Socio-economic aspects of road accidents in developing countries

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TRL Report 247

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EXECUTIVE SUMMARY

This report reviews trends in road accidents and compares developing countries with industrialised countries. Social aspects of road accidents are examined, based on published statistics and on interviews with road accident victims in hospitals in Bangladesh, Fiji, Ghana, Indonesia, Peru and Zimbabwe. Insurance records were analyzed in Swaziland. The costs of road accidents are discussed and recommendations are made regarding how best to estimate these costs in developing countries.

Worldwide, there are estimated to be some half a million road accident fatalities each year. Almost 70 per cent of these occur in the developing world. Whilst there is a general decline in the numbers of fatalities in industrialised countries, the opposite is true elsewhere. If account is taken of levels of motorisation by expressing accident statistics as rate per registered vehicle, then less developed countries (LDCs) have rates 10 to 20 times higher than the best industrialised countries. The worst countries in these terms have fatality rates 100 times higher than the best.

Much higher proportions of those (reported as) injured in road accidents die as a result in the developing world, compared with industrialised countries. The fatality index[1] is also 10 to 20 times higher than in industrialised countries, on the basis of official statistics. There is a clear relationship between fatality index and the numbers of nurses and hospital beds in a country. Thus, not only is the proportion of people injured per vehicle very high in developing countries, but also the death rate is higher.

Another important aspect of road accidents in the developing world is that children under 15 form a higher percentage of road accident victims (typically 15 per cent) compared with industrialised countries (usually about 6 per cent).

The numbers of years lost per road accident fatality, in a sample of developing countries where data are available, is typically twice the numbers of years lost due to the more common diseases.

In this study it is estimated that the global cost of road accidents is US$ 230 Billion per annum. The cost to developing countries is around US$ 36 Billion, although 70 per cent of road accident deaths occur in the developing world. This apparent discrepancy results from the methods used to estimate the cost of an injury or fatality, much of which stems from the loss of production by the victim. In low wage economies this figure is substantially less than in an industrialised country, but as economic growth occurs there will be a consequential increase in the cost of an average road accident fatality.

One feature revealed by the hospital interviews of road accident victims carried out as part of this study is that the median income, in all six countries, was above average. This implies that the loss of output is higher than would be estimated from using national average wage rates, thus the cost of road accidents may be underestimated by current methodology which uses average wage rates. However the choice of hospital to be surveyed stemmed from local contacts and enthusiasm, not a statistical sample. Thus the results may be biased. It is also possible that only the richer victims go to hospital, as others cannot afford the charges which generally apply or the insurance premiums required. More research is needed to resolve this.

There may also be other social factors which influence this result. The age distribution of the road accident victims interviewed was heavily biased towards the economically active age range and towards males. This may reflect a conscious decision only to send male earners to hospital, as their loss to the household is more serious than that of a non-earner. Western attitudes towards protection of the weak do not apply in the harsh economic realities of the poorest countries, where the great majority of road accident victims, or their families, are responsible for the medical costs involved.

Between 40 and 75 per cent of the road accident victims surveyed were earners in a family group; between 9 and 46 per cent were the sole earner. In the hospital surveyed in Bangladesh, only 17 per cent of road accident victims did not have any dependants.

The 'Gross Output' approach is recommended at present as the preferred method for costing road accidents. This sums the value of lost production (by the accident victim), medical costs, property damage and other administrative and police costs to society. A subjective allowance can then be added to represent the 'pain, grief and suffering' of the victim and his/her loved ones. Because the value of lost production is costed on the basis of wage rates, it is important to have a clear profile of road accident victims and their status in society. In the United Kingdom as in other industrialised countries the 'Willingness to Pay' approach is now used to cost road accidents, replacing the 'Gross Output' method. This results in considerable increases in costs of road accidents. Research is clearly needed to determine whether or not the 'Willingness to Pay' approach can be used in the developing world.

Current cost methodology estimates the economic consequences of road accidents, but cannot fully represent the social consequences of the loss of a breadwinner in a large family group, or the grief caused by the loss of a child. As the full report shows, road accidents cause an undue proportion of lost working years and of childhood deaths in the developing world.

[1]The Fatality Index is defined as the percentage of fatalities out of the total number of road accident casualties.

SOCIO-ECONOMIC ASPECTS OF ROAD ACCIDENTS IN DEVELOPING COUNTRIES

ABSTRACT

Apart from the humanitarian aspects of road safety, the injuries and fatalities which occur as a result of road accidents have serious implications for a country in both social and economic terms. As a result of a wide variety of road safety activities and traffic management measures, road accident levels in most industrialised countries are falling, but in developing countries the situation is worsening with road accident deaths increasing.

This report presents the findings of an analysis of available data on road accident fatalities which compares trends in the developing world with that of the developed. Social aspects of road accidents were also examined based on interviews with accident victims in hospitals in Bangladesh, Fiji, Ghana, Indonesia, Peru, Swaziland and Zimbabwe.

1. INTRODUCTION

Apart from the humanitarian aspects of road safety, the injuries and fatalities which occur as a result of road accidents have serious implications for a country in both social and economic terms. As a result of a wide variety of road safety activities and traffic management measures, road accident levels in most industrialised countries are falling, but in developing countries the situation is worsening, with road accident deaths increasing.

Under the Overseas Development Administration's (ODA) Technology Development and Research (TDR) initiative, Ross Silcock Limited, in association with TRL, have undertaken a study of the socio-economic costs of road accidents in less developed countries (LDCs). The results are presented in this report.

The purpose of this project was to expand knowledge of the impact of road accidents on the economy and to assess their implications in socio-economic terms. It is hoped that decision makers can use the results to improve the evaluation process, increase the resources devoted to road safety and thereby reduce accident levels. Alongside these objectives, it has been possible to examine the social implications of road accidents.

In order to put road accidents in the developing world into context, it has been necessary to compare them with trends in industrialised countries (ICs). This has been achieved by analysing published data, from such sources as the International Road Federation Annual Handbook. Data regarding road accidents are not readily available for developing countries, and where they are available, the quality and quantity are varied. Thus trends have been examined for all the Third World countries which have produced relevant information. As information for ICs is more fully recorded, it was possible to use a selection of representative industrialised countries for comparative purposes.

As the numbers of road accident fatalities in developing countries have grown, their relative importance as a cause of death has increased. To gain a measure of this, road accident fatalities have been compared with trends in deaths due to violence and disease (the latter include diseases traditionally associated with LDCs such as typhoid and malaria and so called western diseases such as neoplasms and circulatory disorders). The results of this analysis are discussed in section 3.3.

Earlier work carried out by TRL has shown that children form a larger proportion of road accident fatalities in the developing world than in ICs (Downing and Sayer 1982). To ascertain whether this is still a characteristic of road accident deaths in LDCs, the age profiles of road accident victims in LDCs have been compared with those in ICs.

The age-profile of accident victims can also have an impact on GNP (Gross National Product) and working years lost. Therefore, age related data have been important in calculating the economic costs of road accidents.

In assessing the average cost of a road accident, it is usual to use the 'Gross Output' approach which involves estimating average output or earnings data. It is not clear that such averages are appropriate to road accident victims as they are often far from "average" in a developing country. They are likely to be concentrated in the capital city which normally has a higher than average income per capita and a substantially higher per capita vehicle ownership level than the rest of the country. In addition to this, car owners tend to be at the top end of the income/productivity range in the country; and as such it is arguable that the cost (to society) of losing such people is above average. A countervailing factor is that, in some countries, up to 50 percent of fatalities are pedestrians, who may have below average incomes. However these accidents are predominantly urban, with potentially above average lost output as a result.

Although the broad approach provides valuable data on the overall impact of road accidents, it was considered important here to undertake more detailed studies to provide more qualitative data describing the circumstances of individual accident victims. As part of this project, surveys were carried out in Bangladesh, Fiji, Ghana, Indonesia, Peru, Swaziland and Zimbabwe. These countries were selected because either Ross Silcock or TRL have a current road safety project there, and local contacts could be used to facilitate fieldwork.

