore, any direct comparison between the two should focus on fatalities.

Figure 6.21 Comparison of CAIS and RTAVIS findings



These issues illustrate the difference between national surveys and national surveillance systems well. There are pros and cons in both systems, and a combination of the two usually paints the most complete picture of the issue under consideration. In the case of fatal road traffic accidents, it was known that the fatality reports for RTAVIS were incomplete. The Cambodia Demographic and Health Survey (CDHS) results on road traffic crashes were used to adjust the RTAVIS results to be more complete. Unfortunately, as noted in the box on pages 10 and 11. CDHS injury estimates were incorrect due to incorrect age information. However, it is possible to use the CAIS data which shows that the age and sex pattern of RTAVIS is essentially correct, but that it underestimates road traffic fatalities by a factor of about three.

Once corrected for completeness, RTAVIS information is the better source of information for development of interventions for injury from road traffic. Due to the larger number of fatal crashes in the RTAVIS database, there is

significantly more detailed information in RTAVIS than CAIS upon which to base intervention strategies and decisions.

As more hospitals and private clinics join RTAVIS and as the reports from traffic police increase in completeness, the under-reporting of road traffic fatalities will decrease. It will require another sample survey for road traffic to determine how to properly adjust the surveillance figures to compensate for the under-reporting.

One final point to note regarding the advantages and disadvantages of surveillance systems versus surveys: Using a surveillance system such as RTAVIS alone makes it very difficult to know how to compare its results against other events found by surveillance systems tracking other types of fatalities. For example, how does one accurately compare the numbers for road traffic fatalities as reported by RTAVIS and the numbers for fatal unexploded ordnance (UXO) incidents, as generated by the Cambodia Mine/UXO Victim Information System (CMVIS)? Which of the two is larger in unadjusted data? This can be answered by the use of a national sample survey such as CAIS, where the rates of each type of fatal injury, road traffic versus UXO can be directly determined. In this case, CAIS shows that there are approximately 3,600 road traffic deaths and 245 deaths from UXO incidents.

This ability to compare rates of different events directly is one of the most useful characteristics of a national sample survey. A practical example of this is the comparison of road traffic and UXO as the cause of permanent disability through loss of a limb in children. CAIS showed that approximately 1,050 children lost a limb from road traffic in 2006, and about 20 children lost a limb from UXO incidents. The common impression is that UXO is the larger cause of limb loss in Cambodia, but in reality, road traffic is a much more frequent cause of limb loss in children.

# Chapter 7

# Animal Injury

## Introduction

Animal injury is a very common cause of child injury in LMICs like Cambodia. Most children live in rural areas, in households engaged in farming. This leads to the constant exposure of children to animals, both in the practice of assisting in farming activities, as well as pets and stray non-farm animals such as dogs. Animal injury can result from butting, impaling, being bitten or being stepped on, and the severity of these injuries can range from minor to death. Dog bites that would not otherwise be serious often lead to death from rabies, as it is endemic in Cambodia and both hyper-immunoglobulin and vaccine are costly and not available in many rural areas. Similarly, snake bites are common and can be fatal if the snake is venomous, especially for very young children, who have a small body mass and thus a greater vulnerability to snake venom.

## Fatal animal injury

All of the deaths from animal injuries presented here occurred in the first year of recall and in males, 5 to 17 years old (Figure 7.1). Two-thirds of fatal animal injuries occurred in rural areas. Stray dogs were the sole cause of all animal injury deaths in the first year of recall. All were unprovoked bites (there was no prior contact with the animal beforehand). The resulting rabies infection proved fatal in all three cases. In the second year of recall there were two deaths from snake bites, which are not included in the one year recall rates.

