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AN EPIDEMIOLOGICAL STUDY OF TRAFFIC ACCIDENT AMONG MOTORCYCLISTS WHO SOUGHT CARE AT MAHASARAKHAM HOSPITAL

SUDA SOMBATYOTHA

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF
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MAJOR IN INFECTIOUS DISEASES

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จาก
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Mahidol University

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Thesis
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AN EPIDEMIOLOGICAL STUDY OF TRAFFIC ACCIDENT AMONG MOTORCYCLISTS WHO SOUGHT CARE AT MAHASARAKHAM HOSPITAL

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Suda Sombatyotha

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ชื่อวิทยานิพนธ์ การศึกษาทางระบาดวิทยาของการเกิดอุบัติเหตุในผู้ขับขี่รถจักรยานยนต์ โรงพยาบาลมหาสารคาม
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บทคัดย่อ

การศึกษาครั้งนี้มีวัตถุประสงค์เพื่อศึกษาปัจจัยที่เกี่ยวข้องกับการเกิดอุบัติเหตุของผู้ขับขี่รถจักรยานยนต์ โดยการศึกษาระบาดวิทยาของการเกิดอุบัติเหตุ รถชนกัน ชนรถชนิดอื่น ชนคน ชนสัตว์ สิ่งของ สิ่งกีดขวาง คว่ำเองหรือล้มเอง โดยศึกษาผู้ป่วยที่มารับบริการที่โรงพยาบาลมหาสารคาม ระหว่างวันที่ 1 มกราคม พ.ศ. 2534 ถึงวันที่ 31 ธันวาคม พ.ศ. 2537 (ระยะเวลา 4 ปี) คัดลอกข้อมูลจากแบบบันทึกรายงานการตรวจโรค ผลจากการศึกษา ผู้ประสบอุบัติเหตุส่วนใหญ่เป็นชาย อายุน้อยกว่า 20 ปี สถานภาพโสด เป็นนักเรียน นักศึกษา รองลงมาได้แก่อาชีพเกษตรกรรม อาศัยนอกเขตเทศบาล ช่วงเวลาที่เกิดอุบัติเหตุมากคือ 18.00-21.00 นาฬิกา พบมากในวันเสาร์ เดือนเมษายนพบมากกว่าเดือนอื่น อุบัติเหตุส่วนมากเกิดจากรถจักรยานยนต์คันเดียว ลักษณะการเกิดอุบัติเหตุรถจักรยานยนต์ล้มเองเป็นส่วนใหญ่ อวัยวะที่ได้รับบาดเจ็บมากที่สุดได้แก่ ขาและเท้า รองลงมาได้แก่ แขนและมือ ลักษณะการบาดเจ็บแผลถลอก พบมากที่สุด รองลงมาเป็นแผลฉีกขาด (สามารถมองเห็นได้ภายนอก)

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ผลการศึกษาพบว่า อุบัติเหตุส่วนใหญ่เกิดจากรถจักรยานยนต์ล้มเอง ช่วงเวลา 15.00-18.00 นาฬิกา ดื่มแอลกอฮอล์ร้อยละ 36 สำหรับผู้ป่วยที่รับรักษาในโรงพยาบาลมีระดับแอลกอฮอล์ในกระแสเลือดมากกว่า 50 มิลลิกรัมเปอร์เซ็นต์ ร้อยละ 60 ขับขี่ด้วยความเร็ว 41-60 กิโลเมตรต่อชั่วโมง บนถนนคอนกรีต พื้นถนนเรียบ ทัศนวิสัยดี ปัจจัยที่มีความสัมพันธ์กับการเกิดอุบัติเหตุ ได้แก่ อาชีพรับจ้าง ระยะทางการขับขี่มากกว่า 50 กิโลเมตรต่อวัน ผู้ที่ใช้รถใหม่อายุการใช้งานภายใน 24 เดือน ขนาดความจุรถมากกว่า 100 ลิวบิกเซนติเมตร สภาพรถที่มีกระจกส่องหลังไม่ครบทั้ง 2 ข้าง

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Thesis Title An Epidemiological Study of Traffic Accident among Motorcyclists Who Sought Care at Mahasarakham Hospital

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ABSTRACT

The objective of this study is to find the factors associated with accident among motorcyclists. In an epidemiologal study of traffic accidents caused by collisions among motorcycles and other motorcycle with vehicles, pedestrians, animals, objects, fences and falls, cases were collected from Mahasarakham hospital during January 1, 1991 to December 31, 1994. Information were gathered from out patient department records. Most of the cases were male, aged at least equal 20 years old, single, students, agriculturists and lived outside municipal area. The time of accidents occurred mostly between 18.00-21.00, on Saturday, and in an April. Majority of the accidents were without litigant and the type of accidents were falls. Forearms and hands were the major parts of the body that were injured. Most were visualized abrasion and tear wounds.

A concurrent case control study was also conducted to find factors associated with accidents among motorcyclists who sought care at Mahasarakham hospital. The study comprised of 250 cases (who were attend at the hospital between July 1, 1995 and October 31,1995) with the same characteristics as those in the epidemiological study. Controls were non-accident patients with other disease who also rode motorcycles but without accidents during the study period. Controls had the same sex and age (within 5 year different) with cases. The ratio of cases to controls was 1:1.

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The result shows that among the cases, most of the accidents were falls (40 percent), occurred during 15.00-18.00 (22 percent), Alcoholic consumption was found in 36 percent of all cases, with blood alcohol concentration of over 50 milligrams percent (60 percent among admitted cases), the speed of 41-60 kilometers per hour (35 percent), on concrete road (60 percent), smooth surface (71 percent) and during fine weather (55 percent). The factors found to be associated with the accident were labourers, riding more than 50 kilometers per day, duration of using motorcycle of at least equal 24 months, engine capacity motorcycle of greater than 100 cubic centimeter and a defect of at least 1 rear mirror.

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CHAPTER I

INTRODUCTION

Rationale and Background

Injuries due to road traffic accidents is an increasing public health concern in many developing countries, including Thailand. Most of the crashed vehicles were motorcycles, which also accounted for majority of the injured persons and deaths (1).

Thailand has been experiencing rapid development in all sectors, particularly in the industrial sector during the last 2 decades. Improvement of transportation and increasing traffic are necessary to support such development. The use of high technology to improve the speed of vehicles leads to faster transportation but also increases the severity of accidents.

The Royal Thai Police Department found in 1983 a high rate of newly registered motorcycle of 29% per year, whereas the rate of newly registered personal vehicles icreased about 13% per year (3). The number of registered vehicles in 1991, 1992, and 1993 were 8,481,025, 9,595,191 and 11,101,758 respectively. In 1993, the highest number of registered vehicles were motorcycles 7,260,665 (65.40%), followed by personal vehicles 1,381,048 (12.44%) (3). The number of motorcycles have been increasing rapidly both in urban and rural areas that causes a trend of an increasing burden of accident related to financial problems (1) and the precise number of motor vehicles and motorcycles are still increasing each year (3). The situation of road traffic accidents in the Kingdom is shown in table 1.

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Table 1 Traffic accident-casualties and damaged property recorded by The Royal Thai Department and Highway Department, Thailand, 1990 to 1993.

Year	Whole Kingdom of Police department (1)				High way of highway department (2)			
	Number (case)	Number of dead (case)	Number of injuries (case)	Price of damage (million baht)	Number (case)	Number of dead (case)	Number of injuries (case)	Price of damage (million baht)
1990	40,481	5,765	18,252	259.8	5,453	3,011	7,477	369.2
1991	43,966	6,319	19,458	344.1	5,617	2,882	7,837	420.8
1992	61,329	8,184	20,702	607.8	12,568	5,886	13,488	665.2
1993	84,892	9,496	25,300	1,021.5	17,060	6,799	16,544	751.7

Sources:

(1) Research and Planning Division, The Royal Thai Police Department, Ministry of Interior.
(2) Traffic Engineering Division, Highway Department, Ministry of Communication.

A report on traffic accident of the whole kingdom of Thailand during January to September 1994 stated that traffic accident cases, dead victims and damaged properties were increased as compared to the same period of 1993, with a rate of 23.2%, 56.6% and 38.2%, respectively (4). Motorcyclists, however, remain a high risk group in term of incidence and severity of traffic injuries. Motorcycle is a dominant means of transportation among people in the community to their offices or schools and for use with family members. The number of registered motorcycle was 56% of all registered vehicles, according to Ishido (5). Head is the most important part of the body which caused severe injury and death among the victims (2, 6). Specially noted, injuries among non helmet-user drivers were increased by 6 times (7). The feature injury rate due to motorcycle accident was 50 times and fatal risk was 4 times that of car. Protection from accidents by the use of helmet among motorcyclists leads to a decrease in incidence of head, neck and brain damage (8).

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The effect of an accident are injuries, fatalities, disabilities, loss of persons or loved ones, stress and loss of properties, all of which contributes to public health problems economically and socially countrywide. A preliminary study by professionals from United Kingdom had indicated that road accidents cost about 1-2% of annual Gross National Product (GNP) in developing countries. The enormous damage due to accidents cannot be estimated (5,10).

The Thailand Development Research Institute (TDRI) computed the economic cost of damage on 3 sections in 1993:

1. Damaged property.
2. Income and product of all his life both disability and death victims.
3. Cost of public health care and loss of income during treatment and rehabilitation period.

In 1993 Thailand lost about 61,079-92,290 million baht in a year or 7-10 million baht per hour in contrast to the government budget for the whole kingdom which was about 560,000 million baht (10.91%-16.48%). The lost of all accidents is highest 1 time than road accident (11). About 65% of all injured and death victims were youth, an important segment of the people where society places their hope for nation building. Over half of disabled persons were caused by accidents, a major loss and large burden to the society (3).

Traffic accident at Mahasarakham province has been icreasing every year. In 1994, total vehicles registered at Mahasarakham Transportation Office were about 13,861, of which the largest number was motorcycles (77.17%) (12). The case and fatality rates of traffic accidents of hospitals in Mahasarkham province during 1993 to 1994 (13) is shown in (table 2).

In 1994, about 66.3% of traffic accidents in Mahasarakham province were caused by motorcycle (14). It is therefore interested to study the motorcycle traffic accident in Mahasarakham province on the aspects of characteristics, trend and factors related to motorcycle accident. The resulting data of such a study are essential as a base on the development, implementation and evaluation of an effective injury prevention and control programs.

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Table 2 Case rate and fatal rate from traffic accident per 100,000 population of hospital in Mahasarakham Province in 1991 to 1994.

Year	Case rate/100,000 pop.	Fatal rate/100,000 pop
1991	881.9	3.3
1992	941.8	6.2
1993	1225.7	6.2
1994	1416.4	7.9

Source: Prevention and Control of Accident Program of Hospital in Mahasarakham Province.

Objectives

1. To study the epidemiology of motorcycle traffic accidents during the last 4 years and to compare the trend of past and present.
2. To study the factors associated with motorcycle accident.

Hypotheses

The following factors are associated with motorcycle accident:

1. Personal factors:
   - Demographic characteristics i.e. history of disease, physical condition, mental condition
   - Knowledge of traffic rules
2. Factors of riders:
   - History of alcoholic beverage consumption, drug usage before riding
   - Speed before the event of accident
   - History of accident during the past year
   - Experience of riding motorcycle
   - Frequency of riding/week
   - Having driver's license
3. Vehicle factors:
   - Engine capacity of motorcycle
   - Duration of using motorcycle
   - Modification of engine
   - Complete condition of motorcycle

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Definition of Term

Accident means an unplanned and undesirable occurrance in a sequence of events which usually produces unintended injury, death or property damage.

Traffic accident means an event caused by traffic or transportation which crashed with at least 1 vehicle. This event causes injuries, death or damage of properties.

Knowledge means the recognition of cause of accident, prevention and have knowledge of 1979 traffic laws which described about speed, traffic light, traffic symbol and safety action such as turn right, turn left, intervene, etc.

Experience of riding motorcycle means duration of motorcycle riding experience to date (year).

Income: means income/person/month.

Physical condition means physical condition related to accident that occurred i.e. normal, hungry, syncope, sleepy or drunk.

Mental condition means mental condition related to accident occurred i.e. normal, angry, uneasy, stress or hurry.

Medical condition means drug usage before riding i.e. decongestant, antihistamine, TDMA & metaphetamine or hypertensive drug.

Complete condition of motorcycle means presence of 2 rear mirrors, front-rear light, turn right-turn left light, brake condition and engine condition (fitted) of motorcycle.

Abbreviated Injuries Scale (AIS) classifies severe injuries into 6 levels:

2.1 AIS-1, minor injury is mild wound, abrasion/sprain cracked and immobility of arm bone.

2.2 AIS-2, moderate injury is moderate wound, long wound over 3 inches (body regions) over 2 inches (face area), mild contusion, brain cracked and non movement of arm bone.

2.3 AIS-3, severe injury (severity not fatal) many wounds, wound size over 4 inches (face area) or incision deep wound such as muscle, fracture of arm bones and cracked of leg bone.

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2.4 AIS-4, serious injury (severity to fatal) rupture of spleen, several fracture ribs, fail chest one side.

2.5 AIS-5, critical injury is serious injury, both side fail chest, severe rupture of liver.

2.6 AIS-6, maximum injury is decapitation, hemorrhage in brain may fatal within 60 minutes, divide main arterial.

Gcs = Glasgow coma scale means the measurement of head severe injury which is separated into 3 levels by using score and symptoms.
Level 1 score 13-15 is the least injured head injury.
Level 2 score 9-12 is moderate severed head injury.
Level 3 score 8 or less was the most severed head injury.

Variables

1. Independent variables comprise of 18 variables.

Group 1 general characteristics are 11 variables:

1.1 Demographic:
- History of disease
- Physical condition
- Mental condition
- Knowledge of traffic rules

1.2 Factors of riding motorcycle:
- Experience of riding motorcycle
- Frequency of riding / week
- Having driver's license
- Alcoholic beverage consumption, drug usage before riding
- History of accident during the past year
- Speed

Group 2 Vehicle factors are 4 variables:
- Engine capacity of motorcycle
- Duration of using motorcycle (month)
- Modify engine of motorcycle
- Complete condition of motorcycle

Group 3 Road condition and environmental condition are 3 variables:
- Road condition
- Weather condition
- Type of road

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2. Dependent variable i.e. the accident event which occurred to the motorcyclist.

3 Control variable (confounding variable) i.e.
- Sex
- Age

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CHAPTER II

LITERATURE REVIEW

Definition of Accident

World Health Organization (15) defines accident as "an event, independent of the will of man, caused by a quickly action extraneous manifesting itself by injury to body or mind."

The means of accident, from "Chalermprakiet Division" dictionary (1986) is "an event, independent of the will of man, accidentally."

According to Punyahotra (9), accident means "an unplanned and undesirable occurrence in a sequence of events which usually produces unintended injury, death or property damage."

Type of Accident

The International Statistics Classification of Disease and Related Health problems Tenth Revision (ICD 10) divided accident into two main group:

1. Transportation accident - means an event of a causal communication or transportation such as land accident, marine accident, airline accident, and others includes unknown event.
2. Other external causes of accident injury.

Punyahotra (2) Piyasilpa (17) classified accidents into the following groups:

1. Home or domestic accident - is an event which occurs indoor or outdoor such as electric shock, scald, skid in the bathroom, miss the ladder, cut wound.
2. Occupational accident - means that the event was caused or related to working or occupation such as building construction, the industrial work, etc.
3. Public accident - means the causes of the event occurs in public area such as in school, theater, which includes fire.
4. Natural disaster - such as flood, wildfire, earthquake, volcanic eruption.
5. Transportation accident or traffic accident - means the event were caused by traffic or transportation such as land, marine, railway and airline accidents.

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Effects of Traffic Accident according to Na Chiangmai (18) comprises of the following socioeconomic losses:

1. Loss of economic. It was estimated by both government and non government organizations that the loss was several thousand million baht, primarily due to loss of working hours, law-suit, and income, including traffic jam.

2. Loss of part of society and manpower. Each year, traffic accidents caused high number of manpower loss who were otherwise formed an important component for the development of the country. The injured and disabled persons has become a big burden both to his family and the community.

3. Loss of health. Although the non-fatal victims lost both time and money for treatment, the injured persons may need longer time for treatment more than other diseases and for this reason, the cost of treatment is expensive. The patients eventually recovers but deformity may be one of the outcome.

4. Many of the accident victims suffer from stress and hallucination eventhough they had no serious injury or any disability.

Accident loss, according to Punyahotra (9), usually composed of the following:

1. Human loss - means fatal and injured victims.

2. Psychological and social loss - is intangible loss, depends on victims' personality and sentiment. These loss such as pain, regret, mind suffer, fear, become insane, mental derangement, out of social life and lonely, can not work or survive.

3. Economic loss - estimated to be several thousand million baht each year due to accidents. Accident caused waste of time, law-suit, loss of work, loss of income and traffic jam.

Personal behavior factors related to traffic accident, as describe by Green (19) in the concept of community health are as follows:

1. Human biological factor - his genetics will be affected and thus affects the health, natural growth, age, etc.

2. Environment factor - means the extraneous factors that related to natural factors which precipitate increasing accident such as the economic development, increased transportation, increased numbers of road and vehicles, weather condition, etc.

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3. Life-style and behavior action - are advantage or disadvantage in personal health and may affect to get accident i.e. careless driving, alcoholic drinking, neurostimulant drug use, non-use of helmet, wander about at night, etc.

4. Health care organization - is associated with traffic accident and community health. This organization is authorized to invite Government to make decision by using strategies for reduction of problems such as alcohol intake control law, dissemination of information into the community to beware of traffic accident and safety.

Factors associated with traffic accident, as classified by Na Chiangmai (18) are:

1. Unsafe acting. The behaviors such as carelessness and violation of laws are the main cause of accident. Different level of precise self-care for him and vehicles.

2. Unsafe condition. Environmental condition may precpitate accident, such as skid road, insufficiency of light, non sign on curve road, non rear light of vehicles. Unsafe physical conditions as the cause of accident are easier to solve than human behavior.

Epidemiology of Traffic Accident

Factors associated with traffic accident are human, vehicle, and road & environmental factors.

1. Human Factors

Human factor is the most important cause of accident, especially the violations against the law of road use.

1.1. Type of road users are classified into:

1.1.1 Driver: is the cause of direct accident, which depends on his control of himself and the vehicles in every condition.

1.1.2 Passenger: persons who passage on vehicles and do not drive. Passenger will be associated with the accident when it may occur.

1.1.3 Pedestrian is a weak target for accident because of non-barrier protection. So when accident took place, the pedestrian will be damaged.

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1.2. The driver's characteristics which are associated with accidents are:

1.2.1 Sex: male would have accident more than female since male like to drive vehicles more than female and also like long distance driving. Men have more risk of accident injuries than female, according to a study by Punyahotra (9) and Chontaraviroj (20).