In Swaziland, data were abstracted from insurance records, as the national motor vehicle insurance agency was particularly helpful. In this case the data are nation-wide. In other countries the survey method was to carry out interviews of road accident victims in a selected hospital. The choice of hospital was dictated by local interest and support, and is not intended to be a random selection. No claims are made that the chosen hospitals are representative of conditions throughout the country. The results of the surveys are discussed further in section 5.2.

2. ACCIDENT RATES AND TRENDS

2.1 NUMBER OF ROAD ACCIDENTS WORLDWIDE

Both the World Bank and the World Health Organisation, in independent studies, have calculated that, worldwide, there are around 500,000 fatalities and 15 million injuries per annum as a result of road accidents. Earlier estimates also suggest that about sixty percent of these deaths and injuries take place in those countries of Africa and Asia which are classified by the World Bank as low or middle income (World Bank, 1990 and Yerrell, 1992).

To assess the validity of these estimates, and whether there has been any change, the number of global fatalities by region have been calculated using 1992/93 data. Using data from a number of detailed studies, it has been suggested that the level of under reporting of road accident fatalities in LDCs is at least twenty percent (Sayer and Hitchcock, 1984). Similar studies by James (1991) discovered that under-reporting in industrialised countries is in the order of 6 percent. The data on fatalities have been adjusted to take into account under-reporting. The adjusted figures are presented in table 1.

The results of this calculation confirm that the global number of road accident fatalities is around 500,000 per annum. However, some 70 percent of these occur in developing countries. This suggests that, although globally there has been little change in the number of road accident deaths, the proportion of world fatalities which occur in LDCs has risen.

2.2 GLOBAL TRENDS IN ROAD ACCIDENTS FATALITIES

The percentage change in road accident fatalities by region since 1968 is presented in Figure 1. The trend in ICs has been towards a reduction in fatalities, even though there has been a substantial rise in the number of motor vehicles. Conversely, the number of fatalities has increased substantially in the developing world; for example in Africa there were around 350 percent more road accident deaths in 1990 than there were in 1968.

Motor vehicles play an important role in transporting goods and people, and as such have an impact on GDP (Gross Domestic Product). However, as the number of motor vehicles on the roads increases, there is more potential for road accidents to occur in terms of vehicle-vehicle conflicts or vehicle-pedestrian conflicts. But, as stated previously, road accident deaths in many ICs have decreased, despite the growth in the number of motor vehicles on the road. This reduction is due to the combined effect of many measures: road safety awareness campaigns, legislation (e.g making wearing seatbelts compulsory), driver training, road engineering and higher safety standards for vehicles. Whatever the reasons, this experience demonstrates that it is possible to reduce the number of road accident deaths whilst the number of vehicles on the road is increasing.

TABLE 1

Number of annual road accident fatalities, by region (1992/93)

Continent	Number of fatalities
Europe	97,500
Africa	74,000
North America	45,300
South America	38,500
Asia and Middle East (including Japan)	240,000
Oceania	4,000
TOTAL	499,300
Developing Countries	352,500
Industrialised Countries	146,800

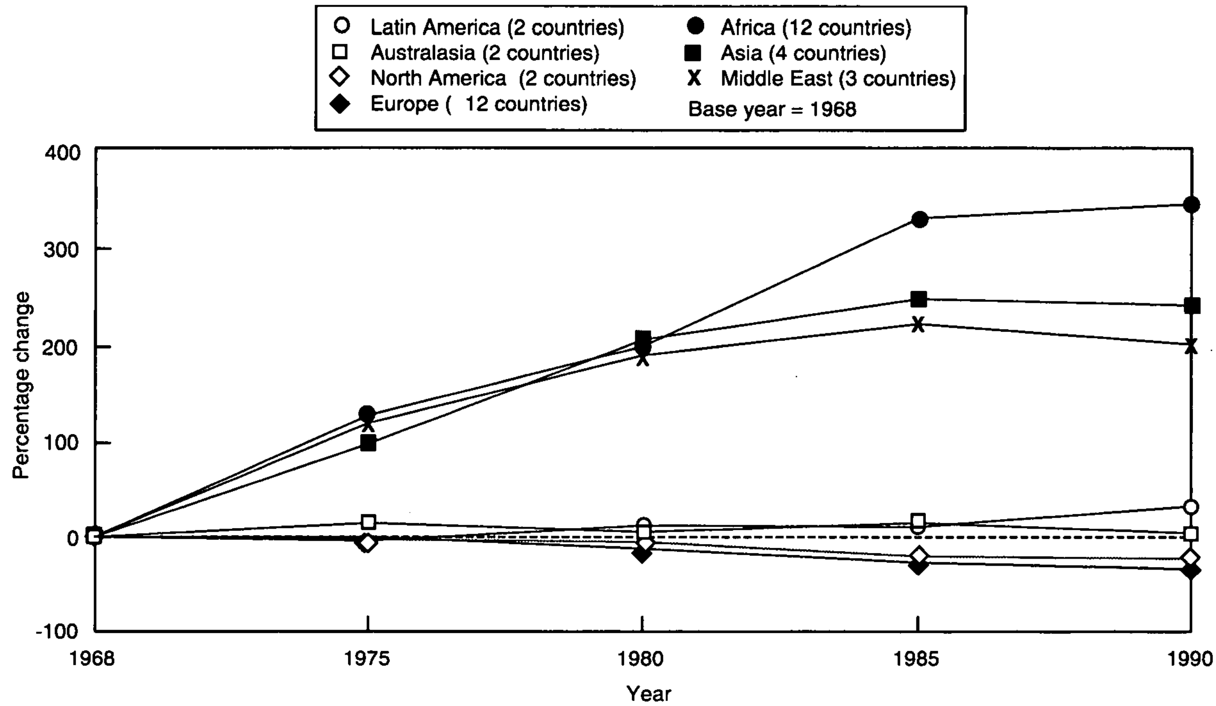

Fig. 1 Percentage change in road accident fatalities

Conversely, in the countries of Africa, Asia and Latin America road deaths have risen with increasing vehicle ownership. Scarce financial resources in these countries means that they have been unable to invest in the wide range of engineering, education and enforcement measures that have proved so successful in the developed world. Yet the economic costs of not taking action are very high, as shown above.

It must be remembered that many developing countries are experiencing a much more rapid rate of growth in vehicle ownership than now prevails in the UK. Looking back at UK accident records during the early years of motorisation, similar growth in road accident fatalities can be seen. For example, road accident fatalities in the UK increased by 50% between 1954 and 1964. It was not until fatality levels had peaked at almost 8,000 in the mid 1960's (compared with 3,650 in 1994) that concerted action began to be taken.

2.3 FATALITY RATES

One way of comparing road accident problems in a large number of countries is to examine a fatality rate, that is the number of deaths with respect to some measure of the use of the road system. The fatality rate is often expressed as the total number of injury accidents occurring per annum per million vehicle kilometres travelled. However, because few LDCs carry out comprehensive traffic surveys or have comprehensive accident reporting systems, these data are not readily obtainable. For the purpose of this research the fatality rate is defined as being the number of road accident deaths per 10,000 licensed vehicles. Fatality rates in these terms are shown in Figure 2.

For developing countries, the fatality rate may in fact be higher than shown as vehicles no longer in service are not always removed from the vehicle register, and as stated previously there is an under-reporting of fatalities. For example, a TRL study in Sri Lanka in 1984 (Sayer and Hitchcock, 1984) compared "official" road accident statistics from police records with those held by hospitals. It was discovered that less than 25 percent of the hospital records of fatal and serious road accidents were identified in the police data. It can be seen from figure 2 that the fatality rates for LDCs are far higher than those for the ICs; for example in Nepal and Bangladesh the fatality rates are 82 and 76.8 fatalities per 10,000 vehicles respectively, compared to 1.9 in Japan.

