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Impact of Road Traffic Crashes in Asia: A Human and Economic Assessment

(Background Paper for Plenary Session 4 of the Provisional Programme)

Final Draft

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IMPACT OF ROAD TRAFFIC CRASHES IN ASIA: A HUMAN AND ECONOMIC ASSESSMENT

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Abstract: *The traffic patterns, modal shares and accident patterns in low and middle-income countries differ significantly from those obtaining in high-income countries. Since road safety research and development has not had a high priority in India and many other Asian countries, we have not been particularly successful in arresting the growth in fatalities and injuries due to road traffic crashes. Estimates of social and economic losses due road traffic crashes have been grossly estimated in all past studies. Studies need to be done with greater scientific rigour to set the record straight. According to our estimates road traffic crashes may be contributing losses of 2-4 per cent of the annual GDP and environmental degradation similar amounts. Therefore, we conclude that: (1) If costs of accidents and environmental degradation are included in calculating feasibility of road projects then, we may arrive at different policy options than those considered at present; (2) The costs of road accidents have to be internalised at the planning stage itself. Once this is done, it will become obvious that much more attention needs to be given to the design of safer roads and highways and that the investment required can be justified on economic grounds; (3) National Governments must establish an independent agency for road safety staffed by professionals; (4) All road projects must be subjected to road safety audits and environmental impact assessments with special reference to the vulnerable road users. (5) A special effort must be made to train a large number of professionals in the scientific approach to road safety.*

Key Words: *Traffic safety, Asia, India, Economic Impact*

INTRODUCTION

The World Health Organization (W.H.O.) released its *World Report On Road Traffic Injury Prevention* in 2004 (Peden, M. 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 W.H.O. (W.H.O., 2009b). 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., 2009a), and followed up with *Global Status Report On Road Safety 2013: Supporting a Decade of Action* (W.H.O., 2013) (GSRRS13). These reports give a broad assessment of the status of road safety in ~178 countries. The data were obtained from

national governments using a standardized survey form.
The GSRRS13 shows that the overall global road traffic fatality rate is 18 per 100 000 population. However, middle-income countries have the highest annual road traffic fatality rates, at 20.1 per 100 000, while the rate in high-income countries is lowest, at 8.7 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.

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

Table 1. Road traffic injury and motor vehicle statistics for Asian countries (Source: WHO 2013)

						FATALITIES ROAD USER TYPE, PER CENT					
COUNTRY	POPULATION	PER-CAPITA INCOME US$ 2010	REPORTED FATALITIES PER 100,000 PERSONS	WHO ESTIMATE FATALITIES PER 100,000 POPULATION	REPORTED/ ESTIMATED RATE	MOTOR VEHICLES	2-3 WHEELERS	CYCLISTS	PEDESTRIANS	OTHERS	TOTAL PERCENT NON MOTOR VEHICLE
AFGHANISTAN	31,411,742	410	4.8	19.8	0.2	NA	NA	NA	NA	NA	NA
BAHRAIN	1,261,835	15,920	5.8	10.5	0.6	44	1	11	39	5	51
BANGLADESH	148,692,128	700	1.9	11.6	0.2	24	16	3	41	17	59
BHUTAN	725,940	1,870	10.9	13.2	0.8	61	3	0	5	32	8
CHINA	1,348,932,032	4,240	5.2	20.5	0.3	23	35	10	25	8	70
INDIA	1,224,614,272	1,260	10.6	18.9	0.6	16	32	5	9	39	46
INDONESIA	239,870,944	2,500	13.0	17.7	0.7	6	36	2	21	35	59
IRAN	73,973,628	4 520	31.4	34.1	0.9	48	23	NA	29	1	> 50
IRAQ	31,671,591	2,380	18.0	31.5	0.6	NA	NA	NA	NA	NA	NA
JAPAN	126,535,916	42,050	4.6	5.2	0.9	31	18	16	35	0	69
JORDAN	6,187,227	4,140	10.8	22.9	0.5	64	0	0	33	3	33
KUWAIT	2,736,732	48,900	13.7	16.5	0.8	NA	NA	NA	NA	NA	NA
LAO PDR	6,200,894	1,010	12.4	20.4	0.6	15	74	1	6	3	82
MALAYSIA	28,401,017	7,760	24.2	25.0	1.0	26	59	3	9	3	71
MALDIVES	315,885	6,150	1.9	1.9	1.0	50	33	0	17	0	50
MYANMAR	47,963,010	868	5.1	15.0	0.3	26	23	9	27	16	58
NEPAL	29,959,364	490	5.6	16.0	0.4	NA	NA	NA	NA	NA	NA
OMAN	2,782,435	19,260	29.5	30.4	1.0	72	3	2	23	0	29
PAKISTAN	173,593,384	1,050	3.0	17.4	0.2	16	39	0	41	4	80
PHILIPPINES	93,260,800	2,060	7.2	9.1	0.8	NA	NA	NA	NA	NA	NA
REP OF KOREA	48,183,586	19,720	11.4	14.1	0.8	25	20	5	38	12	63
SAUDI ARABIA	27,448,086	16,610	24.0	24.8	1.0	NA	NA	NA	NA	NA	NA
SINGAPORE	5,086,418	39,410	3.8	5.1	0.7	9	46	8	29	8	83
SRI LANKA	20,859,949	2,260	11.9	13.7	0.9	68	NA	NA	33	NA	NA
THAILAND	69,122,232	4,150	19.3	38.1	0.5	13	74	3	8	3	84
UAR	7,511,690	39,640	11.0	12.7	0.9	56	3	1	29	12	32
VIET NAM	87,848,460	1,160	13.5	24.7	0.6	NA	NA	NA	NA	NA	NA

