

FACTORS RELATED TO MOTORCYCLE ACCIDENT RISK BEHAVIOR AMONG UNIVERSITY STUDENTS IN NORTHEASTERN THAILAND

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Abstract. Young motorcycle drivers in Thailand are at high risk for road traffic accidents. We conducted this study to identify factors associated with motorcycle accident risk behavior (MARB). We studied 372 randomly selected university students aged 18-22 years (mean 20.2 years; women comprised 68.0% of our participants), who attend a government university in northeastern Thailand. Each student was asked to fill out a questionnaire asking about MARB and factors associated with this behavior. The respondents had an average of 6.2 years ($SD \pm 3.09$) motorcycle driving experience, 72.3% had a motorcycle driver's license and 83.0% had accident insurance. The prevalence of self-reported motorcycle accident injuries was 42.7%. Their major MARB were using a telephone while driving (69.3%), speeding (45.4%), driving with more than one passenger (40.1%), drunk driving (22.1%), and not wearing a helmet (23.3%). Factors related to MARB were: gender, with men engaged in risky behavior more often than women ($p < 0.05$); duration of motorcycle driving - drivers with > 5 years experience were more likely to engage in risky behavior ($p < 0.05$); and knowledge of safe driving, those with a greater knowledge of safe driving were more likely to drive safely ($p < 0.001$). Having a greater awareness of MARB was associated with lower risk of engaging in risky behavior ($p < 0.001$). Students who engaged in risky behavior were more likely to view it as normal behavior ($p < 0.001$) and less likely to have adequate self-control ($p < 0.001$). Our findings indicate a need to strengthen accident prevention programs for university students in northeastern Thailand.

Keywords: motorcycle accident, risk behavior, factors related to risky behavior, university students, Thailand

INTRODUCTION

A report by the Department of Land

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and Transportation for Thailand found motorcyclists were involved in 35.0% of all road traffic accidents (DLT, 2011). Motorcycle drivers aged 15-24 years have the highest risk (29.0%) for traffic death and injuries (MOPH, 2009). This is because of high risk behavior, such as speeding, not wearing a helmet, driving with more than

one passenger, drunk driving, and driving while interacting with friends (Ru-angkanchanasetr *et al*, 2005; Thai Roads Foundation, 2011; Moskal *et al*, 2012). Traffic accidents are caused by multiple factors: human, vehicle and environment (Haddon, 1972; Hajar *et al*, 2000; Lin and Kraus, 2009).

Age and gender are associated with risk behavior. Men engage in risky driving more often than women and teenagers more often than adults (Al-Balbissi, 2003; Lin and Kraus, 2009). Inexperience, inadequate driving training, speeding and not following traffic rules are all human related risk factors (Mullin *et al*, 2000; Chen *et al*, 2009; Peek-Asa *et al*, 2010; Wong *et al*, 2010; Rhodes and Pivik, 2011). Mullin *et al* (2000) found setting a minimum legal age for driving has a great impact on lowering the risk for accidents among young people. Vehicle condition, such as the brakes, visible lights (Smither and Torrez, 2010), and environmental conditions, such as the condition of roads, street lighting, weather, and the presence of rain or fog are factors also affecting road safety (Lin *et al*, 2003; Lin and Kraus, 2009; Beyer and Ker, 2009; Wong *et al*, 2010; Rhodes and Pivik, 2011). Modifiable factors, such as wearing conspicuous clothing and enacting daytime headlight laws, can also impact accident risk (Smither and Torrez, 2010).

A country's economic growth is associated with road traffic accidents (Pang *et al*, 2000; Tanaboriboon and Satiennam, 2005; Lin and Kraus, 2009; Boni *et al*, 2011). Thailand has the highest road traffic accident fatality rate in Southeast Asia: 42.9 per 100,000 population, compared to 12.6-34.5 per 100,000 in Cambodia, Lao PDR, Indonesia, Vietnam and Malaysia (WHO, 2009). Motorcycles are the most important form of transportation in

Southeast Asia (Pang *et al*, 2000; Abu Husan Abu Bakar, 2011). A report by the Thai Transport Statistics Sub-division (2009) reported Thailand has 27 million registered motorcycles, accounting for 63.0% of the two- and three-wheeled motorized vehicles in the country. Deaths from motorcycle accidents are common in Thailand (Tanaboriboon and Satiennam, 2005; Woratanarat *et al*, 2009; Hongsranagon, 2011; Nunn, 2011). Thailand has had rapid economic growth since 1985 (Krongkaew, 1995; Dutt and Mukhopadhyay, 1996). It is transforming from a subsistence-based economy with reliance on agriculture to a market-oriented economy with an increased reliance on industry. This shift has led to changes in infrastructure, organization and delivery of services, including expansion of roads and an increase in vehicle ownership. Motorcycle accidents are common among young people (Royal Thai Police, 2010). There is a strong negative relationship between risky driving behavior and age, with risk for severe accident injury decreasing with increasing age (Mullin *et al*, 2000). However, little is known about this risky driving behavior in Thailand and how it contributes to road traffic injuries (Royal Thai Police, 2010; Stephan *et al*, 2011; Road Safety Operation Center, 2011).