Half of the ten countries with the highest fatality rates in Figure 2 are African. South Africa has the lowest fatality rate of any African country (18.8), but this is some ten times higher than the levels recorded in ICs (e.g Australia has a fatality rate of 1.9). Generally, African countries tend to have comparatively high fatality rates.

A number of countries within Asia, e.g Malaysia and Singapore have relatively low fatality rates (6.1 and 4.5 respectively), but it is arguable that these countries can be classified as "emerging" countries rather than LDCs, and as such are beginning to exhibit the characteristics of industrialised countries.

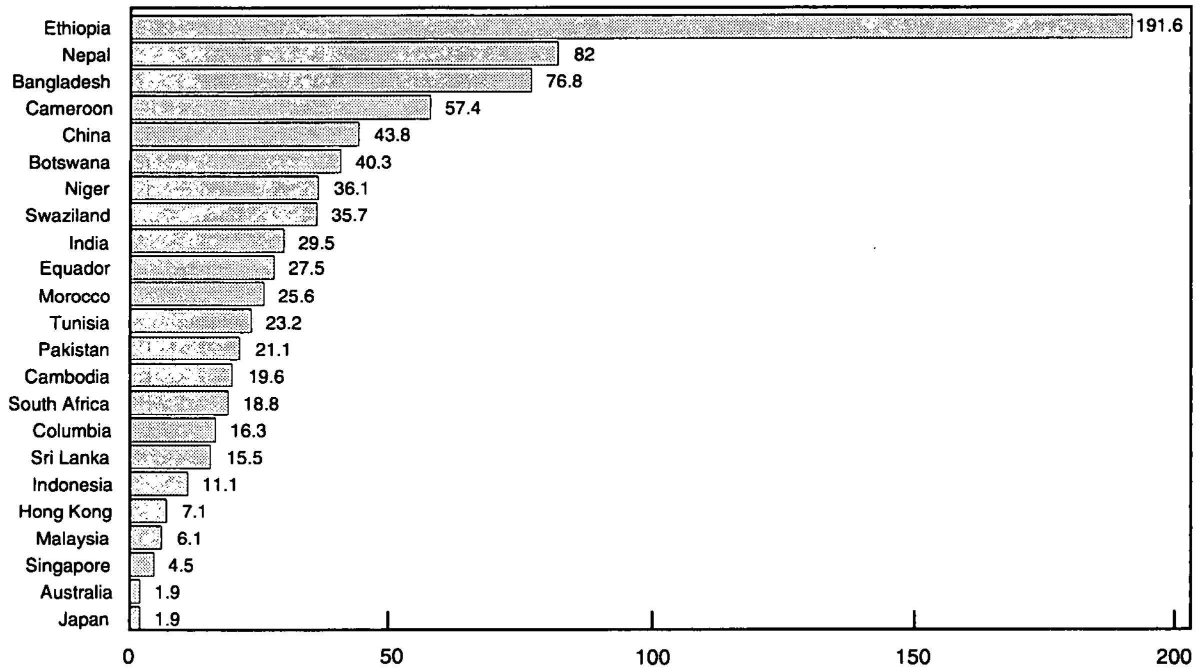

Fig. 2 Fatalities per 10,000 licenced vehicles per year

2.4 USE OF THE 'SMEED' EQUATION

Smeed (1968) analyzed data on road accident fatalities, vehicles and population from 20 industrialised countries for the year 1938, and from his analysis derived the following relationship:

$$\frac{F}{V} = 0.0003 \left(\frac{V}{P}\right)^{-2/3}$$

where F = annual number of fatalities from road accidents

V = number of vehicles in use

P = population.

This relationship can alternatively be expressed as a straight line:

$$\log \frac{F}{V} = -3.52 - 0.63 \log \frac{V}{P}$$

According to the Smeed relationship, the greater the per capita level of vehicle ownership, the lower the per vehicle fatality rate. Jacobs & Hards (1978) repeated the analysis for the same countries for the years 1950, 1960 and 1970, and discovered that the above expression remained true.

In the past, the Smeed equation was criticised in that it was used to 'predict' future numbers of deaths, based on forecasts of future vehicle ownership levels. In this analysis (and an earlier analysis carried out by Jacobs) the equation derived has not been used to predict future numbers of road accident deaths. Rather, it has been used to monitor changes in death rates over time and to compare industrialised and developing countries.

Research has shown that in the developing world, while there is a linear relationship between vehicle ownership and fatality rates per vehicle, this relationship is different from that discovered in ICs; for example Fouracre & Jacobs (1977) discovered the following relationship using 1965 data for a selection of more than 30 developing countries:

$$\log \frac{F}{V} = -3.30 - 0.43 \log \frac{V}{P}$$

A later study by Jacobs (1982) using data for 1978 for 34 developing countries, found a relationship of:

$$\log \frac{F}{V} = -3.48 - 0.70 \log \frac{V}{P}$$

It can be seen that the slopes of these two relationships are markedly different. Although the intercept is similar in both expressions, the gradient has changed from -0.43 to -0.70 in the period 1965 to 1978. This can be seen as a clockwise rotation of the Smeed relationship about the y-axis intercept (i.e a higher fatality rate for a given level of vehicle ownership - see Appendix A).

This rotation is an important feature of the data for developing countries. In virtually all countries in the world the number of vehicles is on the increase. For ICs the implication of this is a reduction over time in per vehicle fatality rate. However, for developing countries, the rotation works against the predictions of the Smeed relationship, and, at least in the short term, increasing vehicle ownership may result in increases in per vehicle fatality rates.

In order to investigate this rotation further, data for the years 1980 to 1992 for 17 Asian and Pacific countries were used to formulate Smeed regression equations for each year. All were significant at below the 1% level, and their coefficients are shown below in Table 2. It would appear that there was a clockwise rotation of the Smeed relationship up to 1987. In more recent years this appears to have levelled out slightly.

For the purpose of this research the above analysis was repeated for Asian, African and South American countries using 1990 data; the results of this calculation are shown in the following equation, and the plot in Figure 3.

$$\log \frac{F}{V} = -3.561 - 0.619 \log \frac{V}{P}$$

This relationship is statistically significant at the one per cent level, showing a strong correlation between vehicle ownership and per vehicle fatality rates; the higher the levels of vehicle ownership, the lower the per vehicle fatality rate. Comparing this result with that obtained by Jacobs (1982), it appears that the line has now rotated anti-clockwise relative to 1978. This suggests that the situation deteriorated between 1965 and 1978, but has improved slightly between 1978 and 1990, at least in so far as the fatality rate relative to vehicle ownership is no longer worsening.

Putting known values for population and number of registered vehicles for the different countries into the above equation allows the number of fatalities to be predicted by the model. It is therefore possible to compare predicted and actual fatalities. This comparison gives some indication of the proximity of a particular country to the regression line, and thus gives some quantification of the relative road safety problem.

TABLE 2

Coefficients for Smeed Equations for 1980-1992 Data (Asian and Pacific Countries)

Year	Intercept	Gradient
1980	-3.43	-0.595
1981	-3.465	-0.608
1982	-3.481	-0.621
1983	-3.542	-0.650
1984	-3.559	-0.642
1985	-3.646	-0.698
1986	-3.699	-0.751
1987	-3.682	-0.715
1988	-3.616	-0.685
1989	-3.596	-0.675
1990	-3.624	-0.693
1991	-3.593	-0.675
1992	-3.681	-0.703