Table 2. Proportion of road traffic fatalities in India by road user type as reported in the WHO Global Status Report on Road Safety 2013 and in-depth studies conducted at different locations in India.

	Fatalities by type of road user, per cent				
	Cars & heavy vehicles	Motorised 2/3 wheelers	Bicyclists	Pedestrians	Other
(a) As reported for India in WHO Global Status Report on Road Safety 2013	37	32	5	9	17
(b) Data from In-depth studies form India					
Delhi*	9	37	6	46	2
Vadodara*	9	29	8	54	0
Agra*	11	39	9	41	0
Highways+	32	24	11	32	1

* Mohan, D. et al., 2013 + Tiwari, G. et al., 2000

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 27 Asian countries is given in Table 1. These data show that 8 countries (30%) were not able to supply data on the proportion of different types of road users killed in crashes. 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 GSRRS13 and from detailed studies from India are given in Table 2. The data included in GSRRS13 indicate that the proportion of 4-wheeler occupants killed in India is greater than that of pedestrians or bicyclists and the unknown proportion is 17%. The in-depth studies conducted in India show a much higher proportion of vulnerable road users killed in cities and highways (Mohan, D. et al., 2013, Tiwari, G. et al., 2000). 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, 2012). In this table the "vehicle type" is probably 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. 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 8 (30%) 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