1.2.2 Age: is an important component of accident according to World Health Organization (WHO). Punyahotra (9) classified age as follows:

- Childhood is age 15 years old and below.
- Adolescent is age between 16-24 years old.
- Middle age is age between 25-64 years old.
- Elderly is age since 65 years old.

In Thailand, most of the accidents occurred among those with the age of 14-24 years old and 25-35 years (Punyahotra) (21).

1.2.3 Law: disobedience such as lack of responsibility, selfish, lack of order are the main factors in the accident.

1.2.4 High speed driving: is an easy cause of accident and causes enormous damage. Specially when the speed is over 80 km/hr, can't stop the vehicle immediately within safe distance and thus accidents occurs.

1.2.5 Abnormal physical condition

1.2.5.1 Incomplete physical conditions, such as body illness or underlying disease like heart disease, diabetes mellitus, epilepsy, would have increase the risk of accident 2 times as compared to those with complete physical condition (Punyahotra) (9).

1.2.5.2 Visual disturbances such as double figure vision, irritated contact lens, loss of vision, etc.

1.2.5.3 Stress and tired physical and emotional status.

1.2.6 Alcohol and medication. Alcoholism and some medications such as decongestant, antihistamine, muscle relaxants and narcotics reduces the ability to drive.

Punyahotra (9) and Kijjatum (22) based on World Health Organization (WHO) defines narcotic as any substance which intake by eat, injection, smoke or smell that will be taken increasingly and over tolerance dose. When lack of these drugs, the body will "suffer from excessive bloody flux."

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Types of narcotics are classified in 2 groups:

1.2.6.1Characteristics classified into 2 type.

1.2.6.1.1 The substances that are effective to the body, mind and economic such as opium, heroine.

1.2.6.1.2 The substances which are used as habitual addiction such as cigarette, diazepam.

1.2.6.2 Effectivity to the body are classified into the following types:

1.2.6.2.1 Depression nerve. It makes dizzy and emotionally unstable, mental inertia and muscle relaxant.

1.2.6.2.2 Stimulating nerve. These drugs are chemical substance synthesis such as amphetamine, diligent drug, anti drowsiness drug. The effect of these drugs are to excite and stimulate the central nervous system, causes nervous anxious. These drugs are frequently used for night workers, long distance drivers, and student utilizes for anti drowsiness.

1.2.6.2.3 Hallucination nerve. It makes nervous hallucinate, visual illusion, and loss of sensation.

1.2.6.2.4 Mix effect. In some narcotics, when the person receives these drug in low dose, it excites the nervous system primarily and depress nervous system the later. High dose of some narcotics when taken, it will hallucinate the nerves.

1.2.6.3 The danger of narcotics are as follows:

1.2.6.3.1 Danger of amphetamine (Kijjatum) (22):

1.2.6.3.1.1 It increases effectiveness to work over and over but the end effect will be very tired.

1.2.6.3.1.2 It will initiate abnormal emotion such as easily irritated. It will be danger to other drivers.

1.2.6.3.1.3 Taken in enormous quantity will develop nervous signs, hallucination, and become frightened.

1.2.6.3.1.4 Disadvantage to the body: it decreases body's normal functions.

1.2.6.3.2 Danger of alcohol:

1.2.6.3.2.1 Effect on health: if a person intake alcohol and become a habitual drinker, then lack of alcohol in the body will "suffer from excessive bloody flux."

1.2.6.3.2.2 Effects of alcohol on accident as described by Wattana (24):

- Blood alcohol concentration 30 mg.% makes a person into joyful state.

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- Blood alcohol concentration 31-50 mg.% give excitement to the body to work quick, make error in decision, excited, over self confidence, risky habit. This when coupled with high speed driving causes serious accident.

- Blood alcohol concentration more than 50 mg.% have effect on inertia of work, brain dizziness, automatic work out of voluntary, slow reflect. The common accident happens due to slowness to brake when necessary.

- Blood alcohol concentration 100 mg.% be work out of voluntary, automatic work to absent minded slumber, pass instantly, unconscious, say that "alcohol pa pai." Drunk drivers have more chances of accident than those who are not drunk.

The Institute of Forensic Medicine and The Thai Royal Police Department had conducted research on blood alcohol concentration from accidental death victims of 719 cases during 1986 to 1990 and the last 6 months (June-December) of 1991. Of death victims due to accidents, 405 cases were found to have blood alcohol concentration positive in (61.8%) and 60.7% respectively.

A study of death victims from accidents in Europe and United State of America found that one half (50%) of fatal cases were caused by alcohol. The alcohol Act such as limited blood alcohol concentration 50 mg.% in Korea, Japan, Finland, Australia, Canada; limited 70 mg.% in Columbia; limited 100 mg.% in some states of United States of America. In Thailand, the Traffic Law limits drivers when drunk only and drivers must not drive while drunk, according to Aungpraphan (25) of the Office of the Under-secretary of the Ministry of Public Health (26) but no standard measurement as other countries have.

1.2.7 Helmet. The objective of helmet use is to reduce severe brain injury of the driver or passenger. Weishbuch (27) in his study found that drivers and passengers without helmet would have risk to die 3 times more than with helmet when an accident occurs.

Helmet must be fitted with head and tight chin strap capable to reduce severe brain injury.

Types of helmet are classified into 3 types:

a. Full face means shell circle shaped, close beside, behind maxillary and chin. In contingency wind-shield made from transparent and colorless materials.

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b. Full shell means shell circle shaped, close beside and behind equal maxillary and behind of neck, the front open from above eye-brow to chin. In contingency wind-shield made from transparent and colorless materials.

c. Half shell means shell half circle shaped, close beside and behind equal ear level. In contingency wind-shield made from transparent and colorless materials.

1.2.8 Skilled drivers such as young drivers and with less experience, do not have well judgement.

1.2.9 Abnormal mental condition such as bad emotion, absent-mental or tense. Persons who have these characters are easily to get accident.

2. Vehicles Factors

Incomplete engine is associated with accident. Incomplete vehicles, lack of checking and care before use including sub-standard vehicles are precipitating factors for accident. Drivers should check completely the engine before use such as brake system, tyre, signal lights, steering wheel, and mirror for prevention and reduction of accident. Engine capacity is related to the speed. Those with less engine capacity and low speed gave less chances of serious accident than big engine capacity. Protection system for safe use of driving such as mirror, protected wind, roll bar, sieve cover wheel protected the feet.

Noise level over 85 decibel causes hearing disturbance. Several motorcyclists use loud noise which causes hearing disturbance and causes difficulty of hearing. Modify pillion causes danger to the driver, scrotum injury is the most common one.

3. Road and Other Environment

3.1 Road condition or characters of road were considered by Panuskaw (28) as:

3.1.1 Lane number: the more lanes, the more street traffic. In Thailand, 50% of road accidents in Bangkok occurred on 3 lanes road.

3.1.2 Width of road: that width of road was found to be less related to accidents.

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3.1.3 Fence-divided road: it has less contribution to accident due mainly to no head-to-head collisions, and reduced light from other lane. Accidents that do happen causes less severe injury.

3.1.4 Shoulder road are area beside of road except footpath. Shoulder road causes safer traffic. Generally, 2 lane road should have shoulder 6 foot width.

3.1.5 Fence beside road to prevent driving out of lane, such as bridge area or curve area. Roads which have fence beside the road causes less severe injury.

3.1.6 Road surface: the problem of road construction is skid surfacing. The road materials could be checked for resistance surface during all season before construction. In Thailand, usually stone-lime are used which is low standard of resistance and rough surface. These factors may precipitate accident.

3.1.7 Light on the road are necessary for drivers associated with visual acuity.

3.2 Environment are classified into:

3.2.1 Incomplete street sign such as traffic sign including warning sign, envision sign, control sign. These signs must be easy to understand, easy to visualize, both day and night time, signs and line on surface road with rebound color.

3.2.2 Natural phenomenon such as heavy cloud, heavy rain, flood cover road, and poor vision due to poor weather.

3.2.3 Human act such as smoking from grass burn, leave rowdy peds on road. These conditions may be dangerous for public health and causes drivers disturbances.

Prevention and Amendment of Traffic Accident

Accident are related to human, vehicle, and environment factors. The measures needed in successful prevention of accidents are as follows:

1. Education and Training Measure

The methods and meaning of training is to know safety measures and instill safety consciousness and discipline of road use. The persons can convey the knowledge for themselves, family, society and community. Appropriate training is composed of 2 strategies:

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1.1 Direct method: the offender is taken to be taught in class room or traffic garden, or join training in offender school.

1.2 Indirect method: the person who was taught the knowledge, now imprint and campaign outside the class room by use of the media.

2. Physical Measure

Improvement and amendment of physical measure are composed of 2 sections:

2.1 The United Kingdom model to environment improvement and amendment by characteristics of road.

2.1.1 Traffic signals improvement such as build traffic signals, timing, phrasing, high intensity.

2.1.2 Lighting. Build light on traffic sign areas, major crossings, pedestrian crossing and curve road.

2.1.3 Footpath improvement such as safety pedestrian island, fence, pedestrian crossing, fly-over bridge.

2.1.4 Parking restriction.

2.1.5 Vehicle channelization by road markings, even line, odd line.

2.1.6 Signing.

2.1.7 Carriageway surface by building improvement, anti-skid surfacing, convexed on surface for speed control.

2.1.8 Other management such as circle construction, oneway of vehicle, safety pedestrian island.

2.2 Environmental improvement of United States of America and Australia model. Environment improvement are composed of physical facility, traffic engineering, traffic control. The components of partial or all strategies are advantage such as improvement traffic signals of pedestrian, pedestrian crossing, fence, safety pedestrian island, fly-over bridge.

3. Legislative Measure

Categories of 5 principles traffic laws:

3.1 Traffic laws in 1979 is a master law of accident prevention. This law are used for driver, pedestrian, persons who lead, ride, control peds, vehicle owner.

3.2 Transportation laws in 1979 are laws of big vehicle safety such as bus, truck. This law is for control of driver, conductor license, bus inspector.

3.3 Car registration laws in 1979 is registry for control light car such as personal cars, motor tricycles, motorcycles. This law uses for control drivers, vehicle owners.

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3.4 The decree of the Revolution council, No. 295 dated November 28, 1972 entitle was of special highway, highway, speed control, traffic signals.

3.5 Issue the decree on helmet use of drivers and passengers of motorcycle riders established, 1992. Helmet use both for drivers and passengers of motorcycle riders in Bangkok Metropolitan published by authority for enforcement on April 1, 1995. Other provinces in the whole country published by authority for enforcement on January 1, 1996.

4. Compulsory physical check up

This check up are related to the driver. It is required in having driver license to have such as good visual acuity, good hearing, arm or leg and other parts without deformity. Notification are needed on clearance of limitation or physical and pass the test. After having driver license, drivers are limited to 4-6 hours of driving, with a total of 10 hours driving in a day. Truck and bus drivers have to go for physical examination every year, and should include information to drivers.

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II. Review of the Literature

Sex

Most of the studies conducted both in Thailand and abroad found that males have higher risk of accident injuries than female.

Chontaraviroj (20) and Thonkeaw (29) stated that an accident event mostly occurred to males because of vigorous characteristics, full perils of age, and love motorcycle riding more as compared to females. Likewise, the study of Sakabucha (30) found that males had more accidents than females because they used vehicles for working and love motorcycle riding more than females. Punyahotra's (2) study on traffic accident in Bangkok found that 75% were males because males were more in danger due to risky work such as soldier, policeman, employee, riders, and staff of goods' transportation. These result where careers were related to riding motorcycle were similar to the studies conducted by Kumjuddussakorn (31), Methaluck (32), Wong et al., (33) and Mclellan et al., (34) which also found that most of them were males.

Age

Several studies found that age was one of the main factors of an accident, where difference in each age group may have different accident event. Most accidents in these studies were found among youth.

Tanmukyakul (35) studied traffic accident victims at Siriraj Hospital during 1973 to 1974 and 1981 to 1982 and found that most accidents were found among those in the age group 15-30 years, with the highest at age group 20-25 years because it's an extraordinary age. This result is similar to that of Kumjuddussakorn (31). A study of factors related to accident victims among motorcyclists who sought care at Taksin hospital showed that the age group with the most victims was 23-27 years.

Thonkeaw (29) reported that most of the 24-29 years old group were found to have more accidents because this age group likes to show off, careless, disobey traffic laws, less experienced, lack of riding skill and lack of sudden judgement associated with accidents. Methaluck (32) found that age group 20-24 years starts working and use vehicles more for work. Chadbunchachai et al., (36) reported that almost all accident victims were below 40 years and that most accidents occurred on adolescent because they like to show off and had high frequencies of motorcycle use.

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Occupation

Motorcycle accidents were found to be dependent on different types of occupation among the population and location. Studies conducted by Punyahotra (1), Kumjuddussakorn (31), Methaluck (32) and Chadbunchachai et al., (36) found that employees with more accidents had occupation as salesman, billing staffs and motorcycle taxi riders etc. But other study such as the one conducted by Thonkeaw (29) found that students had more accidents than others, while Sakabucha (30) found that farmers had more accidents than others.

Marital Status

Thonkeaw (29) studied the epidemiology of traffic accidents among motorcyclists in and out of metropolitan and found that singles had more accidents than the married ones. Similarly, studies conducted by Sakabucha (30), Kumjuddussakorn (31) and Narintaruksa (37) also found that singles had more accidents than married victims. Methaluck (32) studied the factors related to severity of injury among motorcyclists' traffic accident in Bangkok City Hospital found the single victims to be 61.0% different than married victims. Chontaraviroj (20) who analyzed traffic accident statistics at a hospital in Bangkok reported that both singles and married victims would have the same risk of accidents.

Education

A study on factors which influenced traffic accidents among motorcyclists at Taksin hospital found that most of the victims of motorcycle accidents had at least completed primary education, and that the next group had completed secondary education (Kumjuddussakorn) (31). Similarly, Methaluck (32) who studied the factors related to severe injuries due to traffic accidents among motorcyclists in a Bangkok hospital found above one third (39.0%) of the victims had completed primary education. Geamgool (38) found that educational level were associated with accident event, where those who completed primary education had risk 3 times higher than those with high educational level. Hatthaitum (39) found that those with primary education level have an accident rate similar to those with high school education (47.5% and 44.8%, respectively).

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Income

Kumjuddussakorn's (31) study on factors that influenced accidents among motorcyclists who sought care at Taksin hospital found that more than one third (33.9%) accident victims had income between 2,001-3,000 baht/month, and the second level of income were between 1,000-2,000 baht/month. Similarly, the study of Methaluck (39) discovered that riders who had 6,000 baht/month or above had more accident rate than riders who had income below 6,000 baht/month (62.1% and 40.6% respectively). On the contrary, Punyahotra (2), who had classified income (/month) into the following 4 groups: 1,500 baht and below, 1,501-2,500 baht, 2,501-3,500 baht, and above 3,500 baht, found that accident event was similar in each group.

Alcoholic Beverage Consumption Before Riding

Punyahotra (42) found that the major cause of traffic accidents were alcohol consumption, where almost two third of non fatal victims but with disabilities had changeable characters due to brain contusion. Kumjuddussakorn (31) found that riders consumed alcoholic beverage before riding in 38.1% cases. Methaluck (32) found that traffic accidents among motorcyclists sometimes were caused by consumption of alcohol before riding (31.3%), which is similar to Chadbunchachai et al., (36) who reported that 42.7% of accident injuries at Khon Kaen Central hospital in 1993 were caused by alcohol consumption. Similarly, Swaddiwudhipong et al., (40) who studied the epidemiology characteristics of drivers, vehicles, pedestrians and road condition and environment related to traffic accidents at Tak province in 1990 found that accident riders had consumed alcohol before riding.

Alcohol consumption before riding in Thailand is higher than in Singapore according to Wong et al., (41) where he also found that 10% of admitted cases consumed alcohol before riding. Marzuk et al.,(43) studied fatal traffic accident cases at New York in 1984 to 1987 and measured blood alcohol concentration from fatal motorcycle accidents, where he found 34.5% had positive alcohol test. Scrimgeour's (50) study in Papua New Guinea showed that 20% of fatal traffic accidents were caused by alcohol consumption, and that the major cause of fatality was careless riding. Martens et al., (45) found that among young riders, alcohol was the primary cause of accidents. Likewise, Chang and Astrachan (46) found that among head injured patients, 42% were caused by alcohol consumption, as compared to 26% of non alcohol consumption. Lock et al., (47) studied the relation between drinking and riding among student motorcyclists in Khon Kaen, Thailand, and

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found that 24% of the riders had consumed alcohol, and that 50% were riding carelessly. The result showed that riding after alcohol consumption were significantly associated with careless riding (RR = 0.36).

History of Illness

Kumjuddussakorn (31) found that about 22.18% of accident victims had an abnormal condition of either the eye, ear and other organs and about 20.3% had an underlying disease. Methaluck (32) found that injured victims who had abnormal physical condition were associated with severe injuries. Hatthaitum (39) found that about 80% of accident victims had abnormal eye condition and would have risk to accident 1.71 times but were not associated with accident. Accident victims who had abnormal eye condition were 69.2% and would have risk to accident 1.5 times but were not associated with accident.

Riding Experience

Punyahotra (2) surveyed motorcycle accidents in Bangkok and found that 35.7% of those with riding experience of 1-3 years had experienced accidents. This result were supported by the study of Methaluck (32) where he found that most of the accidents (35.3%) occurred among those who had a riding experience of 1-3 years. On the contrary, the study of Swaddiwudhipong et al., (40) showed that 37.5% of those who experienced traffic accidents were those with riding experience of 10 years and above. The study by Wong et al., (41) found that about 16% of victims had 1 year of riding experience, about 32% had riding experience of 1-4 years, about 27% had 5-9 years and about 25% had 10 years or above riding experience. Wong et al., (33) also compared riding experience and accident, where he found that persons who had riding experience 1-4 years accident occurred less than <1 year about 40%, and 5-9 years less accident occurred than <1 year about 50% and 10 years and above less accident occurred than <1 year about 64%.

Frequency of Riding/Week

Geamgool (38) in his study on the factors associated with motorcycle accidents among age group 15-24 years at Trad Province in 1993 found that about 71.4% of the motorcycle accident victims rodes an average 6-7 days/week. The association between accident and the frequency of riding/week were statistically significant ($p=0.018$).

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Speed Before Accident

Sakabucha (30) in his study on highway traffic accidents at hospitals in Prachuap Khiri khan province found that most of the victims were falling from motorcycle due to high speed. In related study, Thonkeaw (29) found that traffic accident among motorcyclists were caused by overspeed limit. Punyahotra (48) found that almost one half (49.1%) of those who had accidents were riding with the speed of 54 km/hr and below. Similarly, the study of Kumjuddussakorn (31) found that the speed of 40-60 km/hr accident contributed to 37.3% of the accidents; Methaluck (32) found about 7.7% with overspeed limits of (80 km/hr); and the study of Swaddiwudhipong et al., (40) found that riders who oversped the limit was a contributory factors to injury; while Geamgool (38) found that about 44.0% of accident had a riding speed of 61-80 km/hr and about 29.1% had the speed of 41-60 km/hr. A study conducted in Singapore by Wong et al., (33) found that above half (51%) had speed below 50 km/hr before accident, while a study by Hatthaitum (39) showed that a speed above 60 km/hr before accident was associated with accident and that risk to accident were 6.95 times more as compared to those low speed riders.

