Analysis of Road Traffic Fatality Data for Asia

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Abstract: The WHO released a *Global Status Report On Road Safety: Time For Action* in July 2009. Here we analyse the data reported by Asian countries. The report demonstrates that a few high income countries have unreliable statistics, and on the other hand a few low-income countries are able set up good data collection systems. Therefore, all countries should be able to set up reasonable data reporting systems given the right policies. Overall and road user specific fatality rates do not have a high correlation with country income levels. The reasons for this are not known. In the absence of more reliable data and identification of risk factors for each country, it is not possible to give very specific country based countermeasures for road safety. It would be adequate at present to focus on measures that have international validity and are known not to have negative side-effects.

Key Words: *Traffic safety, Asia, Per-capita income,*

1. INTRODUCTION

The World Health Organization released its *World Report On Road Traffic Injury Prevention* in 2004 (Peden et al. 2004). This report focused on road traffic injuries (RTI) and fatalities as a worldwide health problem and included a summary of the known risk factors associated with road traffic crashes and possible countermeasures that should be put in place to control the problem. It also pointed out that "Without new or improved interventions, road traffic injuries will be the third leading cause of death by the year 2020". The publication of this report spurred some national and international agencies and civil society groups to give a little more attention to the problem of road safety and a number of resolutions have been passed by the United Nations General Assembly, World Health Assembly and the Executive Board of the WHO (W.H.O. 2009a). As a follow up, the Russian Federation to hosted the First Global Ministerial Conference on Road Safety on 19-20 November 2009. Before this conference the WHO released a *Global Status Report On Road Safety: Time For Action* in July 2009 (W.H.O. 2009b) (GSRRS). This report is the first broad assessment of the status of road safety in 178 countries. The data were obtained from national governments using a standardized survey form.

The GSRRS shows that low-income and middle-income countries on an average have higher road traffic fatality rates (21.5 and 19.5 per 100 000 population respectively) than high-income countries (10.3 per 100 000), and that over half of those who die in road traffic crashes are pedestrians, bicyclists and users of motorized two-wheelers (MTW). Here we analyze the data reported by Asian countries, which include a vast majority of the middle and low-income population of the world, to understand the injury trends by national income and

modal shares of traffic in different societies. These data are used to propose road safety countermeasures and policies that may be necessary to accelerate the reduction in RTI in the future.

2. ROAD TRAFFIC INJURY DATA FROM ASIAN COUNTRIES

The GSRRS was developed over two years by the WHO. A standardised questionnaire was sent to all member states. A National Data Coordinator was identified in each country who was trained and then facilitated by a consensus meeting involving a multisectoral group of up to eight road safety experts. The data and policy information so collected was then sent for government clearance. Data were received from 176 WHO member states and associate member states and 2 non-member areas.

It is widely recognised that fatality statistics suffer from under reporting in many countries and so the WHO team adjusted the fatality figures for a 30 day period for death after the crash. They also used a negative binomial regression model for estimating fatalities for each country by accounting for income, exposure, risk factors and strength of the health system (details: http://www.who.int/violence_injury_prevention/road_safety_status/2009/). Until recently it was not possible to compare RTI trends across countries in Asia as a majority of them do not use similar definitions and have varied degree of under-reporting. The GSRRS has used a scientific approach to estimate the number of RTI fatalities and this makes it possible for us to do some comparisons. In this paper we report how the understanding of RTI changes if we analyse the GSRRS estimates and compare them with self reported statistics from different countries.

A summary of the data reported for 33 Asian countries is given in Table 1. These data show that 12 countries (36%) were not able to supply data on the proportion of different types of road users killed in crashes and 7 (21%) were not able to give complete details of the proportion of motor vehicles operating in the country. Though a majority of the countries provided details, the reliability of data can only be judged by persons who are aware of the procedures used in their country for collection of data. We give an example of the problems by examining the data submitted by India.