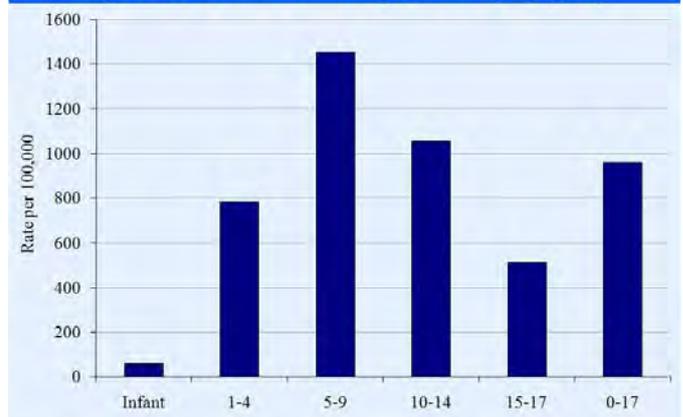
Figure 7.1: Fatal animal injury by sex, place of residence and age group



## Non-fatal animal injury

Animal injury was the second leading cause of injury morbidity in Cambodia. As can be seen in Figure 7.2,

Figure 7.2: Non-fatal animal injury rates by age group

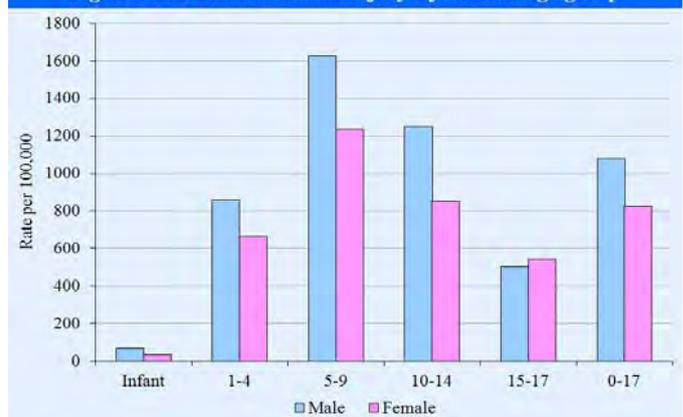


every age group, including infants, experienced some level of morbidity from animal attacks.

Overall, 953 per 100,000 children from 0 to 17 years old suffered a non-fatal injury inflicted by an animal. Each age category except infants had a rate greater than 500 per 100,000, with 5 to 9 year olds having the greatest rate (1431.0/100,000).

Males consistently had higher rates of animal injury in all groups except late adolescence (Figure 7.3). The highest rate was recorded in males aged 5 to 9 with a rate of 1400.1 per 100,000.

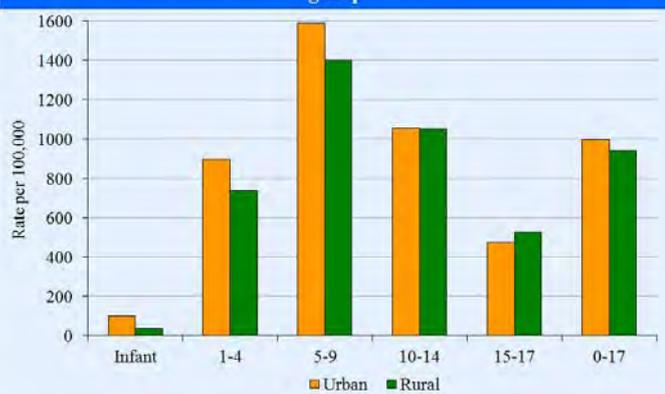
Figure 7.3: Non-fatal animal injury by sex and age group