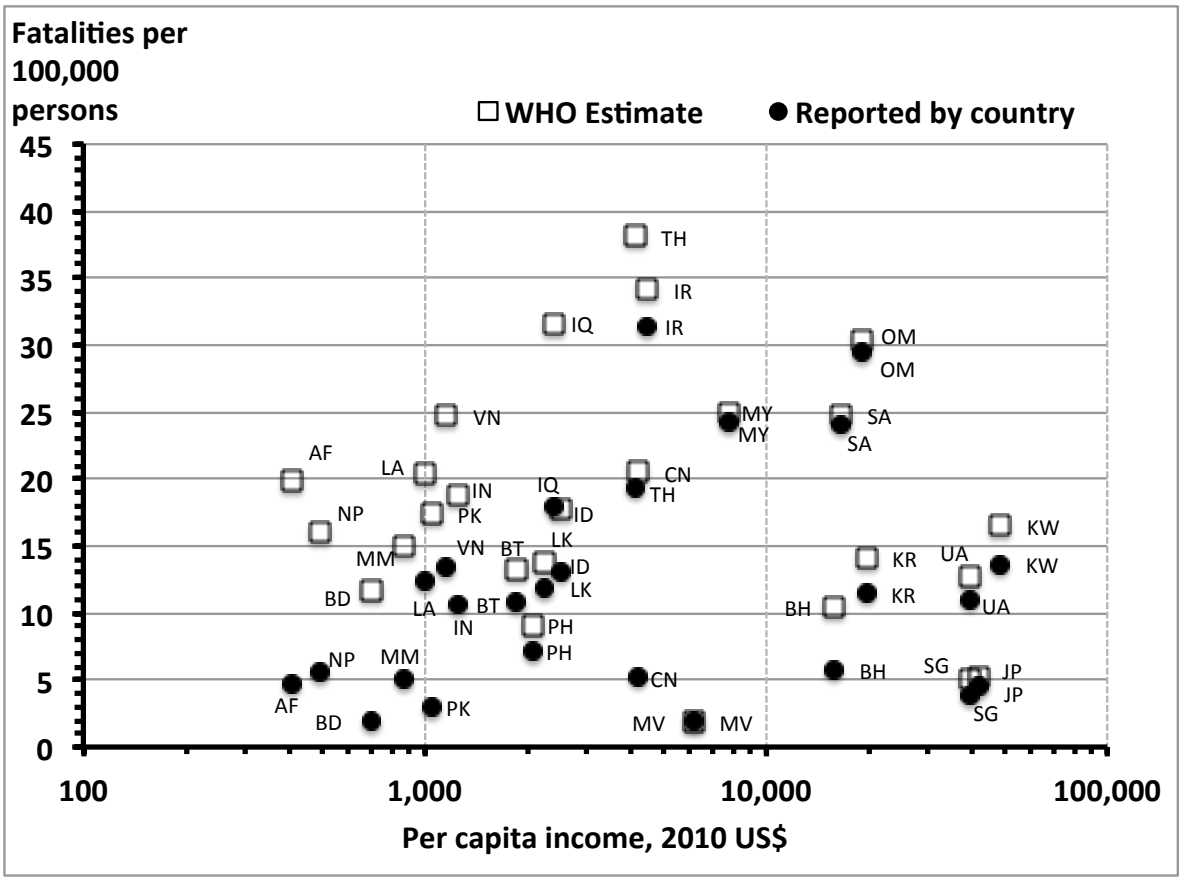

Figure 1. Road traffic fatality rates for Asian countries vs. national per capita income (Source: W.H.O. 2013).

may be more realistic than the point estimate. For example, the WHO estimate for India is 78% greater than the reported fatality rate, however, studies from India suggest the reported rate may underestimate the actual number by around 10%-20% and not 78% (Mohan, D. et al., 2009). It is widely recognised that the official estimates for road traffic fatalities are underestimates (Jacobs, G. 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. Only 4 out of 27 countries report fatality rates within 10% of the WHO estimate (Reported/Estimated rate ratio in Table 1). 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 Kuwait (KW) and Republic of Korea (KR) seem to have underreporting according to the WHO estimate, but low and middle-income countries like Sri Lanka (LK) and Malaysia (MY) report fatality rates close to the WHO estimate. Even if the estimates do not reflect the reality accurately, they do reflect the extent of under-reporting. However, it appears that is not necessary to have high-income levels to develop reliable RTI reporting systems as commonly assumed.

Figure 1 also shows that national RTI fatality rates per 100,000 persons as reported by countries nor WHO estimates have a high correlation with national per capita income in Asia. The WHO estimates seem to have a lower correlation with income than the rates reported by

individual countries. Some high-income countries like Oman (OM) and Saudi Arabia (SA) have higher rates than low and middle-income countries like Indonesia (ID) and Philippines (PH). 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, E. and Cropper, M., 2005). This is probably because all earlier analyses depended on official fatality rates as reported by individual countries. Figure 2 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 (Data from: W.H.O., 2009a). 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. This is probably due to other factors influencing fatality rates - urban living patterns, street and highway infrastructure, etc. (Mohan, D. and Bangdiwala, S., 2013). 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 in all cases.