Data from India for fatalities by different road user type in the GSRRS and a detailed study from India (Tiwari et al. 2000) are given in Table 2. The data included in GSRRS indicate that the proportion of 4-wheeler occupants killed in India is greater than that of pedestrians or bicyclists and the unknown proportion is 41%. Other in-depth studies conducted in India show a much higher proportion of vulnerable road users killed in cities and highways (Table 2). This difference is explained by the fact that the data submitted for India is partly based on official national statistics reported for “fatalities by vehicle type” (NCRB 2008). In this table the “vehicle type” is recorded as one which was thought to be at “fault” and not the one in which the victim was travelling. This is the reason that bicyclists and pedestrians are reported to have low proportions in India in the WHO report. The total number of vehicles reported for India in the GSRRS is 72.7 million. The official statistics overestimate the number of vehicles operating in India because private vehicle owners do not have to register their vehicles every year. They have to pay a onetime tax when they purchase a vehicle. Therefore, out-of-use vehicles remain on the record. Recent studies have estimated that the actual number of private

Table 1. Road traffic injury and motor vehicle statistics for Asian countries (Source: WHO 2009b)

					Percent fatalities by road user type						Percent vehicles					
Country	Coutnry code	GNI per capita for 2007 in US $	Reported fatalities /100,000 persons	Estimated fatalities/ 100,000 persons	Drivers/ passengers of 4-wheeled vehicles	Drivers/ passengers of motorized 2 or 3-wheelers	Cyclists	Pedestrians	Other	Total vehicles	Motor cars	2-3 Wheelers	Minibuses etc	Trucks	Buses	Other
Bahrain	BH	20,610	12.1	12.1	59.4	5.5	6.6	28.6	-	3,82,977	0.81	0.01	0.13	0.01	0.02	0.03
Bangladesh	BD	470	2.6	12.6	26.2	8.2	2.6	53.7	9	10,54,057	0.15	0.62	0.10	0.06	0.03	0.04
Bhutan	BT	1,770	16.9	14.4	-	-	-	-	-	35,703	0.55	0.21	0.02	0.13	0.01	0.09
Brunei	BN	30,580	13.8	13.8	75.8	11.1	1.9	9.2	2	3,04,432	0.83	0.04	0.04	0.01	0.01	0.08
Cambodia	KH	540	11.5	12.1	14.9	62.8	4.7	13.3	4	1,54,389	0.09	0.84	0.04	0.01	0.02	-
