

**Title**

Roadside observation of secondary school students' commuting to school in Vientiane, Laos

**Authors' names and affiliations**

Masao Ichikawa<sup>a,\*</sup>, Shinji Nakahara<sup>b</sup>, Sysavanh Phommachanh<sup>c</sup>, Mayfong Mayxay<sup>c</sup>, Akio Kimura<sup>d</sup>

<sup>a</sup> Faculty of Medicine, University of Tsukuba

<sup>b</sup> School of Medicine, St. Marianna University

<sup>c</sup> Faculty of Postgraduate Studies, University of Health Science

<sup>d</sup> Department of Emergency Medicine and Critical Care, National Center for Global Health and Medicine Hospital

**\* Corresponding author**

Faculty of Medicine, University of Tsukuba, 1-1-1 Tennodai, Tsukuba-shi, Ibaraki 305-8577,  
Japan

## **Abstract**

To investigate modes of secondary school students' commuting to school and their unsafe driving practices in Laos, we conducted a roadside observation in front of the gate of a selected school in central Vientiane in December 2011. Of the 544 students observed, the majority came to school on foot (43%), followed by motorcycle (36%) and bicycle (14%). Of the 195 students who commuted by motorcycle, 45 (23%) drove it themselves. Of the 150 students who commuted as pillion riders, 35 (23%) were driven by a student or another child driver. The prevalence of helmet use among students (3%) was much lower than adults (66%). It was common for adult drivers to wear a helmet but to leave student pillion riders unhelmeted on the same motorcycle. Carrying two or three pillion riders was also often observed. The study revealed the necessity for measures to promote safe travel to school.

**Keywords:** travel to school; helmet use; secondary school; children; Laos

## 1. Introduction

Road traffic injuries are the leading cause of death among children. Globally, more than 260,000 children are killed annually and approximately 10 million are injured. In low- and middle-income countries, those victims are predominately pedestrians and cyclists (Peden et al., 2008). In Laos, the incidence of traffic crashes is increasing as the use of motorized vehicles becomes widespread. Traffic fatalities have increased from approximately 100 in 1990 to 600 in 2007 (WHO, 2009). In Vientiane, the capital of Laos, there were 2,831 traffic crashes in 2003, injuring 3,883 people and causing 164 deaths (ADB, 2005). Of these crashes, 2,189 (77%) involved motorcycles, 203 involved (7%) bicycles, and 174 involved (6%) pedestrians. A hospital survey also indicated that the great majority of crashes involve motorcycles, and that school-age children are the predominant crash victims (HIB, 2006).

In Vientiane, children are commonly driven to school on motorcycles or the children themselves ride motorcycles to school. This is also seen in other Asian countries with a growing population of motorcyclists. In Western countries, it is common for children to be driven to school by car (Roberts et al., 1997), which provides more protection than a motorcycle. Active commuting (i.e., walking and bicycling) to school is being increasingly encouraged to enhance the level of children's physical activity (Chriqui et al., 2012; Pucher and Dijkstra, 2003). In Japan, children usually walk to school, except in rural areas where it is too far to walk, and thus children may commute by public or school bus. Secondary school students may cycle to school, which is allowed if the school is far from home, approximately two kilometers or longer, depending on each school's rules (Ichikawa and Nakahara, 2007).

Today, rapidly motorized cities such as Vientiane are facing two public health challenges for children: road traffic safety and physical fitness. During their daily commute to school, children are exposed to high traffic volumes and a variety of traffic in unsafe road environments, with poor or nonexistent safety facilities and traffic regulations that are not enforced. The motorcycle is an unsafe mode of travel for children because Laos's driving

license system is not fully functioning or enforced, helmets are rarely used, and it is common for a motorcycle to carry more than two pillion riders. In addition, traveling to school by foot or bicycle is not always safe because of a lack of sidewalks and cycle lanes. Reduced active commuting then leads to a lower level of physical activity and cardiovascular fitness among children, with a potential increase in the risk of overweight/obesity and future cardiovascular diseases (Davison et al., 2008; Janssen and LeBlanc, 2010).