This study used the PRECEDE Framework (Green and Kreuter, 2005), incorporating concepts from the Theory of Planned Behavior (TPB) (Ajzen, 1991). The PRECEDE Framework is an acronym for *P*redisposing, *R*einforcing, and *E*nabling Constructs in *E*cosystem *D*iagnosis and *E*valuation. The processes emphasize multiple factors influencing people's health and lifestyle. It evaluates social, epidemiological, behavioral and educational/environmental situations related to a particular problem, such as

motorcycle accidents. Factors taken into account are the predisposing, reinforcing and enabling factors. In the case of motorcycle accidents, the predisposing factors are knowledge of safe driving, attitudes about motorcycle accident risk behavior (MARB), perceived subjective norms and social circumstances, perceived self-control over MARB, and received information about road safety. Enabling factors were the individual's skills and the conditions leading to performing the behaviors of interest. The TPB (Ajzen, 1991) states the healthy behavior of individual results from their intentions and is influenced by their attitudes, subjective norms, and behavioral control. People are more likely to engage in doing something if they plan to do it. William Haddon, Jr (1972), a physician and engineer, is recognized as a modern injury epidemiologist; he has developed a matrix risk classification known as the Haddon Matrix. This matrix serves as a framework to assess injuries and identify preventive strategies. It is composed of three time phases for the crash event, (pre-crash, crash, and post-crash), along with three domains influencing each crash phase, (human, vehicle and equipment, and environment) (Haddon, 1972). Applying these three concepts results in the suggestion that university students are active agents who negotiate and modify their own behaviors within socio-cultural and environmental contexts. They both impact and are impacted by the socio-cultural and environmental conditions in which they live. Motorcycle accidents and injuries among university students result from interrelated factors: the human, vehicle and equipment, and environment. We investigated MARB and factors affecting such behavior among university students in northeastern Thailand. The study results could help uni-

versity students, administrators, public health personnel, related authorities and other organizations develop appropriate solutions to reduce motorcycle accident injuries in this population.

MATERIALS AND METHODS

Study design, setting and participants

This study evaluated undergraduate students at a government university in northeastern Thailand aged 18-22 years ($N = 20,650$; 6,229 men and 14,421 women). The subjects were chosen by conducting a survey asking if they were regular motorcycle drivers, driving at least once a week. Seventy point one percent of regular motorcycle drivers were women and 29.9% were men. Three hundred seventy-two students were then chosen for this study using a known population size formula (Krejcie and Morgan, 1970). The study was conducted from July 2011 to February 2012.

A questionnaire was constructed using in-depth interviews and focus group discussions with fifteen representatives of various organizations and departments both on and off campus and student leaders from the eighteen faculties at the university and the student union. Through these discussions we developed a list of questions about factors related to motorcycle accident risk behavior.

The agreed upon questions were divided into eight specific motorcycle accident risk behaviors (MARB) categories. Motorcycle accident risk behavior was determined using 32 questions answered with a five point scale indicating frequency practices of each MARB from "never" to "always". The scores were reversed for negative questions; therefore, high risk behaviors yielded higher scores. With a total score of 32-160 points, the overall

MARB scores were divided into three risk levels: low (32-64 points), moderate (65-127 points), and high (128-160 points). Each category had its own set of questions and was scored as follows: 1) drunk driving, comprised of three questions, with a total maximum score of 15; 2) driving over the speed limit, comprised of two questions, with a total maximum score of 10; 3) not obeying traffic rules, comprised of nine questions, with a total maximum score of 45; 4) driving while talking on the telephone, comprised of three questions, with a total maximum score of 15; 5) not wearing a helmet, comprised of one question, with a total maximum score of 5; 6) driving with more than one passenger, comprised of two questions, with a total maximum score of 10; 7) driving an unsafe vehicle, comprised of eight questions, with a total maximum score of 40; and 8) driving under unsafe environmental conditions, comprised of four questions, with a total maximum score of 20.

The eight motorcycle accident risk behavior categories were associated three domains (human, vehicle and equipment, and environment). The three domains were designed to provide understanding of risk behavior practices in nine different areas: 1) knowledge of safe driving, 2) attitudes about MARB, 3) perceived subjective norms among peers related to MARB, 4) perceived self-control over MARB, 5) having a motorcycle driver's license, 6) duration of motorcycle driving experience, 7) amount of information received about road safety during the previous year, 8) perceived unsafe motorcycle conditions, particularly the brakes, lights, and rear-view mirrors, and 9) perceived risk due to the road and surrounding conditions both on and off campus.

The scoring for the nine risk factor behavior areas was as follows: 1) mea-

surement of knowledge of safe driving, comprised of 30 questions with a total maximum score of 30 points, with knowledge being divided into low (0-17 points), moderate (18-23 points), and high (24-30 points) levels; 2) Attitudes and perceptions were comprised of 85 questions: attitudes about MARB-37 questions, perceived subjective norms 24 questions, and perceived self-control over MARB 24 questions, with each question having a score from 1 to 5 points: "strongly disagree", "disagree", "somewhat disagree", "agree", and "strongly agree". The scores were reversed for negative questions, therefore, positive attitudes and appropriate perceptions yielded higher scores.