China	CN	2,360	7.2	16.5	22.6	28.1	9.5	26	14	14,52,28,994	-	-	-	-	-	-
India	IN	950	9.0	16.8	15.1	27.4	4.3	12.6	41	7,27,18,000	0.13	0.71	0.05	0.03	0.01	0.07
Indonesia	ID	1,650	7.1	16.2	7	61	13	15	4	6,33,18,522	0.15	0.73	-	0.08	0.04	-
Iran	IR	3,470	32.2	35.8	44.9	11.4	-	33.3	11	1,70,00,000	0.48	0.37	0.01	0.05	0.01	0.09
Japan	JP	37,670	5.2	5.2	37.1	17.6	12.8	32.3	0	9,13,78,636	0.63	0.14	-	0.18	0.01	0.05
Jordan	JO	2,850	16.7	34.2	75.2	0.1	-	24.7	-	8,41,933	0.65	0.01	0.12	0.18	0.02	0.03
Kuwait	KW	40,114	16.9	16.9	-	-	-	-	-	13,64,790	0.55	0.01	0.35	0.07	0.02	0.01
Lao People's Democratic Republic	LA	580	11.2	18.3	-	-	-	-	-	6,41,081	0.02	0.79	0.14	0.03	0.01	0.02
Lebanon	LB	5,770	13.1	28.5	-	-	-	-	-	14,00,000	-	-	-	-	-	-
Malaysia	MY	6,540	23.6	23.6	23.3	58	3	10.1	6	1,68,25,150	0.45	0.47	-	0.05	-	0.03
Maldives	MV	3,200	3.3	18.3	0	75	25	0	-	33,807	0.08	0.79	0.07	0.01	-	0.05
Mongolia	MN	1,290	21.4	19.3	64.9	16.7	0.4	17.9	-	1,61,989	0.68	0.01	0.02	0.21	0.08	0.01
Nepal	NP	340	3.4	15.1	-	-	-	-	-	6,17,305	0.14	0.69	0.02	0.05	0.03	0.07
Oman	OM	11,275	30.7	21.3	-	-	-	-	-	6,29,670	0.72	0.01	0.12	0.06	0.04	0.06
Pakistan	PK	870	4.4	25.3	-	-	-	-	-	52,87,152	0.27	0.51	0.11	0.04	0.05	0.02
Papua New Guinea	PG	850	4.9	14.2	59.9	0	0.8	39.3	-	59,645	0.64	0.02	0.01	0.18	0.11	0.04
Philippines (The)	PH	1,620	1.3	20.0	-	-	-	-	-	55,15,576	0.17	0.48	0.29	0.05	0.01	0.01
Qatar	QA	66,063	23.7	23.7	69.0g	4	27.0k	-	-	6,05,699	-	-	-	-	-	-
Republic Of Korea (The)	KR	19,690	12.8	12.8	36.6	20.7	4.9	37.4	1	1,82,13,228	0.66	0.10	0.06	0.17	0.01	-
Saudi Arabia	SA	15,440	25.7	29.0	-	-	-	-	-	73,98,600	-	-	-	-	-	-
Singapore	SG	32,470	4.8	4.8	14.9	47.7	10.3	27.1	-	8,51,336	0.61	0.17	-	-	0.02	0.21
Sri Lanka	LK	1,540	12.1	13.5	-	65.2	-	32.8	2	31,25,794	0.12	0.63	0.06	0.08	0.03	0.08
Syrian Arab Republic	SY	1,760	18.4	32.9	-	-	-	-	-	13,89,346	0.55	0.09	0.25	0.07	0.03	0.01
Thailand	TH	3,400	19.6	19.6	11	69.7	2.8	8.3	8	2,56,18,447	0.14	0.63	0.19	0.03	0.01	0.01
Timor-Leste	TP	1,510	4.2	16.1	-	-	-	-	-	26,649	0.06	0.72	0.14	0.08	0.01	-
United Arab Emirates	AE	41,082	24.1	37.1	70	1.5	-	28.5	-	17,54,420	0.86	0.01	0.02	0.07	0.02	0.03
Viet Nam	VN	790	14.6	16.1	-	-	-	-	-	2,29,26,230	0.05	0.95	-	-	-	-
Yemen	YE	870	13.4	29.3	-	-	-	-	-	7,77,734	-	-	-	-	-	-

