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Alcohol and Motor Vehicle Injuries

Injury has been, the third leading cause of mortality in the Taiwan Area since 1967 ranking behind only cancer and cerebrovascular disease in relative importance. Like many new industrialized countries, injuries occur mostly in young persons of productive ages. When premature mortality is expressed in terms of years of potential life lost (YPLL), injury becomes the first leading cause of death.

Currently in Taiwan, around 10,000 persons die of injuries each year, averaging one death of injury per seven deaths. Of all deaths of injuries, a half die of injuries from motor vehicle injuries (E810-E819). In USA, about 40 to 60% of drivers killed in traffic injuries, their BAC is higher than 0.1%; and 20 to 30% of drivers brought for emergency care for traffic injuries have a BAC higher than 0.1%. In Taiwan, however, statistics of the Police Department, Ministry of the Interior[1], show that of all traffic violations in 1986, only 0.04% are considered intoxicated driving. The annual reports of the Freeway[2] also show that since its inception in 1974, only 1.6% of all traffic injuries are associated with drunken driving. A study by Chao[3] et al of motorcycle injury patients in some large hospitals in Taipei City gives a 7.19% injury rate by drunken driving. These findings are significantly lower than those of the USA. One of the major reasons is, for limited resources, these studies have not measured with any instrument to test the blood or breath alcohol concentration of the victims. Study by Rutherford[4], however, suggests that the error rate of the clinical judgement of alcohol intoxication can be as high as 23%. We believe in a country where "kan-pei (bottoms-up)" is highly popular, the relation between alcohol and motor vehicle injuries should not be this low.

This study studies the 500 traffic injuries brought forward to the Taipei Veterans General Hospital for surgical emergency care between 2 November 1987 and 9 January 1988. Patients were tested with breathanalyzer (Alco-sensor III) for their breath alcohol concentration immediately after they were brought to the Emergency. For hospitalized patients, their major and minor operations, diagnoses, dates of admission and discharge, and hospital expenses were recorded. A week after discharge, patients were telephone surveyed with a questionnaire as to the causes of injuries, related risk factors concerning human (background characteristics, emotional status, drinking, driver's license), vehicle (make and age), and environment (site of injury, road condition, weather etc), and medical costs. The interview was discontinued when the patients had recovered. If not, the patients were interviewed again in the third week and the second month of their economic losses (including losses of working days, salaries, family members' losses of working days and salaries for the care of patients, costs in transportation, nutrition, special nursing care, and rehabilitation, etc.). One patient was, within two months depending on the severity, interviewed through telephone a minimum of once and a maximum of three times.

The present study collected information for 500 cases, of them, 11 were found to be motor vehicle non-traffic injuries. Thus, the total number of cases studied was 489, of them, 449 had been tested with Alco-sensor III. 40 cases had not been tested for emergent conditions (38%), too young (22.5%), or refusal (10%).

Of the 449 cases tested, 19.2% and a BAC concentration >0.002%, 8.5% had a concentration ≥0.05%, and 3.3% a concentration ≥0.1%. The BAC is measured only after the patient is brought to the emergency, it should be different from the alcohol concentration at the time of injury. When the alcohol concentration at the time of injury was estimated by the ethanol kinetic nomogram, it was found that 21% of the injured were intoxicated, 17% had a BAC ≥0.05%, and 9% had a concentration ≤0.1%. When those above the age of 15 years and being tested were used as demoninator, it was found that 20% of the injured were intoxicated, 10% of them had a BAC ≤0.05%. 6 times more men drank then women (P=0.000029); 4.5 times more of those who caused the injuries drank than the victims (P=0.000001); 3.5 times more people had injuries from drunken driving between 9 pm and 3 am than any other time (P=0.000001); twice more drivers drank than passengers (P=0.0099); 1.5 times more drivers of single vehicle injuries drank than multi-vehicle injuries (P=0.052); and 1.2 times more younger persons in 15 to 29 age group drank than people any other age groups (P=0.31).