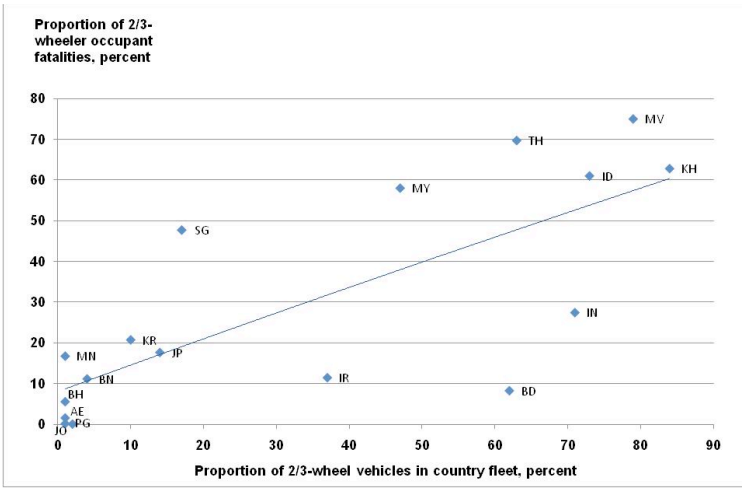

Figure 2. Proportion of 2/3-wheeler occupant fatalities vs. proportion of 2/3-wheeled vehicles in country fleet (Source: W.H.O. 2009a).

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.

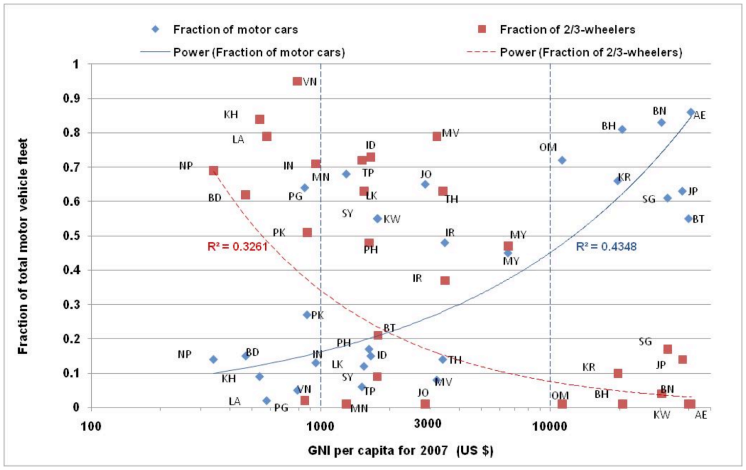

Figure 3. Proportion of 2/3-wheelers and motor cars in vehicle fleet vs. per-capita income in Asian countries (Source: W.H.O. 2009a).

Figure 3 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 $10,000 per-capita. Since most countries are below US% 10,000 income levels at present, it is unlikely that many country annual per-capita incomes will exceed US$ 10,000 in the next two decades. At present Japan is the only high-income country in Asia with a large population. Therefore, we are likely to see continuing high use of MTWs in most Asian countries.

The above analysis indicates that:

- RTI rates in middle and low-income countries are unacceptably high with the majority of the victims being vulnerable road users.
- MTW use will continue to be high in most Asian countries in the medium term future.
- Reliable fatality and injury rates are not available for most Asian countries, therefore, it is not easy to calculate social and economic impacts of RTI on society.
- Any calculations based on official statistics are likely to be underestimates for most Asian countries.