Table 2. Proportion of road traffic fatalities in India by road user type as reported in the WHO Global status report on road safety and in-depth studies conducted at different locations in India.

	Percent fatalities by road user type				
	Drivers/ passengers of 4 wheeled vehicles	Drivers/ passengers of motorized 2- or 3-wheelers	Cyclists	Pedestrians	Other
(a) As reported in Global status report on road safety (Reference: Anon 2009).	15.1	27.4	4.3	12.6	40.5
(b) As reported in in-depth studies from different locations in India (Reference: Tiwari et al. 2000)					
Mumbai	5.0	11.0	6	78	
Delhi	10.0	24.0	10	53	3
Highways*	32.0	24.0	11	32	1

* The data are for 14 selected locations around the country.

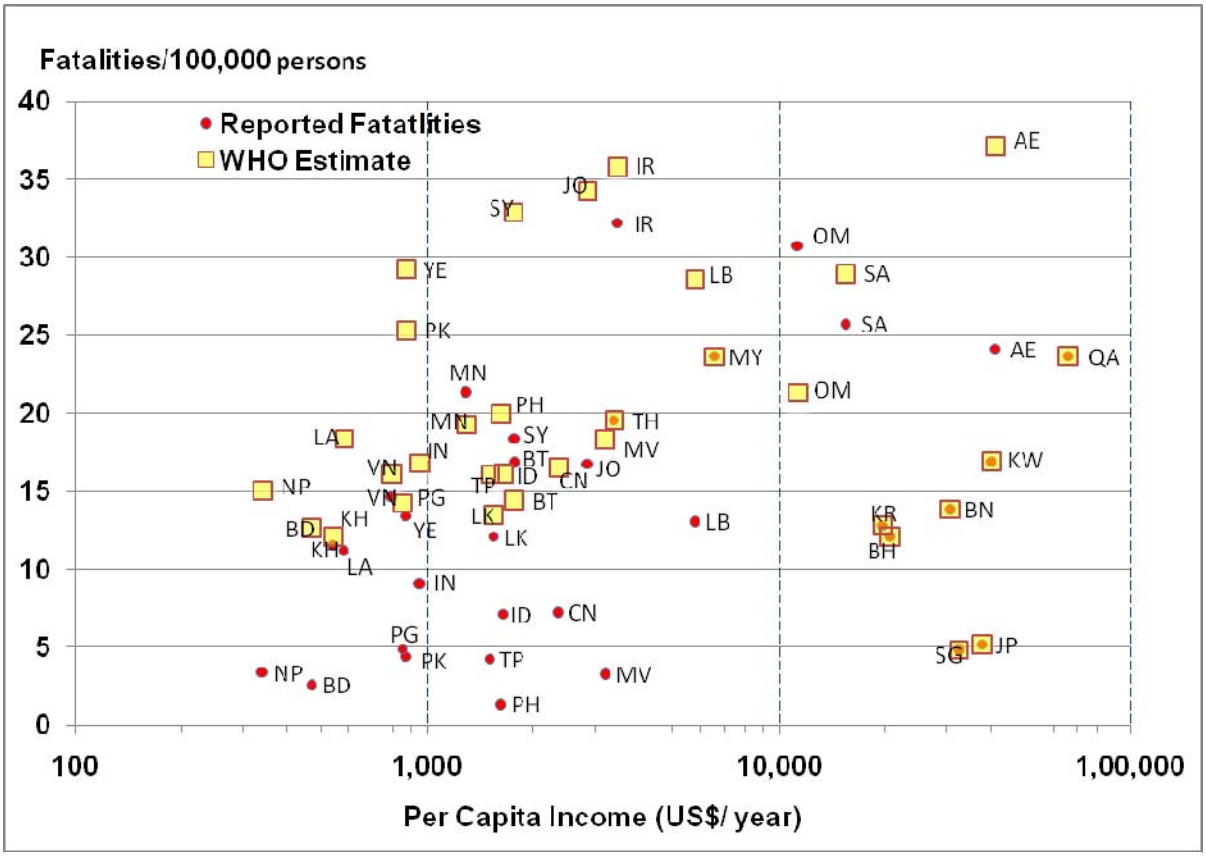

Figure 1. Road traffic fatality rates for Asian countries vs. national per capita income. (Source: W.H.O. 2009b).

vehicles on the road in Delhi is about 60% of the official statistic (Expert committee on auto fuel policy 2002). The total number of vehicles on the road in India is more likely to be around 50 million and not 72.7 million as reported (Mohan et al. 2009). This analysis for India illustrates the problems in collecting reliable traffic injury data from around the world.

Figure 1 shows the country reported and WHO estimates for RTI fatality rates per 100,000 persons plotted against national per-capita income. Only 14 (42%) of the countries have reported fatality rates close to the WHO estimates. The WHO status report uses negative binomial regression model for estimating fatalities for each country by accounting for income, exposure, risk factors and strength of the health system, and the report also gives 90% confidence intervals for fatality estimates. For some countries the lower end of the estimate may be more realistic than the point estimate. For example, the WHO estimate for India is 87% greater than the reported fatality rate, however, studies from India suggest the reported rate may underestimate the actual number by around 10-20% (Mohan, Tsimhoni, Sivak, & Flannagan 2009) and not 87%. It is widely recognised that the official estimates for road traffic fatalities are underestimates (Jacobs et al. 2000). The WHO estimates give a more scientific estimate for these numbers, and the if we take 20% as the estimate for under-reporting in India, then the Indian statistic comes close to the lower limit (90% confidence) of the WHO estimate. The important point to note is that such a large number of countries may be under-reporting even though the WHO estimate may not be absolutely accurate. While more high income countries seem to have reported rates close to WHO estimates than low income countries, it is interesting that both low-income and high-income countries can have under reporting and realistic reporting. For example, a high-income region like United Arab