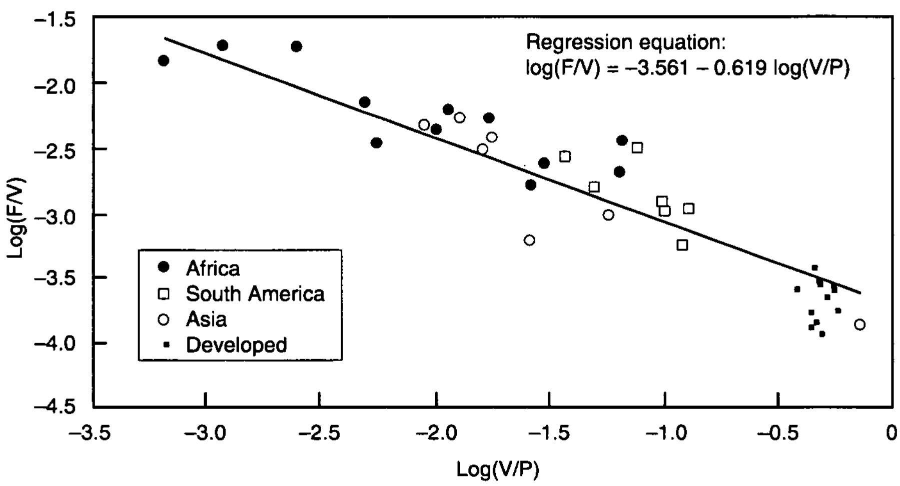

Fig. 3 SMEED analysis

Figure 4 shows the percentage difference between actual and predicted fatalities for each of the countries used in this analysis. The percentage differences have been calculated using the following equation:

$$\text{Percentage difference} = \frac{F_{actual} - F_{predicted}}{F_{actual}} \times 100$$

Australia, France, Germany, Great Britain and The Netherlands were excluded from the regression derivation by virtue of being ICs, but they are shown in Figure 4 for comparative purposes. Since it is accepted that Smeed lines for groups of LDCs tend to lie above those for ICs, it would be expected that these three countries lie below the line, and thus to have less fatalities than predicted; as Figure 4 shows, this hypothesis holds true.

2.5 FATALITY INDEX

The Fatality Index is usually defined as the percentage of fatalities out of the total number of road accident casualties, it is expressed in the following equation:

$$\text{Fatality Index} = \frac{\text{Fatalities}}{\text{Total casulaties}} \times 100\ \%$$

The fatality index shown in figure 5 is based on 1989 data (the latest available). This graph shows that the fatality indices of LDCs are of a much greater magnitude than those of industrialised societies; i.e a greater proportion of all injury road accidents result in death in the developing world.

2.6 FATALITIES AND MEDICAL CARE

Road accidents are usually classified as being fatal if a victim dies within 30 days of the accident occurring; thus, while the higher level of road accidents in developing countries may be attributable to factors such as driver error, poor road conditions or poor traffic management, it is also possible that a lack of medical facilities contribute to the high fatality levels. If medical attention can be given to an accident victim promptly, then the chance of survival is increased. This is illustrated in research by Jacobs and Cutting (1986) who found a significant relationship between fatality index and the number of doctors per capita.

It also worth noting that the fatality indices may be inflated because a greater proportion of accidents involving fatalities are reported to the authorities than those involving slight injuries. As a result the fatality indices are higher than if all injury accidents were accurately recorded.

Fatality indices have been regressed with the following:

- hospital beds per 1000 population;
- doctors per 1000 population; and
- nurses per 1000 population.

The results are presented in figures 6 to 8. These regressions show that there is a significant relationship between hospital beds and nurses per 1000 population, i.e in countries where medical facilities are poor, the fatality index is high.

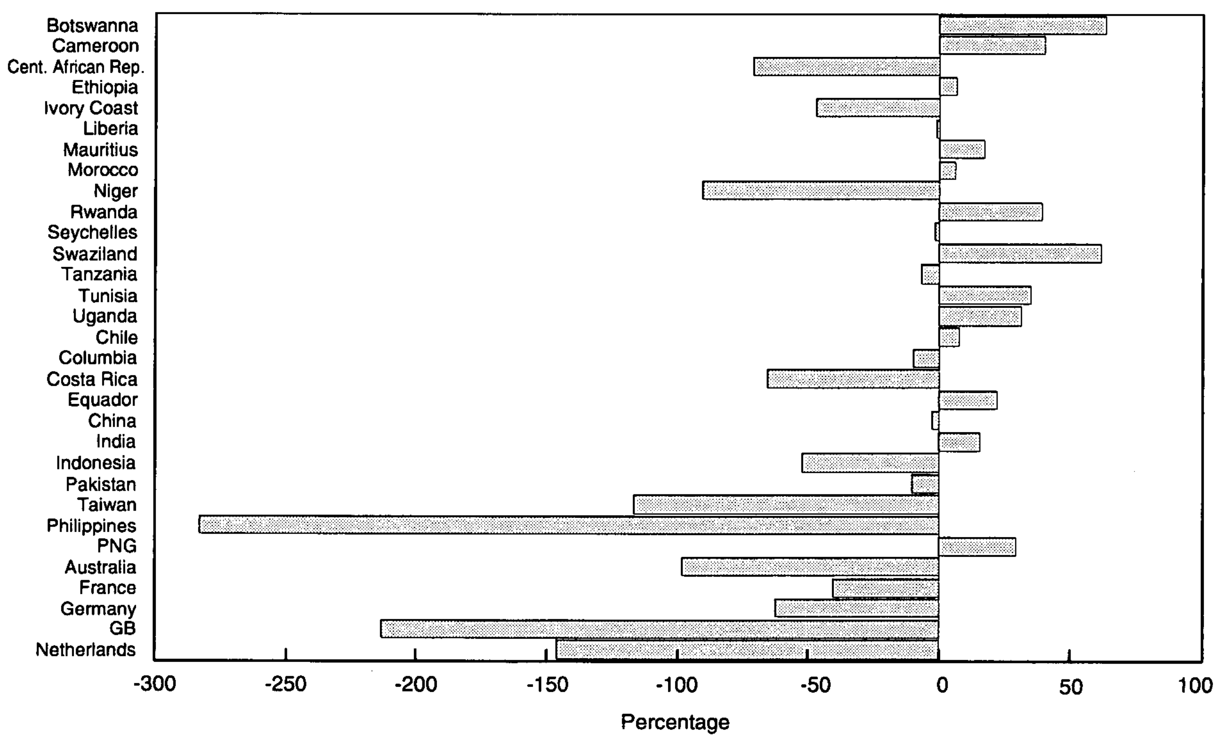

Fig. 4 Percentage difference between actual fatalities and SMEED predictions

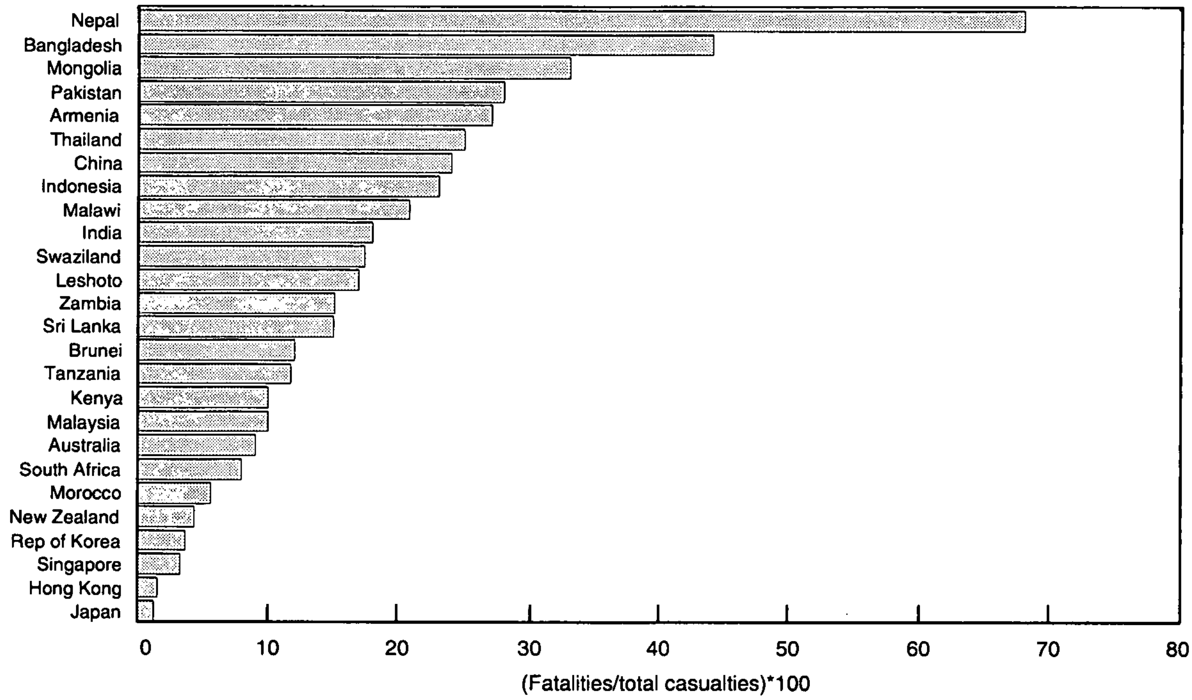

Fig. 5 Fatality Indices (1989)