Knowledge of Traffic Rules

Geamgool (38) studied accident victims and reported that about 51.4% had high knowledge of traffic rules and 48.6% had low level of knowledge, and he also found that low level of knowledge was not associated with accidents. The study of Hatthaitum (39) showed that riders who had higher knowledge of traffic rules than standard score had a prevalence of 41.8%, close to about 48.4% of those with low level of knowledge of traffic rules, and that the risk to accident was not significantly different.

Duration of Having Driver's License

Methaluck (32) studied accident victims and reported that 89.7% had valid driver's license, of which 38% had valid driver's license for 1-3 years. A study by Geamgool (38) found that riders without valid driver's license had accident 2.74 times (95% CI of OR =1.40-5.70) more than those with valid driver's license.

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History of an Accident in The Past Year

A study by Punyahotra (2) found about 39.3% had mild injuries with self care 1-5 times, about 10.0% had mild to severe injuries with physician consultation 1 time or above, and about 89.1% were admitted at hospital at least 1 time. Kumjuddussakorn (31) found that about 82.2% had had accident 1-3 times. On other hand, Swaddiwudhipong et al., (40) found that 61.2% of the patients never had accident, while 32.2% were reported ever had accidents of 1-4 times. Methaluck (32) found that patient ever had accident close to never.

Engine Capacity (cc.) of Motorcycle

Punyahotra (2) studied accident victims and found that about 51.7% had motorcycle engine capacity above 100 cc., while the study of Geamgool (38) showed 93.7% were found to have engine capacity equal to 100 c.c. or above. Similar study in Singapore by Wong et al., (41) found that engine capacity above 250 c.c. had more accidents than those with small engine capacity. But a different result from the study of Hatthaitum (39) who found riders who had small engine capacity (less or equal 100 c.c.) had more prevalence of accident than large engine capacity, eventhough the risk of accident showed no significant difference.

Duration of Using Motorcycle

Punyahotra (2) and Kumjuddussakorn (31) found that most of the victims had been using motorcycle for about 1 year and less, followed by 2-3 years, 4-5 years and 6 years respectively, while Methaluck (32) found about 42.3% with duration of vehicle usage of 1-3 years. Geamgool (38) found 60% was with duration of vehicles use related to accident below 1 year, over 40.0% was with duration of vehicles use of 2 years, and that the duration of using vehicles was not significantly associated with accidents. Hatthaitum (39) found that about 52.4% of riders using vehicles >2 years had accidents and about 47.6% was using vehicles for ≤ 2 years had accident. The duration of using motorcycle >2 years have 1.18 times more risk of accident compared to those with ≤ 2 years.

Modified Engine

Punyahotra (2) found that 10.7% of accident victims had modified their engine and Methaluck (32) found 3.7% that modified their engine. The major objective for modified their engine was a loud noise and high speed. Hatthaitum (39) found about 62.5% accident victims had modified their engine, while 46.4% did not modify engine.

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Complete Condition of Motorcycle

Kumjuddussakorn (31) found that 75.4% of accident victims had complete condition of their vehicle because they were new vehicles. Incomplete condition, such as absence of 2 mirrors or 1 mirror present, were found in 8.5% of accident victims. This result supported Methaluck's (32) study who found 9.0% with incomplete condition (with absence of 2 mirrors and turn right- turn left light). Hatthaitum (39) found that 63.7% motorcycle accident were reported with impaired light but those with good light who had accident were 46.7%. The association between impaired turn right- turn left light and accident was not significant.

Road Condition

Punyahotra (2), Kumjuddussakorn (31), Methaluck (32) and Narintaruksa (37) found that vehicle crashed most commonly on concrete road or asphaltic highway. Geamgool (38) found that most accident happened on asphaltic surface road.

Weather Condition

Punyahotra (2) found that almost half of traffic accidents was during fine weather, just like the study of Thonkeaw (29) and Geamgool (38) who found that accident most commonly happened on fine weather condition. On the contrary, Methaluck (32) found that 30.4% of accidents were due to low-visibility environments (caused by smoke-dark weather).

Type of Road

Kumjuddussakorn (31), Methaluck (32), Geamgool (38) and Kangkakate (49) found that most accidents occurred at straight road.

Severity of Injuries

Tanmukyakul (35) classified severity of injury into 5 levels:

1. Mild severity such as mild wound abrasion, wound incision, wound size less than 5 cm.
2. Moderate severity, such as wound size over 5 cm., fracture of small bone, temporary unconsciousness.
3. Severe severity was large wound and much bleeding, fracture of large bone, abdomen injuries, thoracic injuries, must be admitted for treatment.
4. Serious severity was closed to fatal.
5. Fatal.

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Punyahotra (48) classified injury severity into 2 types:

1. Police classification

1.1 The United Kingdom survey form classified injury into 3 categories:

1.1.1 Fatal - such as injuries victims became fatal within 30 days after the event of accident.

1.1.2 Serious - such as:

- Must be admitted for treatment in hospital.

-Fracture bone, brain injuries, internal organs injuries from external force, severe wound (sight external) and shock which must be admitted for treatment.

1.1.3 Slight such as abrasion sprain or small wound.

1.2 The United State of America Police classified severe injury into 5 categories:

1.2.1 K = fatal

1.2.2 A = Slight Injuries by external causes such as bleeding wound or distortion or do not move from accident event.

1.2.3 B = Injuries such as sprain, abrasion, swelling.

1.2.4 C = Not slight external wound but painful or unconscious.

1.2.5 O = Not have injuries.

2. Abbreviated Injuries Scale (AIS) classifies severe injuries into 6 levels:

2.1 AIS-1, minor injury is mild wound, abrasion/sprain cracked and non-movement of arm bone.

2.2 AIS-2, moderate injury is moderate wound, long wound over 3 inches on body regions or over 2 inches on face area, mild contusion, brain cracked and no movement of arm bone.

2.3 AIS-3, severe injury (severity not fatal) many wounds, wound size over 4 inches on face area or incision deep wound such as fracture of arm bones and movement cracked of leg bone.

2.4 AIS-4, serious injury (severity to fatal) rupture of spleen, several fracture ribs, fail chest on one side.

2.5 AIS-5, critical injury is serious injury, two side fail chest, severe rupture of liver.

2.6 AIS-6, maximum injury is decapitation, hemorrhage in brain, may be fatal within 60 minutes, divide main arterial.

This study adopted the Abbreviated Injury Scale (AIS) criteria to classify severe injuries.

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Body Part Injured

Pholprasert (6) found that the face, body and extremities were the most common (90%) sites of injury from motorcycle accident, while head injury (fracture of skull, brain contusion, hemorrhage in skull cavity) were found in 18% of the cases. Thonkeaw (29) found that body part most severely injured was head, face and neck (41.5% of reported cases), next to arm and leg. Similarly, Sakabucha (30) found that the location of most incision wound was the head and face. Tanmukyakul (35) also found that death motorcycle victims had head injuries. Chadbunchachai et al., (36) reported that most injuries was head (36.2%) and head injuries was the major cause of fatal cases (64.3%). Panitpong (50) found that among 67% victims who died within 24 hours after accident, 71.3% were reported to involve serious brain injury.

The conceptual framework of this study were derived from review of the literature and associated research. The concept is shown as follows:

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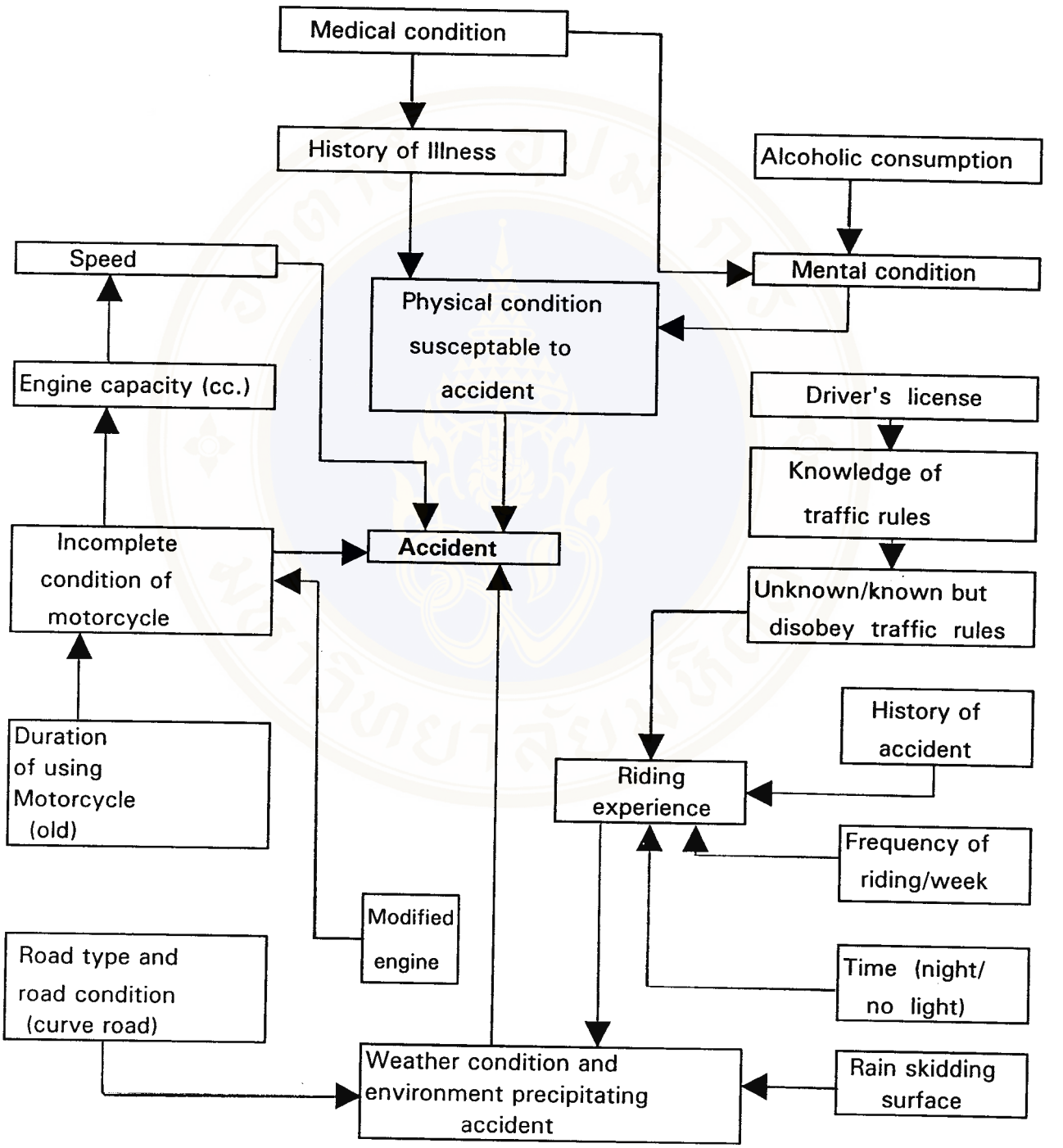
Conceptual Framework



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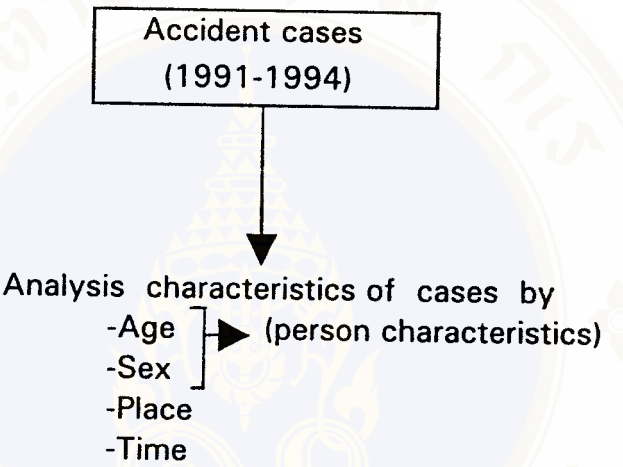
Concept of Epidemiology (study group 1)



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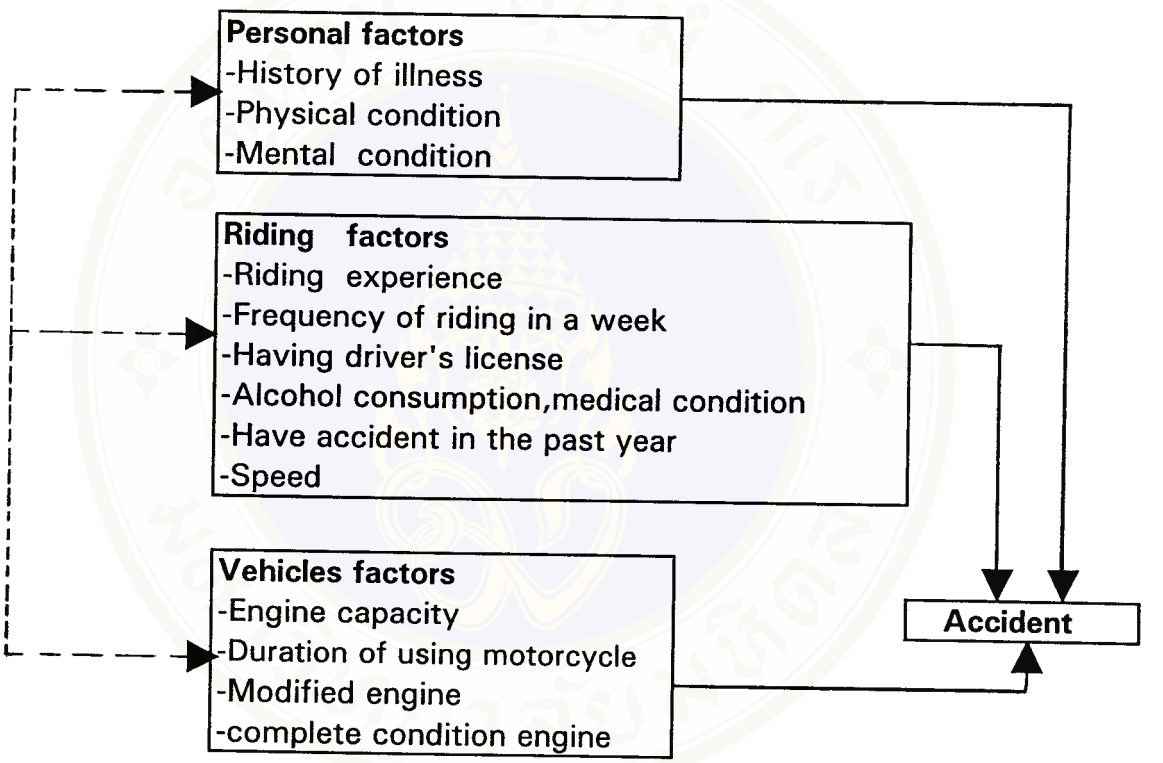
Conceptual Framework (study group 2)



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CHAPTER III

MATERIALS AND METHODS

1. Design

The research design of this study was descriptive epidemiology study to describe disease in terms of person, time, and place through a matched (by sex and age) case control study to analyze the causation of the accident.

2. Place of Data Collection

Mahasarakham hospital, 350 beds of Community Hospital Division, Ministry of Public Health.

3. Time of Data Collection

During July 1, 1995 to October 31, 1995

4. Sample Size

The two scopes of the study were:

4.1 Descriptive epidemiology study of accident patterns among motorcyclists: causes of collisions with motorcycles, pedestrians, animals, fences, and falls. Cases were selected at Mahasarakham hospital during January 1, 1991 to December 31, 1994 (4 years). Information were gathered from out patient department records.

4.2 Case-control study.

Cases were patients at emergency room of Mahasarakham hospital who rode motorcycle had accident by collisions of motorcycles, with other vehicles, pedestrians, animals, objects, fences, and falls. Data were collected during July 1, 1995 to October 31, 1995.

Controls were patients at Mahasarakham hospital with other disease (except accident patients) or relatives of cases who also rode motorcycle but without accident, during the study period. Data were collected from those with the same characteristics to those of cases:

-sex

-age difference <5 years

The ratio of cases to controls was 1:1.

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5. Sample Size for Case-control Study (52- 54).

$$P = \frac{R}{1+R}$$

$$m = \frac{\left[Z_{\alpha/2} + Z_{\beta}\sqrt{P(1-P)}\right]^2}{(P-0.5)^2}$$

$$M = \frac{m}{(P_0Q_1 + P_1Q_0)}$$

$$P_1 = \frac{P_0R}{1+P_0(R-1)}$$

when M = pairs number of case and control = 232.99
R = odds ratio value after exposure = 3.51
P_0 = proportion of exposure in control group = 0.23
P = 0.78
P_1 = 0.50
m = 116.46
Z_α = Z score from Z normal distribution table when fix type I error in fix area equal 5% ($Z_\alpha/2 = 1.96$)
Z_β = Z score from Z normal distribution table when fix type I error in fix area equal 5% ($Z_\beta = 1.645$)

Sample size was computed from main factor which was 1-3 years experience of rider (38). The sample ratio between cases and controls was 1:1. Through this ratio the sample size of each group was found to be at least 233 cases. In order to increase the chance of finding a significant difference, the sample size was increased to 250 cases and 250 controls.

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6. Materials and Methods

Through the literature reviewed, the questionnaire was formed for data collection from Mahasarakham hospital's registration. Then the patients and controls were interviewed.

Questionnaire was composed of 4 components:

Part 1 was composed of the following variables : socio-demography of motorcyclists for study group 1 and 2. These variables were gathered from Mahasarakham hospital's registration.

Part 2 was composed of factors related to accident for study group 2 such as riders' experience. Data were collected from Mahasarakham hospital's registration and through an interview of the patients.

Part 3 was composed of knowledge of traffic rules for study group 2 which were collected through an interview.

Part 4 was composed of the accident data for study group 1 and 2, such as accident characteristics, road condition, weather and environment, accident place, injured part of body, and characteristics of injuries, which were collected from Mahasarakham hospital's registration.

The questionnaire was pretested with 30 motorcyclists, and was revised accordingly until it had valid content.

7. Data Collection

Group study 1: the accident patient was found through the hospital number from out patient department registration section and from hospital's registration. The questionnaire were administered between January 1, 1991 to December 31, 1994 (4 years).

Group study 2: patients of motorcycle accidents who sought care at the emergency room of Mahasarakham hospital were interviewed from July 1, 1995 to October 31, 1995.

8. Data Analysis:

The data were edited and coded before entered into computer and were statistically analyzed by dBase III plus, Epi Info 6 and Stata programs.