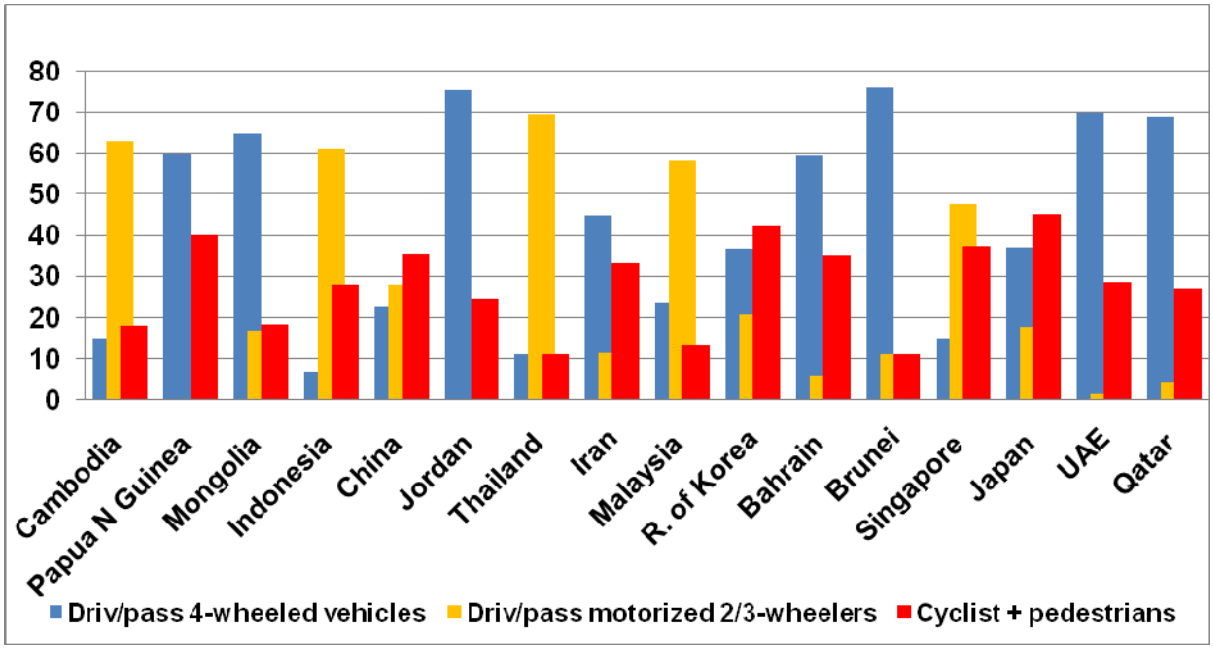

Figure 2. Proportion of RTI fatalities by road user type. Countries are arranged in increasing per capita income from left to right (Source: W.H.O. 2009b).

Emirates (UA) seems to have significant underreporting according to the WHO estimate, but low income countries like Vietnam (VN) and Cambodia (KH) report fatality rates close to the WHO estimate. Even if the estimates do not reflect the reality accurately, they do indicate the extent of under-reporting. Therefore, it appears that is not necessary to have high income levels to develop reliable RTI reporting systems as commonly assumed.

3. RTI TRENDS IN ASIAN COUNTRIES

Figure 1 shows that national RTI fatality rates per 100,000 persons. Neither the number reported by countries nor WHO estimates have a high correlation with national income in Asia. The WHO estimates seem to have a lower correlation than the rates reported by individual countries. Some high-income countries like United Arab Emirates (AE), Oman (OM) and Saudi Arabia (SA) have higher rates than middle income countries like Thailand (TH) and Malaysia (MY). This suggests that higher national incomes do not necessarily produce better road safety policies. This is contrary to the widely held belief that RTI rates are highly dependent on per capita incomes (Kopits and Cropper 2005). This is probably because all earlier analyses depended on official fatality rates as reported by individual countries. The WHO estimates for low-income nations are generally higher than country reports, where as for high-income countries the two estimates are generally closer (with some exceptions).

