Review of injuries over a one year period among 87,134 adults studying at an open university in Thailand

REVIEW OF INJURIES OVER A ONE YEAR PERIOD AMONG 87,134 ADULTS STUDYING AT AN OPEN UNIVERSITY IN THAILAND

Karen Stephan[1], Rod McClure[1], Sam-ang Seubsman[2], Matthew Kelly[3], Vasoontara Yiengprugsawan[3], Christopher Bain[4], Adrian Sleigh[3] and the Thai Cohort Study Team*

[1]Monash University Accident Research Centre, Monash University, Melbourne, Australia; [2]School of Human Ecology, Sukhothai Thammathirat Open University, Nonthaburi, Thailand; [3]National Centre for Epidemiology and Population Health, College of Medicine, Biology and the Environment, The Australian National University, Canberra, Australia; [4]The University of Queensland, School of Population Health, Brisbane, Australia

Abstract. Countries need epidemiological information about population injury statistics to devise preventive strategies. To generate such information we estimated the one-year incidence and distribution of injury in a group of 87,134 adult Sukhothai Thammathirat Open University distance-learning students residing throughout Thailand. Those who participated joined the study by filling out a baseline questionnaire in 2005 which included a one-year recall of injuries serious enough to interfere with daily activities and/or require medical treatment. The more serious injuries were categorised by location, mechanism and intentionality. We collected sociodemographic information about the participants. Nearly 22% of participants reported at least one injury during the previous 12 months. Males, those with lower income and the less educated, had higher injury rates. Home injuries were more common among females. Sports, road and workplace injuries were more common among males. Transport injuries decreased with age and falls increased with age. Most injuries were unintentional. Injury rates among Thai adults are high. We identified at risk groups by injury mechanism and setting. Before interventions can be devised more research is needed regarding exposure and vulnerability in at risk socio-demographic groups.

Key words: injury frequency, baseline survey, community-based group, Thailand

Correspondence: Adrian Sleigh, National Centre for Epidemiology and Population Health, Australian National University, Bldg 62 Mills Road, Canberra 0200, Australia.
Tel: +61 2 6125 2378; Fax: +61 2 6125 0740; E-mail: adrian.sleigh@anu.edu.au

*Thai Cohort Study Team: **Thailand:** Jaruwan Chokhanapitak, Chaiyun Churewong, Suttanit Hounthasarn, Suwanee Khamman, Daoruang Pandee, Suttinan Pangsap, Tippawan Prapamontol, Janya Puengson, Yodyiam Sangrattanakul, Sam-ang Seubsman, Boonchai Somboonsook, Nintita Sripaiboonkij, Pathumvadee Somsamai, Duangkae Vilainerun, Wanee Wimonwattanaphan. **Australia:** Chris Bain, Emily Banks, Cathy Banwell, Bruce Caldwell, Gordon Carmichael, Tarie Dellora, Jane Dixon, Sharon Friel, David Harley, Matthew Kelly, Tord Kjellstrom, Lynette Lim, Anthony McMichael, Tanya Mark, Adrian Sleigh, Lyndall Strazdins, Vasoontara Yiengprugsawan.

INTRODUCTION

Injury accounts for 9% of global mortality, with 90% of injury deaths occurring in lower and middle income countries (Krug, 2004; Nakahara and Ichikawa, 2006). As middle income countries undergo industrialization, modernization and motorization in response to the world's increasingly globalized economy, these countries experience a growing burden of injury (Plitponkarnpim *et al*, 1999; Roberts, 2004; Nakahara and Ichikawa 2006; Moniruzzman and Andersson, 2008). Prevention of injury mortality has become "a priority for (transitional) middle income countries" (Plitponkarnpim *et al*, 1999). The increasing burden of injury in middle income countries is occurring at the same time the decreased exposure to high risk environments in high income countries is reducing their injury burden (Plitponkarnpim *et al*, 1999; Moniruzzman and Andersson, 2008).

Information obtained from individual countries is important for international in injury prevention and control (Sleet *et al*, 2003). In lower and middle income countries, data collection about the nature and extent of injuries "is still in its infancy" (Krug, 2004). As a consequence of this lack of data, the importance of injury as a cause of disability-adjusted life-years is undervalued and solutions to addressing this problem are under developed and underfunded (Krug, 2004).