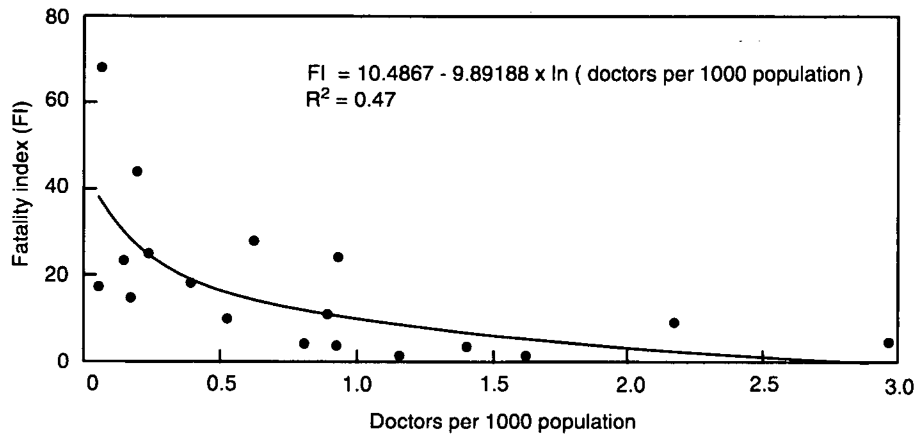

Fig. 6 Fatality index against doctors per 1000 population

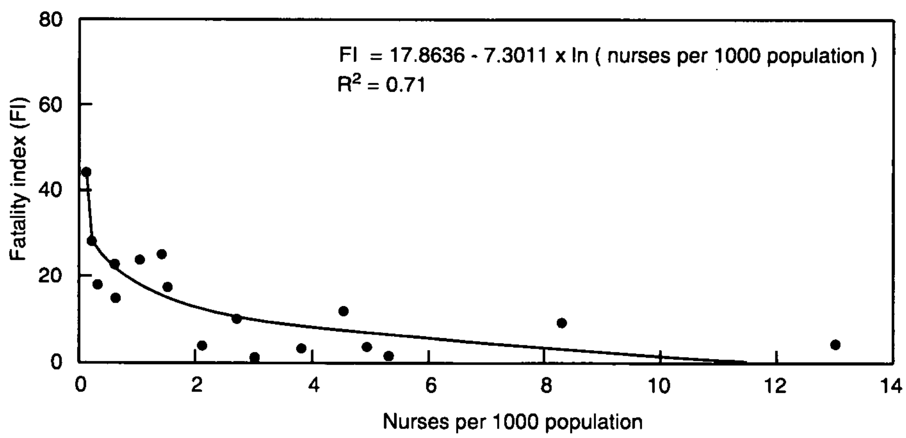

Fig. 7 Fatality index against nurses per 1000 population

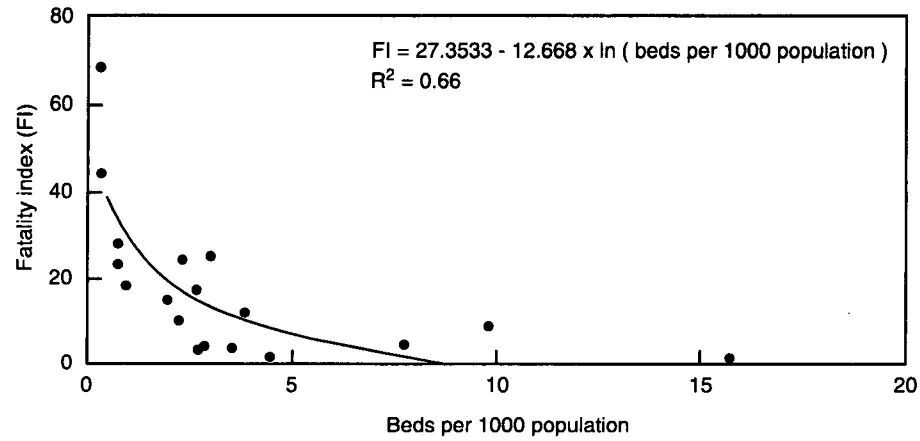

Fig. 8 Fatality index against hospital beds per 1000 population

Consequently, if medical facilities are improved, then the number of people injured in road accidents who subsequently die can be reduced. However, as well as medical care in hospitals, road accident victims stand a greater chance of survival if medical attention can be given promptly. Therefore improvements may also need to be made to ambulance facilities, and paramedical training given to ambulance staff.

In addition to differences in medical facilities, it must be remembered that there are differences in the nature of road accidents between industrialised and developing countries which can affect the fatality index. In the United Kingdom, there are strict regulations covering the operation of public service vehicles; for example they have to pass a comprehensive annual test each year, and in addition to this, may also be subject to spot checks carried out by the Vehicle Inspectorate. There are also regulations covering the number of passengers carried. But, in the developing world, vehicles such as open-topped lorries maybe used to carry fare paying passengers, and capacity may not be restricted, thus if an accident occurs involving a 'bus', then the likelihood of fatalities occurring is relatively high.

3. SOCIAL ASPECTS OF ROAD ACCIDENTS

3.1 ROAD ACCIDENT DEATHS BY AGE

There are some road accident characteristics which are prevalent in the developing world, but which are different from those found in ICs. For example, Downing and Sayer (1982) found that children under 15 years of age formed a relatively high proportion of fatalities in the developing world compared to elsewhere. Over a sample of 19 LDCs, they discovered that under 15 year olds accounted for twenty percent of fatalities. Similar analyses for nine ICs showed that under 15's made up ten percent of fatalities; therefore the proportion of fatalities to under 15's in the developing world was twice as high as in ICs. The results of this study are presented in Tables 3 and 4.

These results show that in developing countries the accident fatalities tend to be in the younger age-groups. However, differences between the traffic and population characteristics of developing and ICs may help to explain the difference in road accident fatalities to under 15 year olds. For example, Downing and Sayer (ibid) discovered that in their sample of LDCs, 28 percent of the population were under 15 compared to 9 percent in the ICs studied.

To ascertain whether there have been any changes in the age profiles of road accident fatalities, more recent data for industrialised and developing countries have been obtained and analyzed. However, due to paucity of information, these later groups of countries differ somewhat from those used by Downing and Sayer and this must be borne in mind when comparing the results of the two studies. Thus, while the results of the two studies are not directly comparable, they are indicative of trends in road accident fatalities to under 15's.

This analysis has shown that under 15's now account for around 15 percent of fatalities in developing countries compared with 6 percent in ICs (see Tables 5 and 6); therefore the proportion of fatalities to under 15's in LDCs appears to have fallen. But, relative to ICs the situation is worsening - fatalities to under 15's in the developing world are now approximately 2.5 times higher than elsewhere, as opposed to being twice as high in the earlier study.