Figure 2 shows the proportion of different users killed in toad traffic crashes in different countries for which data are available. It is interesting that the sum of pedestrian, bicycle and motorised 2/3 wheeler fatalities is greater than 4-wheel occupant fatalities in most countries, low-income or high-income. The exceptions are Gulf states and some states with very small populations. Papua New Guinea and Mongolia have high 4-wheeler proportions at very low per-capita incomes (< US$ 1,300). It is difficult to explain this in the absence of more details regarding the reliability of data and recording procedures from these countries. Proportion of 2/3-wheeler fatalities in Thailand and Malaysia (middle-income countries) are reported to be very high and pedestrian fatalities very low. This is curious because low and middle income

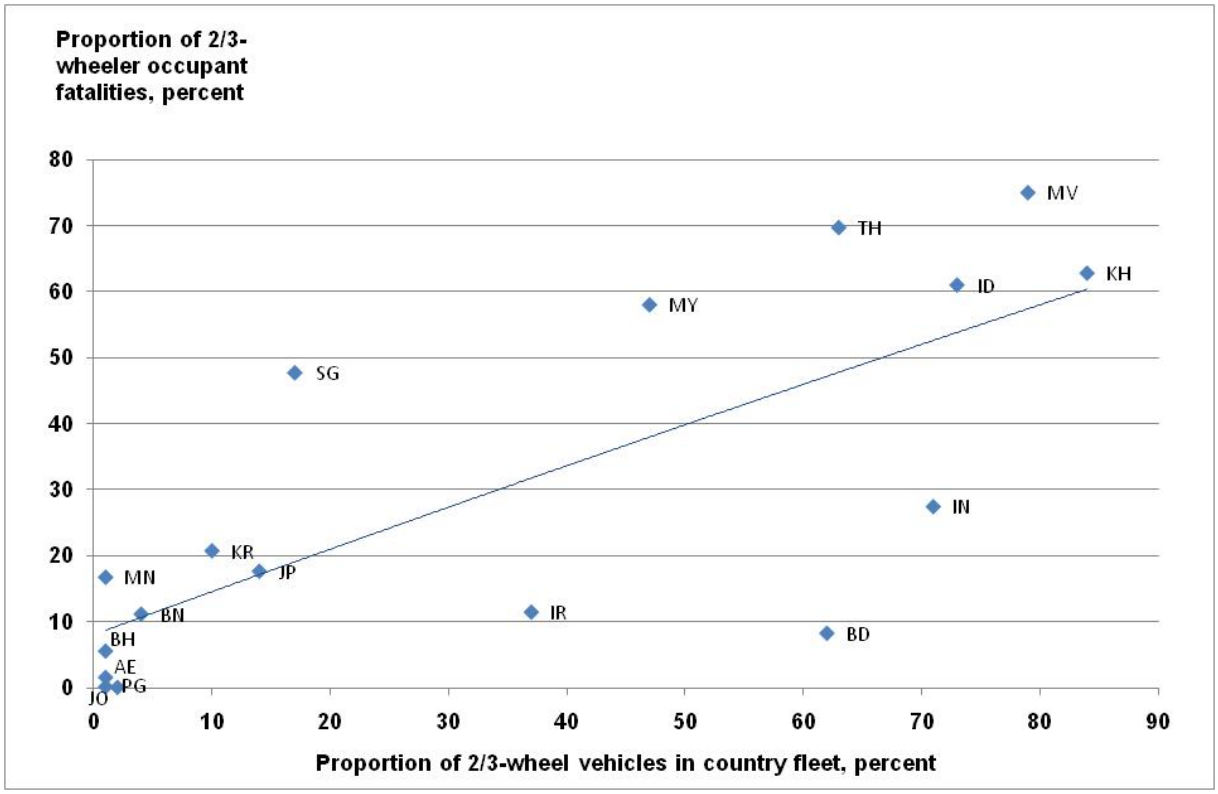

Figure 3. Proportion of 2/3-wheeler occupant fatalities vs. proportion of 2/3-wheeled vehicles in country fleet (Source: W.H.O. 2009b).

countries generally report high pedestrian fatality rates also. It is possible that because Thailand and Malaysia have a very high proportion of motorcycles compared with cars (TH and MY respectively in Figure 3) the pedestrian fatality rate is low as pedestrians would have a lower probability of being hit by cars in this situation. On the other hand pedestrian-motorcycle crashes would be less likely to produce fatalities due to low mass of the vehicles. It is also possible that the data reported by these countries for pedestrian fatalities are underestimated.