Thailand is one of the few lower and middle income countries to develop a national hospital-based injury surveillance system (Santikarn, 1999). These data have been used to plan for injury control at both national and international levels (Santikarn, 1999; Santikarn *et al*, 2002). While the importance of hospital-based surveillance is beyond question, there are limitations of injury estimates derived solely from such systems (Sethi *et al*, 2004). Hospital-based surveillance underestimates the burden of injury as it captures only a small proportion of non-fatal injuries that present to hospital. Systematic information about injury events is rarely recorded.

In contrast to hospital-based surveillance, community-based surveys can more accurately capture the population incidence of injuries along with more detailed information about the nature of injury events (Heinen *et al*, 2004; Krug, 2004; Sethi *et al*, 2004). To help provide such data for Thailand, we collected information regarding injury frequency and circumstances in a multi-faceted baseline survey of a large community-based group recruited in 2005. Here we report the injury results obtained at baseline when we enquired about events over the previous 12 months. This individual-based information will be compared to the results of a recent household-level Thai National Injury Survey (Sitthiamorn *et al*, 2007).

MATERIALS AND METHODS

Data

The Thai Health-Risk Transition Study includes an ongoing population-based Thai Cohort Study (TCS) of 87,134 adult Sukhothai Thammathirat Open University (STOU) students residing throughout the country. It is referred to as an open university because it does not require high school graduates to pass an entrance test. The study population is made up of distance-learning students studying with STOU in 2005. The baseline TCS data collected in 2005 included retrospective recall over the previous year about frequency of injury and a wide array of demographic, socio-economic, behavioral and transpor-

tation factors that could be linked to or modify Thailand's injury risks.

Details regarding population selection and methodology have been previously reported (Sleigh *et al*, 2008). The 2005 student register listed about 200,000 names and addresses of persons studying with STOU. A 20-page pre-tested questionnaire was mailed to each student and 87,134 (44%) responded. The respondents differed a little by course, year of enrollment, sex ratio, geographic location and age. The study group represents the Thai population well in terms of sex ratio, median age, religion, regional distribution, occupation and median income (Sleigh *et al*, 2008). A greater proportion of the study population resided in urban areas (51.8%) compared to the Thai population (31.1%), although some estimates of the urban population in Thailand indicate the actual proportion was about 40% in 2003 (Webster, 2005). Because the study population was comprised of distance learning university students, virtually all participants had completed high school, indicating they had a higher level of education than the general population. This attribute is advantageous for obtaining accurate responses to the complex questionnaire mailed to them.

Data scanning and editing were conducted using Thai Scandevet software. Further data editing was completed using SQL and SPSS software. Analysis was carried out using SPSS and STATA. Individuals with missing data were excluded, so the totals vary a little based on the information available.

Measures

All respondents were asked "In the **last 12 months** how many injuries have you had that were serious enough to interfere with daily activities and/or required medical treatment", "where were you when you were injured" and "was this injury related to transport". If the reported injury was not transport related respondents were then asked "what was the cause of this injury". If injured more than once, respondents reported details on their most serious injury. Location of occurrence of the injury event was coded as home, road, sports facility, workplace agricultural, workplace non-agricultural or other. The mechanism causing this most serious injury was classified as: transport, assault, fall, other blunt force, drowning, bite/sting, gunshot, stab/cut, fire/heat and poisoning. Respondents were also asked whether their most serious injury was unintentional (using the Thai word *ubatihet*), was intentional (involving another person), or intentional (not involving another person).

Definitions

Participants were divided into 5 age groups: 15-19, 20-29, 30-39, 40-49 and 50 years and over. Marital status was classified as single or partnered. Self-reported residence in 2005 was classified as rural or urban. The respondents' incomes were divided into 2 groups: those earning more than or less than 10,000 Baht per month (USD238). Lastly, the achieved education level of respondents was classified as high school or lower or beyond high school.

Descriptive analysis

The absolute and relative 12 month frequency (*ie*, proportion reporting injury) of at least one injury was calculated for the socio-demographic and economic groups stratified by age group. The location of occurrence, mechanism and intent for the most serious injuries were reported for males and females separately, across age groups. The population studied was so large we did not attempt on first description to make statistical inferences; even small differences were statistically signifi-

cant. We preferred to focus on the obvious findings and avoid unnecessary emphasis on *p*-values.

Ethical issues

Ethics approval was obtained for the study from Sukhothai Thammathirat Open University Research and Development Institute (protocol 0522/10) and the Australian National University Human Research Ethics Committee (protocol 2004344) and informed written consent was obtained from all participants.

