A MACRO ANALYSIS OF ROAD ACCIDENT TRENDS IN MALAYSIA

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abstract: This paper aims to discuss the road accident situation in Malaysia and analyse the past and present trends in road accidents, casualties and fatalities. Accident fatality rates and indices for Malaysia are derived and compared with selected developed countries to bring about a comparative assessment of the gravity of the problem faced by the country. Certain accident characteristics peculiar to the country are highlighted and discussed in view of getting greater understanding and searching for appropriate ways to deal with the problem. Attempts are made to explore possible relationships between accident fatalities and accident exposure variables. A number of statistically significant accident trend models were derived using regression analysis and these provide fairly reasonable estimates of accident fatalities based on population size and number of registered vehicles.

1. INTRODUCTION

It has been quite frequently mentioned that Malaysia has enjoyed a relatively rapid economic growth over the past two decades which among others has led to the growth of urban centers and expansion of the transport and road networks to cater for the increasing demand in movement of people and commodities. The number of registered vehicles increased considerably from 669,294 vehicles in 1970 to over 6.2 million in 1992 (Public Works Department Malaysia, 1994), almost nine-fold within 22 years. The high increase in vehicle registration has led to an increase in vehicle ownership from 13.4 persons per vehicle in 1970 to 2.9 persons per vehicle in 1992. Not only do more people have been able to own a vehicle, the booming economy has enabled more people to own more than one vehicle. The increase in the level of motorisation and the continued reliance and dependence on the private vehicle by the majority of people (including commuters) look set to continue well into the future due to the relatively poor public transport system.

Apart from having the usual problems resulting from rapid urbanisation and tremendous increase in motorised traffic (such as traffic congestion, environmental pollution and deterioration of the quality of life), the country is also facing an acute problem of road accidents. The death toll due to road accidents in the country has been increasing every year and there appear to be no indication that the situation would change for the better despite numerous efforts geared towards dealing with the problem. The cost of accidents in terms of damage to vehicles and properties alone (not including cost of fatalities, treatment, bereavement etc.) amounted to about RM 130.2 million (about US$ 50 million) per annum for the year 1992 (Royal Malaysia Police, 1992). The government has responded positively towards combating the problem and has even set a target of reducing road accident fatalities

by 30% by the year 2000 taking 1989 as the base year (Karim, 1995). A National Action Plan which outlines a comprehensive strategy towards achieving the desired objectives was formulated in 1992 and is now in various stages of implementation. The much needed change in the desired direction is yet to be seen.

2. GENERAL ACCIDENT TRENDS

Even though some would expect that the tremendous increase in motorised traffic would result in an increase in the actual number of accidents, however, the issue is whether the actual increase reflects the general road safety level over time. It may be rather too drastic to expect that the actual number of accidents to drop significantly (although it is not impossible) within the situation where motorised traffic has increased dramatically. It is therefore quite common to observe the accident trend as indexed to certain exposure variables. *Fig.1* shows the trends in accident fatality rates for Malaysia while *Fig.2* and *Fig.3* illustrate comparisons between Malaysia and selected developed countries in terms of fatalities per 100,000 population and fatalities per 10,000 registered vehicles respectively.