In order to qualify the above, it is necessary to examine the age profiles of the countries, because a significant change in the percentage in the 5-14 age range may help to explain changes in the proportion of fatalities to under 15's. The percentages of the population for each country between the ages of 5 and 14 are shown in Tables 3 to 6. The mean percentage of children in this age range has fallen in LDCs, but risen in ICs; despite this increase in ICs, fatalities to under 15's have fallen significantly. However, in the LDCs

TABLE 3

The involvement of children under 15 years of age in road accidents in developing countries
(Downing and Sayer 1982)

Country	Year	Number of fatals under 15	Total number of fatals	% of all fatals aged under 15	%population aged 5-14 years
Angola	1973	57	398	14	24
Colombia	1970	568	1954	29	29
Cyprus	1975	9	110	8	20
Egypt	1971	226	546	41	27
Hong Kong	1975	51	319	16	22
Jamaica (1st 6 months)	1978	45*	211	21	30
Jordan	1973	57	171	33	28
Malawi	1977	42*	317	15	25
Malaysia	1977	289	1740	17	29
Mauritius	1973	25	135	19	28
Mexico	1974	1790	8871	20	29
Peru	1970	227	1036	22	28
Philippines	1974	369	1276	29	30
Reunion	1969	17	79	21	29
Singapore	1975	25	245	10	27
Sri Lanka	1976	83	303	27	26
Swaziland	1978	25	157	16	30
Thailand	1975	867	5181	17	29
Venezuela	1973	572	3353	17	29
TOTAL		5344	26402	20	28

* Age was given for pedestrian and cyclist casualties only. Other casualties have been assumed to be over 14.

TABLE 4

The involvement of children under 15 years of age in road accidents in industrialised countries
(Downing and Sayer 1982)

Country	Year	Number of fatals under 15	Total number of fatals	% of all fatals aged under 15	%population aged 5-14 years
Australia	1974	372	3814	10	18
Canada	1974	804	6325	13	18
France	1976	918	13577	7	17
Japan	1975	1721	14196	12	15
Spain	1977	453	4843	9	18
Sweden	1977	80	1031	8	14
United Kingdom	1977	638	6641	10	16
USA	1976	4309	45422	9	20
West Germany	1977	1393	14978	9	15
TOTAL		10688	110827	10	15

TABLE 5

The involvement of children under 15 years of age in road accidents in developing countries (current study: 1990 data)

Country	Number of fatals under 15	Total number of fatals	% of all fatals aged under 15	%population aged 5-14 years
Botswana	60	379	15.8	28.3
Brazil	3681	28432	13.0	22.6
Colombia	635	4326	14.6	24.0
Egypt	841	3248	25.8	25.4
Ecuador	378	2021	18.7	24.7
Fiji	13	88	14.7	24.3
Korea	1363	13142	10.3	17.3
Malaysia	463	3580	12.9	23.2
Mexico	1967	13964	14.0	25.8
Nicaragua	71	390	18.2	28.1
PNG	66	307	21.4	25.2
Peru	160	842	19.0	24.1
Puerto Rico	39	578	6.7	18.7
AVERAGE			15.2*	24.0*

*NOTE: Brazil has a much larger number of fatalities, and to avoid biasing the average, the average of averages has been used.

TABLE 6

The involvement of children under 15 years of age in road accidents in industrialised countries (current study: 1990 data)

Country	Number of fatals under 15	Total number of fatals	% of all fatals aged under 15	%population aged 5-14 years
Australia	132	1881	7.0	14.4
Belgium	93	1830	5.0	12.1
Canada	238	3463	6.8	13.7
France	398	9042	4.4	13.4
Italy	334	9123	3.6	11.3
Netherlands	81	1240	6.5	11.9
New Zealand	54	657	8.2	14.0
Sweden	35	747	4.6	11.5
Switzerland	36	752	4.8	11.3
United Kingdom	315	4681	6.7	12.6
USA	2738	40115	6.8	14.4
West Germany	497	10909	4.5	10.5
Average			5.9	13.1

there has been a small reduction in deaths to under 15's, but correspondingly there has been a reduction of the percentage of the total population in this age group. This reinforces the conclusion that, in comparison to ICs, the situation regarding road accident deaths to under 15's in LDCs is worsening.

3.2 ROAD ACCIDENT FATALITIES AND OTHER CAUSES OF DEATH

One way of assessing the importance of road accidents as a cause of death is to compare death rates from road accidents with those of other causes. Using data provided by the World Health Organisation (WHO) Jacobs and

Bardsley (1977) discovered that for a sample of 15 developing countries, road accident deaths were the tenth most important cause of death (behind such causes as bronchitis, circulatory, parasitic and infectious diseases); and for the age-group 5-44 years they were second only to deaths due to other accidents, suicides and homicides combined.

In this section of the report, the present significance of road accidents is reviewed and road accidents are compared to (a) diseases normally associated with both the developed and the developing worlds and (b) death due to violent causes.

3.2.1 Road accident deaths compared with deaths due to disease

Jacobs and Bardsley (1977) also looked at trends in road accidents fatalities compared to death due to disease in a number of developing countries over the years 1960-1972. They discovered that road accident fatalities were increasing over time whilst over the same time period deaths as a result of diseases traditionally associated with the Third World were decreasing.

Jacobs and Bardsley's work has been updated as part of the study, to establish whether these trends have continued. Road accident fatalities have been compared with deaths from disease and the results are shown in Table 7 (for 23 developing and 10 industrialised countries).

This shows that there has been a substantial decline in infectious diseases, typhoid and TB in LDCs, but a massive increase in deaths due to road accidents. Relative to the base year of 1965 road accident fatalities in LDCs had increased almost fourfold by 1990, compared with a 23 per cent increase in industrialised countries. Whilst there have also been substantial increases in deaths from so-called 'western' illnesses such as cancer and circulatory disease, the growth in the number of deaths from road accidents is extremely high.

3.2.2 Road accident deaths compared with deaths due to violent causes

Table 8 shows the proportions of fatalities by violent cause for 1990 (the latest year available). Violent causes of death for the purpose of this research were fatalities resulting from: fire, drowning, all other (violent causes), suicide, homicide, and road traffic accidents.

It was not possible to obtain such comprehensive information for a large number of LDCs, therefore a sample of developing countries were used to compile the data in Table 8. While they might not necessarily be representative of the developing world in general, they do provide useful information which serves to give an indication of the relative importance of road accident fatalities as a cause of premature death.

TABLE 7

Percentage change in deaths due to diseases and motor vehicle accidents (current study)Base year = 1965

		1970	1975	1980	1985	1990
Typhoid	ICs	-35.5	-64.0	-67.2	-84.9	-93.0
	LDCs	+51.5	+4.4	-22.7	-40.1	-56.6
TB	ICs	-35.7	-55.2	-69.8	-80.5	-84.2
	LDCs	-15.3	-13.8	-17.1	-31.7	-33.6
Other parasitic and	ICs	+31.6	+47.1	+6.4	-14.8	-8.1
infectious diseases	LDCs	+32.6	+32.6	+4.98	-6.7	-10.3
Cancer	ICs	+32.5	+50.1	+61.7	+77.3	+85.7
	LDCs	+16.7	+30.4	+111.6	+117.5	+185.3
Circulatory	ICs	+96.5	+112.9	+125.2	+88.5	+108.7
	LDCs	+77.9	+142.6	+408.5	+223.7	+498.0
Pneumonia	ICs	+15.3	+12.3	-18.3	-10.6	-11.7
	LDCs	+32.4	-3.7	+15.9	-5.99	-7.3
Bronchitis	ICs	+112.5	+68.0	+101.3	+102.9	+817.0
	LDCs	-6.4	-8.9	+43.5	+29.9	+20.7
Motor vehicle	ICs	+53.3	+49.7	+45.9	+24.0	+22.8
accidents	LDCs	+11.7	+85.6	+348.8	+370.8	+392.7

(See References: Table 7 Countries)

TABLE 8

Cost of road accidents by region in 1990
(as 1 per cent of GNP)

	LDCs	ICs
Fire	1.7	2.4
Drowning	7.2	2.3
All other (violent causes)	19.7	25.6
Suicides	8.8	32.9
Homicide	25.9	3.1
Road Traffic Accidents	36.5	33.7
TOTAL	100	100

From Table 8 it can be seen that road accident fatalities now account for a similar proportion of violent deaths in the developing and developed world. However, as stated previously, it is necessary to be wary of accepting the results at face value; if it were possible to provide the same information for a different sample of LDCs, then the results may differ.