RESULTS

The relative frequency of at least one injury in the previous 12 months was 21.5% for the entire study population (Table 1). For all age groups, the risk of having at least one injury was consistently higher for males (24.8%) than females (18.8%). Injury risk varied little across age groups but it did tend to decline in respondents older than 30 years. Similar injury risks were reported for rural and urban areas. Across all age-groups, those earning 10,000 Baht per month or less displayed consistently higher injury risk (22.9%) than those earning higher wages (19.0%). Likewise, for all age-groups, those with only high school or lower education were at higher risk for injury (23.2%) than those who were educated beyond high school (19.9%). Those who were single had marginally higher rates of injury than those with partners (21.9% *vs* 20.4%); this small difference was noted for all age groups.

Injury more commonly occurred at home in females than in males (6.2% *vs* 4.3%) (Table 2). Males were more frequently injured on the road (6.8% *vs* 5.1%), at sports facilities (5.2% *vs* 1.0%), in agricultural workplaces (1.5% *vs* 0.6%) and non-agricultural workplaces (3.4% *vs* 2.5%). The age effects were prominent; for those injured at home, rates were highest in the youngest and oldest males and tended to be stable across all age groups for females. Age effects were notable for road injuries and similar between sexes with injury rates halving across the age range. Sports injuries became less frequent in those over age 40 for both sexes but were 5 times more frequent in males (5.2% *vs* 1.0%). Agricultural injuries occurred with a stable frequency across working age groups and were substantially lower in females. Non-agricultural workplace injuries occurred in all age groups but were most common in the 20-29 year age group in both sexes.

Transport was by far the most common mechanism of injury for all age-groups (Table 3), with 9.9% of males and 7.0% of females identifying it as the mechanism of their most serious injury. Age effects were also apparent, in that younger male and female respondents were more likely to report transport-related injuries than older respondents. Falls were the second most reported mechanism for injury in males (4.6%), particularly among those over 20, and in females of all ages (3.8%). The proportion of respondents that reported falls increased with age in both males and females. Blunt force (3.3% of males and 2.1% of females) was the third most reported mechanism. The proportion of males reporting blunt force as the cause of their most serious injury fell with age, however, the relationship with age was not as apparent for females. The same could be said for stabs/cuts (2.7% of males and 1.9% of females) which was the fourth most common reported mechanism. Other injury mechanisms were reported infrequently, particularly drowning (0.1% of males and females) and gunshot wounds (0.1% of males and 0.02% of females).

Table 1
Reported absolute (#) and relative (%) frequency of at least one injury during the previous 12 months by respondents sociodemographic and economic characteristics.

	Injury frequency[a] by age group (years)											
	15-19		20-29		30-39		40-49		>50		Total	
	n	No. Injured (%)[a]	*n*	No. Injured (%)	*n*	No. Injured (%)	*n*	No. Injured (%)	*n*	No. Injured (%)	*n*	No. Injured (%)
Study group	2,502	547 (21.9)	44,207	9,855 (22.3)	27,309	5,623 (20.6)	10,948	2,251 (20.6)	2,150	455 (21.2)	87,134	18,733 (21.5)
Sex												
Male	851	221 (26.0)	16,872	4,440 (26.3)	13,745	3,330 (24.2)	6,464	1,455 (22.5)	1,546	347 (22.4)	39,482	9,793 (24.8)
Female	1,651	326 (19.7)	27,334	5,415 (19.8)	13,563	2,292 (16.9)	4,484	796 (17.8)	604	108 (17.9)	47,642	8,938 (18.8)
Residence												
City/Town	1,124	256 (22.8)	21,389	4,836 (22.6)	14,579	2,978 (20.4)	6,304	1,273 (20.2)	1,350	295 (21.9)	44,756	9,639 (21.5)
Countryside	1,360	288 (21.2)	22,547	4,959 (22.0)	12,525	2,606 (20.8)	4,541	952 (21.0)	764	146 (19.1)	41,740	8,952 (21.4)
Income (Baht)[b]												
≤10,000	2,269	509 (22.4)	36,866	8,385 (22.7)	13,064	2,963 (22.7)	2,774	717 (25.8)	450	106 (23.6)	55,428	12,681 (22.9)
>10,000	38	8 (21.1)	6,157	1,215 (19.7)	13,722	2,557 (18.6)	7,956	1,491 (18.7)	1,636	340 (20.8)	29,516	5,612 (19.0)
Education												
High school or less	2,375	523 (22.0)	20,419	4,869 (23.8)	13,500	3,063 (22.7)	5,062	1,162 (23.0)	1,086	237 (21.8)	42,448	9,855 (23.2)
Beyond high school	124	23 (18.5)	23,691	4,962 (20.9)	13,733	2,546 (18.5)	5,838	1,077 (18.4)	1,052	214 (20.3)	44,443	8,822 (19.9)
Marital status												
No partner	2,267	493 (21.7)	32,567	7,224 (22.2)	10,112	2,146 (21.2)	2,502	548 (21.9)	391	88 (22.5)	47,843	10,499 (21.9)
Partner	139	26 (18.7)	10,484	2,259 (21.5)	16,362	3,241 (19.8)	8,077	1,613 (20.0)	1,659	338 (20.4)	36,727	7,478 (20.4)