Of the 489 motor vehicle injury cases, 7 died, giving a fatality rate of 1.43%. The completion rate of questionnaire was 84%, 61% were motorcycle injuries 15% were pedestrian injuries. Since motorcycle injuries are more, they are used for further discussion.

The descriptive epidemiology of the motorcycle injuries shows that: the admission rate is 26%, there are more male than female cases, 58% of the cases are in the 15-29 age group, more injuries occur between 7-8 am, 11-12 am, and 5-6 pm, and specific to motorcycle accident, between 9-10 pm when evening class students are returning home. 72% of young peole under 25 years of age are injured during this period of time.

The risk factors of human in the pre-injury phase selected for study are: the emotional status of the driver, the driver's license, the amount of drinking, sex, age, and their relation with economic losses. An average value of direct and indirect Economic losses is used as a criterion for high and low economic losses. The average economic loss for motorcycle injury is NT$36,450. Any loss above this figure is considered high, and low if lower than the average. In motorcycle injuries, the emotional status of driver (P=0.0071) and the amount of drinking (P=0.0089) are found to be significantly associated with economic loss. Vehicle factors in the pre-injury phase, whether the cycle is borrowed, its age and make, are not significantly associated with the economic loss. Of environmental factors in the pre-injury phase, visibility is highly related to the economic loss (Table 1).

Table 1. Risk Factors of Motorcycle Injury by pre-injury and injury phases

	Pre-injury phase (human factors)								Pre-injury phase (Enviromental factors)				Injury phase															
	Emotional Status of driver			Driver's license		Alcohol concentration			Weahter		Visibility		Types of other vehicle				Helmet		Speed		Capacity of motorcycle		Site of injury				Road condition	
	Intoxicated	Tired or sick	Good	Yes	No	≤ 0.002%	0.002 - 0.05%	≥ 0.05%	Rainy, foggy	Fair, cloudy	Poor	Good	Truck, bus	Pick-up, car	Motorcycle	Bicycle, pedestrian, object	Yes	No	≤ 40 km/hr	> 40 km/hr	≤ 100 C.C.	> 100 C.C.	Speedway	Cross road	Slow lane	Up-hill, slope	Flat	Bumpy
high loss	47	46	26	32	30	79	52	44	34	31	45	28	60	35	31	26	33	33	26	40	28	35	66	29	26	24	23	27
P-value	0.00071* (X^2 for trend)			0.92		0.0089* (X^2 for trend)			0.76		0.021*		0.025* (X^2 for trend)				0.9		0.0005*		0.32		0.00016* (X^2 for trend)				0.5	

In the injury phase, risk factors such as types of other vehicle, helmet, speed, capacity of motorcycle, site of injury, road condition, the injury condition, and the causes of injury are studied. In motorcycle injuries, types of other vehicle (P=0.025), speed (P=0.021) are found to be significantly related to the high economic loss (Table 1). Many injuries are head-tail collision (33%) and head collision (21%). Drinking and brake failure (21% each) are the two major causes of injuries.

In the analysis of single variables, variables such as alcohol concentration (concentration $>0.002\%$ for intoxicated and concentration $\leq 0.002\%$ for non-intoxicated), visibility (good and poor), speed (≤ 40 km/hr and >40 km/hr), types of other vehicle (vehicles-bus and truck, and motrocyels-motorcycles, bicycles, and pedestrians), site of injury (speedway-cross road and slope, and slow lane) are found to be significantly related to economic loss. Their possible interactions are studied by stratified analysis, and their relations are further analyzed by the Logistic Regression Model. Forward selection method then is applied to identify the best logistic regression model. The result is:

logit p(x) = $-1.450+0.022$ (site of injury 1) -0.010 (site of injury 2) $+1.642$ (site of injury 3) -0.119 (speed) $+1.28$ (alcohol) -0.029 (types of other vehicle 1) $+0.247$ (types of other vehicle 2) $+0.805$ (types of other vehicle 3) -3.130 (visibility) $+2.924$ (speed $\times$ visibility) $+1.699$ (types of other vehicle 1 $\times$ visibility) $+2.768$ (types of other vehicle 2 $\times$ visibility) $+3.746$ (types of other vehicle 3 $\times$ visibility).