IMPACT OF RTI ON SOCIETY

A very large number of HMCs have been estimating the costs of road traffic crashes over the past three decades. The methods used and costs allocated have generated a great deal of discussion and debate, in particular because of the difficulty of putting monetary values on pain and suffering. A study undertaken by the European Federation of Road Traffic Victims on impact of road death and injury in collaboration with the Commission for European Union gives the following qualitative conclusions regarding the effect of road traffic crashes on victims (European Federation of Road Traffic Victims, 1995):

- *Physical and mental impairment through road traffic injury can have long-term effects which deny victims the ability to maintain their standard of living.*
- *A large proportion of the relatives of dead and disabled victims, as well as the disabled themselves, suffer psychological disorders. The worst situation is that of the relatives of the dead.*
- *The bereaved are the worst affected - 70% - by relationship problems, communication difficulties and sexual problems. The figure for relatives of disabled victims is 40%, and for the disabled themselves 50%. After 3 years these problems do not decrease as one would expect, but worsen for each category by about 5 points.*
- *About 50% of the relatives of victims, and the victims themselves, state that for extended periods they consume more psychotropic products like tranquillisers, sleeping tablets, tobacco, alcohol and drugs than before the incident.*
- *It is sometimes believed that due to the tragedy, the relationship of the respondents with their normal social partners deteriorates*
- *The capacity to enjoy life as before the crash tragically disappears for 91% of the relatives of dead victims for the first 3 years. After this period, the loss persists for long periods for 84% of them. For many this loss will be permanent.*

We have quoted from this report extensively because it is important to note that economic costing of human tragedies can only be used as an inefficient tool to understand the partial costs of the problem.

SOCIAL COST OF ROAD TRAFFIC INJURIES

Calculation of direct and indirect costs of injuries, deaths and damage due to road traffic crashes started in the 1970s and many such analyses have been done in USA and Europe (Braddock, M. et al., 1992, Brazier, J. et al., 1996, Carlsson, G., 1997, De Blaeij, A. et al., Elvik, R., 1994, Elvik, R., 2000a, Elvik, R., 2000b, Elvik, R., 2001, Lensminde, K., 2004, Mayeres, I. et al., 1996).The main objective of assessing costs has been to provide an objective tool for help in selecting more cost-effective countermeasures for road safety and also to justify expenditures for the same. However, critics like Hauer (1994) question the very basic principles of cost-benefit analysis where human lives, pain and suffering are involved. Professionals like Hauer working in this area take the position that putting a monetary value on human life is ethically unacceptable. As far as the liberal economists are concerned the objective of cost-benefit analysis is welfare maximisation. The process is neutral with respect to distributive outcomes and is insensitive to how the impacts are distributed between various groups of the population. For example, in India a large proportion of the pedestrians who get killed would come from the low-income strata of the population and car drivers from the high-income strata. If a cost-benefit analysis is attempted for increase in speeds of cars in urban areas then the increase in costs due to higher incidence of deaths among poor pedestrians could be offset by timesaving of rich drivers. Most people would consider such a justification immoral and unacceptable. However, governments, municipalities, and car and companies do incur costs when human beings are injured or killed in traffic crashes.

No matter what methods are used, the economic costs of traffic crashes turn out to be so high that it becomes easier for professionals to justify higher expenditures in promoting road safety. A report commissioned by the Global Road Safety Partnership of the World Bank summarise the efforts in the area and conclude that "overall it does appear that in most countries, costs exceed 1 per cent of GDP which may now be considered to be an underestimate of national accident costs" (Jacobs, G. et al., 2000). A more recent report by IRAP (Mcmahon, K. and Dahdah, S., 2008) discusses the background to valuation of safety benefits, briefly reviews the main methodologies that are in use, and presents recommendations for values for use in economic appraisal. They state that "estimates of the value of statistical life are heavily influenced by income regardless of the method that is used. Both Willingness-to- pay and the Human Capital/Lost Output approach provide estimates that are income dependent. A study of Valuation in a range of European countries found that about 40% of the variation between fatality values in the different countries could be accounted for by variation in Gross Domestic Product (GDP) per capita (Alfaro, J.-L. et al., 1994)". Table 3 shows the Value of Statistical Life as a ratio of per capita income (2004) for selected countries. IRAP recommends that a reasonable rule of thumb for the default value for the economic appraisal model is 70 as a central ratio value, with a range of 60 to 80 for sensitivity analysis. They recommend for the purposes of IRAP to use 10 as the default ratio of the number of serious injuries to the number of fatalities and for sensitivity analysis this ratio will vary between 8 and 12. However in some countries this ration can vary between 15-20 (Mohan, D. et al., 2009). Further, they suggest that a reasonable value of serious injury for the economic appraisal model is

Table 3. Value of Statistical Life as a ratio of per capita income (2004) for selected countries (Adapted from Mcmahon, K. and Dahdah, S., 2008).