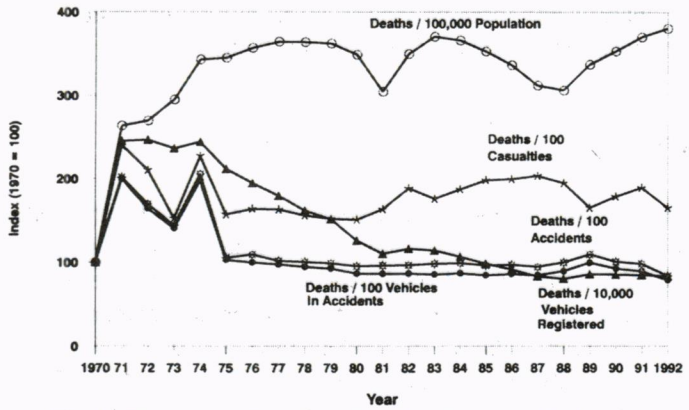


Fig.1. Trends in Accident Fatality Rates in Malaysia

It can be inferred from *Fig.1* that there has been a considerable increase in all the accident fatality rates from 1970 to 1974, possibly due to the rapid increase in motorised traffic which is not met with an equally rapid expansion and/or improvement of the road network and transport facilities within that period. Fatalities per 10,000 registered vehicles began to decrease thereafter and since 1988 began to level-off to around the 1970 value. However, the fatalities per 100,000 population is still indicating a fluctuating trend about the 1974 value which is much higher than the 1970 value. The fatality rates in terms of deaths per 100 accidents and deaths per 100 vehicles involved in accidents have remained fairly constant since 1975 onwards. This would imply that the probability of a death resulting from an accident is still in the same magnitude as it was then. Thus, although it may appear that there is an improvement in terms of fatalities per 10,000 registered vehicles, the risk of getting fatal injury in an accident is still as high as it was then.

While there is a general tendency in the developed countries for accident fatality rates to decrease, accident deaths per 100,000 population for Malaysia has not shown any significant positive change (*Fig.2*). Nevertheless, the fatality rate in terms of deaths per 10,000 registered vehicles does indicate a positive downward trend although it is still well above the level achieved in the developed countries (*Fig.3*).

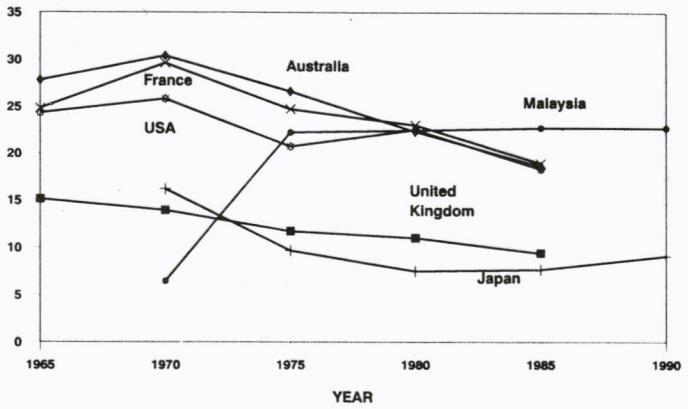


Fig.2. Deaths Per 100,000 Population

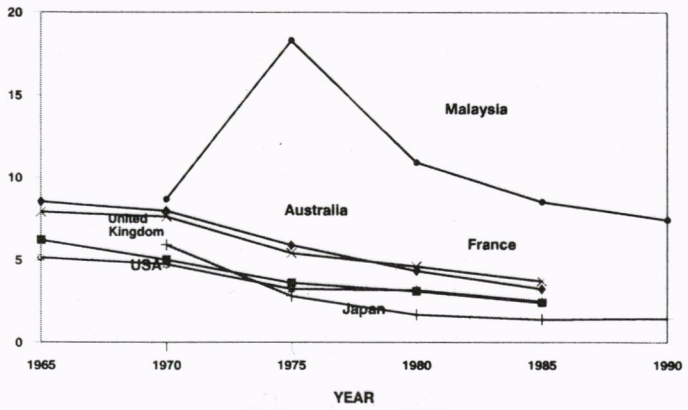


Fig. 3. Deaths Per 10,000 Registered Vehicles

3. CHARACTERISTICS OF ACCIDENTS AND FATALITIES

Looking at the vehicle types involved in accidents in relation to vehicle registration revealed that a high percentage of buses (including long haul intercity buses) and taxis, which are the main public transport modes available, are involved in accidents (*Fig.4*). A possible reason for this could be the fact that these drivers spend more time on the road as compared to other drivers. As such their accident potential would be higher due to their longer period of exposure on the road. Nonetheless, one may argue that these drivers would be more experienced to handle potential accident situation and to avoid an accident. Other factors

such as fatigue, speeding and inattentive driving, however, could be dominant contributory factors which may ultimately lead to accidents involving these category of drivers. A specific in-depth study on this case would be necessary before any concrete understanding can be attained.