The overall perceived risk for the roads and surrounding conditions was comprised of eight questions about on campus area (four questions) and off campus area (four questions). Each question was given a score from 1 to 3 points representing low to high risk conditions. The overall score was divided into three risk groups: low (1-8 points), moderate (9-16 points) and high (17-24 points). Road traffic accident specialists confirmed the validity of the questionnaire. The questionnaire reliability had a Cronbach's alpha coefficient based on 46 samples. Internal consistency of the scales was satisfactory, ranging from 0.74 to 0.83.

Data analysis

Quantitative data were analyzed using descriptive and inferential statistics. Descriptive statistics consisted of frequency, mean and standard deviation. The chi-square test and Spearman's rank correlation coefficient were used to investigate relationships between demographic and personal information, predisposing, enabling, and reinforcing factors for MARB in the study population, particu-

larly for non-normally distributed variables. The Statistical Package for Social Science (SPSS, version 17.0; IBM, Armonk, NY) was used for all statistical analysis. Qualitative data used content analysis.

The study was approved by the Ethics Committee of Mahasarakham University (Ref. no 0315/2010), and the Ethics Committee of Mahasarakham General Hospital (Ref no. 0027.2/8550), Thailand.

RESULTS

Demographic and personal characteristics

Three hundred seventy-two university students were included in the study; 68.0% were women, which was near the proportion of women at the university who were regular motorcycle drivers (70.1%, 14,421 out of 20,650). Thirty point one percent of the students were in their third year, 64.2% were studying the humanities and social sciences, and 44.4% resided off campus. The age range of participants was 18-22 years (mean 20.2 years; $SD \pm 1.29$). Seventy-three point nine percent reported driving a motorcycle every day and 83.0% had compulsory third party insurance coverage for their motorcycles. The motorcycle insurance rate in Thailand is based on the engine capacity, with the usual range of 75-150 cc.

Motorcycle accident risk behavior

Forty-two point seven percent of participants reported having a motorcycle accident during the previous year (Table 1). Of these, 94.1% had a mild injury, such as a skin abrasion. Some reported moderate to severe injuries requiring medical treatment, including head and brain injuries (2.9%), fractured bones (1.8%), and abdominal injuries (1.2%). Data from Mahasarakham University for 2011, revealed 14 students died from traf-

Table 1
Demographics and personal characteristics of the university students.

Variable	n (%)
Sex	
Male	119 (32.0)
Female	253 (68.0)
Age (years)	
18-19	119 (22.0)
20-21	202 (51.6)
22-23	59 (15.9)
Major	
Humanities and social sciences	232 (62.4)
Science and technology	106 (28.5)
Health sciences	34 (9.1)
Frequency of motorcycle driving (days per week)	
1-2	14 (3.8)
3-4	29 (7.8)
5-6	54 (14.6)
7	275 (73.9)
Mean ($\pm SD$)	6.3 (± 1.42)
Motorcycle accident during the previous year	
No	204 (57.3)
Yes	168 (42.7)
1-2 times	142 (84.5)
3-4 times	24 (14.3)
5 times	2 (0.2)

fic injuries, giving a mortality rate of 36.2 per 100,000 population.

Eight MARB were identified from the sampling of the university students in this current study. The overall MARB of this group of students was reported in a moderate level of practice (mean 72.6 points; $SD \pm 14.6$), however, driving while talking on the telephone (13.7%), driving with more than one passenger (10.5%), driving over the speed limit (9.1%), drunk driving (6.2%), and not wearing a helmet (5.6%) were in the top five most common MARB. These university students also reported having a moderate MARB, particu-

Table 2
Frequency of motorcycle accident risk behavior.

MARB	Frequency of reported behaviors			
	Low <i>n</i> (%)	Moderate <i>n</i> (%)	High <i>n</i> (%)	Total <i>n</i> (%)
Driving while talking on the telephone (Low = 1-5, Moderate = 6-10, High = 11-15)	114 (30.6)	207 (55.7)	51 (13.7)	372 (100)
Driving with more than one passenger (Low = 1-3, Moderate = 4-6, High = 7-10)	223 (59.9)	110 (29.6)	39 (10.5)	372 (100)
Driving over the speed limit (Low = 1-3, Moderate = 4-6, High = 7-10)	203 (54.6)	135 (36.3)	34 (9.1)	372 (100)
Drunk driving (Low = 1-5, Moderate = 6-10, High = 11-15)	290 (78.0)	59 (15.9)	23 (6.2)	372 (100)
Not wearing a helmet (Low = 1.0-1.6, Moderate = 1.7-3.3, High = 3.4-5.0)	285 (76.6)	66 (17.8)	21 (5.6)	372 (100)
Not obeying traffic rules (Low = 1-13, Moderate = 14-27, High = 28-30)	257 (69.1)	111 (29.8)	4 (1.1)	372 (100)
Driving an unsafe vehicle (Low = 1-5, Moderate = 6-10, High = 11-15)	259 (69.6)	110 (29.6)	3 (0.8)	372 (100)
Driving under unsafe environmental conditions (Low = 1-6, Moderate = 7-13, High = 14-15)	256 (68.8)	115 (30.9)	1 (0.3)	372 (100)
Overall (Low = 32-64, Moderate = 65-127, High = 128-160)	242 (65.1)	129 (34.7)	1 (0.3)	372 (100)
Mean point, Standard deviation (+SD)	72.6 (\pm 14.6)			
Range	36 - 118			

larly driving under unsafe environmental conditions, not obeying traffic rules, and driving an unsafe vehicle (Table 2).