As stated previously, information is not always available over time for developing countries, and therefore it was not possible to select a representative sample of LDCs and compile reliable time-series information on death by cause. However, by using the available data, it has been possible to provide some time series data on the proportion of all violent deaths that were the result of road accidents.

The trends in road accident deaths as a percentage of all violent deaths in LDCs and ICs are shown in Figure 9. Since the 1960 base year, the proportion of road accident fatalities has risen in LDCs so that in 1990 road accident fatalities account for 34 percent of all violent deaths in LDCs compared to 13 percent in 1960. Comparatively in ICs, road accident fatalities have remained in the order of 30 percent over the time period examined. Thus road accidents have grown in significance as a cause of violent death.

3.3 YEARS LOST AS A RESULT OF ROAD ACCIDENTS COMPARED WITH OTHER CAUSES

The age profile of accident victims will have implications on the economy of a country in terms of working years lost. On-going research at TRL has calculated the number of years lost and working years lost as a result of road accident fatalities compared to other causes of death; typhoid, malaria, malignant neoplasms, circulatory diseases, respiratory diseases, all accidents (this includes road accidents), other accidents and homicides, for a sample of countries chosen because the relevant data were readily available. The results are shown in Tables 9 and 10 for years lost, and 11 and 12 for working years lost. Whilst this analysis is interesting and gives some indication of the serious nature of the road accident problem, it must be remembered that the above countries are not necessarily representative of either the developed or developing worlds in general. However, the results show that premature death as a result of road accidents is a substantial cause of lost productive years.

4. COSTS OF ROAD ACCIDENTS

4.1 GLOBAL ECONOMIC COSTS OF ROAD ACCIDENTS

As well as the social costs such as pain, grief and suffering that arise as a result of road accidents, there are also economic costs which can place a severe financial strain on

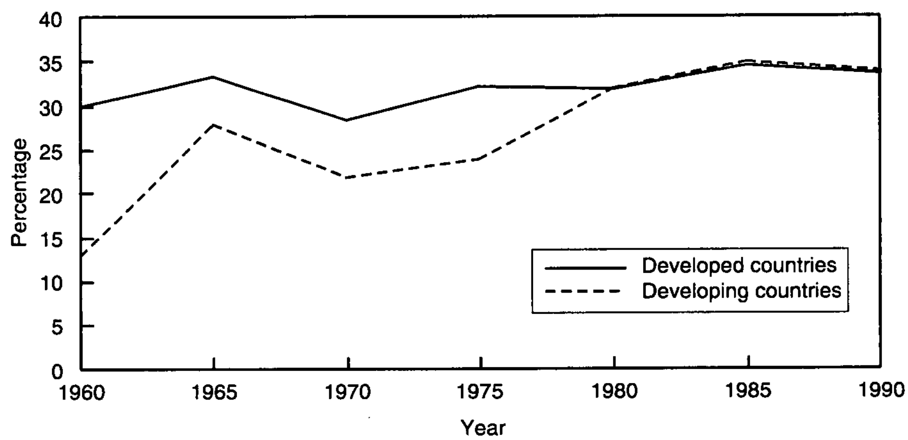

Fig. 9 Road traffic fatalities as a percentage of all violent deaths in developing and industrialised countries.

TABLE 9

Number of years lost per fatality by specific cause (developing countries)

	Argentina 1990	Costa Rica 1989	Mexico 1991	Mauritius 1992	PuertoRico 1991	Trinidad/Tobago 1991
Infectious diseases	26.6	36.0	43.9	31.2	16.1	20.5
Typhoid	22.5	0.0	35.7	53.7	0.0	9.7
Malaria	0.0	0.0	26.9	0.0	0.0	0.0
Cancer	14.6	16.6	19.1	17.4	14.0	14.6
Circulatory	10.3	11.1	12.5	12.1	10.5	10.0
Respiratory	15.9	17.7	29.7	15.2	12.1	15.4
All accidents	33.8	36.1	40.2	34.6	32.9	33.8
Road accidents	35.1	39.5	40.7	30.4	36.5	35.0
Homicide	38.4	40.8	41.1	40.5	43.3	39.3
TOTAL	17.6	23.1	28.9	18.8	17.8	16.1

TABLE 10

Number of years lost per fatality by specific cause (industrialised countries)

	Canada 1991	USA 1990	UK 1992	Australia 1992	Japan 1992	New Zealand 1991
Infectious diseases	15.7	16.0	17.7	16.0	11.5	20.6
Typhoid	0.0	18.7	55.1	0.0	0.0	0.0
Malaria	1.0	38.3	27.0	32.0	0.0	30.0
Cancer	13.4	13.4	11.3	13.9	15.0	14.1
Circulatory	8.6	9.1	7.6	8.5	10.0	8.8
Respiratory	7.9	9.3	6.7	9.0	8.1	8.3
All accidents	30.7	33.8	25.7	33.7	26.2	36.3
Road accidents	40.5	39.9	36.0	41.5	34.2	44.1
Homicide	43.1	44.2	41.8	43.0	42.9	44.6
TOTAL	13.1	14.1	9.9	13.1	13.1	13.7

TABLE 11

Number of working years lost per fatality by specific cause (developing world)

	Argentina 1990	Costa Rica 1989	Mexico 1991	Mauritius 1992	Puerto Rico 1991	Trinidad/Tobago 1991
Infectious diseases	8.2	13.1	14.2	10.5	6.1	10.0
Typhoid	12.3	0.0	18.3	34.0	0.0	0.0
Malaria	0.0	0.0	17.0	0.0	0.0	0.0
Cancer	4.9	6.2	8.3	8.1	4.1	6.4
Circulatory	2.7	3.1	4.0	4.3	2.2	3.4
Respiratory	3.9	3.5	6.1	6.3	3.2	5.8
All accidents	19.4	22.9	27.0	25.0	21.7	23.9
Road accidents	23.5	25.9	28.9	22.2	24.9	25.7
Homicide	26.2	26.7	29.6	24.0	32.6	29.0
TOTAL	5.0	7.3	10.4	7.2	6.6	7.1

TABLE 12

Number of working years lost per fatality by specific cause (industrialised countries)

	Canada 1991	USA 1990	UK 1992	Australia 1992	Japan 1992	New Zealand 1991
Infectious diseases	5.5	5.4	6.8	5.6	2.4	8.0
Typhoid	0.0	4.0	44.0	0.0	0.0	0.0
Malaria	0.0	26.0	17.3	22.7	0.0	19.0
Cancer	3.3	3.3	2.5	3.5	3.4	3.9
Circulatory	1.4	1.6	1.1	1.2	1.7	1.6
Respiratory	1.2	1.6	0.8	1.3	1.1	1.4
All accidents	19.0	21.6	15.4	20.8	13.1	24.0
Road accidents	27.2	27.1	24.1	27.5	20.1	30.6
Homicide	27.5	30.8	26.2	27.3	21.9	27.5
TOTAL	3.7	4.2	2.2	3.5	3.1	4.1

a countries' resources. Fouracre and Jacobs (1976) calculated that for any country, the cost of road accidents is equivalent to approximately 1 percent of its gross national product (GNP). To gauge the economic cost of road accidents, GNP by region for 1990 has been calculated using statistics published in the World Bank Atlas, and then one percent of GNP has been determined (see Table 13).

From the above data, it was calculated that the global cost of road accidents may well be of the order of US$ 230 billion per year, with the cost to LDCs being around US$ 36 billion. Apart from the humanitarian aspect of reducing road accident fatalities, a strong case can be made for reducing road accident deaths on economic grounds alone, as they consume financial resources that LDCs can ill afford.