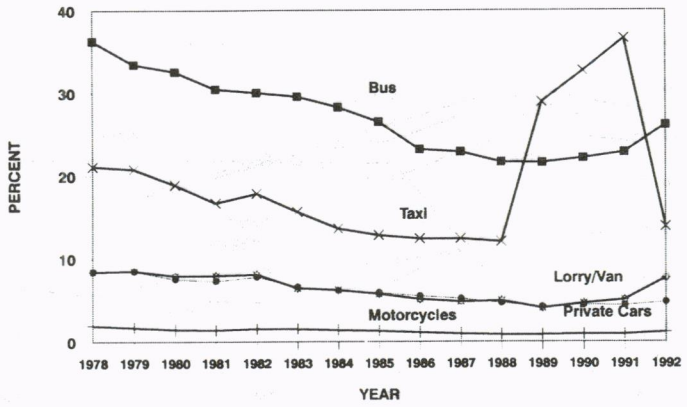


Fig. 4. Percentage of Vehicles in Accidents in relation to Vehicle Registration

One issue that has been given much emphasis in recent years is concerned with fatalities amongst motorcyclists. Motorcycles form the largest share of the vehicle population, probably a characteristic feature of several developing countries like Malaysia. These motorised two-wheelers are popular due to obvious reasons such as economical, reliable, versatile and affordable to most people. Although motorcycles only form about 18% of the total vehicles involved in accidents (in 1992), it is unfortunate that the number of motorcycles involved in fatal accidents is highest amongst all vehicles (*Fig.5*) and motorcyclists also form the highest fatalities amongst all types of road users (*Fig.6*). It is quite obvious that motorcyclists would end up worst in event of a crash with other motor vehicles since the motorcycle do not offer much protection for the riders.

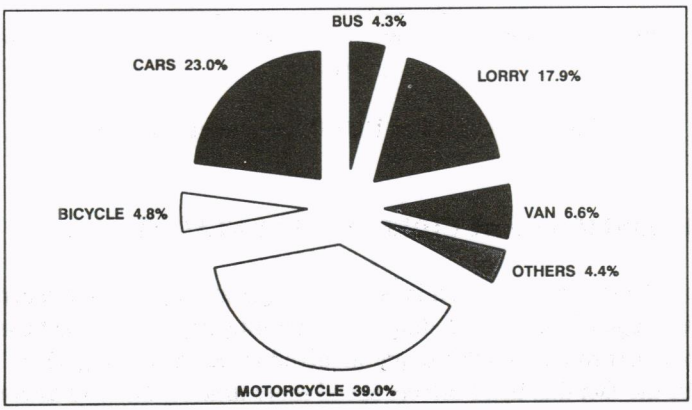


Fig. 5. Component Ratios of Vehicles Involved in Fatal Accidents (1992)

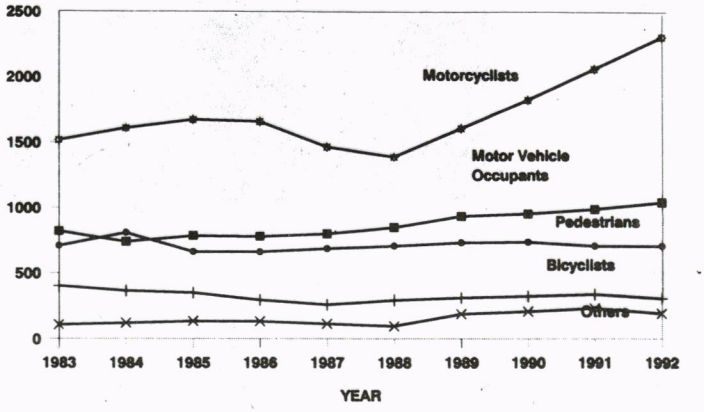
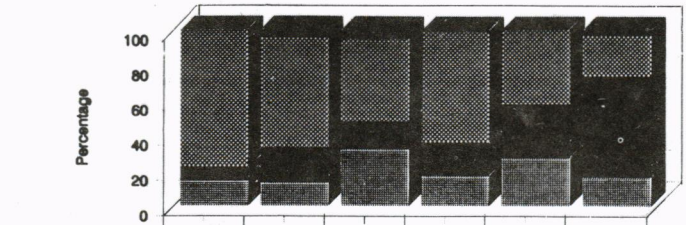


Fig. 6. Fatalities by Types of Road Users

Various measures and campaigns specifically targeted for the safety of motorcyclists have been given more emphasis due to the gravity of the problem. One particular low-cost accident countermeasure was the nation-wide "ride-bright" campaign and regulation launched in July and September 1992 respectively. This involves motorcyclists switching on their headlights during daytime for increased visibility and more conspicuous to other motorists. Early indications appear to indicate a fairly high degree of compliance and daytime accidents involving motorcycles at certain study areas showed a decline (Sohadi, 1993). Any significant long term effect of this measure would be ascertained in the near future and reflected in the yearly accident statistics.