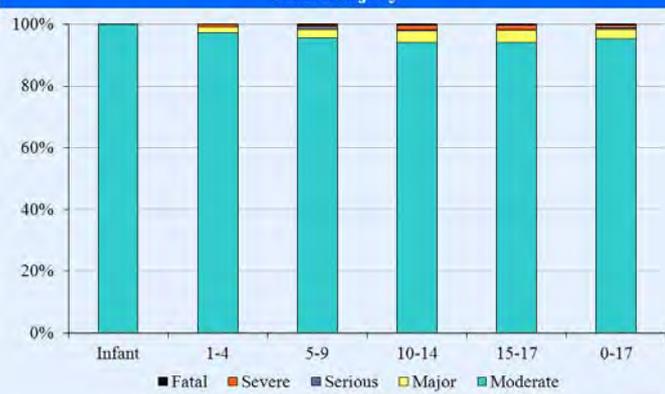
There was a trend for animal injuries in children under 10 years old being higher in urban areas than in rural areas, but the difference is not statistically significant (Figure 7.4). Overall, children had approximately equal rates of injury in both areas.

Most animal injuries were moderate in severity, although 5% were severe enough to require at least one day of hospitalization. One percent of injuries in 0-17 year olds resulted in permanent disability (Figure 7.5).

**Figure 7.4: Non-fatal animal injury by place of residence and age group**

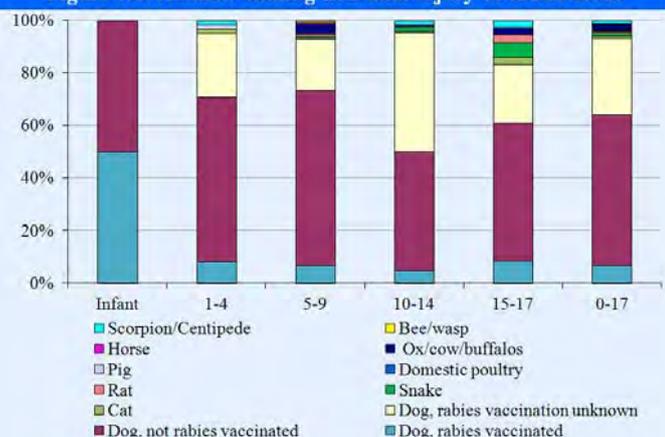


**Figure 7.5: Proportion of injury by severity and age group in animal injury**



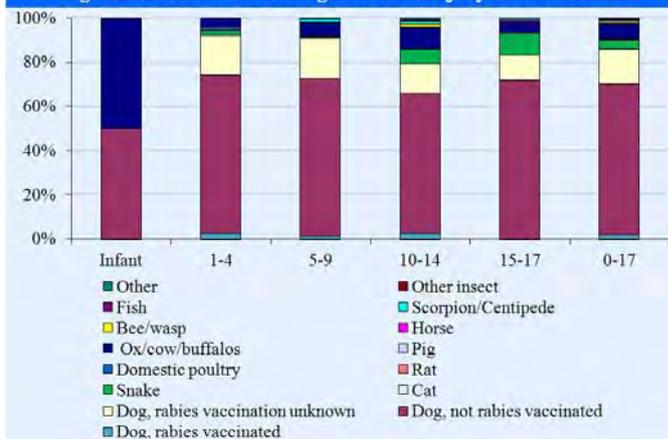
Dogs were the sole cause of non-fatal injury in infants in urban areas (Figure 7.6). Nine out of ten of all non-fatal animal attacks in urban children ages 0-17 were caused by dogs. Of the dogs involved in those attacks, only 7% were known to be vaccinated against rabies. Other animals which caused non-fatal injury in children in urban areas were oxen/cows/buffalos (2%) and snakes (1%).

**Figure 7.6: Animals causing non-fatal injury in urban areas**



In infants in rural areas (Figure 7.7) non-fatal animal injuries were caused by oxen/cows/buffalos or dogs. In the older rural age groups (1-17), dogs caused 86% of non-fatal animal injuries, of which just 1% of the dogs were rabies vaccinated. In late adolescence (15-17), snake bites caused 10% of non-fatal animal injuries in rural areas.