Supportive data from the in-depth interviews and focus group discussions indicated obstacles that prevented this population group from wearing a helmet. These obstacles included the helmet interfering with their hairstyle, discomfort when wearing a helmet in warm weather, and the consequence of blurred vision, particularly at night. Their reasons for driving over the speed limit included traveling during rush hour and being in a hurry, most specifically when rushing to class, to an appointment, or to an off campus home, requiring long distance travel for visiting their families over the weekend.

Three domains of MARB: human domain Predisposing factors. Eighty-four point one percent of participants had a high level of knowledge about safe driving (Table 3), specifically regarding obeying traffic rules (96.0%), driving under poor environmental conditions (91.1%), driving an unsafe vehicle (87.1%), driving with more than one passenger (84.9%), drunk driving (83.6%), and not wearing a helmet (75.6%).

However, there were some misunderstandings about safe driving. These included the thought that wearing a half-sized helmet was safe (23.1%). Forty-seven percent stated wearing a helmet impaired their visual field and 61.3% said it impaired hearing. Sixty-one point eight

Table 3
Perceptions of the subjects about human, vehicle and equipment, and environmental domains related to motorcycle accidents.

Variable	<i>n</i> (%)	Variable	<i>n</i> (%)
Human domain		Enabling factors	
Predisposing factors		Duration of motorcycle driving experience (years)	
Knowledge of safe driving		<1	
Low (0-14 points)	8 (2.2)	1-5	143 (38.4)
Moderate (15-20points)	51 (13.7)	6-10	194 (52.2)
High (21-30 points)	313 (84.1)	≥ 11	33 (8.9)
Attitudes about MARB		Having a motorcycle driver's license	
Low (1- 61 points)	0 (0.0)	No	103 (27.7)
Moderate (62-123 points)	81 (21.8)	Yes	269 (72.3)
High(124-185 points)	291 (78.2)	Vehicle and equipment domain	
Perceived norms among peers related to MARB		Enabling factors	
Low (1-40 points)	0 (0.0)	Perceived unsafe motorcycle condition	
Moderate (41-80 points)	173 (46.4)	Low (1.00-2.50 points)	259 (69.6)
High(81-120 points)	199 (53.5)	Moderate (2.51-3.50 points)	110 (29.6)
Perceived self-control over MARB		High (3.51-5.00 points)	3 (0.8)
Low (1-40 points)	3 (0.8)	Environmental domain	
Moderate (41-80 points)	200 (53.8)	Enabling factors	
High(81-120 points)	169 (45.4)	Perceived risk due to road and surrounding conditions on campus	
Reinforcing factors		Low (1-4 points)	3 (0.8)
Amount of information received about road safety		Moderate (5-8points)	139 (37.4)
No	103 (27.7)	High (9-12 points)	230 (61.8)
Yes	269 (72.3)	Perceived risk due to road and surrounding conditions off campus	
1-3 sources	224 (83.3)	Low (1-4 points)	16 (4.3)
4-5 sources	39 (14.5)	Moderate (5-8points)	151 (40.6)
6-8 sources	6 (2.2)	High (9-12 points)	205 (55.1)

percent stated using a hands free device while talking on the phone made it safe to drive.

Sixty-eight point five percent of students had positive overall attitude about MARB, however, the proportion of those with a positive attitude varied on categories of MARB. Primary, they had positive attitudes about avoiding driving under unsafe conditions (80.4%), not obeying traffic rules (73.7%), driving while talking on the telephone (73.7%), driving an

unsafe vehicle (70.2%), drunk driving (69.9%), and driving over the speed limit (61.6%). A small number of students had positive attitudes about not wearing a helmet (44.6%), and driving with more than one passenger (40.9%) (Table 4). Sixty-six point one percent of students believed driving without a turn signal was an important determinant of an accident.

Over half of the students strongly believed their friends influenced their MARB, specifically regarding not obeying

Table 4
 Knowledge level about safe driving, attitudes toward MARB, perceived norms and perceived self-control over MARB among study subjects.