Group study 1:

General data of the epidemiology of accidents among motorcyclist were described statistically such as numbers, percentiles, means, medians, and standard deviations.

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Group study 2:

Descriptive statistics such as numbers, means, modes and standard deviations were used to describe the general information including socio-demographic factors and the level of knowledge of traffic rules.

Analytic statistics such as Chi-square test was applied to determine an association between the study factors and motorcyclist who had accident.

Estimation of Odds Ratio (OR) and its 95% confidence interval among cases and controls were performed by Mantel-Haenzel test which were used for stratification analysis in order to control for confounding variables. Conditional Multiple Logistic Regression was used for inferential advance statistics of these study variables by using Multivariate analysis.

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CHAPTER IV

RESULT

This epidemiological study of motorcycle accident among patients and relatives of patients at Mahasarakham Hospital composed of 2 part:

1. Group 1: characteristics of motorcycle traffic accident during January 1, 1991 to December 31, 1994 (data from out patient department records only).
2. Group 2: factors associated with motorcycle accident in retrospective study or concurrent case control study, with matching on some variables suspected as possible strong confounder, such as age, sex.

Presentation of the Result:

1. Characteristics of motorcycle traffic accident during January 1, 1991 to December 31, 1994.
2. Characteristics of motorcycle traffic accident of case-control study group 2 (July 1, 1995 to October 31, 1995).
3 Comparison of factors associated with motorcycle traffic accident among cases and controls groups, including both univariate and multivariate analysis.

Result of Study Group 1

1. General characteristics of study group 1 during January 1, 1991 to December 31, 1994.

1.1 General characteristics and socio-economic

From patients of motorcycle traffic accident treated at Mahasarakham hospital during 1991 to 1994, data were collected through the out patient department records of which 619, 781, 1,081 and 1,515 cases respectively, were included.

Sex

Most cases found were males, 80.8%, 81.4%, 82.9% and 82.4% respectively, from 1991 to 1994 (Table 3).

Age

The age of the cases were between 11-77 years old.

In 1991 study group, the minimum age was 12 years and maximum age was 66 years old, and the average age was 25.9 years (sd = 9.97). The most number of cases had age 20 years, or about 36.3% of the total cases.

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In 1992 study group, the minimum age was 13 years and maximum age was 68 years, with an average age of 21.15 years (sd = 10.50). The most number of cases had age 20 years, or about 38.2% of the total case. The next group was 21-30 years old which was about 36.7%.

In 1993 study group, the minimum age was 11 years, maximum age was 77 years, and the average age was 25.93 years (sd = 10.68). The most number of cases had age 20 years, or about 42.6% of the total cases. The next group was 21-30 years old (31.2%).

In 1994 study group, the minimum age was 11 years, maximum age was 66 years, while the age average was 25.85 years (sd = 10.88). The most number of cases had age 20 years, or about 42.7%. The next this age group was the 21-30 years (31.4%).

Age groups: 31-40 years, 41-50 years, >50 years are shown in Table 3.

Residential Area

Those who lived outside the municipal area were 69.6%, 73.1%, 67.9% and 72.9% respectively, from 1991 to 1994. While those who lived within the municipal area are shown in Table 3.

Marital Status

Majority of the accident victims were singles, 64.9%, 63.8%, 64.8% and 65.2% from 1991 to 1994, respectively. The next was married with 33.4%, 35.9%, 34.5% and 33.9% from 1991 to 1994, respectively. The least were widowed/ divorced/ separated as shown in Table 3.

Occupation

The data showed 3 major occupations among the motorcycle accident victims, these were: students, agriculturists and labourers. From 1991 to 1994, there were 29.7%, 28.9%, 33.2% and 37.5% students, respectively; agriculturists were 26.3%, 28.8%, 24.3% and 25.9% respectively; labourers were 22.8%, 21.6%, 24.1% and 23.0% respectively (Table 3).

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Table 3 Characteristics of study group 1 during 1991 to 1994.

Characteristics	1991		1992		1993		1994	
	No.	%	No.	%	No.	%	No.	%
Sex								
male	500	80.8	636	81.4	896	82.9	1248	82.4
female	119	19.2	145	18.6	185	17.1	267	17.6
Age (years)								
≤20	227	36.7	298	38.2	461	42.6	647	42.7
21-30	225	36.3	289	36.7	337	31.2	475	31.4
31-40	97	15.7	104	13.3	158	14.6	212	13.9
41-50	53	8.6	64	8.2	85	7.9	118	7.8
>50	17	2.7	28	3.6	40	3.7	63	4.2
Residential area								
within municipal area	188	30.4	210	26.9	347	32.1	411	27.1
outside municipal area	431	69.6	571	73.1	734	67.9	1104	72.9
Marital status								
single	402	64.9	490	62.7	701	64.8	988	65.2
married	207	33.4	280	35.9	373	34.9	513	33.9
widowed/ divorced/ separated	10	1.7	11	1.4	7	0.7	14	0.9
Occupation								
none worker	33	5.4	26	3.3	38	3.5	38	2.5
students	184	29.7	226	28.9	359	33.2	568	37.5
agriculturists	163	26.3	225	28.8	263	24.3	392	25.9
labourers	141	22.8	169	21.7	261	24.1	349	23.0
merchants	28	4.5	26	3.3	47	4.4	39	2.6
semi-government officer	3	0.5	5	0.7	3	0.3	4	0.3
government officer	67	10.8	104	13.3	110	10.2	125	8.2

Time

The time most accidents took place were at 18.00-21.00, which were about 25.0%, 26.2%, 27.5% and 25.2% from 1991 to 1994, respectively. The second in range of time at 15.00-18.00 were about 13.7%, 17.9%, 16.0% and 18.6% from 1991 to 1994, respectively, as shown in Table 4.

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Days of the Week

Accidents happened on Saturdays slightly higher than other days of the week, which were 17.5%, 13.6%, 15.7% and 15.2%, respectively; Sundays were 16.8%, 14.9%, 14.6% and 15.8% respectively; while the third was found to be on Mondays for about 11.9%, 18.9%, 16.7% and 15.2% respectively from 1991 to 1994 as shown in Table 4.

Month

Motorcycle accidents on April were higher than those at other months, which were 11.6%, 14.3%, 13.0% and 11.4% respectively from 1991 to 1994. The next was in December and were found to be 19.9%, 11.6%, 12.1% and 8.2% respectively from 1991 to 1994. Motorcycle accidents' data are presented each months on Table 4.

Table 4 Characteristics of accidents classify by time, day, month during 1991 to 1994.

Characteristics	1991		1992		1993		1994	
	No.	%	No.	%	No.	%	No.	%
Time								
00.00-03.00	16	2.6	25	3.2	73	6.8	102	6.7
03.00-06.00	24	3.9	21	2.7	38	3.5	47	3.1
06.00-09.00	62	10.1	81	10.4	112	10.4	192	12.7
09.00-12.00	68	10.9	100	12.8	138	12.8	177	11.7
12.00-15.00	117	18.9	119	15.4	121	11.2	106	6.9
15.00-18.00	85	13.7	140	17.9	173	16.0	280	18.6
18.00-21.00	155	25.0	204	26.2	297	27.5	382	25.2
21.00-24.00	92	14.9	89	11.4	129	11.8	229	15.1
Day								
Monday	74	11.9	147	18.9	180	16.7	230	15.2
Tuesday	88	14.2	97	12.4	170	15.7	190	12.5
Wednesday	79	12.8	105	13.5	121	11.2	200	13.2
Thursday	80	12.9	90	11.6	143	13.2	190	12.5
Friday	86	13.9	118	15.1	139	12.9	235	15.6
Saturday	108	17.5	106	13.6	170	15.7	230	15.2
Sunday	104	16.8	116	14.9	158	14.6	240	15.8

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Table 4 (continued)

Characteristics	1991		1992		1993		1994	
	No.	%	No.	%	No.	%	No.	%
Month								
January	69	11.1	28	3.6	71	6.6	152	10.0
February	32	5.2	23	2.9	80	7.4	165	10.9
March	43	6.9	46	5.9	105	9.7	143	9.4
April	72	11.6	112	14.3	141	13.0	173	11.4
May	48)	7.8	94	12.0	42	3.9	84	5.5
June	26	4.2	52	6.7	88	8.1	102	6.7
July	26	4.2	87	11.1	77	7.1	137	9.0
August	42	6.8	85	10.9	81	7.5	90	5.9
September	27	4.4	87	11.1	114	10.6	116	7.7
October	60	9.7	51	6.5	100	9.3	123	8.2
November	51	8.2	26	3.4	51	4.7	108	7.1
December	123	19.9	90	11.6	131	12.1	122	8.2

Type of Accidents

The most motorcycle were among those involved in self-accidents, which were found much as 51.4%, 46.5%, 45.7% and 46.1% respectively from 1991 to 1994. The next was collisions among motorcycles, which were 25.0%, 28.8%, 28.1% and 28.4% respectively from 1991 to 1994. Motorcycle accidents are shown in Table 5.

Characters of the Type of Crash

The most number of type of crash on motorcycle accidents were fell, which were about 51.9%, 46.4%, 46.3% and 46.2% respectively, from 1991 to 1994. Next highest were crashed with others (such as with motorcycles, bicycles, motor vehicles, pedestrians, animals, fences), which were 38.0%, 45.2%, 46.3% and 41.8% respectively, from 1991 to 1994. While the lowest was knocked down by others (for instance: motorcycles, motor vehicles), which were 10.2%, 8.5%, 7.4% and 11.6% respectively, from 1991 to 1994 (Table 5).

Injured Body Parts

The most common injured body parts were legs including feet, which were 51.9%, 50.2%, 53.0% and 52.4% respectively, from 1991 to 1994. Next were arm including hand and shoulder, which were 47.0%, 53.3%, 53.1% and 47.9% respectively, from 1991 to 1994. The third, face area, which were 33.4%, 41.1%, 39.8% and 37.0% respectively from 1991 to 1994. Other parts of the body are presented in Table 5.

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Severity of Injury

The most severe kind of injury found were abrasion, which were 96.6%, 90.3%, 97.8% and 97.5% respectively from 1991 to 1994. Next was tear wound (sight external) with 40.9%, 40.5%, 47.0% and 44.6% respectively from 1991 to 1994. The third was fractures, which were 11.6%, 15.9%, 15.7% and 16.0% respectively from 1991 to 1994.

Fatal cases from motorcycle accidents were found as many as 0.8%, 0.1%, 1.7% and 0.3% respectively from 1991 to 1994. The other kind of injury severity are shown in Table 5.

Glasgow Coma Scale (GCS)

Glasgow coma scale (GCS), the measurement of severe head injury, are separated into 3 levels. The GCS were estimated from score and symptoms. Study group: the most in number found was GCS level 1 (score 13-15), which were 97.4%, 97.7%, 97.2% and 98.2% respectively from 1991 to 1994. The next found was GCS level 2 (score 9-12), which were 1.3%, 2.0%, 1.1% and 1.2% respectively from 1991 to 1994. GCS level 3 (score 8) are shown in Table 5.

Motorcycle accident patients most commonly found were out patient cases with 77.1%, 70.2%, 67.3% and 70.3% respectively from 1991 to 1994. The admitted cases were 22.9%, 29.8%, 32.7% and 29.7% respectively from 1991 to 1994. Severity of injury were tabulated according to the Abbreviated Injury Scale (AIS). AIS-1 the was found the most with about 74.2%, 67.9%, 64.7% and 66.2% respectively from 1991 to 1994. Table 5 shown AIS in each levels.

Table 5 Characteristics type of accident during 1991 to 1994.

Characteristics	1991		1992		1993		1994	
	No.	%	No.	%	No.	%	No.	%
Collision								
motorcycles	155	25.0	226	28.9	304	28.2	430	28.3
bicycles	22	3.6	27	3.5	23	2.2	39	2.6
motor vehicles	68	11.0	106	13.6	162	14.9	250	16.5
pedestrians	3	0.5	10	1.3	7	0.6	12	0.8
animals	30	4.8	33	4.2	44	4.1	50	3.3
fences	23	3.7	17	2.2	40	3.7	36	2.3
falls	318	51.4	362	46.4	501	46.3	698	46.2
Type of Crash								
falls	318	51.4	362	46.4	501	46.3	698	46.2
crash	238	35.8	353	45.2	500	46.3	636	41.9
knock down	63	10.1	66	8.4	80	7.4	181	11.9

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Table 5 (continued)

Characteristics	1991		1992		1993		1994	
	No.	%	No.	%	No.	%	No.	%
Body Part Injured								
head	92	14.9	137	17.5	193	17.9	238	15.7
face	207	33.4	321	41.1	430	39.8	561	37.0
neek	7	1.1	9	1.2	12	1.1	15	1.0
chest	38	6.1	42	5.4	91	8.4	78	5.1
spine	1	0.2	2	0.3	14	1.3	5	0.3
abdomen	10	1.6	11	1.4	32	3.0	21	1.4
back	29	4.7	30	3.8	60	5.6	58	3.8
arm & hand	291	47.0	416	53.3	574	53.1	725	47.9
leg & foot	321	51.9	392	50.2	573	53.0	794	52.4
sex organ & buttock	15	2.4	14	1.8	25	2.3	33	2.2
eye	7	1.1	7	0.9	4	0.4	6	0.4
Severity of Injury								
abrasion wound	598	96.6	705	90.3	1057	97.8	1477	97.5
tear wound	253	40.9	316	40.5	508	47.0	675	44.6
chest injuries	5	0.8	7	0.9	6	0.6	7	0.5
abdomen injuries	6	0.9	10	1.3	6	0.6	6	0.4
sprain	40	6.5	55	7.0	72	6.7	94	6.2
fracture	72	11.6	124	15.9	170	15.7	242	16.0
cut part of arm/leg	0	0	1	0.1	2	0.2	5	0.3
unconscious from brain contusion	19	3.1	44	5.6	31	2.9	50	3.3
airway obstruction	10	1.6	8	1.0	15	1.4	3	0.2
foreign body on eye	4	0.6	8	1.0	3	0.3	11	0.7
dead	5	0.8	1	0.1	18	1.7	4	0.3

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Table 5 (continued)

Characteristics	1991		1992		1993		1994	
	No.	%	No.	%	No.	%	No.	%
Glasgow Coma Scale (score)								
level 1	603	97.4	763	97.7	1051	97.2	1488	98.2
level 2	8	1.3	16	2.0	12	1.1	18	1.2
level 3	8	1.3	2	0.3	18	1.7	9	0.6
Type of Cases								
admitted cases	142	22.9	233	29.8	354	32.7	450	29.7
OPD cases	477	77.1	548	70.2	727	67.3	1065	70.3
Abbreviated Injury Scale (score)								
1	458	73.9	530	67.9	699	64.7	1003	66.2
2	74	11.9	98	12.5	198	18.3	239	15.9
3	76	12.5	131	16.8	149	13.8	229	15.1
4	6	0.9	17	2.2	15	1.4	34	2.2
5	0	0	4	0.5	2	0.2	5	0.3
6	5	0.8	1	0.1	18	1.6	5	0.3

General Characteristics of Study Group 2

1. General Characteristics

1.1 General characteristics and socio-demographic characteristics of study group 2 (composed of 250 cases and 250 controls) were:

Sex

About 77.6% of cases and controls were males. Distribution of sexes amonng cases and controls were not significantly different ($p = 1.00$) (Table 6).

Age

The 250 cases had an average age of 26.09 years ($sd = 10.79$), while the 250 controls had an average age of 26.14 years ($sd = 10.65$). Distribution of age, both in cases and controls, were not significantly different ($p = 1.00$) (Table 6).

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Marital Status

About 63.2% of the cases and 60.8% of the controls were singles. Other marital status (married, divorced, widowed, separated) are shown in (Table 6). Distribution of marital status between cases and controls were not significantly different ($p = 0.311$).

Educational Level

The majority (33.2%) of the cases had completed primary education. The next group (26.0%) was those who had completed secondary education, and those with vocational education were 20.8%, while about 20.0% nearly to college education or above. As for the educational level of the controls, the majority (27.2%) had completed college education or above, and 26.4% completed secondary education, while 24.8% completed vocational education and 21.6% completed primary education.

Distribution of educational levels in cases and controls were significantly different with $p = 0.009$ (Table 6).

Residential Area

About 68.4% of the cases and 70.8% of the controls lived outside the municipal area. Residential area distribution among cases and controls were not significantly different ($p = 0.56$) (Table 6).

Occupation

The majority (36.4%) of cases were students, the next group was labourers (32.8%) and the agriculturists (14.4%). The majority (43.6%) in controls were students, next was labourers (22.0%), and the third was government officer (15.6%).

Distribution of occupation in cases and controls were significantly different at $p = 0.02$ (Table 6).

Income

Income (baht/month) was classified into 4 categories:

- no income-2,000
- 2,001-4,000
- 4,001-6,000
- >6,000

Among cases, the highest income was of 30,000 baht/month, with an average income of 3,378.96 baht/month (sd = 3,936.207), while the lowest had no income. About 44.8% of the cases had income of 2,000 baht/month, the next was 2,001-4,000 baht/month (33.2%). Among

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controls, the highest income was 50,000 baht/month, with an average income of 3,573.12 baht/month (sd = 5,200.00), while the lowest had no income. About 56.8% of the controls had income 2,000 baht/month. And the lowest income (8.4%) had 4,001 - 6,000 baht/month.

Distribution of income in cases and controls were different significantly with $p < 0.001$ (Table 6).

Table 6 Characteristics of cases and controls.

Characteristics	cases		controls	
	number	percent	number	percent
Sex				
male	194	77.6	194	77.6
female	56	22.4	56	22.4
	$\chi^2 = 0.00$	df. = 1	p-value = 1.00	
Age (years)				
14-20	105	42.0	105	42.0
21-30	81	32.4	81	32.4
31-40	30	12.0	30	12.0
>40	34	13.6	34	13.6
	$\bar{X} = 26.092$	sd. = 10.787	$\bar{X} = 26.148$	sd. = 10.652
	$\chi^2 = 0.00$	df. = 3	p-value = 1.00	
Residential area				
within municipal area	79	31.6	73	29.2
outside municipal area	171	68.4	177	70.8
	$\chi^2 = 0.34$	df. = 1	p-value = 0.56	

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Table 6 (continued)

Characteristics	cases		controls	
	number	percent	number	percent
Educational level				
primary	83	33.2	54	21.6
secondary	65	26.0	66	26.4
vocational	52	20.8	62	24.8
college or above	50	20.0	68	27.2
	χ^2=9.52	df.=3	p-value=0.009	
Occupation				
none worker	5	2.0	5	2.0
students	91	36.4	109	43.6
agriculturists	36	14.4	30	12.0
labourers	82	32.8	55	22.0
semi-government officcer	1	0.4	3	1.2
government officer	22	8.8	39	15.6
	χ^2=9.81	df.=5	p-value=0.02	
Marital status				
single	158	63.2	152	60.8
married/ widowed/ divorced/ separated	92	36.8	98	39.2
	χ^2=0.31	df.=1	p-value=0.58	
Income (baht/month)				
≤2,000	112	44.8	142	56.8
2,001-4,000	83	33.2	43	17.2
4,001-6,000	19	7.6	21	8.4
>6,000	36	14.4	44	17.6
	$\bar{X}$ =3378.96	sd.=3936.20	$\bar{X}$ =3573.12	sd.=5200.06
	χ^2=17.14	df.=3	p-value<0.001	

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1.2 Riding Behavior

Average Daily Riding Time

Cases had the highest average daily riding time of 12 hrs, with an estimated mean average of 1 hr 19 minutes (sd = 1 hr 48 minutes), while the lowest average daily riding time was 10 minutes. The most (49.2%) had an average daily riding time of 31 minutes - 1 hr, and the next (32.4%) had 10 minutes - 30 minutes, while 18.4% was >1 hr. As for the controls, the highest average daily riding time was 12 hrs, and the estimated mean of the average was 1 hr 4 minutes (sd = 1 hr 27 minutes), while the lowest average daily riding time was 10 minutes. Most of the controls (43.6 %) had 31 minutes - 1 hr, about 40.0% had 10 minutes - 30 minutes, and 16.4% for >1 hr.