Despite its public health importance in low- and middle-income countries, where the burdens of both traffic injuries and chronic diseases are increasing (Peden et al., 2004; WHO, 2005), little attention has been paid to the traffic safety of school children during travel to school and their active commuting to school in these countries. Therefore, we conducted a roadside observation of secondary school students in central Vientiane to investigate their mode of travel to school and unsafe driving practices while traveling by motorcycle, a commonly seen mode of travel among students in this city.

## **2. Methods**

We conducted a roadside observation of secondary school students as they traveled to school in Vientiane. For this preliminary survey, we purposely chose a public, lower secondary school located in central Vientiane, along a straight arterial road with a wide sidewalk, with only one gate; thus, we could ensure good visibility for our roadside observations, and minimize any missed observations. The student age range for this school level is between 11 and 14 years. Some children might come from far away because there is no school district zoning system. The school opened the gate at 7:00 and closed it at 8:30 in the morning.

We filmed students traveling to school in the morning on a single non-raining day from 7:00 to 8:30 in December 2011, using two video cameras shooting each direction of the road in front of the school gate. Viewing the films, two research assistants independently recorded

each student's mode of travel and gender. Students were identifiable as they were wearing school uniforms. As some students came to school with their siblings or friends attending another school, we only counted students who entered the school gate.

For those students who came to school by motorcycle, their helmet use and whether they drove or were driven to school were recorded. In addition, if they had any companions on the motorcycle, their helmet use and estimated age group were also recorded. The estimated age groups consisted of "adult" and "other child" (that is, any child other than the students of our target school and judged as non-adults).

Discrepancies in the recording were resolved by watching the scene again with a third person. Of the 347 drivers and pillion riders observed, we achieved 98% agreement in recording helmet use, 95% for age, and 94% for gender, with high Kappa statistics (0.97, 0.94, and 0.91, respectively). All discrepancies regarding helmet use and age were resolved. However, we could not identify the gender of seven people who were not students because of the helmets they were wearing and the limited resolution of the film.

The survey procedure was approved by the research ethics committee of both the University of Health Sciences in Laos and the University of Tsukuba in Japan. We also received approval from the Department of Education of Vientiane. Prior to the survey, we explained the aim of the study to the school principal and teachers. On the survey day, teachers counted the number of attendees in the class and conducted in-class student travel tallies. The aim of the tallies was to examine the proportion of students we might have missed in our observations and to determine whether these omissions distorted our findings regarding the distribution of the mode of travel to school.

We calculated the proportion of mode of travel by the students' gender. The prevalence of helmet use was calculated among motorcycle riders (adult, student, and other child), stratified by drivers and pillion riders. In this calculation, riders standing or sitting in front of the motorcycle driver were categorized as pillion riders. Risk ratio (RR) and 95% confidence

interval for helmet use was also calculated to show the magnitude of helmet non-use among students and other children compared with adults. We further counted the difference in helmet use between drivers and student pillion riders on the same motorcycle.

### 3. Results

On the survey day, 238 male and 346 female students attended their classes and the camera recorded 220 male (92%) and 324 female (94%) students at the school gate. Of the total of 544 students observed, the majority came to school on foot (43%), followed by motorcycle (36%), bicycle (14%), car (7%), and *tuk-tuk* (motorized tricycle) (0.4%). Distribution of the mode of travel was similar between male and female students (Table 1). In the travel tallies, 199 male (84%) and 294 female (85%) students were recorded. In contrast to our roadside observation, the proportion of motorcycle commuters (40%) was greater than walking commuters (33%), followed by bicycle (17%), car (10%), and *tuk-tuk* (0.4%).