Level of appropriateness	MARB									
	Driving while talking on the telephone n (%)	Driving over the speed limit n (%)	Driving with more than one passenger n (%)	Driving under unsafe environmental conditions n (%)	Not obeying traffic rules n (%)	Driving an unsafe vehicle n (%)	Not wearing a helmet n (%)	Drunk driving n (%)	Overall	
Knowledge of safe driving ^a										
Low	46 (12.4)	285 (76.6)	56 (15.1)	13 (3.5)	15 (4.1)	13 (3.5)	5 (1.3)	61 (16.4)	8 (2.2)	
Moderate	116 (31.2)	68 (18.3)	0 (0.0)	20 (5.4)	81 (21.8)	35 (9.4)	86 (23.2)	285 (76.6)	51 (13.7)	
High	210 (56.4)	19 (5.1)	316 (84.9)	339 (91.1)	276 (74.2)	324 (87.1)	281 (75.6)	26 (7.0)	313 (84.1)	
Attitudes about MARB ^b										
Low	11 (3.0)	0 (0.0)	20 (5.4)	0 (0.0)	0 (0.0)	0 (0.0)	0 (0.0)	6 (1.6)	0 (0.0)	
Moderate	87 (23.4)	143 (38.4)	200 (53.4)	66 (17.7)	82 (22.0)	111 (29.8)	206 (55.4)	106 (28.5)	81 (21.8)	
High	274 (73.7)	229 (61.6)	152 (40.9)	299 (80.4)	290 (78.0)	261 (70.2)	166 (44.6)	260 (69.9)	291 (78.2)	
Perceived norms among peers related to MARB ^c										
Low	2 (0.5)	7 (1.9)	14 (3.8)	0 (0.0)	0 (0.0)	2 (0.5)	3 (0.8)	2 (0.5)	0 (0.0)	
Moderate	208 (55.9)	169 (45.4)	244 (65.8)	164 (44.1)	138 (37.1)	175 (47.0)	189 (50.8)	151 (40.6)	173 (46.5)	
High	162 (43.5)	196 (52.7)	114 (30.6)	208 (55.9)	234 (62.9)	195 (52.4)	180 (48.4)	219 (58.9)	199 (53.5)	
Perceived self-control over MARB ^c										
Low	21 (5.6)	36 (9.7)	47 (12.6)	26 (7.0)	60 (16.1)	7 (1.9)	26 (7.0)	22 (5.9)	3 (0.8)	
Moderate	177 (47.6)	138 (37.1)	190 (51.1)	187 (50.3)	133 (35.8)	170 (45.7)	116 (31.2)	106 (28.5)	200 (53.8)	
High	174 (46.8)	198 (53.2)	135 (36.3)	159 (42.7)	179 (48.1)	195 (52.4)	230 (61.8)	244 (65.6)	169 (45.4)	

MARB; motorcycle accident risk behavior.

^a Low = low level of knowledge about safe driving, Moderate = moderate level of knowledge about safe driving, High = high level of knowledge about safe driving.

^b Low = negative attitudes, Moderate = somewhat agree with negative and positive attitudes, High = positive attitudes.

^c Low = inappropriate perception, Moderate = somewhat inappropriate perception, High = appropriate perception.

Table 5
Associations between personal characteristics and MARB among university students.

Variable	MARB risk level			χ^2	<i>p</i> -value
	Low	Moderate-high	Total		
	<i>n</i> (%)	<i>n</i> (%)	<i>n</i> (%)		
Sex				4.942	0.02*
Male	24 (20.2)	95 (79.8)	119 (100.0)		
Female	176 (69.6)	77 (30.4)	253 (100.0)		
Total	200 (53.8)	172 (46.2)	372 (100.0)		
Duration of motorcycle driving experience (years)				6.134	0.04*
≤ 5	77 (74.8)	26 (25.2)	103 (100.0)		
6-10	146 (61.9)	90 (38.1)	236 (100.0)		
≥ 11	19 (57.6)	14 (42.4)	33 (100.0)		
Total	200 (53.8)	172 (46.2)	372 (100.0)		

^aLow=32-64 points; ^bModerate-high=65-160 points; * *p*<0.05.

Table 6
Associations between MARB and predisposing factors among study subjects.

Variable	Mean ^a points (SD)	Correlation ^b	<i>p</i> -value
Knowledge of safe driving	22.7±2.62	-0.389	0.001
Attitudes about MARB	83.1±19.20	-0.656	0.001
Perceived subjective norms among peers related to MARB	59.7±13.51	-0.587	0.001
Perceived self-control over MARB	83.7±12.78	-0.63	0.001

^aThe mean scoring of predisposing factors; knowledge score = 0-30 points; attitudes score = 37-185 points; perceived norms score 24-120 points; perceived self-control score 24-120 points.

^bSpearman's rank correlation.

traffic rules (62.9%), drunk driving (58.9%), driving under poor environmental conditions (55.9%), driving over the speed limit (52.7%), and driving an unsafe vehicle (52.4%). Forty-eight point four percent reported having been appropriately influenced by their peers in not wearing a helmet, driving while talking on the telephone (43.5%), and driving with more than one passenger (30.6%). Fifty-three point seven percent were intended by peer norms (Table 4).

More than half of the students strongly believed they had adequate self-control over their MARB, specifically drunk driving (65.6%), not wearing a helmet (61.8%), driving over the speed limit (53.2%), and driving an unsafe vehicle (52.4%). Less than half reported having adequate self-control over not obeying traffic rules (48.1%), driving while talking on the telephone (46.8%), driving under poor environmental conditions (42.7%), and driving with more than one passenger (36.3%). Forty-five point

four percent believed they had self-control over MARB (Table 4).