Figure 3 shows that in general countries that have a higher proportion of 2/3-wheel vehicles in their fleet have a higher proportion of 2/3 occupant fatalities. However, there is a reasonable spread of fatality proportions around each vehicle proportion. Japan (JP) and Singapore (SG) are high income countries that have similar 2/3-wheeler fleet ratios (reporting is likely to be reliable, country and WHO fatality estimates are similar) but Singapore fatality ratio is 2.7 times greater than that of Japan though their overall fatality rates are similar. This indicates that even countries that have similar incomes, vehicle fleet ratios, motor vehicle standards and traffic regulations can have different fatality patterns.

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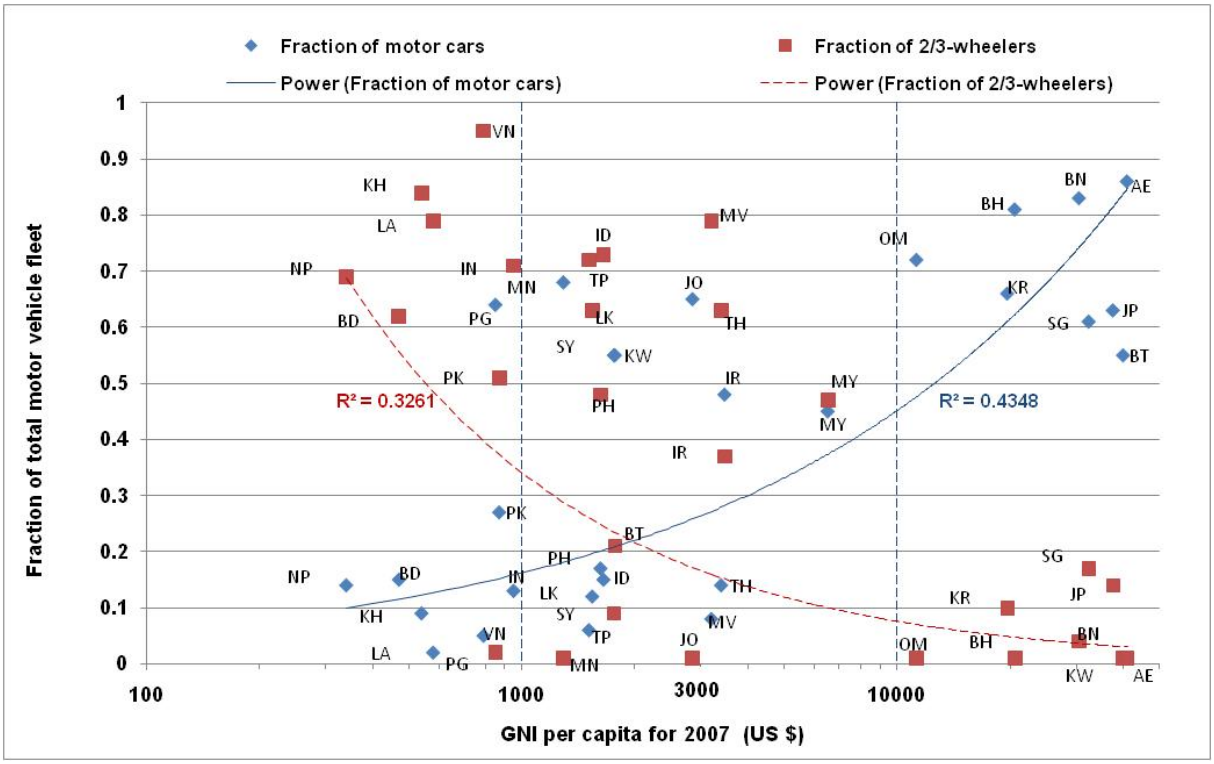

Figure 4. Proportion of 2/3-wheelers and motor cars in vehicle fleet vs. per-capita income in Asian countries (Source: W.H.O. 2009b).

highway infrastructure, etc. (Mohan 2008a). Figure 3 also indicates that data supplied by some of the countries may not be reliable. Bangladesh (BD), a low-income country with a high proportion of 2/3-wheeled vehicles reports very low proportion of fatalities. It is possible that the data reported does not reflect reality. It is also not clear why Thailand (TH), Malaysia (MY) and Indonesia (ID) have very high proportion of 2/3-wheeler fatalities.