Of the 195 students who traveled by motorcycle, 45 (23%) drove the motorcycles themselves and 150 (77%) were pillion riders. Of the 150 pillion riders, 115 (77%) were driven by adult drivers, 16 (11%) by student drivers, and 19 (13%) by other child drivers. Of the 45 student drivers, 30 (67%) carried no pillion riders, 14 had 1 pillion rider, and 1 student driver had 2 pillion riders. Of the 18 other child drivers carrying a student pillion rider, 1 carried 2 pillion riders. Of the 106 adult drivers carrying a student pillion rider, 33 (31%) carried 2 or 3 pillion riders.

The prevalence of helmet use among students (3%) and other children (7%) was significantly lower than that among observed adults (66%), with RR of 0.04 for students and 0.10 for other children (Table 2). In all age groups (adult, student, and other child), pillion riders were less likely to wear helmets than drivers. Table 3 shows the difference in helmet use between drivers and student pillion riders on the same motorcycle. It was rare that both a driver and a pillion rider wore helmets. We found only one such case with an adult driver. On

motorcycles driven by adults (with the exception of the observation mentioned above), it was more common that drivers wore helmets compared with no helmets worn at all on the motorcycles. On motorcycles driven by students, no one wore helmets. On motorcycles driven by other children, only two drivers wore helmets. In 10 cases where the driver carried 2 students, neither student wore helmets (data not shown).

#### **4. Discussion**

We found that approximately half of the observed secondary school students walked or cycled to school, while more than one in three commuted by motorcycle. Among these motorcycle commuters, approximately one in four drove the motorcycles themselves. Helmet use was very rare among students even with adults. It was common for adults to wear a helmet and to leave the students unhelmeted. Carrying two or three pillion riders on the same motorcycle was also often observed.

Active commuting to school is a current global strategy aimed at enhancing levels of physical activity and reducing the risk of chronic diseases. This strategy should be more vigorously facilitated in Laos and other low- and middle-income countries, where it is estimated that 80% of all chronic diseases occur (WHO, 2007, 2008). In Vientiane, however, its poor road infrastructure and increased traffic volumes might deter students from engaging in active commuting to school. Moreover, active commuting may not be feasible for students who have to travel a long distance to school. In Vientiane, there is no school district zoning system. Therefore, students may attend schools that are some distance from their homes. In this case, the use of public transportation could still help them increase their level of physical activity because they would have to walk to and from the bus stop. However, Vientiane's current public transportation is unsafe, inconvenient, and uncomfortable. Previous studies in Western countries suggest that active commuting is influenced by various factors, namely individual, family, school, community, and environment characteristics (Davison et al., 2008;

Trapp et al., 2011). This should be investigated in rapidly motorized countries such as Laos to determine how to facilitate active commuting and public transportation use in their own context.

If students cannot help but ride a motorcycle or are driven to school, then traffic regulations should be followed. Laos's Land Traffic Act states that: "motorcyclists shall be at least 15 years of age" (Article 10), "people on motorcycles shall wear standard helmets" (Article 13), and "for motorcycles, only one adult person and one child under 11 years of age are allowed to sit at the back" (Article 13). However, as shown in the results, these regulations are largely ignored or people are unaware of them. It should be noted that secondary school students under 15 years old are not allowed to drive motorcycles by law, so the student drivers we observed would be unlikely to have received proper driving training or held a valid driving license. Moreover, the hospital survey in Vientiane suggested that adult drivers are also often unlicensed (HIB, 2006). Such unlicensed and underage drivers would have a greater risk of causing a crash (Kraus et al., 1991; Shope et al., 2008). It is also noted that carrying an excess number of riders, which was often seen with the adult drivers in our observation, would affect handling and braking distance. This might also increase the risk of a crash. In addition, the lack of helmets would increase the risk of death and head injuries in a crash (Liu et al., 2008). Clearly, the enforcement of traffic regulations is essential to improve these risky behaviors.