Seventy-two point three percent of the participants received information about road safety and safe driving during the previous year. The amount of information they received ranged from one to eight sources (mean 2.1 sources; $SD \pm 1.1$). Eighty-three point three percent of the students reported receiving 1-3 sources of information about road safety. Their major sources of information were signs or posters (64.5%), participating in university workshop training (56.4%) and listening to public radio (47.3%). They also indicated they received information about road safety and safe driving from such sources as on campus organizations, including the Security Protection Division (35.2%) and the Student Affairs Division (25.3%).

However, 27.7% of participants stated they had not received information about road safety and safe driving from any source during the previous year (Table 3).

Enabling factors. Seventy-two point three percent of participants had a motorcycle driver's license. The range of duration of motorcycle driving experience among participants was 1/2-14 years (mean 4.3 years $SD \pm 2.5$). Fifty-four point eight percent had 5-9 years driving experience (Table 3).

Three domains of MARB: Vehicle and equipment

Enabling factors. Sixty-nine point six percent of students strongly reported their motorcycles were driven under safe conditions. Three participants stated their motorcycles were unsafe. Thirty point four percent stated their motorcycles were only moderately safe (Table 3).

Three domains of MARB: Environmental domain

Enabling factors. Sixty-one point eight percent of students perceived a high level

of risk due to road and surrounding conditions on campus, while 55.1% reported a high level of risk due to conditions off campus (Table 3).

Data indicating high risk conditions on-campus were inadequate road lights (72.8%), unclear and inadequate traffic signs (64.8%), rough roads with curves and uneven surfaces (51.9%), and inadequate traffic lights (44.4%). The off-campus conditions involved inadequate traffic signs (76.1%), inadequate road lights (75.8%), unclear and rough roads with curves and uneven surfaces (62.4%), and inadequate traffic lights (53.0%).

Factors affecting MARB

MARB among participants was significantly associated with personal characteristics (gender) and one enabling factor (duration of motorcycle driving experience). Male university students had significantly different MARB from their female peers ($p = 0.020$). More men (55.2%) engaged in moderate to high levels of MARB than women (44.8%), ($p < 0.05$). MARB also differed by duration of motorcycle driving experience ($p = 0.040$). Those with 6-10 years of motorcycle driving experience (52.3%) engaged in moderate to high levels of MARB than those with less than 5 years driving experience (15.1%) and those with more than 11 years driving experience (8.1%) ($p < 0.05$).

MARB did not differ by year of study, education level, income, living on- or off-campus, by major, by having insurance or not, by human domain related factors, such as the amount of information received about road safety and safe driving, or due to enabling factors, such as having a motorcycle driver license ($p < 0.05$) (Table 5).

The Spearman's rank correlation showed a significant relationship between

knowledge of safe driving and MARB ($p < 0.001$).

Those who had a positive attitude about MARB were less likely to engage in MARB ($p < 0.001$).

Perceived norms were also associated with MARB ($p < 0.001$). The more the participants perceived subjective norms of appropriate driving on peers, the less they engaged in MARB ($p < 0.001$).

Perceived self-control over MARB was also associated with MARB ($p < 0.001$). Those with a higher perceived sense of self-control over the MARB engaged in lower levels of MARB ($p < 0.001$) (Table 6).

We did not find significant correlations between amount of information received about road safety and safe driving during the previous year and MARB ($p < 0.05$). Perceived risks of road and surrounding conditions both on and off campus were not associated with MARB ($p < 0.05$). From focus group discussions, participants believed MARB was due to unsafe environmental conditions, specifically hazardous roads, lack of regulatory signs or warning posters in hazardous areas, dust particles, street lighting, retained water on the road surface, rough and uneven road surfaces, and lack of warning signs, especially in the community surrounding the university, constituted dangerous conditions. The students also asserted that road management served as their major causes of motorcycle accidents. Avoid enforcement of the traffic laws and regulations at police check points made university students to engage in MARB and increase the incidence of motorcycle accidents and injuries. The students reflected their words as the following.

“Factors such as not obeying traffic rule, particularly driving in the wrong direction, and driving on poor road surfaces are among the leading

risk behaviors causing motorcycle accident among our university students” (Fourth-year female student aged 22 years, majoring in the health science faculty group).

“Driving on an unsafe road surface and driving on the roads with no regulations or traffic signs are the most frequent risk behaviors among the students here in our university” (Third-year female student aged 21 years, majoring in a humanity and social science faculty group).

“Drunk driving and driving in the wrong direction, suddenly turning the motorcycles around to avoid police roadblock and checkpoints to inspect their license, accidental insurance or other checking are risk behaviors causing motorcycle accidents among university students” (Third-year male student aged 21 years, majoring in a science and technology faculty group).

Despite the lack of a significant correlation between environmental conditions and MARB among this group of university students, survey data show over half of the students perceived high risk due to road and surrounding conditions, both on campus (61.8%) and off campus (55.1%).