In comparing the component ratios of fatalities by road user type between Malaysia and selected developed countries for 1992 revealed that the majority of the fatal road users in the developed countries are occupants of motor vehicles whereas in Malaysia they are the motorcyclists (*Fig.7*). It is therefore not surprising to find that much emphasis in the developed countries is directed towards improvement of vehicle safety standards for better protection of its occupants in event of a crash. Measures such as the use of rear seat belts, child restraints and air bags would help reduce injuries and probably bring down the fatality rate significantly, particularly in the developed countries. Nevertheless, such measures are probably not adequate for countries like Malaysia and much more is required since the majority of fatalities are still the motorcyclists.



	USA	FRANCE	UK	GERMANY	JAPAN	MALAYSIA
Others	0	4	5	1	0	3
Motor Veh Occupant	78	63	47	63	42	23
2-Wheeler Occupants	6	16	11	11	21	51
Pedal Cyclist	2	4	5	8	10	7
Pedestrian	14	13	32	17	27	16

Pedestrian Pedal Cyclist 2-Wheeler Occupants Motor Veh Occupant Others

Fig. 7. Component Ratio of Fatalities by Road User Type (1992).

A closer look into the casualty distribution pattern in different types of localities (for 1992) revealed that the vast majority of deaths occur in rural areas with 65.1% against 7.8% for city, 11.8% for urban and 15.4% for built-up areas (*Fig.8*). A comparison of the ratio of deaths to casualties between these localities further indicate that rural location has the highest ratio (14%) which is almost double that of city (7.2%). There may be several reasons for this characteristic, one of which could be the difference in nature and severity of crashes in those localities. It is envisaged that more high speed collisions are likely to occur in rural areas as compared to urban and city areas. While this may be true, however, there may be other contributory factors such as delayed treatment of accident victims due the long distance between accident location in the rural area and the nearest hospital, or the lack of certain emergency medical equipment to treat accident victims on-site or at hospitals in the small towns in rural areas. It is reasonable to appreciate that immediate medical treatment may help reduce severity of injuries, or perhaps increase the chances of saving life. Further improvement to ambulance services and emergency medical facilities with well trained para-medical personnel and support staff will definitely be of great value. The gradual development of proper trauma centers in towns located close to high ranking accident blackspots could be a worthwhile venture.

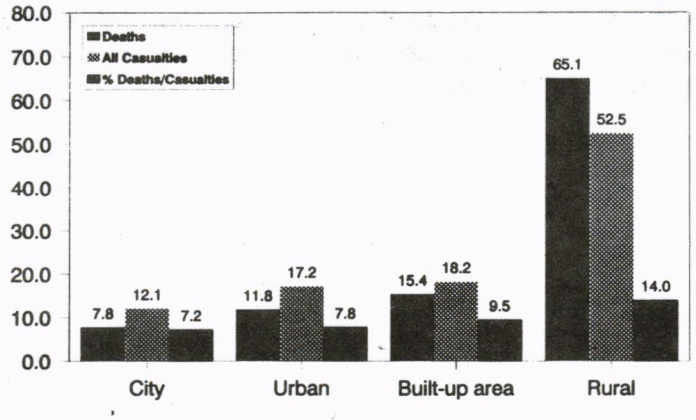


Fig. 8. Component Ratios of Type of Locality for Casualties and Fatalities (1992).

Even though the occurrence of accidents are fairly distributed in various types of localities, the majority of fatal accidents seem to fall within the rural environment with 63.1% (for 1992). The percentage of fatal accidents to total accidents in rural areas is almost seven times that of city areas (Karim, 1995). This indicates the need for greater attention and efforts to be channelled towards improving the accident situation in rural areas. Although the accident-prone locations could be identified based on accident records, a thorough on-site accident investigation would probably be the best way of knowing the appropriate countermeasure to be applied at a particular location. A systematic ranking of accident blackspots would help establish the priority list for treatment of accident-prone roads in the rural areas, especially when there is budget constraints. Nevertheless, since the costs of road accidents are high, a substantial investment in improving the accident situation would be justifiable.