With regard to helmet use, attention should be paid to the gap in their use between adults and children, whereby children are exposed to the greater risk. This gap cannot necessarily be explained by the barriers to helmet use identified in previous studies: low perceived efficacy of helmets, limited sight/hearing and discomfort due to helmet wearing, negative norms for helmet use, high helmet cost, low perceived risk of crash involvement and being ticketed for non-use (Germeni et al., 2009; Hung et al., 2008; Ranney et al., 2010; Zamani-Alavijeh et al., 2011). For example, an underestimation of crash risk would reduce helmet use for both adults and children, producing no significant gap between them.

There could be a unique barrier to child helmet use. In Vietnam, for example, a claim was circulated via the media that helmet wearing could increase the risk of neck injuries in children (Pervin et al., 2009). This was the main reason reported by parents for not making their children wear helmets. To our knowledge, such a concern has not been raised in Laos. Further investigation is required to identify factors producing the gap that needs to be filled.

Promotion of child helmet use is feasible in our study area, because low-cost standard motorcycle helmets are readily available, at approximately US\$9 for a child's helmet and US\$21 for an adult helmet; these prices are largely affordable for those who can afford to purchase a motorcycle. In some parts of Thailand, helmets can be purchased at a subsidized cost, approximately one third of that in Laos (Khon Kaen Hospital, 2010). Such financial support might help reduce the perceived costs of helmets and increase the willingness to pay for them (Pham et al., 2008).

It must be noted, however, that there is no epidemiological evidence to date on the effectiveness of child motorcycle helmets in preventing fatalities and head injuries. Though there are potential benefits of wearing motorcycle helmets among children because bicycle helmets are shown to be effective in preventing head injuries among children and in bicycle collisions with motor vehicles (Bambach et al., 2013; Thompson et al., 1996), the potential benefits would be largely reduced by improper use of motorcycle helmets (Yu et al., 2011). This is challenging particularly among children as the size of their head will change unlike adults.

The limitation of the current study is that our roadside observation was limited to just one school during a morning rush hour on a single non-raining day. The mode of travel to school and motorcycle helmet use could vary across the city, between morning and afternoon, and on different days with different weather. Such detail data should be collected in the near future to plan situation-specific effective interventions. It is also noted that the quality of helmets and how the helmets were worn, which would influence protection against head injuries (Yu et al.,

2011), were not taken into account because this is beyond the scope of the current study.

The benefits of using a video camera to record our roadside observations are that we could more accurately record the scene and repeatedly check the scene. We found it particularly useful in observing the heavily congested road where we had to check many students at one time. However, the heavy traffic on the road still obscured the scene somewhat, often making observation difficult. Moreover, the width of the scene captured by the video camera was limited, so we may have miscounted some students who were, for example, driven to school and let out away from the school gate, out of the range of the video camera, and then walked to school. This could have resulted in the discrepancies between the results for the roadside observation and in-class tallies. It is possible that we underestimated the proportion of motorcycle commuters.

In conclusion, it is common for secondary school students to travel to school by motorcycle and to rarely wear helmets even with adult drivers. It is also widespread for adult drivers to carry two or three pillion riders during travel to school. Therefore, traffic regulations need to be enforced to promote safe travel to school.

## **Acknowledgements**

We thank the participating school teachers and students. This work was supported by the Grant for National Center for Global Health and Medicine (22-11). The authors declare that there are no conflicts of interest.

## References

Asian Development Bank (ADB) (2005). *ADB-ASEAN: regional road safety program – national road safety action plan (2005-2010): road safety action plan in the Lao People's Democratic Republic*. Asian Development Bank, Manila.

Bambach, M.R., Mitchell, R.J., Grzebieta, R.H., Olivier, J. (2013). The effectiveness of helmets in bicycle collisions with motor vehicles: a case-control study. *Accident Analysis and Prevention*, 53, 78-88.