Country	Economy	Value of Statistical Life (VSL), 2004 US$	VSL/per capita income
Australia	HIC	1,304,135	45
Netherland	HIC	1,806,000	58
USA	HIC	3,000,000	83
Malaysia	MIC	722,022	76
Vitenam	LIC	53,063	21
India	LIC	147,403	56

HIC, MIC, LIC: High, Middle and Low-Income country

25% of the value of a fatality, with a range of 20% to 30% for sensitivity analysis. The equivalent values in terms of multiplier of GDP per capita are a central value of 17 with a range of 12 to 24 for sensitivity analysis.

Table 4. Estimates of costs due to road traffic crashes in India (Adapted from Anon, 2000)

Type of accident	Estimated cost in Indian Rs. (1999)
Fatal	535,489
Serious injury	106,959 – 242,736
Minor injury	18,855
Property damage	-
Damage to buses	47,100
Damage to trucks	48,700
Damage to cars	16,200
Damage to 2-wheelers	4,100

COST OF INJURY IN INDIA

The last study on evaluation of RTI costs in India was sponsored by the Ministry of Surface Transport (India) and conducted by M/s Tata Consultancy Services (2000). A summary of the values calculated in these studies is given in Table 4.

The study conducted by Tata Consultancy Services an estimate of road accident costs as 0.69 per cent of GDP of India but the study makes the following mistakes (Mohan, D., 2002):

(a) The "useful life" of an Indian is assumed to be 62 years. However, the probability of an Indian dying before age 5 was 97 per thousand in 1999 which would give a low life expectancy at birth. This is why even the disability-adjusted life expectancy in India at age 60 was found more than 11 years. Other estimates show that even in 1992-1992 persons at age 10 could expect to live up to 68 years and those at 50 up to 73 years of age (Bose, A., 1996). Therefore, this study has also underestimated the life expectancy by more than 10 years (>15%). This is critical, because with improving health standards individuals are active and provide very useful social functions well beyond the age of 62.

(b) The study did not account for the undercounting inherent in the official statistics on road accidents.

(c) The costs of medical treatment are taken from government hospitals which include a large number of hidden subsidies.

(d) There is no attempt made to understand the differentials in wages of different road users and to account for it. Since pedestrians and bicyclists are likely to belong to the poorer sections of the population they will lower the accident costs in this way of calculation as they have a higher involvement in crashes. This method therefore does not satisfy the condition of acceptability to the public.

(e) The major statistical error, however, is the underestimate of injuries and vehicle damage in this study. For 1995 they use the figures of 68,351 for fatalities and 266,541 for injuries. This is a ratio of 1:3.9 for fatalities:injuries. If we take the conservative ratio of 1:15:70 for fatalities:serious-injuries:minor injuries and a 5 per cent under count for fatalities we get the figures as shown in Table 5. The cost of injuries alone according to this estimate is approximately Rupees 322,000 million against total estimate of Rupees 69,502 million by the Tata Consultancy

Table 5. Revised estimates for costs of road traffic crash injuries in India for 1995 (Source: Mohan, D. 2002)

Injury severity	*Estimated number of persons*	*Estimated cost in 1995 Rs (million)*
Fatalities	71,948	38,527
Serious-major injuries	1,079,220	188,698*
Minor injuries	5,036,360	94,960
TOTAL		**322,186**
Total cost as per cent of GDP		**3.2 per cent**

** Note: cost of serious injuries is taken as the average of serious and major injuries (Rs.174847.5) as stated in the in the TCS report*

report. This revised estimate indicates the road accident costs to 3.2 per cent of the GDP of India in 1995.