DISCUSSION

The prevalence of MARB in the study population was moderate, similar to the previous study in Bangkok (Ruangkanchanasetr *et al*, 2005). There were eight identified MARB among our study subjects: driving while talking on the telephone, driving with more than one passenger, driving over the speed limit, drunk driving, not wearing a helmet, not obeying traffic rules, driving an unsafe vehicle, and driving under poor environ-

mental conditions. Zamani-Alavijeh *et al*, (2010) studied on motorcycle use in Iran, reported seven MARB: not obeying traffic rules, driving under the influence of alcohol, driving without proper skills, illegally transporting passengers, not wearing a helmet, performing stunts, and illegally transporting cargo. Of these, the first five were identical to the MARB in our study. Our study did not find the MARB of driving when tired as indicated in other study (Silva *et al*, 2012).

Driving while talking on the telephone (13.7%) constituted the highest MARB practiced among the university students in this study. Driving while using a cellular phone is illegal in Thailand, and little is known about this among the motorcycle drivers. Much information exists regarding cellular phone use while driving an automobile in Thailand. One study of 11,000 drivers in Thailand found 81.6% of those surveyed used telephone while driving, this was implicated as the cause of accidents in 6.3% of all accidents in Thailand (Office of Policy and Strategy, 2011). Silva *et al* (2012) studied Brazilian couriers ($n=750$) aged 18-24 years and found that 23.1% of this group used a cellular phone while driving. This is slightly higher than the percentage seen in our study. Despite the availability of hands-free cellular phones and other related devices, Liu and Ou (2011) found hands-free cellular phones significantly affected driving behaviors and reaction time and accuracy of responses among older and younger drivers.

Driving with more than one passenger was the second most common MARB in our study (10.5%). This prevalence in our study is similar to a study from France (12.3%) (Moskal *et al*, 2012). It is controversial whether the presence of a passenger on the vehicle is a safety issue.

Moskal *et al* (2012) found one passenger increased the risk of an accident among moped drivers, but was protective among motorcycle drivers. In our study the risks increased with more than one passenger; problems included losing balance when driving and difficulty in controlling the vehicle. Driving a motorcycle with more than one passenger is illegal in Thailand.

Driving over the speed limit (9.1%) was the third most common MARB in our study. Forty-five point four percent of all respondents in our study admitted to driving over the speed limit. This prevalence is higher than the 26.6% found among Taiwanese motorcyclists aged 18-28 years (Wong *et al*, 2010). Sixty point six percent of the highway traffic accidents in Thailand occur due to speeding (Thai Roads Foundation, 2011).

Seventy-six point six percent of participants in our study wore a helmet when driving. This is higher than the national average of 52.6% (Thai Roads Foundation, 2011). The proportion of those who did not wear a helmet in our study (23.4%) is lower than another study of adolescents from Bangkok (50.1%) (Ruangkanchanasetr *et al*, 2005). The reasons given for not wearing a helmet have been widely reported. The reasons given by participants in our study included: interference with hair styles, impaired visual ability when driving at night, and feeling uncomfortable in warm weather. In a survey of motorcyclists and their passengers ($n = 954,956$) (Behavioral Risk Factor Surveillance System, 2010), participants stated reasons of short travel distance (64.0%), travel off the main road (37.0%), being in a hurry (29.0%), discomfort in warm weather (21.0%), no place to keep a helmet (10.0%), distance from police checkpoint (8.0%), lack of a helmet (7.0%), perceived having a minimal chance of getting into

an accident (6.0%), and lacking a helmet for passengers (4.0%) (Thai Roads Foundation, 2011). The target goal for 100% helmet is used throughout the country. Our findings highlight the need to promote helmet use in the population under studied.

Drunk driving was a common MARB in our study. The prevalence of drunk driving was found among adolescents in Bangkok (Ruangkanchanasetr *et al*, 2005). Nationwide study found 19.8% of drivers reporting drinking alcohol in one hour of driving a motorcycle (Thai Roads Foundation, 2011). Based on the Injury Surveillance System in Thailand, among people injured in traffic accidents in Thailand, a report 25.8%-30.4% of accident victims had a blood alcohol level exceeding 50.0 mg% (Thai Roads Foundation, 2011). When compared to the baseline survey data in 2005 on the distribution of transport injury and related risk behaviors in a large national cohort of Thai adults ($n = 87,134$) (Stephan *et al*, 2011), drunk driving among the participants in our study was lower than those of the comparable cohort in that study which indicated 56.0% of drunk driving among men, and 21.0% among women. Since drunk driving contributes to one-fourth to one-third of traffic injuries in Thailand, anti-drunk driving campaigns needed to have a high priority.

Not obeying traffic rules was reported by 29.8% of the participants. This percentage is higher than the 19.6%-25.3% reported among Taiwanese motorcyclists aged 18-28 years (Wong *et al*, 2010). Practices mentioned by our participants included: running a red light, driving in the wrong direction, driving in a false lane, passing in a no passing zone, turning in front of another driver, and turning without a signal. Practices reported by Taiwanese

included: right and left turn violations and running a red light. Setting up police checkpoints does not appear to have a positive impact on safe driving. Student motorcycle drivers were likely to attempt to escape from police traffic inspections, increasing their driving against traffic regulations.