Chriqui, J.F., Taber, D.R., Slater, S.J., Turner, L., Lowrey, K.M., Chaloupka, F.J. (2012). The impact of state safe routes to school-related laws on active travel to school policies and practices in U.S. elementary schools. *Health and Place*, 18, 8-15.

Davison, K.K., Werder, J.L., Lawson, C.T. (2008). Children's active commuting to school: current knowledge and future directions. *Preventing Chronic Disease*, 5(3)  
[http://www.cdc.gov/pcd/issues/2008/jul/07\\_0075.htm](http://www.cdc.gov/pcd/issues/2008/jul/07_0075.htm). Accessed on 22 June, 2012.

Germeni, E., Lionis, C., Davou, B., Petridou, E.T. (2009). Understanding reasons for non-compliance in motorcycle helmet use among adolescents in Greece. *Injury Prevention*, 15, 19-23.

Handicap International Belgium (HIB) (2006). *HIB Hospital Survey April 2006 – Results*. Handicap International Belgium, Vientiane.

Hung, D.V., Stevenson, M.R., Ivers, R.Q. (2008). Barriers to, and factors associated, with observed motorcycle helmet use in Vietnam. *Accident Analysis and Prevention*, 40, 1627-

1633.

Ichikawa, M., Nakahara, S. (2007). School regulations governing bicycle helmet use and head injuries among Japanese junior high school students. *Accident Analysis and Prevention*, 39, 469-474.

Janssen, I., LeBlanc, A.G. (2010). Systematic review of the health benefits of physical activity and fitness in school-aged children and youth. *International Journal of Behavioral Nutrition and Physical Activity*, 7, 40.

Khon Kaen Hospital (2010). *Community youth helmet use project in Khon Kaen and Nakorn Ratchasima*. Khonkaen Printing, Khon Kaen.

Kraus, J.F., Anderson, C., Zador, P., Williams, A., Arzemanian, S., Li, W., Salatka, M. (1991). Motorcycle licensure, ownership, and injury crash involvement. *American Journal of Public Health*, 81, 172-176.

Li, Y., Fernie, G. (2010). Pedestrian behavior and safety on a two-stage crossing with a center refuge island and the effect of winter weather on pedestrian compliance rate. *Accident Analysis and Prevention*, 42, 1156-1163.

Liu, B.C., Ivers, R., Norton, R., Boufous, S., Blows, S., Lo, S.K. (2008). Helmets for preventing injury in motorcycle riders. *Cochrane Database of Systematic Reviews*, Issue 1. Art. No.: CD004333. DOI: 10.1002/14651858.CD004333.pub3.

Peden, M., Oyegbite, K., Ozanne-Smith, J., Hyder, A.A., Branche, C., Rahman, A.K.M.F.,

Rivara, F., Bartolomeos, K. (Eds.) (2008). *World report on child injury prevention*. World Health Organization, Geneva.

Peden, M., Scurfield, R., Sleet, D., Mohan, D., Hyder, A.A., Jarawan, E., Mathers, C. (Eds.) (2004). *World report on road traffic injury prevention*. World Health Organization, Geneva.

Pervin, A., Passmore, J., Sidik, M., McKinley, T., Nguyen, T.H., Nguyen, P.N. (2009). Viet Nam's mandatory motorcycle helmet law and its impact on children. *Bulletin of the World Health Organization*, 87, 369-373.

Pham, K.H., Le Thi, Q.X., Petrie, D.J., Adams, J., Doran, C.M. (2008). Households' willingness to pay for a motorcycle helmet in Hanoi, Vietnam. *Applied Health Economics and Health Policy*, 6, 137-144.

Pucher, J., Dijkstra, L. (2003). Promoting safe walking and cycling to improve public health: lessons from The Netherlands and Germany. *American Journal of Public Health*, 93, 1509-1516.