Distribution of the average daily riding time in cases and controls were not different significantly (p = 0.209) (Table 7).

Average Daily Riding Distance

The cases had the lowest average daily riding distance of 4 Kms, and the highest was 200 Kms. The mean riding distance was 25.236 Kms. (sd = 24.32). The majority (36.8%) drivers had riding distance 15 Kms/day while 30.8% had 16-20 Kms/day. The controls had an average lowest daily riding distance 2 Kms and the highest was 200 Kms. The mean riding distance was 21.58 Kms (sd = 15.47). The most (43.6%) had riding distance 15 Kms/day while 26.0% had 16-20 Kms/day.

Distribution of average daily riding distance in cases and controls were not significantly different (p = 0.165) (Table 7).

Frequency of Riding/Week

Majority of the cases (71.6%) and the controls (66.0%) used to ride as many as 6-7 days/week. The rest used to ride as follow: 10.4% of the cases and 12.4% the controls as many as 4-5 days/week; 14.4% of the cases and 15.2% of the controls as many as 2-3 days/week, and 3.6% of the cases and 6.4% of the controls, as many as 1 day/week.

Distribution of frequency of riding/week were not significantly different (p = 0.38) (Table 7).

Average Riding Speed

The highest riding speed among the cases was 120 km/hr, and the mean average speed of riding was 67.74 km/hr (sd = 19.3), while the lowest had an average riding speed of 20 km/hr. Most (48.4%) of the cases had a speed of >80 km/hr, another 40.0% had a speed of 61-80 km/hr, and 11.6% had a speed of 60 km/hr. The controls had the

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highest speed of 120 km/hr, and the mean average speed of riding 69.78 (sd = 20.19), while the lowest average riding speed of 20 km/hr. Most (44.0%) of the controls had a riding speed of > 80 km/hr, another 38.0% had a speed of 61-80 km/hr, and 18.0% had a riding speed of 60 km/hr.

Distribution of the average speed of riding were not significantly different among cases and controls (p = 0.128) (Table 7).

Table 7 Characteristics of riding behavior in cases and controls.

Characteristics	cases		controls	
	number	percent	number	percent
Average daily riding time (hr)				
10min-30min	81	32.4	100	40.0
31min-1hr	123	49.2	109	43.6
>1hr	46	18.4	41	16.4
	$\bar{X}$ =1hr19min	sd.=1.48	$\bar{X}$ =1hr4min	sd.=1.27
	χ^2=3.13	df.=2	p-value=0.209	
Average daily riding distance (Km)				
≤15	92	36.8	109	43.6
16-20	77	30.8	65	26.0
21-30	43	17.2	47	18.8
31-50	20	8.0	21	8.4
>50	18	7.2	8	3.2
	$\bar{X}$ =25.24	sd.=24.32	$\bar{X}$ =21.58	sd.=15.47
	χ^2=6.50	df.=4	p-value=0.165	
Frequency of riding/week (day)				
6-7	179	71.6	165	66.0
4-5	26	10.4	31	12.4
2-3	36	14.4	38	15.2
1	9	3.6	16	6.4
	χ^2=3.02	df.=3	p-value=0.38	

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Table 7 (continued)

Characteristics	cases number	percent	controls number	percent
Average riding speed (Km/hr)				
≤60	29	11.6	45	18.0
61-80	100	40.0	95	38.0
≥81	121	48.4	110	44.0
	$\bar{X}$ =67.74	sd.=19.3	$\bar{X}$ =69.78	sd.=20.19
	χ^2=4.11	df.=2	p-value=0.13	

1.3 Physical Factors

History of Illness

About 6.8% of the cases and 11.2% of the controls had history of illness and it showed that the controls had more history of diseases.

Distribution of history of illness in cases and controls were not significantly different ($p=0.09$) (Table 8).

Drug Usage Before Riding

Decongestant: 26.0% of controls used decongestant before riding, higher than in cases (10.4%).

Distribution of decongestant usage before riding in cases and controls were different significantly ($p<0.001$).

Antihistamine: 50.8% of controls used antihistamine before riding, higher than in cases (33.6%).

Distribution of antihistamine use before driving in cases and controls were different significantly ($p < 0.001$).

TDMA & metaphetamine: 1.2% in cases and 0.8% in controls used TDMA & metaphetamine before riding.

Distribution of TDMA & metaphetamine usage before riding in cases and controls were not significantly different ($p=0.065$).

Antihypertension: 1.6% in cases and 0.4% in controls used antihypertension before riding.

Distribution of antihypertension drug usage in cases and controls were not significantly different ($p = 0.178$) (Table 8).

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Alcoholic Beverage Consumption Before Riding

About 63.6% of the controls ever consumed alcohol, which was higher than that of the cases (55.2%). Beverage consumption before riding in controls were 64.0% and the cases were 56.0% and other description are shown in Table 8.

Distribution of alcohol and beverage consumption before riding were not significantly different in cases and controls ($p = 0.056$ of alcoholic and $p = 0.068$ of beverage, respectively).

Table 8 Characteristics of physical factors in cases and controls.

Characteristics	cases		controls	
	number	percent	number	percent
History of illness				
no	233	93.2	222	88.8
yes	17	6.8	28	11.2
	$\chi^2 = 2.95$	df. = 1	p-value = 0.09	
Drug usage before riding				
Decongestant				
ever	26	10.4	65	26.0
never	224	89.6	185	74.0
	$\chi^2 = 20.433$	df. = 1	p-value < 0.001	
Antihistamine				
ever	84	33.6	127	50.8
never	166	66.4	123	49.2
	$\chi^2 = 15.16$	df. = 1	p-value < 0.001	
TDMA & metaphetamine				
ever	3	1.2	2	0.8
never	247	98.8	248	99.2
	$\chi^2 = 0.202$	df. = 1	p-value = 0.65	
Hypertensive drug				
ever	4	1.6	1	0.4
never	246	98.4	249	99.6
	$\chi^2 = 1.818$	df. = 1	p-value = 0.18	

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Table 8 (continued)

Characteristics	cases		controls	
	number	percent	number	percent
Alcoholic consumption before riding				
yes	138	55.2	159	63.6
no	112	44.8	91	36.4
	$\chi^2 = 3.657$	df. = 1	p-value = 0.06	
Beverage consumption before riding				
yes	140	56.0	160	64.0
no	110	44.0	90	36.0
	$\chi^2 = 3.33$	df. = 1	p-value = 0.07	

1.4 Riding Factor

Riding Experience

The cases had an average riding experience of 7.88 years (sd = 38.275), the lowest riding experience was 1 year and the highest was 35 years. The experience of >9 years was 34.4% among the cases, 4-6 years was 29.2%, and 3 years was 24.4%. As for riding experience of the controls, the highest was 35 years, average riding experience of 8.752 years (sd = 7.005), and the lowest was 3 years. The experience > 9 years was 36.4% of the controls, 4-6 years was 28.0% and 3 years was 22.4%, respectively.

Distribution of riding experience were not different significantly in cases and controls (p = 0.905) (Table 9).

Having Driver's License

About 22.8% of the cases had driver's license and over three-fourth (77.2%) had no driver's license. As for the controls, 26.0% had driver's license and 74.0% had no driver's license.

Distribution of having driver's license in cases and controls were not significantly different (p = 0.404) (Table 9).

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Methods of Obtaining Driver's License (specially having driver's license).

Methods of obtaining driver's license by examination and test riding were found in 96.5% of the cases and in 89.2% of the controls. Other methods of obtaining driver's license (examination with no test riding, bought, short course training by police) were found in 3.5% of the cases and in 10.8% of the controls.

Distribution of methods of obtaining driver's license were not significantly different (Fisher s exact test 1-tailed = 0.117) in cases and controls (Table 9).

Duration of Having Driver's License (year)

Among the cases, the lowest duration of having driver's license was 1 year, the highest was 30 years, and an average of 5.175 years (sd = 32.969). The most number of 3 years were found over one half (56.1%) in cases, and 24.6% were found on 4-6 years, while 10 years were found in 17.5% and 7-9 years were found in 1.8%, respectively. Among the controls, the lowest duration of having driver s license was 1 year, the highest was 30 years, with a mean of 8.194 years (sd = 7.205). Duration of having driver's license 3 years were found in 36.9%, 10 years were were found in 35.8%, 4-6 years were found in 15.4% and 7-9 years were found in was found 12.3%.

Distribution of duration of having driver's license in cases and controls were significantly different (p = 0.008) (Table 9).

History of Accident During the Past Year

The cases had history of accidents of 18.0%, which was lower than controls (27.6%). Those with never had accident were 82.0% in cases and 72.4% in controls.

Distribution of history of accident during the past year in cases and controls were not significantly different (p = 0.086) (Table 9).

Severity of Injury of Last Accident During the Past Year
(specially ever had an accident)

Around 82.2% of the cases had mild severity of injury with self care and consult physician, while those with moderate severity of injury and serious severity of injury and were admitted in hospital were 17.8%. Among the controls, 82.3% had mild severity of injury with self care and mild severity of injury with consult physician, while about 17.7% with moderate severity of injury and serious severity of injury were admitted.

Distribution of severity of injury of last accident during the past year were not significantly different in cases and controls (p = 0.801) (Table 9).

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Table 9 Characteristics of riding factors in cases and controls.

Characteristics	cases		controls	
	number	percent	number	percent
Riding experience (year)				
≤3	61	24.4	56	22.4
4-6	73	29.2	70	28.0
7-9	30	12.0	33	13.2
>9	86	34.4	91	36.4
	$\bar{X}$ =7.88	sd.=38.275	$\bar{X}$ =8.752	sd.=7.005
	χ^2=0.56	df.=3	p-value=0.905	
Having driver's license				
no	193	77.2	185	74.0
yes	57	22.8	65	26.0
	χ^2=0.69	df.=1	p-value=0.40	
Methods of obtaining driver's license				
✡ extest	55	96.5	58	89.2
✡✡ other	2	3.5	7	10.8
		fisher's exact (1 tailed)		p=0.117
Duration of having driver's license (year)				
1-3	32	56.1	24	36.9
4-6	14	24.6	10	15.4
7-9	1	1.8	8	12.3
≥10	40	17.5	23	35.8
	$\bar{X}$ =5.175	sd.=32.969	$\bar{X}$ =8.194	sd.=7.205
	χ^2=6.73	df.=3	p-value=0.008	
History of accident during the past year				
ever	45	18.0	62	24.8
never	205	82.0	188	75.2
	χ^2=3.44	df.=1	p-value=0.04	

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Table 9 (continued)

Characteristics	cases		controls	
	number	percent	number	percent
Severity of injury of last accident				
*msc	37	82.2	51	82.3
**msa	8	17.8	11	17.7
	$\chi^2 = 0.06$	df. = 1	p-value = 0.801	

✡ extest means examination & test driving
✡✡ other means examination not drives, bought, short course riding by police
*msc means mild and self care with consult physician
**msa means moderate and severe must admitted

1.5 Knowledge of Traffic Rules

As to the score on knowledge of traffic rules of the cases, the highest score was 18, average score was 13.992 (sd = 2.408), and the lowest score was 3. The score of 11 was found in 13.2% of the case, score 12-15 was found in 56.4% and score 16 was found in 30.4% of the cases. Among the controls, the lowest score was 5, average score was 13.756 (sd = 2.505), and the highest score was 18. Score of 11 was found in 15.6% of the controls, score 12-15 was found in 60.4% and score 16 was found in 24.0%.

Distribution of knowledge of traffic rules were not significantly different in cases and controls (p = 0.256) (Table 10).

Table 10 Knowledge of traffic rules (score) in cases and controls.

Knowledge	cases		controls	
	number	percent	number	percent
Knowledge (score)				
≤11	33	13.2	39	15.6
12-15	141	56.4	151	60.4
≥16	76	30.4	60	24.0
	$\bar{X} = 13.992$	sd. = 2.408	$\bar{X} = 13.756$	sd. = 2.505
	$\chi^2 = 2.724$	df. = 2	p-value = 0.256	

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Description Detail of Knowledge

Both the cases and the controls were lack of knowledge in driving, overtaking other vehicle, and the law, 28.0% and 29.6%, respectively.

On driving at u-turn area, 58.8% of the cases were lack of knowledge in this part, but was higher than that of the controls (49.2%).

On stop area, cases were lack of knowledge in this part by 25.2%, but which was lower than controls (32.8%).

On the meaning of traffic light "white-yellow" beside the road, cases were lack of knowledge in this part and was near to the controls (33.2% and 31.6%, respectively.

On the meaning of traffic light "white-red" beside the road, cases were lack of knowledge in this part by 33.2%, which was lower than controls (37.6%).

Driver s must keep on the left side in most event. The cases were lack of knowledge on this part, and were higher than that of the controls (44.8% and 42.4%, respectively).

On the methods of protection from accident, 27.2% in cases was lack of knowledge in this part, which was lower than the controls (33.2%). Other parts lack of knowledge are shown in (Table 11).

Table 11 Presentation of lack part of knowledge in cases and controls.

Lack part of knowledge	cases		controls	
	number	percent	number	percent
Drives overtake the other	70	28.0	74	29.6
Driving at u-turn area	147	58.8	123	49.2
Light traffic "yellow-wink" means	29	11.6	39	15.6
Stop any area in laws	63	25.2	82	32.8
Light traffic "white-black" means	16	6.4	19	7.6
Light traffic "white-yellow" means	83	33.2	79	31.6
Light traffic "white-red" means	83	33.2	94	37.6
Light traffic red and green, arrow head straight right	5	2.0	12	4.8

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Table 11 (continued)

Lack part of knowledge	cases		controls	
	number	percent	number	percent
Driver must drives keep left side the most in any event	112	44.8	106	42.4
Before turn right, turn left, change lane, reduce speed or stop must open light or hand sign distance within (metre)	49	19.6	51	20.4
Traffic sign no entry	30	12.0	35	14.0
Traffic sign no parking	35	14.0	44	17.6
Methods to reduce severe injuried, deformed and fatal	54	21.6	62	24.8
Methods to protection accident	68	27.2	83	33.2
Stop immediate aware of	27	10.8	28	11.2

2. Vehicle Factors

Duration of Using Motorcycle (month)

The lowest duration of using motorcycle among the cases was 1 month, the highest was 240 months, and the average was 29.76 months (sd = 8.75). The most (41.6%) use was 25-60 months among the cases, next was 38.0% for 6-24 months. Among the controls, the lowest use was 2 months, the highest was 216 months, and the average was 32.88 months (sd = 0.86). About 48.4% of the use was 25-60 months, next to the most was 6-24 months by about 31.6%. Other are shown in Table 12.

Distribution of duration of using motorcycle were significantly different (p = 0.012) in cases and in controls.

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Engine Capacity (cc.)

About 73.2% in the cases and 60.0% in the controls had an engine capacity of 101-150 cc., and about 18% in the cases and 26.4% in the controls had 80-100 cc. respectively. The other are presented in Table 12.

Distribution of engine capacity in cases and in controls were significantly different ($p=0.015$).

Motorcycle Condition

Motorcycle condition with 2 impaired rear mirrors were found in 46.4% of the cases, which was higher than the controls (28.4%). Instead of cases have 2 rear mirrors of 53.6%, 71.6% in controls.

Distribution of impaired 2 rear mirrors in cases and controls were significantly different ($p<0.001$).

Motorcycle condition with 1 impaired rear mirror were found in 13.2% of the controls, higher than the cases at 5.2%. About 94.8% of the cases and 86.8% of the controls have 1 to hind sight.

Distribution of 1 impaired rear mirror in cases and in controls were significantly different ($p=0.02$).

Front-rear light, turn right-turn left light, brake condition and engine condition (lost or fitted) of motorcycle are presented in Table 12.

Modified Engine

The main objective of modified engine was high speed or loud noise. About 0.8% among controls and 2.4% among cases had modified their engine. Cases that had not modified their engine was 99.2% and 97.6% in controls, respectively.

Distribution of modified engine were not significantly different between cases and controls ($p=0.154$) (Table 12).

Check Completed of Motorcycle

Complete checked of motorcycle were done mostly by self and general technician. Motorcycles checked were 78.8% in cases and 67.2% in controls. Other were by self and technician at motorcycle center where 21.2% were checked in cases and 17.6% in controls (Table 12).

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Table 12 Presentation vehicle factors in cases and controls.

Factors	cases		controls	
	number	percent	number	percent
Duration of using motorcycle (month)				
≤6	31	12.4	15	6.0
7-24	95	38.0	79	31.6
25-60	104	41.6	121	48.4
61-108	13	5.2	26	10.4
>108	7	2.8	9	2.6
	$\bar{X}$ = 29.76	sd. = 8.75	$\bar{X}$ = 32.88	sd. = 0.86
	χ^2 = 12.9	df. = 4	p-value = 0.012	
Engine capacity (cc.)				
<80	18	7.2	24	9.6
80-100	45	18.0	67	26.4
101-150	183	73.2	150	60.0
>150	4	1.6	9	3.6
	χ^2 = 10.37	df. = 3	p-value = 0.015	
Motorcycle condition impaired 2 rear mirrors				
impaired	116	46.4	71	28.4
have	134	53.6	179	71.6
	χ^2 = 17.29	df. = 1	p-value < 0.001	
Motorcycle condition impaired 1 rear mirror				
impaired	13	5.2	33	13.2
have	237	94.8	217	86.8
	χ^2 = 9.58	df. = 1	p-value = 0.002	
Have front-rear light				
have not	10	4.0	18	7.2
have	240	96.0	232	92.8
	χ^2 = 2.42	df. = 1	p-value = 0.120	
Have turn right -turn left light				
have not	2	0.8	7	2.8
have	248	99.2	243	97.2
	χ^2 = 2.828	df. = 1	p-value = 0.093	

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Table 12 (continued)

Factors	cases		controls	
	number	percent	number	percent
Brake condition				
lost	4	1.6	5	2.0
fited	246	98.4	245	98.0
	$\chi^2 = 0.113$	df. = 1	p-value = 0.74	
Engine condition				
lost	2	0.8	9	3.6
fited	248	99.2	241	96.4
	$\chi^2 = 4.55$	df. = 1	p-value = 0.033	
Modified engine				
modify	2	0.8	6	2.4
normal	248	99.2	244	97.6
	$\chi^2 = 2.03$	df. = 1	p-value = 0.154	
Check completed of motorcycle				
✡ Seg	197	78.8	206	82.4
✡ ✡ Set	53	21.2	44	17.6

✡Seg means self and general technician motorcycle check
✡ ✡ Set means self and technician of motorcycle center check

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3. Accident Data

Time

The accidents took place the most (21.6%) during the time of 15.00-18.00, and the next (21.2%) during the time of 18.00-21.00. The rest of the time during the day in which the accidents took place are shown in Table 13.