[a] Relative frequency = [(number injured over twelve months) / (number at risk)] x100
[b] USD1= THB 40 in 2005

Table 2
Absolute and relative (%) frequency of at least one injury during the previous 12 months by location of occurrence of most serious injury, by age and sex.

Age group (years)	Injury frequency (%)[a] by location					
	Home	Road	Sports facility	Agricultural workplace	Non-agricultural workplace	Total
Males						
15-19	50 (5.9)	86 (10.1)	45 (5.3)	6 (0.7)	16 (1.9)	221 (26.0)
20-29	690 (4.1)	1,355 (8.0)	930 (5.5)	240 (1.4)	681 (4.0)	4,440 (26.3)
30-39	560 (4.1)	836 (6.1)	782 (5.7)	216 (1.6)	446 (3.2)	3,330 (24.2)
40-49	306 (4.7)	332 (5.1)	269 (4.2)	97 (1.5)	175 (2.7)	1,455 (22.5)
>50	91 (5.9)	78 (5.0)	41 (2.7)	23 (1.5)	29 (1.9)	347 (22.4)
Total	1,697 (4.3)	2,687 (6.8)	2,067 (5.2)	582 (1.5)	1,347 (3.4)	9,793 (24.8)
Females						
15-19	99 (6.0)	117 (7.1)	22 (1.3)	8 (0.5)	36 (2.2)	326 (19.7)
20-29	1,798 (6.6)	1,575 (5.8)	247 (0.9)	135 (0.5)	770 (2.8)	5,415 (19.8)
30-39	735 (5.4)	557 (4.1)	151 (1.1)	102 (0.8)	271 (2.0)	2,292 (16.9)
40-49	289 (6.4)	165 (3.7)	37 (0.8)	36 (0.8)	83 (1.9)	796 (17.8)
>50	47 (7.8)	19 (3.1)	5 (0.8)	3 (0.5)	11 (1.8)	108 (17.9)
Total	2,968 (6.2)	2,434 (5.1)	462 (1.0)	284 (0.6)	1,171 (2.5)	8,938 (18.8)

[a]Percentages represent relative frequency of injury in a given age-sex group. For example among 15-19 year old males (*n*=851, see Table 1) 50 or 5.9% were injured at home over the previous 12 months

Table 3
Absolute and relative (%) frequency of at least one injury during the previous 12 months by mechanism for the most serious injury, by age and sex.