An analysis of the accident data (1992) further indicate that 25% of fatal accidents and 24% of all accident fatalities are in residential areas. This situation need to be properly addressed and appropriate steps taken to improve the level of road safety in residential areas. While it is quite certain that site-specific accident studies are essential before effective countermeasures could be implemented, it is also important to consider general policy issues that may affect the outcome of future development of residential developments, particularly with respect to road safety. It may be worthwhile to consider reviewing the overall planning and design process for residential development, especially with regards to safety aspects of residential street network, pedestrian facilities and children's playground, to name a few. Development of a traffic safety audit procedure and incorporating it within the planning process would help identify possible deficiencies which may affect the level of road safety at certain locations. The institutionalisation of the road safety audit procedure would be a great step ahead. The problem of speeding on residential streets, an issue commonly cited, may be addressed by implementing appropriate traffic calming measures.

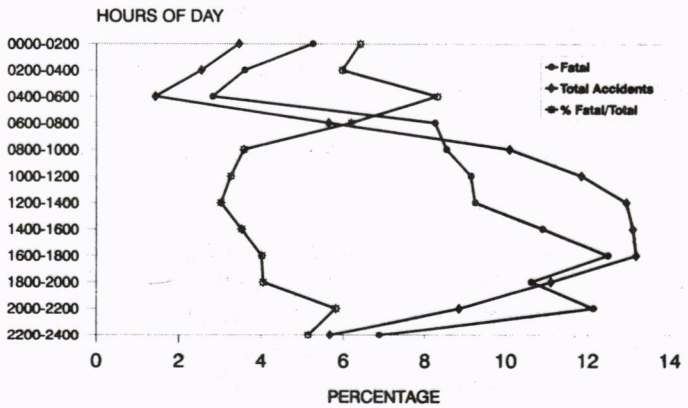
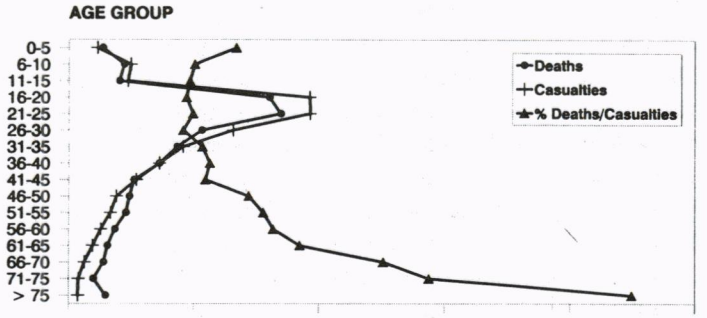


Fig. 9. Component Ratios for Accidents by Hours of the Day (1992).

Although more accidents occur during the day, it is observed that the ratio of fatal accidents to total accidents are higher during the hours between 8:00 pm and 8:00 am (*Fig.9*). This further strengthen the opinion that the probability of having fatal accident at night hours (including dawn) is higher than that during the daytime. Drivers response to external stimuli

on the road would be greatly affected at night due to reduced visibility especially when there is no street lighting or road lighting conditions are poor and speed is high. It is important to emphasise to drivers the need to have extra precaution and application of defensive driving techniques at night more than during the day because of the problem of reduced visibility. This issue should be adequately addressed in driver training prior to obtaining license to drive and emphasised during regular road safety campaigns.

An investigation of the age distribution of accident casualties for 1992 revealed that the majority of casualties and fatalities falls between the age of 15 and 40 (*Fig.10*). About 40% of the casualties are actually in the age group 16 to 25 years old. The number of fatalities are also highest for this age group compared with other age groups. It is also observed that the ratio of deaths to total casualties are higher for the older age groups with a maximum of about 45% for those above 75 years old. Although the older age groups only form a minority within the total accident casualties, however, the high percentage of fatalities as compared to total casualties would be a cause for concern.



	0-5	6-10	11-15	16-20	21-25	26-30	31-35	36-40	41-45	46-50	51-55	56-60	61-65	66-70	71-75	> 75
Deaths	3	4	4	16	17	11	9	7	5	5	5	4	3	3	2	3
Casualties	2	5	5	19	19	13	9	7	5	4	3	3	2	1	1	1
% Deaths/Casualties	13	10	10	9	10	9	11	11	11	14	16	16	18	25	29	45

Fig. 10. Component Ratios for Casualties by Age Group (1992).