Days of the Week

Most (20.0%) of the motorcycle accidents happened on Saturdays, the next frequency were found on Sundays (17.6%) and on Mondays (14.0%). The other days of the week in which the accidents took place are presented in Table 13.

Area Where the Accident Occurred

Area where the accidents occurred were mostly (54.0%) outside of the municipal area, and another 46.0% happened within the municipal area (Table 13).

Type of Accident

The type of motorcycle accidents were mostly fell (40.4%), collision with other motor vehicles (23.2%) and collision with other motorcycle (22.8%). Motorcycle accidents that collided with bicycles, pedestrians, animals, and fences are shown in Table 13.

The Type of Accident Character

The type of accident character found were mostly crashed (44.4%), the next was fell (40.0%) and knock down (15.6%), as shown in Table 13.

Physical Condition

Physical condition found related to motorcycle accidents was normal physical condition (83.6%), syncope abnormal physical condition found was 8.4%, while other abnormal physical conditions are shown in Table 13.

Mental Condition

Mental condition found related to motorcycle accidents the most was normal mental condition (62.0%) and the next was abnormal mental condition (hurry or rush) at 36.4%. Other abnormal mental conditions such as angry, uneasy, and stress are shown in Table 13.

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Consumption of Alcoholic Beverage

Alcoholic beverage consumed before accident was found among 36.0% of the patients but those that did not consume any alcoholic beverage was found among 64.0% of the patients. Detected blood alcohol concentration (BAC) among admitted cases that were found with 0 mg.% were about 36.0%, with 1-49 mg.% were about 4.0%, with 50-200 mg.% were about 45.3%, and with >200 mg.% were about 14.7%, respectively (Table 13).

Speed Before Accident Occurred

In term of speed before the accident, it was classified into 40 Km/hr (34.4%), 41-60 Km/hr (34.8%), 61-80 Km/hr (25.6%), >80 Km/hr (5.2%), respectively (Table 13).

Type of the Road

Most of the road where the accidents happened were concrete road (60.0%) and asphaltic road (33.6%). Stone roads and ground roads were 4.8% and 1.6%, respectively (Table 13).

Road Surface

The surface of the roads where most of the accidents took place were smooth (71.2%) and rough surfaced roads (22.8%). The road with skidded surface, mud, and road on construction were 3.2%, 1.2%, and 1.6%, respectively. The areas of the road where the accidents happened were at mid block (52.0%), at curve roads (31.6%), and at road intersections with 16.0% (Table 13).

Weather Condition

Around 55.2% accidents took place during fine weather while it was 34.0% during dark weather. Other weather conditions are shown in (Table 13).

Injured Body Parts

The most often body part injured were legs (58.4%) including foot, while arms and hands including shoulders were 54.0% and face area were 34.0%. The other parts of the body are shown in (Table 13).

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Severity of Injury

The highest form of severity of the injury was abrasion (97.6%), second at 45.6% were tear wound and tear tendon (sight external). The third was fracture of bones (24.0%). Other severity of injury are presented in (Table 13).

Glasgow Coma Scale (GCS)

Glasgow coma scale (GCS) were classified into severe head injuries, cases with GCS level 1 (GCS 13-15) were found the most in 98.8%, while 1.2% had level 2 (GCS 9-12).

Most of the patients were out patients at 70% and admitted patients at 30% (Table 13).

Table 13 Factors of accident data in cases.

Factors	number	percent
Time accident		
day time	147	58.8
night time	103	41.2
Time		
00.00-03.00	18	7.2
03.00-06.00	5	2.0
06.00-09.00	24	9.6
09.00-12.00	41	16.4
12.00-15.00	28	11.2
15.00-18.00	54	21.6
18.00-21.00	53	21.2
21.00-24.00	27	10.8
	mode = 16.00	
Days of a week		
Sunday	44	17.6
Monday	35	14.0
Tuesday	39	15.6
Wednesday	29	11.6
Thursday	30	12.0
Friday	23	9.2
Saturday	50	20.0

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Table 13 (continued)

Factors	number	percent
Area at accident occurred		
within municipal area	115	46.0
outside municipal area	135	54.0
Type of accident (collisions with)		
motorcycles	57	22.8
bicycles	2	0.8
motor vehicles	58	23.2
pedestrians	7	2.8
animals	17	6.8
fences	9	3.6
falls	100	40.0
Character type of accident		
falls	100	40.0
crash	111	44.4
knock down	39	15.6
Physical condition		
normal	209	83.6
hungry	1	0.4
syncope	21	8.4
sleepy	16	6.4
drunk	3	1.2
Mental condition		
normal	155	62.0
angry	1	0.4
uneasy	2	0.8
stress	1	0.4
hurry	91	36.4
Alcoholic beverage consumption		
yes	90	36.0
no	160	64.0

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Table 13 (continued)

Factors	number	percent
Blood alcohol concentration (mg%) (admitted cases, n = 75)		
0	27	36.0
1-49	3	4.0
50-200	34	45.3
>200	11	14.7
Speed before accident (Km/hr)		
≤40	86	34.4
41-60	87	34.8
61-80	64	25.6
>80	13	5.2
Type of road		
concrete	150	60.0
asphaltatic	84	33.6
stone	12	4.8
ground	4	1.6
Road surface		
smooth	178	71.2
rough	57	22.8
skidding	8	3.2
mud	3	1.2
during road construction	4	1.6
Road area		
mid block	130	52.0
curve road	79	31.6
intersection	40	16.0
before bridge	1	0.4
Weather condition		
fine	138	55.2
dawn	20	8.0
dark	85	34.0
rain	7	2.8

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Table 13 (continued)

Factors	number	percent
Body part injured		
head	29	11.6
face	85	34.0
neck	1	0.4
chest	14	5.6
abdomen	6	2.4
back	14	5.6
forearm, hand include shoulder	135	54.0
leg include foot	146	58.4
sex organs & buttock	5	2.0
eye	1	0.4
Severity of injury		
abrasion	244	97.6
tear wound	114	45.6
abdomen injuries	4	1.6
sprain	6	2.4
fracture	60	24.0
unconscious from brain contusion	1	0.4
airway obstruction	1	0.4
foreign body on eyes	1	0.4
Glasgow coma scale (score)		
level 1 (GCS 13-15)	247	98.8
level 2 (GCS 9-12)	3	1.2
Abbreviated Injury Scale		
AIS 1	173	69.2
AIS 2	11	4.4
AIS 3	66	26.4

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The Relation Between Factors of Accident

The relation between type of crash and alcoholic beverage consumed before accidents among cases: alcoholic consumed before motorcycle accidents were related to 51.1% of those who fell, 38.9% of those who crashed to the other and 10.0% of those who knocked down.

Association between type of crash and the speed of motorcycle before accident took place were classified into 1) speed up to 40 Km/hr, of which 31.4% were knocked down, 27.9% fell and 40.7% crashed; 2) the speed of 41-60 Km/hr, of which 52.9% crashed to the other, 41.4% fell, 5.7% knocked down; and 3) the result of the speed of 61-80 Km/hr and >80 Km/hr are shown in Table 14.

Table 14 Type of crash with alcoholic beverage consumption and speed of accident in case.

Variables	fall		crash		knock down	
	number	percent	number	percent	number	percent
Alcoholic consumption						
use	46	51.1	35	38.9	9	10.0
not	56	35.0	73	45.6	31	19.4
Speed before accident (Km/hr)						
≤40	24	27.9	35	40.7	27	31.4
41-60	36	41.4	46	52.9	5	5.7
61-80	33	51.6	24	37.5	7	10.9
>80	6	46.2	6	46.2	1	7.6

Type of accident associated with alcoholic beverage consumption before the accident took place: motorcycle accidents was associated with 51.1% of those who fell and 21.1% of those who collided with other motor vehicles. Other collisions related to alcoholic beverage consumption are shown in Table 15.

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Table 15 Type of accident with alcoholic beverage consumption in cases.

collision with	motorcycle	bicycle	motor vehicle	pedestrian	animal	fence	fall
	no.(%)	no.(%)	no.(%)	no.(%)	no.(%)	no.(%)	no.(%)
alcohol consumption							
yes	14(15.6)	0	19(21.1)	2(2.2)	5(5.6)	4(4.4)	46(51.1)
no	43(26.9)	2(1.3)	39(24.4)	5(3.1)	12(7.5)	5(3.1)	54(33.7)

Physical condition related to the type of accident: 1) normal physical condition: 34.6% among those who fell while riding motorcycle, 26.5% among those who collided with other motor vehicles, 25.5% among those who collided with other motorcycles, while other are shown in Table 16; 2) abnormal physical condition (hurry, syncope, sleepy) related to the type of accident were found among 66.7% of those who collided with fences, and among 26.0% of those who fell; 3) drunk patients were found among 66.7% of those who fell and 33.3% among those who collided with fences (Table 16).

Table 16 Physical condition with type of accident in cases.

Physical condition	normal		hungry/syncope/ sleepy		drunk	
	number	percent	number	percent	number	percent
Type of accident (collisions with)						
motorcycles	53	25.5	4	10.2	0	0
bicycles	2	0.9	0	0	0	0
motor vehicles	55	26.5	3(	7.7	0	0
pedestrians	7	3.4	0	0	0	0
animals	14	6.7	3	7.7	0	0
fences	5	2.4	3	7.7	1	33.3
falls	72	34.6	26	66.7	2	66.7

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Mental condition related to the type of accidents: 1) normal mental condition: 35.3% were found related with fell, 27.6% were found related with those who had collisions with motor vehicles, and 26.2% were found related with those who had collisions with other motorcycles. 2) abnormal mental condition of stress (angry, uneasy, stress, hurry) were related to nearly half (47.9%) of those who fell, and 17.0% were found related with those who had collisions with other motorcycles. Other characters are shown in Table 17.

Table 17 Mental condition with type of accident.

Mental condition	normal		angry/uneasy/stress/hurry	
	number	percent	number	percent
Type of accident (collisions with)				
motorcycles	41	26.2	16	17.0
bicycles	2	1.3	0	0
motor vehicles	43	27.6	15	15.9
pedestrians	5	3.2	2	2.1
animals	7	4.5	10	10.7
fences	3	1.9	6	6.4
falls	55	35.3	45	47.9

The relation between type of crash to alcoholic beverage consumption before accident among admitted cases (n = 75): 48.9% of those who fell were found related to alcoholic beverage consumed, 42.5% with alcoholic beverage consumption were related to crash, and 8.6% were found with knock down (table 18).

Type of crash with blood alcohol concentration (admitted cases, n = 75): 48.5% of those who fell were found with blood alcohol concentration (BAC) 50-200 mg.%, 45.5% were found with BAC > 200 mg.%. About 46.4% of those who crashed were found with BAC 0 mg.%, while 45.5% were found with BAC > 200 mg.%. Other characters are shown in (table 18).

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Table 18 Type of crash with alcoholic beverage consumption (admitted case, n = 75).

Type of crash	fall		crash		knocked down	
	number	percent	number	percent	number	percent
Alcoholic beverage consumption						
use	23	48.9	20	42.5	4	8.6
no	8	28.6	13	46.4	7	25.0
Blood alcohol concentration (mg%)						
0	8	28.6	13	46.4	7	25.0
1-49	2	66.7	1	33.3	0	0
50-200	16	48.5	14	42.4	3	9.1
>200	5	45.5	5	45.5	1	9.0

Alcoholic beverage consumption: among admitted cases, 61.3%, and 25.1% were found to be OPD cases (Table 19).

Table 19 Alcoholic beverage consumption of cases.

Factor	Alcoholic beverage consumption		No alcoholic beverage consumption	
	number	percent	number	percent
Type of cases				
admitted cases	46	61.3	29	38.7
OPD cases	44	25.1	131	74.9
	$\chi^2 = 29.84$	df. = 1		p-value < 0.001

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4. The Factors Association with Accident

4.1 Socio-demography Factors

Residential Area

About 68.4% of the cases and 70.8% of the controls lived outside the municipal area, while there were 31.6% of the cases and 29.2% of the controls who lived within the municipal area.

The association between residential areas and accident was not significant ($p = 0.545$) (Table 20).

Marital Status

About 63.2% of the cases and 60.8% of the controls were singles, while 36.8% of the cases as well as 39.2% of the controls had marital status of non-single (married, divorced, widowed, separated).

The association between marital status and accident was not significant ($p = 0.397$) (Table 20).

Educational Level

About 33.2% of the cases and 21.6% of the controls had completed primary education, while 26.0% of the cases and 26.4% of the controls had completed secondary education. About 40.8% of the cases and 52.0% of the controls had completed vocational level or above.

The association between educational level and accident was significant at $p = 0.001$. Persons who completed only primary education would have 2.16 times (95% CI of OR = 1.35-2.49) more risk of accident as compared to those who completed vocational education or above. Among the secondary education, there was no different statistically in risk of accident as compared to those who completed vocational education or above (Table 20).

Occupation

Among the study population, 36.4% of the cases and 43.6% of the controls were students; 14.4% of the cases and 12% of the controls were agriculturists; and 32.8% of the cases and 22.0% of the controls were labourers. Another 16.4% of the cases and 22.4% of the controls had other occupation (not worker, government officers, merchants, semi-government officers).

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The association between occupation and accident was significant at p=0.012. Labourers would have 2.06 times (95% CI of OR=1.17-3.61) more risk of accident as compared to reference group (not working, government officers, merchants, semi-government officers). In all other groups, there were no statistical difference in accident when compared to reference group (Table 20).

Income (baht/month)

About 77.2% of the cases and 72.8% of the controls had income of ≤4,000 baht/month while 22.8% of the cases and 27.2% of the controls had income of >4,000 baht/month.

The association between income and accident was not significant (p=0.194) (Table 20).

Table 20 Factors association with accident in cases and controls.

Factors	cases		controls		OR	95% CI (OR)	p-value
	number	percent	number	percent			
Residential area							
outside municipal area	171	68.4	177	70.8	0.88	0.59-1.31	0.545
within municipal area	79	31.6	73	29.2	1.00		
Marital status							
single	158	63.2	152	60.8	1.27	0.73-2.23	0.397
other	92	36.8	98	39.2	1.00		

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Table 20 (continued)

Factors	cases		controls		OR	95% CI (OR)	p-value
	number	percent	number	percent			
Educational level							
primary	83	33.2	54	21.6	2.16	1.35-2.49	0.001
secondary	65	26.0	66	26.4	1.30	0.82-2.08	0.266
vocational /above	102	40.8	130	52.0	1.00		
Occupation							
students	91	36.4	109	43.6	0.89	0.46-1.71	0.725
agriculturists	36	14.4	30	12.0	1.60	0.83-3.12	0.162
labourers	82	32.8	55	22.0	2.06	1.17-3.61	0.012
*reference	41	16.4	56	22.4	1.00		
Income (baht/month)							
≤4,000	193	77.2	182	72.8	1.37	0.85-2.19	0.194
>4,000	57	22.8	68	27.2	1.00		

*reference means no worker/ merchants/ semi-government officers/ government officers

4.2 Riding Behavior

Average Daily Riding Time

About 18.4% of the cases and 14.8% of the controls had average daily riding time >1 hour, while 81.6% of the cases and 85.2% of the controls had average daily riding time ≤1 hour.

The association between average daily riding time and accident was not significant (p=0.244) (Table 21).

Average Daily Riding Distance

About 7.2% of the cases and 3.2% of the controls had average daily riding distance of >50 Kms, while 92.8% of the cases and 96.8% of the controls had average daily riding distance of ≤50 Kms.

The association between average daily riding distance and accident was significant at p=0.041. Those who had average daily riding distance >50 Kms would have 2.67 times (95% CI of OR=1.04-6.83) more risk of accident as compared to average daily riding distance of ≤50 Kms (Table 21).

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Frequency of Riding in a Week

About 82.0% of the cases and 78.4% of the controls had frequency of riding as much as 6-7 days in a week while, 18.0% of the cases and 21.6% of the controls had frequency of riding of only 1-5 days in a week.

The association between frequency of riding in a week and accident was not significant (p=0.180) (Table 21).

Average Speed

About 51.6% of the cases and 56.0% of the controls had average speed of >60 Km/hr, while 48.4% of the cases and 44.0% of the controls had average speed of ≤60 Km/hr.

The association between average speed of >60 Km/hr and accident was not significant (p=0.229) (Table 21).

Table 21 The association between riding behavior factors and accident.

Factors	cases		controls		OR	95 % CI OR	p-value
	number	percent	number	percent			
Average daily riding time (hr)							
≤1	204	81.6	213	85.2	1.00		
>1	46	18.4	37	14.8	1.36	0.81-2.28	0.244
Average daily riding distance (Km)							
≤50	232	92.8	242	96.8	1.00		
>50	18	7.2	8	3.2	2.67	1.04-6.83	0.041
Frequency of riding/week (day)							
6-7	205	82.0	196	78.4	1.29	0.87-1.90	0.180
1-5	45	18.0	54	21.6	1.00		
Average speed (Km/hr)							
>60	129	51.6	140	56.0	0.77	0.50-1.18	0.229
≤60	121	48.4	110	44.0	1.00		

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4.3 Physical Factors

History of Illness

About 6.8% of the cases and 11.2% of the controls had history of illness, while 93.2% of the cases and 88.8% of the controls never had history of illness.

The association between history of illness and accident was not significant ($p = 0.083$) (Table 22).

Drug Usage Before Riding

About 33.6% of the cases had antihistamine and decongestant before riding (TDMA and metaphetamine 1.2%, anti-hypertension drug 1.6%), while 48.0% of the controls had antihistamine and decongestant (0.8% of TDMA and metaphetamine, 0.4% of antihypertensive drug). For instance, among cases 66.4% had not antihistamine and decongestant, 98.8% of TDMA and metaphetamine, 98.4% of antihypertension drug. Among the controls, 52.0% had not antihistamine and decongestant, 99.2% of had not TDMA and metaphetamine, 99.6% of had not anti-hypertension drug.

The association between antihistamine and decongestant use before riding to accident was significant as protective factors ($p < 0.001$).