Age group (years)	Injury frequency (%)[a] by mechanism										
	Transport	Assault	Fall	Other blunt force	Drowning	Bite/sting	Gunshot	Stab/cut	Fire, heat	Poisoning	Total
Males											
15-19	113 (13.3)	12 (1.4)	30 (3.5)	33 (3.9)	0 (0)	15 (1.8)	0 (0)	31 (3.6)	2 (0.2)	1 (0.1)	221 (26.0)
20-29	1,827 (10.8)	132 (0.8)	769 (4.6)	638 (3.8)	16 (0.1)	293 (1.7)	15 (0.1)	507 (3.0)	79 (0.5)	82 (0.5)	4,440 (26.3)
30-39	1,282 (9.3)	68 (0.5)	637 (4.6)	411 (3.0)	10 (0.1)	220 (1.6)	9 (0.1)	348 (2.5)	57 (0.4)	33 (0.2)	3,330 (24.2)
40-49	564 (8.7)	20 (0.3)	286 (4.4)	184 (2.8)	5 (0.1)	101 (1.6)	6 (0.1)	144 (2.2)	27 (0.4)	15 (0.2)	1,455 (22.5)
>50	141 (9.1)	1 (0.1)	93 (6.0)	29 (1.9)	0 (0)	33 (2.1)	3 (0.2)	21 (1.4)	4 (0.3)	3 (0.2)	347 (22.4)
Total	3,927 (9.9)	233 (0.6)	1,815 (4.6)	1,295 (3.3)	31 (0.1)	662 (1.7)	33 (0.1)	1,051 (2.7)	169 (0.4)	134 (0.3)	9,793 (24.8)
Females											
15-19	158 (9.6)	8 (0.5)	54 (3.3)	30 (1.8)	0 (0)	25 (1.5)	0 (0)	31 (1.9)	11 (0.7)	5 (0.3)	326 (19.7)
20-29	2,074 (7.6)	76 (0.3)	1,022 (3.7)	606 (2.2)	29 (0.1)	474 (1.7)	4 (0.01)	575 (2.1)	120 (0.4)	73 (0.3)	5,415 (19.8)
30-39	801 (5.9)	30 (0.2)	507 (3.7)	266 (2.0)	5 (0.04)	226 (1.7)	4 (0.03)	208 (1.5)	65 (0.5)	19 (0.1)	2,292 (16.9)
40-49	273 (6.1)	9 (0.2)	181 (4.0)	88 (2.0)	3 (0.07)	85 (1.9)	1 (0.02)	70 (1.6)	27 (0.6)	10 (0.2)	796 (17.8)
>50	43 (7.1)	0 (0)	37 (6.1)	9 (1.5)	0 (0)	10 (1.7)	0 (0)	7 (1.2)	0 (0)	1 (0.2)	108 (17.9)
Total	3,350 (7.0)	123 (0.3)	1,801 (3.8)	999 (2.1)	37 (0.1)	820 1.7)	9 (0.02)	891 (1.9)	223 (0.5)	108 (0.2)	8,938 (18.8)

[a] Percentages represent relative frequency of injury in a given age-sex group. For example among 15-19 year old males (*n*=851, see Table 1) 113 or 13.3% incurred a transport related injury.

Table 4
Absolute and relative (%) frequency of at least one injury in previous 12 months by intent of most serious injury, by age and sex.

Age group (years)	Injury frequency (%)[a] by intent				
	Unintentional[b]	Intentional (involving another person)	Intentional (no other person involved)	Intention unreported	Total
Males					
15-19	150 (17.6)	17 (2.0)	47 (5.5)	7 (0.8)	221 (26.0)
20-29	2,861 (17.0)	383 (2.3)	972 (5.8)	224 (1.3)	4,440 (26.3)
30-39	2,040 (14.8)	288 (2.1)	746 (5.4)	256 (1.9)	3,330 (24.2)
40-49	777 (12.0)	103 (1.6)	430 (6.7)	145 (2.2)	1,455 (22.5)
>50	186 (12.0)	17 (1.1)	93 (6.0)	51 (3.3)	347 (22.4)
Total	6,014 (15.2)	808 (2.0)	2,288 (5.8)	683 (1.7)	9,793 (24.8)
Females					
15-19	214 (13.0)	19 (1.2)	76 (4.6)	17 (1.0)	326 (19.7)
20-29	3,165 (11.6)	250 (0.9)	1,719 (6.3)	281 (1.0)	5,415 (19.8)
30-39	1,350 (10.0)	114 (0.8)	660 (4.9)	168 (1.2)	2,292 (16.9)
40-49	436 (9.7)	48 (1.1)	222 (5.0)	90 (2.0)	796 (17.8)
>50	67 (11.1)	2 (0.3)	27 (4.5)	12 (2.0)	108 (17.9)
Total	5,233 (11.0)	433 (0.9)	2,704 (5.7)	568 (1.2)	8,938 (18.8)

[a]Percentages represent relative frequency of injury in a given age-sex group. For example among 15-19 year old males (*n*=851, see Table 1) 150 or 17.6% reported experiencing an accidental injury.
[b] Using the Thai word *ubatihet*, implying "unintentional".

Nearly two-thirds of all injuries were reported to be "unintentional", with the risk of unintentional injury being 15.2% for males and 11.0% for females (Table 4). Males had a higher risk than females of an intentional injury involving another person (2.0% *vs* 0.9%), while the risk for an intentional injury with no other person involved was similar between males (5.8%) and females (5.7%). For both males and females, those under age 30 were more at risk of unintentional injury, while for intentional injuries (both involving and not involving another person), no age effects were apparent. The proportion of respondents for whom intent was unreported increased with age.