An interesting observation was made when the accident data for 1992 was analysed according to sex of drivers involved in accidents. Of all the accidents, 95.1% involved male drivers while only 4.9% involved female drivers. This is quite understandable since the male driver population is much higher. However, the ratio of fatal accidents to total accidents is higher for male drivers (4.3%) as compared to female drivers (2.1%). This means that 4.3% of all accidents involving male drivers results in fatalities while only 2.1% of all accidents involving female drivers result in fatalities. While there may not be a significant difference between these values, it still seem to imply that female drivers have more of those characteristics of a better driver. It could be possible that in general most female drivers in Malaysia drive at lower speeds and with extra care as compared to male drivers. However, this has yet to be further substantiated by a specific study on the issue.

4. ACCIDENT TREND MODELS

Further analysis of the accident data leads to a closer examination of the accident trend over a period of time, particularly with respect to fatalities. Accident data for the period between 1970 and 1992 was used in the analysis. It is anticipated that there could be a meaningful relationship that relates accident fatalities to certain accident exposure variables. In this particular analysis, it is assumed that the exposure of road users (both motorised and non-motorised) may be represented by population size and the exposure to the motor vehicle system represented by number of registered vehicles. A number of accident trend models were subsequently derived using regression analysis. The following are four statistically significant models derived using regression analysis which relates the number of accident fatalities to the population and number of registered vehicles:

$$F = 0.08193\ (NP)^{0.3355} \quad \text{.....(1)}$$
$$F = 0.009686\ (NP^2)^{0.2647} \quad \text{.....(2)}$$
$$F = 9175\ (N/P)^{0.7107} \quad \text{.....(3)}$$
$$F = 145.3\ (N)^{0.5792}\ (P)^{-0.3398} \quad \text{.....(4)}$$

where, F = number of accident fatalities
N = number of registered vehicles
P = population

The coefficient of correlation, R^2, for each of the four equations are given in *Table 1*. The predicted number of fatalities were then determined using the equations for the same time period and compared with the actual accident fatalities. The deviations between the predicted values and the actual number of fatalities were determined. The percentage error for predicted values and the average absolute percentage error for each of the models are given in *Table 1*.

Table 1. Statistical Significance of Trend Models

Model	R^2	% Error Range	Ave.Abs.% Error
1	0.89	-14.6 to 13.9	6.37
2	0.89	-13.6 to 14.0	6.57
3	0.90	-20.0 to 16.3	6.84
4	0.91	-18.4 to 12.7	6.38

The fairly close concurrence between the predicted values obtained by the four models and the actual accident fatalities over the twenty-two years period appear to indicate that there is a possible meaningful relationship between the number of traffic accident fatalities and population size and number of registered vehicles. These models may be used as prediction tools for any base case forecasting of future traffic accident fatalities in Malaysia. However,

it should be emphasised that there are numerous factors contributing to traffic accidents and fatalities and as such these prediction models need to be further refined and only used as a rough guide.

5. CONCLUDING REMARKS

The road accident situation in Malaysia has been discussed and a macro analysis of the road accident trends presented. Certain accident characteristics peculiar to the country has been highlighted and contrasted with selected developed countries. Some suggestions on possible measures to deal with the issue of road accidents were also proposed. Attempts were made to investigate possible relationships between accident fatalities and accident exposure variables. Four statistically significant models which provide fairly reasonable estimates of the accident fatalities based on population size and number of registered vehicles were obtained using regression analysis. These models not only provide a possible explanation to the trends observed but also could be used as a base case prediction tool.

REFERENCES

Karim, M.R. (1995) An Investigation on Fatal Road Traffic Accidents. **IATSS RESEARCH, Vol.19, No.1**, pp.69-72.

Public Works Department Malaysia (1994) **Malaysian Roads General Information 1994**. Roads Branch, Kuala Lumpur.

Royal Malaysia Police (1992) **Statistical Report Road Accidents Malaysia 1992**. Traffic Branch, Kuala Lumpur.

Sohadi, R.U.R. (1993) Impacts of Ride-Bright Campaign and Regulation on Motorcycle Accidents in Malaysia. **Proceedings Conference on Asian Road Safety 1993**, Kuala Lumpur, Oct.1993.