In real daily life, persons who had antihistamine and decongestant before riding would easily get accident. The opposite result of this study where persons who had these drugs before riding would be a protective factors of accident were due to invalid item of the questionnaire. It might be indept questions of this accident only.

In all kinds of drugs, there were no statistical difference to accident of those who had these drug as compared to those who had not, as shown in Table 22.

Alcoholic Beverage Consumption Before Riding

About 56.4% of the cases and 65.2% of the controls had consumed alcoholic beverage while 43.6% of cases and 34.8% of controls had not consumed alcoholic beverage.

The association between alcoholic beverage consumption before riding and accident was as protective factors with $p = 0.016$.

The fact in real life, persons who had an alcoholic beverage consumption before riding would be easier to have an accident. But the result of this study where the persons who had alcoholic beverage consumption before riding would be protective factors of accident were due to invalid item of the questionnaire. It might be indept questions of this accident as are shown in Table 22.

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Table 22 The association between physical factors and accident.

Factors	cases		controls		OR	95% CI OR	p-value
	number	percent	number	percent			
History of illness							
have	233	93.2	222	88.8	1.00		
have not	17	6.8	28	11.2	0.56	0.29-1.08	0.083
Antihistamine and decongestant usage							
use	84	33.6	130	52.0	0.425	0.28-0.64	<0.001
use not	166	66.4	120	48.0	1.00		
TDMA and metaphetamine usage							
use	3	1.2	2	0.8	1.5	0.25-9.98	0.657
use not	247	98.8	248	99.2	1.00		
Antihypertensive drug usage							
use	4	1.6	1	0.4	4.0	0.45-35.79	0.215
use not	246	98.4	249	99.6	1.00		
Alcoholic beverage consumption							
intake	141	56.4	163	65.2	0.57	0.36-0.89	0.016
not intake	109	43.6	87	34.8	1.00		

4.4 Riding Factors

Riding Experience

About 46.4% of the cases and 49.6% of the controls had riding experience of > 6 years, while 53.6% of the cases and 50.4% of the controls had riding experience of ≤6 years.

The association between riding experience of £6 years and accident was not significant (p = 0.366) (Table 23).

Having Driver's License

About 77.2% of the cases and 74.0% of the controls had no driver's License, while 22.8% of the cases and 26.0% of the controls had driver's License.

The association between not having driver's License and accident was not statistically significant (p = 0.372) (Table 23).

History of Accident in the Past Year

About 18.0% of the cases and 27.6% of the controls had history of accident in the past year while 82.0% of the cases and 72.4% of the controls had no accident in the past year.

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History of Accident in the Past Year

About 18.0% of the cases and 27.6% of the controls had history of accident in the past year while 82.0% of the cases and 72.4% of the controls had no accident in the past year.

The association between had accident in the past year and accident was not statistically significant (p=0.064) (Table 23).

Table 23 The association between riding factors and accident.

Factors	cases		controls		OR	95% CI OR	p-value
	number	percent	number	percent			
Riding experience (year)							
≤6	134	53.6	126	50.4	1.23	0.79-1.92	0.366
>6	116	46.4	124	49.6	1.00		
Having driver's licence							
have	193	77.2	185	74.0	0.82	0.53-1.27	0.372
not have	57	22.8	65	26.0	1.00		
History of accident in the past year							
ever	45	18.0	62	24.8	0.66	0.42-1.02	0.064
never	205	82.0	188	75.2	1.00		

4.5 Vehicle Factors

Duration of Using Motorcycle

About 49.6% of the cases and 62.4% of the controls had duration of using motorcycle >24 months, while 50.4% of the cases and 37.6% of the controls had duration of using motorcycle ≤24 months.

The association between the duration of using motorcycle and accident was statistically significant at p=0.004. It means those who were using motorcycle ≤24 months would have 1.71 times (95% CI of OR=1.18-2.47) more risk of accident as compared to those using motorcycle >24 months (Table 24).

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Engine Capacity

About 74.8% of the cases and 63.6% of the controls had an engine capacity of >100 cc, while 25.2% of the cases and 36.4% of the controls had an engine capacity of ≤100 cc.

The association between an engine capacity of >100 cc and accident was statistically significant at p=0.004. It means that those who had an engine capacity of >100 cc would have 1.88 times (95% CI of OR=1.22-2.88) more risk of accident as compared to those with an engine capacity of ≤100 cc (Table 24).

Motorcycle Condition

About 51.6% of the cases and 39.6% of the controls had a defect of at least 1 rear mirror, while 48.4% of the cases and 60.4% of the controls had a complete 2 rear mirrors.

The association between a defect of at least 1 rear mirror and accident was significant at p=0.008. It means that those who had a defect of at least 1 rear mirror would have 1.63 times (95% CI of OR= 1.13-2.33) more risk of accident as compared to those with a complete 2 rear mirrors (Table 24).

Engine Modification

About 0.8% of the cases and 2.4% of the controls had modified their engine, while 99.2% of the cases and 97.6% of the controls had not modified their engine.

The association between modified engine and accident was not significant (p=0.179) (Table 24).

Table 24 The association between Vehicle factors and accident.

Factors	cases		controls		OR	95% CI	p-value
	number	percent	number	percent		OR	
Duration of using motorcycle (month)							
>24	124	49.6	156	62.4	1.00		
≤24	126	50.4	94	37.6	1.71	1.18-2.47	0.004
Engine capacity (cc.)							
≤100	63	25.2	91	36.4	1.00		
>100	187	74.8	159	63.6	1.88	1.22-2.88	0.004

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Table 24 (continued)

Factors	cases		controls		OR	95% CI OR	p-value
	number	percent	number	percent			
Motorcycle condition a defect of at least 1 rear mirror							
impaired	129	51.6	99	39.6	1.63	1.13-2.33	0.008
completed	121	48.4	151	60.4	1.00		
Engine modification							
modify	2	0.8	6	2.4	0.33	0.07-1.65	0.179
normal	248	99.2	244	97.6	1.00		

4.6 Knowledge of Traffic Rules

About 54.4% of the cases and 57.6% of the controls had low level knowledge of traffic rules (≤14 score), while 45.6% of the cases and 42.4% of the controls had high level knowledge of traffic rules (>14 score).

The association between low level knowledge of traffic rules and accident was not significant (p=0.462) (Table 25).

Table 25 The association between knowledge of traffic rules and accident.

Factors	cases		controls		OR	95% CI OR	p-value
	number	percent	number	percent			
Knowledge of traffic rules (score)							
≤14	136	54.4	144	57.6	0.87	0.61-1.25	0.462
>14	114	45.6	106	42.4	1.00		

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The Multiple Logistic Regression Analysis

After bivariate analysis of variables, the significant variables were: labourers, average daily riding distance of >50 Kms per day, duration of using motorcycle ≤24 months, engine capacity of >100 cc, motorcycle condition with a defect of at least 1 rear mirror. Multivariate analysis was then used to control the confounding factors, resulted in real factors that were associated with accidents.

As result of the multiple logistic regression, the corrected OR for confounding factors were significantly associated with: labourers have higher risk of accident (adjusted OR=2.18; 95% CI of OR= 1.22-3.88; p=0.008), persons who had average riding distance of >50 kms per day have higher risk of accident (adjusted OR=2.69; 95% CI of OR=1.01-7.12; p=0.006), persons who used motorcycle for ≤24 months have higher risk of accident (adjusted OR= 1.72; 95% CI of OR=1.17-2.53; p=0.006), persons who used motorcycle with an engine capacity of >100 cc have higher risk of accident (adjusted OR=1.97; 95% CI of OR=1.25-3.09; p=0.004) and persons who used motorcycle with a defect of at least 1 rear mirror have higher risk of accident (adjusted OR=1.55; 95% CI of OR=1.06-2.55; p=0.023), as shown in Table 26.

Table 26 Comparative Odds Ratio of univariate analysis and multivariate analysis.

Factors	univariate OR (95% CI of OR)	**multivariate OR (95% CI of OR)	*p-value
Labourers	2.06(1.17-3.61)	2.18(1.22-3.88)	0.008
all others*	1.00	1.00	
Average daily riding distance (Km)			
>50	2.67 (1.04-6.83)	2.69 (1.01-7.12)	0.006
≤50*	1.00	1.00	
Duration of using motorcycle (month)			
≤24	1.71(1.18-2.47)	1.72(1.17-2.50)	0.006
>24*	1.00	1.00	

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Table 26 (continued)

Factors	univariate OR (95%CI of OR)	**multivariate OR (95%CI of OR)	*p-value
Engine capacity (cc.)			
>100	1.88(1.22-2.88)	1.97(1.25-3.09)	0.004
≤100*	1.00	1.00	
Motorcycle condition a defect of at least 1 rear mirror			
a defect of at least 1 rear mirror	1.63(113-2.33)	1.55(1.06-2.55)	0.023
complete *	1.00	1.00	

** Adjusted for age, sex and education
* p-value of Multiple Logistic Regression
* reference group

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CHAPTER V

DISCUSSIONS, SUMMARY AND RECOMMENDATIONS

Discussion on Study Result

Marital Status

Most of the cases were singles, the same as the result of several previous studies (29-31, 37). It was found that the singles had more accidents than the married ones (and widowed/ divorced/ separated) because singles were the youngest, full of the perils of age, love the extraordinary, did not care for their families and less aware of accidents.

Occupation

The association between occupation and accident was statistically significant ($p = 0.008$), which demonstrated that labourers would have risk 2.18 times (95% CI of OR = 1.22-3.88) more accidents as compared to the reference group (not working, merchants, semi-government officer, government officer) because labourers need motorcycle more than the others for their daily life. The result of this study is similarly to other studies (1, 31-32, 36), but on the contrary, the study of Tonekeaw (29) found that most of the cases were students, while Sakabucha (30) reported that most of them were agriculturists.

Educational Level

Previous studies by Kumjuddussakorn (31), Methaluck (32), Geamgool (38) and Hatthaitum (39) found that persons with primary education had more accidents than those with other educational level. This is so because low educational level is associated with occupation, income, health concerns and safety knowledge.

In this study after adjusting for other confounding factors, there was no significant association found between educational level and accident.

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Income

About 44.8% of the cases and 56.8% of the controls had income level of ≤2,000 baht/month. Income usually depends on occupation and educational level. It was believed that persons with low income would have less safety knowledge and tend to take less care of themselves than persons with high income. But in this study there was no significant association between the level of income and accidents after adjusting for other confounding factors.

From the study of Kumjuddussakorn (31), it was found that 33.9% of motorcycle accident patients with income level of 2,001-3,000 baht/month had more accidents. Punyahotra (2) had classified income level into ≤1,500, 1,501-2,500, 2,501-3,500 and >3,500 baht/month, and found that there was no relation between income level and accident. Hatthaitum (39) found that those with an income level of ≥6,000 baht/month had more accidents than those with an income level of <6,000 baht/month (62.1% and 40.4%, respectively). Methaluck (32) found that the most number of the accident were among persons who had an income level of 2,500-4,999 baht/month.

Average Distance of Daily Riding

Average distance of daily riding and accident was statistically significant. Persons who had an average riding distance of >50 Kms daily would have 2.69 times (95% CI of OR=1.01-7.12) more risk to an accident as compared to those with an average daily riding distance of ≤50 Kms. This could be explain by the fact that long riding distance would have more stress and tiredness which have a direct effect to accident. This result support the study of Hatthaitum (39) who found that risk of accident was related to long riding distance (>100 Kms in a day). Even after adjusting for other confounding factors, the average daily riding distance and accident was still statistically significant at p=0.006.

Frequency of Riding/Week

In this study, it was found that riding frequency of 6-7 days/week made them very tired and this may be one of the factors related to accident. After adjusting for other confounding factors, the association between riding frequency of 6-7 days/week and accident was not statistically significant. In this case, the cases that has riding frequency of 6-7 days/week were close to the controls (82.0% and 78.4%), if the sample size was increased, it may have a significant difference.

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Previous study by Geamgool (38) demonstrated that about 71.4% of motorcycle accident victims rode as often as 6-7 days/week. The association between riding frequency of 6-7 days/week and accident was statistically significant at $p = 0.018$.

Average Speed

Slightly more than half of the cases have an average speed of >60 Km/hr, which was close to those of the controls (51.6% and 56.0%, respectively). Persons who use high speed usually can't stop their vehicle in time because it is always difficult to make the right judgement at such a short time. In this study after adjusting for confounding factors, there was no significant association found between high speed and accident. Similarly, the previous study of Geamgool (38) described that motorcyclists who had a speed of >80 Km/hr would have risk of accident 3.07 times more when compared to the speed of 41 Km/hr, while Hatthaitum (39) reported that high speed riding was associated with accident where the speed of >60 Km/hr would have 6.94 times more risk of accident as compared to speed those with the speed of ≤60 Km/hr.

History of Illness

In this study, persons who had or not history of illness was not significantly related to accident. This might be due to the fact that the number of sick persons was small so that the result became inconclusive. In fact, persons who have diseases (i.e. heart problems, hypertension, loss visual acuity, and epilepsy) when they have a ride, they might easily get accident.

Previous study by Kumjuddussakorn (31) described that 22.2% of the accident persons had their abnormal eyes, ears and other organs and 20.3% more had an underlying diseases. The study conducted by Methaluck (32) found that injured victims who had an abnormal physical condition were associated with severe injuries. Hatthaitum (39) described that about 80% of accident victims had an abnormal ear, but no association was found with accident. Another 69.2% of accident persons were found with an abnormal eyes but there was no association with accident.

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Drug Usage Before Riding

An antihistamine and decongestant usage before riding could easily cause accident. The effect of these drugs are drowsiness, inertia and fatigue. Both the cases and the controls have taken an antihistamine and decongestant (33.6% and 48.0%, respectively), The association between antihistamine and decongestant use before riding to accident was significant as protective factors ($p<0.001$).

In real daily life, persons who had antihistamine and decongestant before riding would easily get accident. The opposite result of this study where persons who had these drugs before riding would be a protective factors of accident were due to invalid item of the questionnaire. It might be indept questions of this accident only. A study by Methaluck (32) demonstrated that 80.0% of the riders who had several drugs before riding i.e. snuff, smelling salts, acetaminophen, mild stimulus nerve (red bull, M-100), but these usage of drugs had no significant association with accident.

TDMA and metaphetamine affect the body by an increase in work load, but at the end, the effect were tired, emotional distortion, uneasy, irritable and dangerous for other riders.

Alcoholic Beverage Consumption Before Riding

About 55.2% of the cases had an alcoholic beverage before riding. Because the effect of alcohol are to reduce riding ability, error in decision making, and abate vehicle control, it is easier to get an accident. But the association between alcoholic beverage consumption before riding and accident was as protective factors with $p=0.016$.

The fact in real life, persons who had an alcoholic beverage consumption before riding would be easier to have an accident. But the result of this study where the persons who had alcoholic beverage consumption before riding would be protective factors of accident were due to invalid item of the questionnaire. It might be indept questions of this accident

Several previous studies (31-32, 38) found that accident persons who had alcoholic beverage before riding perceived that they were drunk.

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Riding Experience

Riding experience of ≤6 years was found in 53.6% of the cases and 50.4% of the controls. This variable was not statistically significant with accident because the number of those with less riding experience were close to those with more riding experience. If sample size was increased, it may have significant difference. Several studies (2, 31-32, 37, 39) found that people who have less riding experience would have more accident than those with more riding experience.

Having Driver's License

The study of Geamgool (38) found that riders who had no valid driver's license were significantly related with accident. Those who had no valid driver's license would have 2.74 times (95% CI of OR = 1.40-5.70) more risk to accident as compared to those who had valid driver's license. It was believed that persons who had valid driver's license must pass tests and obey traffic rules, knowledge of traffic rules, signs, and signals so they had less accident.

This result support previous studies. Methaluck (32) found that persons who had no valid driver's license would have more severe injuries than those who had valid driver's license. The duration of having driver's license of 1-3 years found to be the most. After adjusting for other confounding factors, the association between having driver's license and accident became non-significant. Hatthaitum (39) found that having driver's license were related to more accidents because the campaign of traffic knowledge and riding test for driver's license of the Provincial Transportation Office were done before the study.

History of Accident During the Past Year

In this study, approximately 18.0% of the cases and 24.8% of the controls had history of accidents during the past year. Persons who had history of accident during the past year would have been more careful in riding. After adjusting for other confounding factors, the association between experience of accident during the past year and present accident was not significant.

The study of Punyahotra (2) reported that 39.3% of those with minor injuries requiring self care had experienced 1-5 times accidents, while the study of Kumjuddussakorn (31) found that 82.2% had experienced of accident 1-3 times. The study of Swaddiwudhipong et al., (40) reported that 61.2% persons ever had accident. But differently, the study of Methaluck (32) described that persons who ever had accident were near to those who never had.

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Knowiedge of Traffic Rules

In this study, it was found that in 54.4% of the cases and in 57.6% of the controls, motorcycle riders had low level of traffic rules knowledge. The association between low level knowledge of traffic rules to accidents was not statistically significant. Level of knowledge do not express to perceive traffic laws or know of traffic rules but violate act.

Hatthaitum (39) reported that 41.8% of the riders who had accidents have higher than standard level of knowledge of traffic rules, which is close to those with low level of knowledge at 48.4%. She described that low level knowledge of traffic rules was not significantly associated with accidents. This is similar to the study of Geamgool (38) who demonstrated that victims who had high knowledge of traffic rules were about 51.4% and those with low level were about 48.6%. The association between low level knowledge of traffic rules and accident was statistically significant.

Duration of Using Motorcycle

In this study, 50.4% of the cases and 37.6% of the controls had ≤24 months of duration of using motorcycle. Persons who used motorcycle on short duration had less high speed and other skills, and were not intimate with the vehicles. Duration of using motorcycle for ≤24 months were statistically associated with accident after adjusting for other confounding factors. Persons who used motorcycle with a duration of ≤24 months would have 1.72 times (95% CI of OR =1.17-2.50; p =0.006) risk to accident as compared to the duration of using motorcycle >24 months.

Previous study by Methaluck (32) found that most of the accident persons had duration of motorcycle use for 1-3 years. Similar study by Punyahotra (2) and Kumjuddussakorn (31) reported that most of the accident persons had duration of motorcycle use below 1 year. The study of Geamgool (38) demonstrated that duration of motorcycle use of <2 years were close to those with ≥2 years and duration of using motorcycle <2 years and accident was not statistically significant.

Engine Capacity (cc.)

In this study feature that 74.8% in cases and 63.6% in controls of engine capacity >100 cc. Engine capacity >100 cc. had statistical association with accident after adjusting for other confounding factors. Person who had engine capacity >100 cc. would have 1.97 times (95% CI of OR= 1.25-3.09; p =0.004) compared to engine capacity ≤100 cc. Since high engine capacity association with high speed and full power, which easily cause of accident.