DISCUSSION

Based on the Thai Open University (STOU) baseline survey in 2005, this paper presents a descriptive overview of injury, providing population estimates of frequency and incidence by person, setting, mechanism and intent. The main finding of this large national study was that baseline injury rates were high, with over 20% of the study group reporting an injury during the last 12 months. Males reported more injuries than females. Having low income or lower education was associated with higher rates of injury. Injury at home was more common for females than males but the opposite was true

for sports, road and workplace injuries. Transport injury risk in both sexes decreased with age but falls increased with age. The majority of injuries were reported to be unintentional among both males and females.

Our study design did not permit analysis of differential exposure by sex, age, occupation or socio-economic status so we are unable to distinguish between vulnerability and exposure when interpreting observed differences in various injury rates. One notable strength of this study was the size and national distribution of the study population which represents well adult Thais in terms of sex ratio, age, religion, income and other important factors (Sleigh *et al*, 2008). The sample was substantially better educated than the average adult Thai and this should have helped improve the accuracy of the reports but it also means that the study population was less able to represent injury patterns associated with lower levels of education. The recall period we adopted (12 months) is similar to that used in many other population studies of injury but is subject to 2 forms of recall error: memory decay and memory telescoping. These errors have opposing effects and the net result is partly a function of the severity of the injury, the length of the recall period and the relationship between the person reporting the injury and the person injured. Long recall periods, reporting on other people and using a low severity threshold will all be subject to memory decay and underreporting. For one year recall by proxy respondents reporting against a moderately low injury threshold the under-recall will approximately halve the annual injury event estimates (Harel *et al*, 1994).

Underestimation of injuries is a well known problem encountered in developing country health statistics, and it is reasonable to expect Thailand is also affected. For example, the informative periodic Thailand Health Profile (Wibulpolprasert, 2008), estimated the national road traffic fatalities toll to be 13,766 in 2004 and a large National Injury Survey (NIS) conducted that same year by Chulalongkorn University, The Alliance for Safe Children and UNICEF, produced estimates of a national road traffic toll of 20,000 people – almost 50% more than the Thailand Health Profile estimate (Sitthi-amorn *et al*, 2007). This estimation problem is compounded by difficulties in comparing injury rates that depend on different reporting thresholds, reporting systems, survey populations or different categories of respondents.

The injury rates in our study population per 100,000 per year were almost fourteen times higher than those reported by the NIS (21,500 *vs* 1,573). However, the relative proportions of injury by sex, age, and mechanisms were quite similar in the two injury studies. Some of the differences in magnitude of injury rates may be accounted for by the difference in the samples from which the data was obtained. The STOU sample was less rural (48% versus 61%) and better educated (high school education in nearly 100% versus 56% in the general population). Both of these factors were likely to have lowered the threshold of concern about injuries (Johansson, 1991), and to have increased the recall of minor injuries. Some of the differences may be due to the different methods used for the two studies. The STOU cohort was instructed to report injuries that interfere with daily life and/or require medical care, whereas the NIS respondents were asked to recall injuries severe enough to require three or more days off work, and/or three or more days

of restricted activity and/or require medical care. Thus, the NIS set the injury threshold at "moderate to severe" and the STOU captured injury events starting at a lower threshold. Injuries of low severity are more common than high severity injuries, so the inclusion of injuries of a lower severity would be expected to substantially increase the injury estimates. STOU respondents were reporting injuries they had personally experienced, whereas NIS informants were reporting those of the entire household, hence, most of their estimates are based on proxy respondents.

Because of better education and the non-use of proxies for reporting, the STOU data are probably minimally affected by underestimation problems that are normally encountered in developing country injury statistics. If this is true, our STOU results indicate a much higher injury burden in lower and middle income countries than has previously been recognized. The ongoing Thai Cohort Study will yield prospective incidence data as the cohort is followed through time from 2005 and we can expect a much better understanding of causal pathways for injury once these longitudinal data are available. On the basis of data available already, including those presented here, we already know a substantial proportion of the Thai population is injured every year. The injury rates are associated with a variety of socio-demographic factors; risks vary considerably across various segments of the population. Before interventions are possible we need to understand how the increased risk observed among certain socio-demographic groups for specific injury categories (*eg*, more road injuries among young people or more home injuries among older people) are due to excess exposure and how much are due to intrinsic susceptibility.

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