That is, the relative risk of high loss for intoxicated person in motorcycle injury is 3.6 times higher than that of the non-in-toxicated person; the economic loss of an injury on speedway is 5.2 times higher than that on a slow lane. When site of injury and drinking are controlled, in a motorcycles collision with speed >40 km/hr, the relative risk of high loss under poor visibility is 4.48 times of that under good visibility.

In the post-injury phase, the median time from injury to emergency is 40 minutes, the average stay in hospital is 10 days, the average total economic loss for a hospitalized patient is NT$96,214, and for a non-hospitalized patient, NT$5,614. 36% of the hospitalized patients still require treatment two months after discharge, 10% of them either suspended their schooling or resigned from job. Only 5% of the non-hospitalized patients still require treatment two months after.

A major limitation of the present study is its representativeness. The only available Alco-sensor III is located in the Toxicology Counseling Center of the Taipei Veterans General Hospital, patients of its Emergency, and only 500 of them for the limited available time, were selected for study. The external validity of the study is, thus, somewhat impaired. There were in total 783 traffic injury cases at the Emergency during the study period. When the 489 interviewed cases and the 294 non-interviewed cases were compared of their sex, age, types of injury, time of injury, no significant difference was found (P values are 0.93, 0.27, 0.052, and 0.22 respectively). In terms of hospitalization and the duration of hospital stay, no significant difference was found between the two groups either (P values are 0.22 and 0.89). In other words, the two groups did not differ significantly in the severity of injuries.

Physicians who operated the Alco-sensor III were trained only once. The control of their quality could also pose a problem. Again, for limited funds available, only 33 randomly selected patients were taken blood samples for blood alcohol concentration testings while they were tested with Alco-sensor III. The result, though, would not necessarily indicate the quality of the operator, the literature review[5] shows, however, that when the blood alcohol concentration is 0.1 g/dL, the accuracy of Alco-sensor III is ± 0.01. Hence, if the BAC tested with Alco-sensor III and gas chromatography are close, the quality of the operator is assured. Patients of the study were grouped into cooperative, fair, and non-cooperative by their attitudes at the time of testing. In the cooperative and fair groups, the standarized regression coefficient between the two methods, and the ideal regression at $b=1$ did not show any significant difference. In the non-cooperative group, though the standarized regression coefficient between the two methods and the ideal regression at $b=1$ showed some difference, the impact was limited as there were only six patients in the group.

The use of AIS (Abbreviated Injury Scale) or CRIS (Comprehensive Research Injury Scale) for the judgement of the severity of injury requires special professional training. Instead, hositalization is often used by researchers as a criterion for the judgement of severity. However, in Taiwan, hospitalization often depends in a great deal upon the availability of medical insurance and the nature of the hospital. When hospitalization was used in the present study as an index of severity, no relation was found between various risk factors and severity. If, however, economic loss was used as an index, factors such as the site of injury, speed, visibility, and types of other vehicle were found to be related to the economic loss. There was also interaction between speed and visibility, and types of other vehicle and visibility. Hence, the use of economic loss as an index of the risk factors seems feasible. Although no such index has been tested out in other countries, our experience could provide some basis for the establishment of hypotheses in the future studies.

24% of all injured drivers in motorcycle injuries were intoxicated. This is close to the 22-35% of Johnston's[6] findings. Under similar circumstances, the chances of resulting in high economic loss for intoxicated drivers are 3.6 times higher than the non-intoxicated ones. This finding is higher than Waller's findings of 1.73-2.09 times more intoxicated drivers resulting in more serious injuries than non-intoxicated ones. The dependent variables defined in the two studies are different. We, however, believe the problem of drinking driving in Taiwan