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A previous study by Hatthaitum (39) demonstrated that an engine capacity of >100 cc and accident was not significantly related. Different from the above study, Geamgool (38) reported that an engine capacity of ≥100 cc. were statistically associated with accident (p=0.027). Persons who had an engine capacity of ≥100 cc. would have 2.48 times (95% CI of OR = 1.20-5.55) more risk to accident as compared to those with an engine capacity of <100 cc.

Motorcycle Condition

About 51.6% in the cases and 39.6% in the controls had a motorcycle condition with a defect of at least 1 rear mirror. The association between a defect of at least 1 rear mirror and accident were statistically significant. After adjusting for confounding factors, persons who had motorcycle condition with a defect of at least 1 rear mirror would have 1.55 times (95% CI of OR= 1.06-2.26; p= 0.023) more risk to accident when compared to those with 2 complete mirrors. This is so because motorcycle condition with a defect of at least 1 rear mirror was related to the ability of riding where with less hind sight to other vehicles would cause accident easily.

The study by Hatthaitum (39) reported that impaired 2 mirrors had no association to accident, and that risk to accident was not different.

SUMMARY

This epidemiologic study on motorcycle accident describes the patterns of: cause of collisions with motorcycles, pedestrians, animals, fences, and falls among patients at Mahasarakham hospital during January 1, 1991 to December 31, 1994. The information were gathered from out patient department records and hospital's registration.

Data from 250 cases and 250 controls were collected. The cases were patients who rode motorcycles and had accident due to collisions with other motorcycles, other vehicles, pedestrians, animals, objects, fences, and falls which were treated at emergency room of Mahasarakham hospital. Patients who reported during July 1, 1995 to October 31, 1995 were included in the study. The controls were 250 patients with other diseases (except accident patients) or relatives who rode motorcycle but had no accident during this study period. The data were collected by the same characteristics to those of the cases: sex, age difference <5 years, and ratio of cases to controls was 1:1. Questionnaire was administered for collecting data from Mahasarakham hospital's registration. Questionnaire was pretested with samples which have

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the same characteristics as the study samples, then the questionnaire were improved until it was complete and had valid content. The patients and controls were then interviewed. The data were collected by interviewing persons with motorcycle accident, patients who could report data, and through statistical and surgery registration from in-patient department and laboratory unit.

The result of this study was divided into 5 sections as follows:

1. General characteristics and its relation to accident.
2. Riding factors and its relation to accident.
3. Vehicle factors and its relation to accident.
4. Accident data.
5. Univariate analysis and multivariate analysis.

1. General characteristics and its relation to motorcycle accident.

This was a descriptive epidemiological study conducted during January 1, 1991 to December 31, 1994. The finding of this study was that most of the motorcycle accident victims were males, singles, ≤20 years old, were living outside the municipal area and with low education. The highest number of accidents took place mainly on Saturdays, between 18.00-21.00 hours and on the month of April. Majority of the riders of the motorcycle who had accidents were without litigant, the type of accidents were falls and the affected parts were foot and leg and the nature of injury was abrasion.

This case control part of the study were done from July 1, 1995 to October 31, 1995.

The male comprises 77.6% of both cases and controls. The cases were an average 26.09 years old and controls were 26.15 years old. The males were singles in 63.2% of the cases and in 60.8% of the controls. Among the cases, 33.2% completed primary education and, among controls, 27.2% completed college education. Both groups had been living outside municipal area cases (cases 68.4% and controls 70.8%). The monthly income was 4,000 baht in 77.2% of the cases and 72.8% of the controls. Students comprised 36.4% of the cases and 43.6% of the controls.

For socio-demographic characteristics and its relation to accident of motorcyclists, the labourers seems to have higher risk to accident.

The variables of residential area, marital status, completed primary education, income ≤4,000 baht/month, all of which were not associated to accident.

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2. Riding factors and its relation to accident

The majority of riding characteristics were average daily riding time of <1 hr, and nearly two-third had riding frequency of 6-7 days/week. Nearly half had an average riding speed of 81 Km/hr, a few had history of illness, 6.8% in cases and 11.2% in controls. On drug usage before riding, about 10.4% of the cases had decongestant usage before riding, one-half of the cases had an antihistamine usage before riding, slightly higher than one-half of the cases ever consumed alcoholic beverage before riding, slightly higher one-half both among the cases and the controls had riding experience of 6 years, over tw-third of the cases had no driver's license, most in both the cases and the controls obtained driver's license by examination and test drives, over half of the cases had 1-3 years duration of having driver's license, and most of the cases never had accident in the past year.

According to accident and its relation to riding factors, the highest rate of accidents were the subjects who had an average daily riding distance of > 50 kms, and it was significantly ($p=0.047$) related to accident. Those who ever had accident in the past year would have 0.65 times more risk to accident as compared to those who never had. This is because the persons who ever had accident would be more watchful, and more careful in riding.

3. Vehicle factors and its relation to accident.

Duration of using motorcycle of ≤2 years was 50.4% among the cases and 37.6% among the controls. Almost two-third among the cases had an engine capacity of 101-150 cc. while it was 60.0% among the controls. Nearly half of the cases had impaired 2 mirrors hind sight motorcycle condition, while it was 28.4% among the controls. There were 5.2% of the cases and 13.2% of the controls with impaired 1 hind sight mirror. There were 0.8% among the cases and 2.4% among the controls who had modified engine.

According to accident and its relation to vehicle factors, two of the highest rate were the subjects who had an engine capacity of >100 cc. and a defect of at least 1 rear hind sight mirror. Duration of using motorcycle of £2 years would have 1.71 times more risk to accident as compared to those with >2 years because those who use motorcycle ≤2 years were less careful and showed high speed riding.

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4. Accident data

Days of a week with the most motorcycle accident was on Saturdays, which was about 20.0%. The highest percentage, about 28.4% of accidents, took place between 16.00-20.00. The area which had more accidents (53.8%) were outside municipal area. The type of most accidents was motorcycle falls, which stood at 40.4%. On the characters type, the highest (44.4%) was crash and the next was falls (40.0%). Normal physical condition were about 83.6% and normal mental condition about 62.0%. Alcoholic beverage consumption before accident were about 36.0%. Detected (BAC) blood alcohol concentration (specially among admitted cases, n=75) were found in about 60.0% of BAC >50 mg%.

About 34.8% had a speed of 41-60 Km/hr before accidents. Type of road was concrete in 60.0% of the accidents. The road surface of which most (71.2%) motorcycle accidents took place was smooth surface. The area of the road of which most (52.0%) accidents took place was at mid block. The weather condition at which most (55.2%) accidents took place was on fine weather.

The body part most often (58.4%) injured was leg, include foot, and about 54.0% near to arm and hand including shoulder. The highest type of severe injury was abrasion (97.6%).

5. Univariate analysis and multivariate analysis

Univariate analysis

Univariate analysis showed that the factors associated with accidents were (only those with difference of $p<0.05$ could be considered statistically significant): persons who completed primary education, labourers, average riding distance of >50 kms per day, antihistamine and decongestant usage before riding, alcoholic beverage consumption, ≤24 months duration of using motorcycle, engine capacity of >100 cc and a defect of at least 1 rear mirror.

Multivariate analysis

Multivariate analysis used, performed after statistically significant with univariate analysis, was the conditional multiple logistic regression in order to control other confounding variables. The 5 significant predictors which were associated with accidents were labourers, average riding distance of >50 kms per day, ≤24 months duration of using motorcycle, engine capacity of >100 cc, and a defect of at least 1 rear mirror.

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RECOMMENDATIONS

1. Based on the result of this study, the researcher recommends the integration to the government and non-government organizations' programs for prevention and control of traffic accidents and amendment of road user behaviour of the following:

1.1 Inform the general public through a special campaign about the concern of safe riding and the knowledge of traffic laws and road accident prevention. At least twice a year of follow-up campaign for right behavior, right act and discipline.

1.2 The motorcyclists who rides the distance of >50 kms per day should have an increased awareness of road use.

1.3 Motorcyclists who had ≤24 months duration of using motorcycle would have a higher risk of accident, therefore they must improve more riding skills, high knowledge of traffic rules and drive according to the law, and should be aware of riding rules and regulations.

1.4 Motorcyclists with an engine capacity of >100 cc. have high risk of accidents. They must, therefore, observe safe riding with the use of low speed.

1.5 The Traffic Police should be fully authorized to enforce traffic laws to control the behavior of road users. They must issue ticket or fine the rider who violated the law and includes motorcycle with a defect of at least 1 rear mirror. The Traffic Police must act validly and consistent for discipline and safe riding among motorcyclists.

2. For further study, the researcher recommend:

2.1 Study on economic loss due to motorcycle accidents.

2.2 Comparison study on the characteristics of injuries among helmet user and non user.

2.3 Study to find suitable type of helmet for warm weather use and with protection from wind irritation, and an efficient sight.

2. Follow up study on blood alcohol concentration among motorcyclists with accidents.

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APPENDIX

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APPENDIX

QUESTIONAIRE

Identification number.....

Title

An epidemiological study of traffic accident among the motorcyclists at Mahasarakham Hospital

Part 1 Demographic characteristics of motorcyclists that is sex, age, education level, occupation, income, marital status.
Part 2 Factors associated with accident.
Part 3 Knowledge of traffic rules.
Part 4 Accident data.

QUESTIONAIRE

Part 1 Demographic characteristics

1. Name.....surname.....

2. Sex [ ]1 male [ ]2 female

3. Age.....years.

4. Residential area place.....number.....village.....
road.....subdistrict.....district.....province.....

5. marital status
[ ]1. single [ ]2. married [ ]3 widowed/divorced/separated

6. Educational level
[ ]1. primary education [ ]2. secondary education
[ ]3. vocational education [ ]4. college education or above

7. Occupation
[ ]1. non worker [ ] 2. students
[ ]3. agriculturists [ ]4. labourers
[ ]5. merchants [ ]6. semi government officer
[ ]7. government officer

8. Income.....baht/month

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Part 2 Factors associated with accident, riding experience and vehicles factors

1. Riding experience.....years.

2. Have driver's licence
   [ ]1. have
   [ ]2. does not have (skip to no.5)

3. Methods of obtaining driver's licence.
   [ ]1. by examination and test driving
   [ ]2. by examination and not test driving
   [ ]3. by short course of police
   [ ]4. bought

4. Duration of having driver's licence.....years.

5. Frequency of riding /week.
   [ ]1. 6-7 days
   [ ]2. 4-5 days
   [ ]3. 2-3 days
   [ ]4. 1 day

6. Average daily riding time.....hours.

7. Average daily riding distance.....kilometres.

8. History of disease
   [ ]1. heart
   [ ]2. hypertension
   [ ]3. colour blind
   [ ]4. loss of visual acuity such as vision one eye
   [ ]5. gloucoma, cataract
   [ ]6. diabetes mellitus
   [ ]7. migraine
   [ ]8. chronic alcoholism
   [ ]9. chronic joint infection, gout, rheumatoid arthritis
   [ ]10 epilepsy
   [ ]11. hearing loss
   [ ]12. no history of disease
   [ ]13. unknown

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9.Drug usage before rides motorcycle

Type of drug	usually	sometime	never
antihistamine			
decongestant			
TDMA & metaphetamine			
antihypertensive drug			

10. History of accident during the past year.
[ ]1. no (skip to no. 12)
[ ]2. yes. number.....times
The last at day.....month.....year.....
Caused by.....

11. Have you had severe injuries of last accident during the past year ?
[ ]1. mild injuries, self care
[ ]2. mild injuries, consult physician
[ ]3. moderate injuries, consult physician
[ ]4. severe injuries, admitted for treatment

12.How often did you had alcohol consumption before riding motorcycle ?
[ ]1. usually [ ]2. somtime [ ]3. never

13.How often did you had beverage consumption before riding motorcycle ?
[ ]1. usually [ ]2. somtime [ ]3. never

14.Duration of using motorcycle
[ ]1. < 6 months [ ]2. 6-24 months
[ ]3. 25-60 months [ ]4. 61-81 months
[ ]5. > 81 months

15.Motorcycle engine capacity
[ ]1.≤80 cc [ ]2. 81-100 cc
[ ]3. 101-150 cc [ ]4. > 150 cc

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16.Motorcycle condition.

[ ]1. normal condition

[ ]2 abnormal condition

[ ]2.1. impaired 2 mirrors

[ ]2.2. impaired 1 mirror

[ ]2.3. no right-left light

[ ]2.4. no front-rear light

[ ]2.5. impaired brake

[ ]2.6. loose engine motorcycle

17.Modify engine of motorcycle.

[ ]1. no

[ ]2. modify engine motorcycle for high speed or lound noise

18.Checking completed motorcycle by.

[ ]1. yourselves

[ ]2. general technician

[ ]3. specific technician at centre motorcycle

19.Average speed of riding motorcycle.....km/hr

Part 3 Knowledge of traffic rules.

Check true condition of these choice questions.

1.How do you rides overtake the other in laws ?

[ ]1. on slope, on bridge, on curve road.

[ ]2. within 60 metres across, intersection, cross, circle or safety pedestrian island.

[ ]3. cloud, rain, dust within 30 metres.

[ ]4. within 30 metres across, intersection, cross, circle.

2.How you can u-turn any area ?

[ ]1. have traffic sign turn left or turn right.

[ ]2. have traffic sign don't u-turn.

[ ]3. safety area or within 100 metres from bridge area.

[ ]4. at across /intersection have traffic sign u-turn.

3. Traffic light yellow-wink at any area means.

[ ]1. reduce speed and beware pass through.

[ ]2. stop behind line and safe, don't disturb traffic, beware rides.

[ ]3. stop.

[ ]4. accelerate speed and speedly pass.

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4.Stop area in laws.
[ ]1. within 10 metres of across road.
[ ]2. in cross, intersection, or within 10 metres of intersection.
[ ]3. within 15 metres before bus stop and 3 metres behind.
[ ]4. within 10 metres of traffic signal.

5. Signal " white-back" on foot path this means.
[ ]1. no parking.
[ ]2. no stop.
[ ]3. parking.
[ ]4. no parking, stop just for a moment.

6.Signal "white-yellow" on foot bath this mean.
[ ]1. no parking.
[ ]2. no stop.
[ ]3. parking.
[ ]4. no parking, stop just a moment.

7.Signal "white -red" on foot-path this mean.
[ ]1. no parking.
[ ]2. no stop.
[ ]3. parking.
[ ]4. no park ,don't stop.

8.Traffic light red and green arrow head arrow to right this mean.
[ ]1. stop strenght, turn left pass through.
[ ]2. stop strenght, turn right pass through.
[ ]3. through strenght, turn right don't pass.
[ ]4. stop strenght, turn right wait.

9.Phrase is mean "drivers must drives keep left side the most".
[ ]1. motorcycle [ ]2. low speed motor vehicle
[ ]3. bus [ ]4. all of above

10.Turn left, turn right, change lane, reduce speed or stop must open light or hand sign of at
least distance.
[ ]1. 30 metres [ ]2. 40 metres
[ ]3. 50 metres [ ]4. 60 metres

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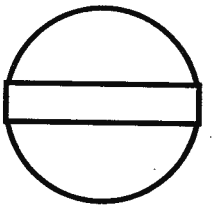
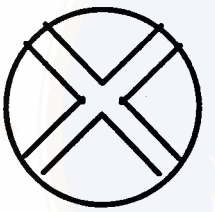
The meaning of these traffic symbol.

11. 

[ ]1.no parking
[ ]2.no entry
[ ]3.no stop
[ ]4.not all of above

12.

[ ]1.no parking
[ ]2.no entry
[ ]3.no stop
[ ]4.not all of above

13. 

[ ]1.no parking
[ ]2.no entry
[ ]3.no stop
[ ]4.not all of above

14.

[ ]1.u-trun
[ ]2.drive along
[ ]3.circle
[ ]4.not all of above

15. The motorcycle accident were cause from.
[ ]1. riders do not helmet.
[ ]2. riders disobey traffic laws.
[ ]3. riders do not have driver's licence.
[ ]4. not all of above.

16.Rider's must have methods to reduction severe injuries,disabitlity and fatality from motorcycle accident.
[ ]1. use helmet
[ ]2. rides with will
[ ]3. skill ride
[ ]4. all of above

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17. Rider's must have methods to protection from motorcycle accident.

[ ]1. skill ride
[ ]2. rides in traffic laws
[ ]3. not alcohol or alcoholic beverage consumption
[ ]4. all of above

18. Immediately stop motorcycle must awareness of.

[ ]1. speed
[ ]2. brake distance
[ ]3. justment time
[ ]4. all of above

Part 4 Accident characteristics (interview victims from motorcycle accident).

1.Date-month-year of accident.....

2.Time at accident

[ ]1. day (time .....)
[ ]2. night (time.....)

3. Place of accident

[ ]1. within municipal area
[ ]2. outside municipal area

4.Type of accident

[ ]1. collisions with motorcycles
[ ]2. collisions with bicycles
[ ]3. collisions with cars, trucks, pick-ups, vans and other motor vehicles
[ ]4. collisions with pedestrians
[ ]5. collisions with animals
[ ]6. collisions with barroads, fences
[ ]7. falls

5.Type of collisions

[ ]1.falls
[ ]2. crash
[ ]3. were knocked down

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6.Physical condition before accident.

normal [ ] 0

abnormal

[ ]1 = hungry
[ ]2 = syncope
[ ]3 = sleepy
[ ]4 = drunk

7.Mental condition before accident event.

normal [ ] 0

abnormal

[ ]1. angry
[ ]2. uneasy
[ ]3. stress
[ ]4. hurry

8.Alcohol or alcoholic beverage consumption before accident.

[ ]1.yes
[ ]2. no

9.Blood alcohol concentration.....(mg %) (among admitted cases).

10.Riding speed before accident .....km/hr.

11.Road type at accident event.

[ ]1. concrete
[ ]2. asphaltic
[ ]3. stone
[ ]4. ground

12.Road surface at accident event.

[ ]1. smooth
[ ]2. rough
[ ]3. skidding
[ ]4. mud
[ ]5. during road construction

13.Road condition at accident event.

[ ]1. midblock
[ ]2. curve road
[ ]3. intersection
[ ]4. circle
[ ]5. before bridge

14.Weather condition at accident occurred.

[ ]1. fine
[ ]2. dawn
[ ]3. dark
[ ]4. rain

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15.Body part injured of accident.

[ ]1. head
[ ]2. face
[ ]3. neck
[ ]4. chest
[ ]5. spine
[ ]6. abdomen
[ ]7. back
[ ]8. arm, hand include shoulder
[ ]9. leg include foot
[ ]10. sex organ and buttock
[ ]11.eye

16.Severely injured of body.

[ ]1. contusion/abrasion
[ ]2. tear/tear of tendon
[ ]3. thorac injury
[ ]4. abdomen injury
[ ]5. sprain
[ ]6. fracture
[ ]7. cut part of arm/leg
[ ]8. unconscious from brain contusion
[ ]9. airway obstruction
[ ]10. foreign body on eye

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17.Glasgow coma scale.....score.

18.Admission

[ ]1. admitted
[ ]2. OPD case

19.Level of abbreviate injury severity.....

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