Estimate Based on IRAP Guidelines 2008

Table 6 shows estimates for cost of RTI in India in 2012 based on IRAP guidelines (Mcmahon, K. and Dahdah, S., 2008). These rough estimates also suggest that the cost of Road traffic injuries in India could well amount to 2.8 per cent of GDP of the country.

Table 6. Estimates for cost of RTI in India in 2012 based on IRAP guidelines

Statistical value	IRAP Ratio	Estimated number 2012	Total amount for country, million Rs.
Life	56*PCI	150,000	756,000
Serious Injury	17*PCI	1,500,000	2,295,000
Total for life lost and injury			3,051,000
Per cent of GDP			2.8

Notes: (1) All values used based on median numbers suggeted by IRAP (Mcmahon, K. and Dahdah, S., 2008.) (2) Per capita income (PCI) in India and GDP vales used for 2012. (3) 10% undercount assumed for total fatalities in India in 2012)

Summary

The above discussion suggests that societal cost of road traffic crashes could well be around 3 per cent of the GDP of Asian countries including India. Besides the economic costs associated with RTI, it is possible that the social costs may be higher in low and middle-income countries (LIC & MIC) than high-income countries (HIC) for the following reasons:

- LIC and MIC generally have higher rates of road crashes than HIC.
- Since cost of life is reflected in the per-capita income of the country and its GDP, the proportion of costs due to loss of life should be similar all countries.
- As a proportion of per capita income, costs of similar levels of medical care are higher in LIC/MIC as compared to those in HIC.
- Because of a scarcity of good rehabilitation care facilities and lack of aids for the disabled, road crash victims suffering permanent disability would suffer greater lack of access and employment opportunities in LIC/MIC.
- Owing to lack of welfare functions provided by the state and health care facilities, families of injury victims have to spend much more time looking after injury victims in LIC/MIC. This causes greater time and economic losses overall.

THE ROAD AHEAD

The fact that road traffic crashes may be contributing losses of 3 per cent of the annual GDP in India and other Asian countries and environmental degradation similar amounts, makes it imperative that we use this knowledge for making policy making more rational regarding the following issues:

(a) Modal choices concerning motorised transport, bicycling and walking
Investments in transportation must be made very carefully so that the returns are optimised. If costs of RTI and environmental degradation are included in calculating feasibility of road projects then, we may arrive at different policy options than those considered at present.

(b) Investments in safety features and designs for urban roads and rural highways
Estimates of social and economic losses due road traffic crashes have been grossly estimated in all past studies. Studies need to be done with greater scientific rigour to set the record straight. In the next few years large investments are going to be made in urb and and rural

infrastructure. The discussion in previous sections illustrates that the losses due to RTI are very high on our roads and the victims include a disproportionate share of pedestrians, bicyclists and other road users. Highways, once constructed, have a long life span and design faults continue to have their deleterious effects over this period. To reduce these losses the actual costs of road accidents have to be internalised at the planning stage itself. Once this is done, it will become obvious that much more attention needs to be given to the design of safer highways and that the investment required can be justified on economic grounds.

(c) Independent agency for road safety

All states must establish an independent agency for road safety staffed by professionals. Since the annual losses amount to more than 3 per cent of GDP, even a 5 per cent in decrease in RTI per year can effect huge savings. The international experience suggests that there is a strong correlation between scientific research and reduction in RTI. At present insignificant amounts are spent on safety research in most Asian countries. This agency would have the responsibility of promoting and commissioning such work. As a start, 0.5 per cent of highway construction funds may be allocated for starting the department.

(d) Integration of safety and environmental issues

The environment impact assessment and road safety audit reports of all highway and road construction projects must be considered in a joint meeting to clear conflicting policy options and to strengthen synergistic policies.

(e) Capacity building

A special effort must be made to train a large number of professionals in the scientific approach to road safety. To do this special road safety centres (stand alone and in universities) will need to be established and existing ones strengthened in all regions of the country. The World Bank has published a special report regarding the role and responsibilities of road safety professionals (Bliss, T. and Breen, J., 2009), and the recently released *India Transport Report* includes a special chapter on safety that outlines the steps needed to build build professional capacity in India (National Transport Development Policy Committee, 2014).

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