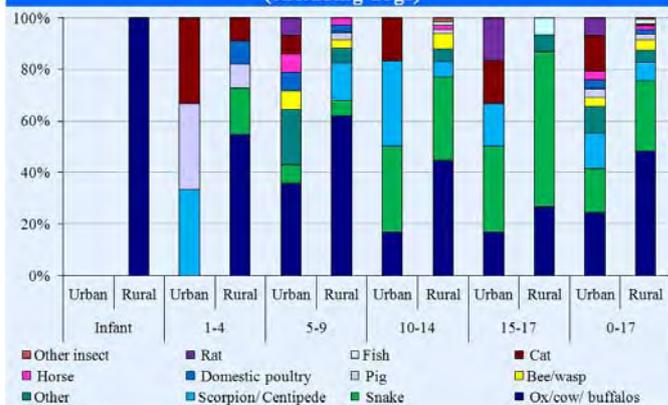
**Figure 7.7: Animals causing non-fatal injury in rural areas**



### Factors related to animal injury – except dog bites

As dogs caused nine out of ten non-fatal animal injuries among children, Figure 7.8 illustrates which animals, excluding dogs, caused non-fatal injuries in children by place of residence. Ox/cow/buffalos caused the most injuries followed by snakes in both urban and rural areas. Injuries from Cats and Scorpion/centipedes are associated more with urban children, while snakes and ox/cow/buffalos account for over three-quarters of the injuries in rural children.

**Figure 7.8: Animals causing non-fatal injury by area and age group (excluding dogs)**



Non-fatal animal injuries, aside from dogs, resulted predominately from unprovoked attacks in all children. Overall, rural children (0-17) primarily suffered animal injuries through unprovoked attacks (46%) while animals used for working injured a child 7% of the time. In urban areas, children were injured through an unprovoked attack over half the time (55%) and playing with the animal caused 38% of injuries (Figure 7.9).

The majority of injury inflicted by animal attack, excluding dogs, in both urban (66%) and rural (41%) areas was from biting (Figure 7.10). The exception was in rural infants where all animal related injuries resulted from the child being stepped on. In rural areas being stepped on (15%) and kicked (11%) were also common ways of being injured.

Figure 7.9: Reasons for non-fatal animal injury by area and age group (excluding dogs)

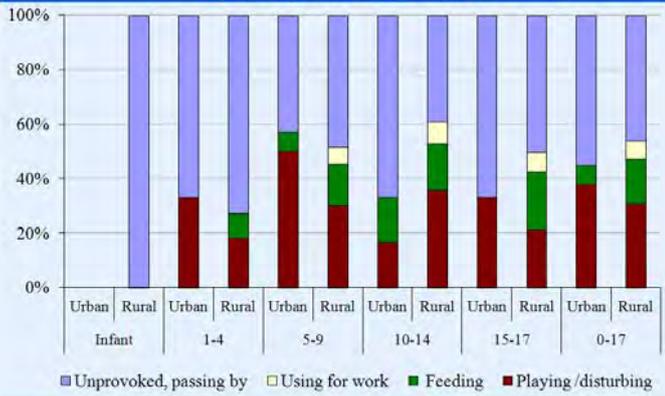
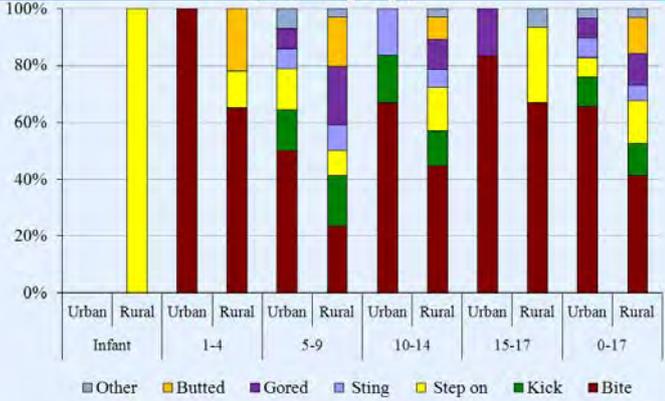


Figure 7.10: Type of non-fatal animal injury by area and age group (excluding dogs)



### Factors related to dog bite injury

Exposure rates of children to dogs are high, as the majority of children live in households that have dogs (Table 7.11). Rural households with children have higher dog ownership rates, with over two-thirds (68%) owning dogs, and nearly half of urban homes (45%) owning dogs (Table 7.11).