In order to propose safety policies for the future it is necessary to have some idea about how vehicle fleet distributions change with increase in income, especially motorcycle ownership. It is important for us to understand motorcycle ownership trends because these vehicles have a very high risk of being involved in fatal crashes. It is assumed by many policy makers that car ownership increases and motorcycle ownership decreases with increasing per-capita incomes. Figure 4 shows that this is only roughly true and generally car proportions increase and 2/3-wheeler proportions decrease with increases in per-capita incomes (The numbers do not add up to 100 for each country as other vehicles are not included). However, there are large variations at similar levels of income. The correlation by income is weak for both under incomes less than $10,000 per-capita. Proportion of car ownership becomes greater than 2/3-wheeler ownership for all cases only when incomes exceed US$ 10,000 per-capita per year. Incomes double every 10 years at growth rates of 7% per year. Since most countries are below US% 3,000 income levels at present, it is unlikely that many country annual per-capita incomes will exceed US$ 10,000 in the next two decades. At present Japan is the only high-income country in Asia that has a large population. It is also interesting that Japan and Singapore have a relatively high motorcycle ownership level but only Japan has low fatality rates both overall and that for and 2-wheelers.

4. CONCLUSIONS AND RECOMMENDATIONS

Data presented above show that few countries have reliable RTI related data at present. However, some general trends are discernable:

- While higher income countries tend to produce more reliable RTI data, this is not always true. Some high income countries have unreliable statistics and some low-income countries are able set up good data collection systems. Therefore, all countries should be able to set up reasonable data reporting systems given the right policies.
- Vulnerable road user fatalities constitute the majority of all RTI fatalities in all large Asian countries including the high income countries. These groups need special attention in all road safety activities.
- 2/3-wheeled vehicles constitute a high proportion of all vehicles in large low and middle-income countries in Asia and this is not likely to change over the next two decades. Even Japan and Singapore have a greater 2/3-wheeler proportion in their vehicle fleets than many other high-income countries around the world.
- Overall and road user specific fatality rates do not have a high correlation with income levels. The reasons for this are not known.

It appears that factors other than income levels, car and road design, and policing influence fatality rates per-capita for each country. Much more work will have to be done in this area before the variability in crash rates can be explained satisfactorily for Asian countries.

In the absence of more reliable data and identification of risk factors for each country, it is not possible to give very specific country based countermeasures for road safety. It would be adequate at present to focus on measures that have international validity and are known not to have negative side-effects (Elvik and Vaa Truls 2004;Mohan 2008b;Peden, Scurfield, Sleet, Mohan, Hyder, Jarawan, & Mathers 2004). Some of these are listed below:

<u>Pedestrian and bicyclist safety</u>

- Reserve special space for non-motorized modes on all arterial roads and highways.
- Speed control in urban areas: maximum speed limits of 50 km/h on arterial roads need to be enforced by road design and police monitoring, and 30 km/h in residential areas and by judicious use of speed-breakers, dead-end streets and mini- roundabouts.
- Increase the conspicuousness of bicycles and small by fixing reflectors on all sides and wheels and painting them yellow, white or orange.

<u>Motorcycle and motor vehicle safety</u>

- Notify and enforce mandatory use of helmets and daytime headlights by motorised two-wheeler riders.
- All cars must conform to international crashworthiness regulations and enforcement of seatbelt use laws.
- Restrict front-seat travel in cars by children and the use of child seats.

<u>Road measures</u>

- Traffic calming in urban areas and on rural highways passing through towns and

villages and reserve spaces for bicycles and pedestrians.
- Improve existing traffic circles by bringing them in accordance with modern roundabout practices and substitute existing signalized junctions with roundabouts.

Enforcement

- Enforce speed limits with a combination of technological aids and policing.
- Strict control of drinking and driving.

Research and Policy

- Since all policy measures and research activities need reliable data, all countries must set up data recording systems to get minimum victim, vehicle and location details.
- Every country must have a national road safety board staffed with professionals who set policy and research agenda.
- There are wide variations in crash patterns within countries of similar income. The reasons for these variations need to be investigated on an urgent basis.

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