Driving an unsafe vehicle was reported by 30.4% of our participants. Unsafe vehicle conditions included incomplete lighting systems, which included light signals, impaired brakes, absence of rear-view mirrors, and failure to periodically check the motorcycle's condition. Little is known about the contribution of unsafe motorcycles to traffic risk behaviors; however, driving an old automobile was contributed to risk behaviors in Singapore (Weng and Meng, 2012).

Driving in unsafe environmental conditions was reported by 30.9% of study participants. These risks included rough and bumpy road surfaces, inadequate road lights, particularly when driving at night, and driving on rainy days. A study of the Canadian's population, Wickens *et al* (2012) investigated driver aggression. These participants reported driving on busy road, both men (39.8%) and women (35.2%), respectively from high to low. In addition, environmental factors such as the availability of public transportation was also found to effect traffic injuries among motorcycle drivers (Ramos *et al*, 2011).

Forty-two point seven percent of motorcycle accidents was reported among university students in our study during the previous year, 6.0% requiring medical care. This result was lower than the reported 12.2% in the 2009 National Injury Surveillance in Thailand (Bureau of Epidemiology, 2009). Despite the lower severity of injuries, and far lower mortal-

ity rate from the 10 per 100,000 population (Thai Roads Foundation, 2011), the high level of MARB in this population makes prevention in this group important.

Our results showed MARB differed by gender and length driving experience. Attitudes about MARB were also associated with MARB ($p < 0.001$). Knowledge about safe driving and perceived control over MARB were negatively correlated with MARB ($p < 0.001$).

A gender difference in MARB is well described in the literature (Stephan *et al*, 2011; Moskal *et al*, 2012; Weng and Meng, 2012). Men engage in driving over the speed limit and drunk driving more frequently than women. We found male drivers engaged in MARB more than female drivers.

Duration of driving experience was associated with MARB. Lin *et al* (2003) in a study of junior college students from Taiwan found more driving experience, older age of the driver and having in a driver's license decreased the risk of motorcycle accidents. Moskal *et al* (2012) studied risk factors for injury accidents among moped and motorcycle drivers found motorcyclists who had a driver's license for a longer duration had a lower risk of involvement in an accident. In our study university students with more years driving experience engaged in higher levels of MARB: among those with driving experience greater than 11 years, 42.4% had MARB, among those with 6-10 years, 38.2% had MARB and among those with driving experience less than 5 years, 25.2% had MARB.

In our study, those with correct attitudes about MARB were less likely to engage in MARB than those with less appropriate attitudes, similar to study by Chorlton and Conner (2012) from the

United Kingdom. They found those with an attitude that it was okay to speed were more likely to do so.

In our study, those who perceived the norm among their peers related to moderate to high risk level of MARB were likely to engage in MARB ($p < 0.001$), similar to the study by Moller and Haustein (2014) from Denmark. They investigated relationship between driving behaviors and peer influence on speeding among male drivers and found that males who perceived higher level of peer speeding tended to increase speeding, particularly among male aged 18 years. Knowledge about safe driving was inversely correlated with MARB ($p < 0.001$) in our study, similar to a study by Dong *et al* (2011).

Participants who perceived to have a high level of control over MARB engaged in less MARB ($p < 0.001$). Perceived behavioral control is an important proximal determinant of behaviors (Ajzen, 1991).

Participants who perceived environmental factors played an important role in rates of MARB and traffic accidents among university students. These conditions included having unsafe roads and surrounding conditions, both on and off campus; particularly rough and uneven road surfaces, retained water on roads, lighting, inadequate traffic signs, and lack of law enforcement regarding those drivers who did not comply with traffic regulations. Therefore, it is important to take into account environmental management both inside and outside the university.

This study we investigated MARB and the factors associated with it among university students in northeastern Thailand. We identified 8 MARB: driving while talking on the telephone, driving with more than one passenger, driving over the speed limit, drunk driving, not wearing a

helmet, not obeying traffic rules, driving unsafe vehicles, and driving under poor environmental conditions. Findings from this study suggest appropriate solutions for traffic accident prevention. Strengthening knowledge related to safe driving, correct attitudes about MARB, self-control over MARB, and peer norms about MARB can all benefit this population. Relevant organizations both on and off campus need to be included in improving the roads and environment. Law enforcement participation is also needed to improve risk.

ACKNOWLEDGEMENTS

The authors would like to thank the Division of Research Facilitation and Dissemination, and the Faculty of Medicine, Mahasarakham University (MSU), for providing funding for this study. Our thanks also go to the MSU's Registrar Division, Buildings and Grounds Division, Student Affairs Division, and Security Protection Division, as well as the Mahasarakham General Hospital for providing data about university student health. Our special thanks also go to Dr Bangorn Kumpol for her advice regarding statistic, and Wendy Beck and Dr Tim Cushnie for their valuable suggestions in writing the manuscript.

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