Ranney, M.L., Mello, M.J., Baird, J.B., Chai, P.R., Clark, M.A. (2010). Correlates of motorcycle helmet use among recent graduates of a motorcycle training course. *Accident Analysis and Prevention*, 42, 2057-62.

Roberts, I., Carlin, J., Bennett, C., Bergstrom, E., Guyer, B., Nolan, T., Norton, R., Pless, I.B., Rao, R., et al. (1997). An international study of the exposure of children to traffic. *Injury Prevention*, 3, 89-93.

Shope, J.T., Bingham, C.R. (2008). Teen driving: motor-vehicle crashes and factors that contribute. *American Journal of Preventive Medicine*, 35(3S), S261-S271.

Thompson D.C., Rivara F.P., Thompson, R.S. (1994). Effectiveness of bicycle safety helmets in preventing head injuries: a case-control study. *Journal of American Medical Association*, 276, 1968-73.

Trapp, G.S., Giles-Corti, B., Christian, H.E., Bulsara, M., Timperio, A.F., McCormack, G.R., Villaneuva, K.P. (2012). Increasing children's physical activity: individual, social, and environmental factors associated with walking to and from school. *Health Education and Behavior*, 39, 172-82.

World Health Organization (WHO) (2005). *Preventing chronic diseases: a vital investment*. World Health Organization, Geneva.

World Health Organization (WHO) (2007). *A guide for population-based approaches to increasing levels of physical activity: implementation of the WHO global strategy on diet, physical activity and health*. World Health Organization, Geneva.

World Health Organization (WHO) (2008). *School policy framework: implementation of the WHO global strategy on diet, physical activity and health*. World Health Organization, Geneva.

World Health Organization (WHO) (2009). *Global status report of road safety: time for action*. World Health Organization, Geneva.

Yu, W.Y., Chen, C.Y., Chiu, W.T., Lin, M.R. (2011). Effectiveness of different types of motorcycle helmets and effects of their improper use on head injuries. *International Journal of Epidemiology*, 40, 794-803.

Zamani-Alavijeh, F., Bazargan, M., Shafiei, A., Bazargan-Hejazi, S. (2011). The frequency and predictors of helmet use among Iranian motorcyclists: A quantitative and qualitative study. *Accident Analysis and Prevention*, 43, 1562-9.

**Table 1** Transportation mode for travel to school by secondary school students by gender

	Male (n=220)	Female (n=324)	Total (n=544)
Walk	93 (42%)	142 (44%)	235 (43%)
Motorcycle	82 (37%)	113 (35%)	195 (36%)
Bicycle	32 (15%)	43 (13%)	75 (14%)
Car	12 (5%)	25 (8%)	37 (7%)
<i>Tuk-tuk</i>	1 (0.5%)	1 (0.3%)	2 (0.4%)

**Table 2** Helmet use among students, other children, and adults as drivers and pillion riders, and risk ratio (RR) and 95% confidence interval (CI) for helmet use among students and other children compared with adults

	Driver		Pillion rider		Total		RR	95% CI
	n	Helmeted (%)	n	Helmeted (%)	n	Helmeted (%)		
Students	45	4 (8.9%)	150	1 (0.7%)	195	5 (2.6%)	0.04	0.02, 0.09
Other children	18	2 (11.1%)	26	1 (3.8%)	44	3 (6.8%)	0.10	0.03, 0.31
Adults	106	70 (66.0%)	2	1 (50.0%)	108	71 (65.7%)	Reference	

**Table 3** Difference in motorcycle helmet use between drivers and student pillion riders on the same motorcycle, by type of driver

	Helmet use	Student pillion rider	
		(+)	(-)
Student driver	(+)	0	0
	(-)	0	15
Other child driver	(+)	0	2
	(-)	0	16
Adult driver	(+)	1	69
	(-)	0	36

Note: The value in the table indicates the number of motorcycle with a combination of helmeted and unhelmeted driver and pillion rider by type of driver.