Table 7.11: Child exposure to dogs

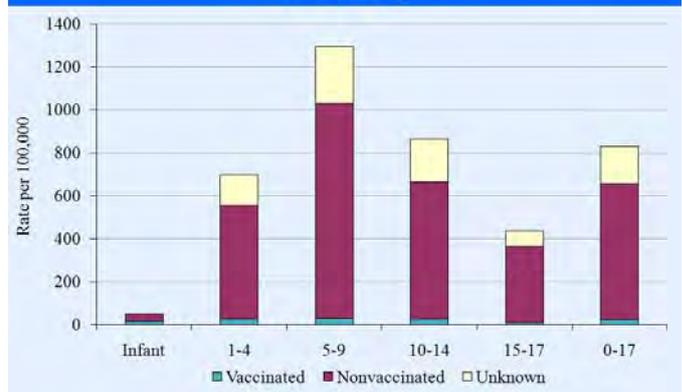
Exposure	Childs age	
	<18 %	<5 %
Children who live in a HH with a dog	61.8	55.6
Rural	68.5	62.1
Urban	45.3	39.5
Children living in HH with vaccinated dog	2.7	2.3
Urban	8.3	7.1
Rural	1.3	1.0

Dog rabies vaccination rates are higher in urban areas than rural (8% vs. 1%) but quite low, regardless.

In order to be counted, a dog bite had to cause either the seeking of care, a loss of a day of work or school or a child being unable to engage in activities of daily living (feeding, dressing or washing self) for at least one day. Thus, the bite rate measured in the survey was for significant bites (Figure 7.12).

While the dog bite rate was lower for infants than older children, it was still high enough that on average, one

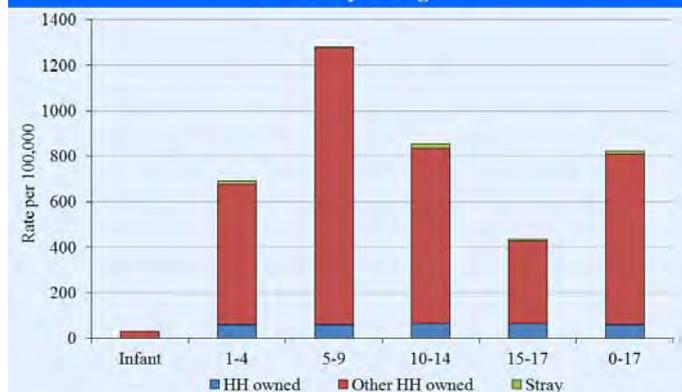
Figure 7.12: Annual dog bite incidence by age of child and status of dog



out of every 1,980 infants suffered a significant dog bite in the previous year. Rates were extremely high in older children, and in the peak age group, one out of every 77 children, 5-9 years old, suffered a significant dog bite.

The dogs biting the child were overwhelmingly owned dogs, but owned by households nearby, and not the household the child resided in. Stray dogs were rarely the cause of the bites reported (Figure 7.13). Almost equally low proportions of children in urban and rural areas reported seeing a stray dog within 25 meters of their homes in the previous week (6.0 vs. 5.6% respectively).

Figure 7.13: Annual dog bite incidence by age of child and ownership of dog



The majority of children were bitten by dogs that were unprovoked. Due to the significant numbers of rabid dogs in Cambodia, about 5% of the reported bites were caused by rabid dogs (Figure 7.14).

Figure 7.14: Activity\* of child when dog bite occurred