TABLE 13

Cost of road accidents by region in 1990
(as 1 per cent of GNP)

Continent	US$ million
Europe	77200
Africa	4200
North America	71900
South America	11100
Asia and Middle East (including Japan)	60000
Oceania	4000
TOTAL	228400

4.2 ESTIMATED COSTS BY COUNTRY

If it is assumed that road accidents cost approximately 1 per cent of GNP in all countries, then a crude estimate can be derived of the annual costs of road accidents in countries throughout the developing world.

On this assumption, it can be seen that in large countries, such as Mexico and India, road accidents may well be costing US$2,500 million to US$3,200 million per annum. In countries such as South Africa and Pakistan, costs may well be between US$500 million to over US$1,000 million each year. In smaller countries, such as Zimbabwe and Kenya, costs may well be between US$55 million to US$70 million. The World Bank definition of a developing country (an average GNP per capita below US$3,500) encompasses all of these countries. They can ill afford to incur such large costs to their economies each year as a result of road accidents.

Unfortunately, road safety is but one of the many problems demanding its share of funding and other resources in developing countries. Even within the boundaries of the transport and highway sector, difficult allocative decisions have to be taken regarding the resources that any government can devote to road safety. In order to assist in this decision making process it is essential that a method be devised to determine the cost of road accidents and the value of preventing them.

The first need for cost figures is at the level of national resource planning to ensure that road safety is ranked equitably in terms of investment in its improvement. Fairly broad estimates are usually sufficient for this purpose, but they should be made on a comparable basis with other sectors competing for the scarce funds.

Substantial returns are available from investment in road safety. In a recent assignment carried out by TRL, it was shown that a programme of investment in road safety engineering, education, training and traffic law enforcement, costing some £100,000 pa, would reduce the national cost of road accidents by 5% each year. In a country with an estimated total cost of road accidents of £20 million pa, this implies an annual saving of £1 million, for an investment of £100,000; a benefit:cost ratio of about 10:1.

A second consideration when deriving the cost of road accidents is to ensure that the best use is made of any investment and that the best (and the most appropriate) safety improvements are introduced in terms of the benefits which they will generate relative to the costs of implementation. Failure to associate specific costs with road accidents will almost certainly result in the use of widely varying criteria in the choice of measures and the assessment of projects that affect road safety. As a consequence it is unlikely that the pattern of expenditure on road safety will be in any sense optimal. In particular, if safety benefits are ignored in transport planning, then there will inevitably be an under investment in road safety.

4.3 HOW TO COST ROAD ACCIDENTS

TRL has recently produced a document (Overseas Road Note 10 (1996)) outlining a number of systematic methods that can be used to cost road accidents. The Road Note details at least six methods which can be used to cost road accidents. These include:

i) Gross Output (or human capital) approach;

ii) Net Output approach;

iii) Life Insurance approach;

iv) Court Award approach;

v) Implied Public Sector Valuation approach; and

vi) Value of Risk Change (or willingness to pay) approach.

If accident costs and values of their prevention are ultimately intended for use in conventional cost-benefit analyses in order to determine the most efficient way of allocating scarce financial resources, then the most theoretically appropriate method to use by far is the willingness to pay approach. However, whilst this method has been adopted in countries such as the UK, USA, New Zealand and Sweden, the difficulty of obtaining reliable empirical estimates has been considerable. Furthermore, whilst the willingness to pay approach was adopted in the UK in 1988 to cost fatal accidents, the use of the method to cost non-fatal accidents presented problems which have only recently been resolved (Jones-Lee et al, 1993 and Hopkin and O'Reilly, 1993).

The willingness to pay approach can also be criticised on the grounds that values are obtained directly for adults only (children being unable to complete the complex questionnaires used to derive values). Children form a very high proportion of people killed or injured in developing countries (about twice that in the UK) and the willingness to pay approach might therefore appear inappropriate for this reason alone. Similarly, the method used in the UK is to obtain values for drivers or passengers of motor vehicles only. Again this weakens the case for its use in LDCs where significant proportions of people killed and injured are pedestrians and pedal cyclists. Lastly, it may be more difficult to value changes in risk in LDCs because of the difficulty in respondents providing a monetary value in economies where many transactions do not involve the use of money, and where the informal sector is much stronger.

It thus seems unlikely that reliable willingness to pay values can be determined in LDCs for some time. It is therefore recommended that the gross output approach be applied. However, in order to capture some of the 'humane' considerations implicit in the willingness to pay approach, gross output values should be supplemented by an allowance for 'pain, grief and suffering' of those involved in road accidents. This was the approach used for many years in the UK prior to the adoption of the willingness to pay approach. The way in which this can be done in practice is fully described in Overseas Road Note 10.

In summary, the gross output approach sums the following components;

a) an estimate of the lost output (from the accident victims);

b) the cost of medical treatment;

c) damage to vehicles and other property; and

d) administrative and police costs.

To this, can be added a subjective allowance for pain, grief and suffering.

Lost output is usually estimated by applying wage rates to estimates of the numbers of working days lost as a result of road accidents. Depending on the detail and accuracy of data available, wage rates can be applied by sex, age group, geographic region and socio-economic class, but it is rare for such data to be available. In general, national average wage rates are applied to give a crude estimate. The hospital surveys carried out here (see section 5) reveal that road accident victims have incomes above the national average, suggesting that road accident costs may be underestimated if national average wage rates are used. However it cannot be claimed that these surveys are necessarily representative and, as discussed in section 5.2.7, there are other possible explanations for this finding.

Hospital and medical costs are an important part of the costs of road accidents, not only because of their monetary value, but also because there is a substantial opportunity cost involved in societies where medical facilities are in short supply. The results of the hospital surveys are reported in section 5.2.8 and Table 24. These reveal that the majority of costs fall within one month's income (of the victim). As the time away from normal life reported by the victims interviewed in hospital was around one month, this suggests that hospital costs are of a similar order to the loss of output involved - for hospitalised accident victims. This group roughly equates to those suffering 'serious injury'. Clearly the loss of output as a result of fatalities is much greater; and for 'minor injuries' much less.

Other aspects of road accident costs are not covered by the hospital surveys, but Road Note 10 gives an example of how these may be calculated, based on data from Cyprus. For serious casualties (which is the group broadly represented by the hospital surveys) the lost output, medical costs and property damage are each of a similar order, and together comprise 96% of the total cost - excluding any allowance for pain, grief and suffering. In the Cyprus example, a fatal accident is estimated to cost twenty times the cost of a serious accident, due wholly to the large loss of output involved.

The work reported here supports the broad method proposed in Road Note 10, but suggests that there may be a general underestimation of loss of output, due to the higher than average income levels of road accident victims.

4.4 JUSTIFICATION FOR EXPENDITURE ON ROAD SAFETY MEASURES

Sabey and Taylor (1980) undertook a detailed study of the effectiveness of different ways of reducing road accidents. The study also estimated the annual expenditure in the UK on all road safety measures. This was shown as around one billion pounds (1980 prices); almost as much as the cost of the road accidents themselves.

Expenditure on road safety measures in the UK has been shown to be particularly cost-effective. For example, between 1965 and 1994 road accidents fell by over 50 per cent, while over the same period the number of motor vehicles registered has almost doubled (see Table 14).

Assuming expenditure on road safety improvements are effectively targeted at specific problem areas and are thus cost-effective, then, in principle, any expenditure less than the estimated costs can be justified. It is clearly optimistic to suggest that developing countries will spend sums equivalent to expenditure in the UK. However, given the levels of accident cost involved, substantial investment in road safety can be justified.

If the broad estimate of 1 per cent of GNP is accepted as a yardstick measure, then typical national costs have been estimated in section 4.2. The UK figures above show that substantial reductions in road accident fatalities can be achieved. Detailed evaluations of individual schemes in the UK, particularly low-cost engineering treatments, have shown that very high economic rates of return can be achieved from investment in accident reduction measures. Evidence is beginning to emerge that similar results can be achieved in the developing world.

If say 10 per cent of estimated road accident costs were set as a justifiable level of expenditure on road safety measures, on the grounds that high rates of return are very likely on the initial investments in road safety measures in countries where little has been achieved, then typical expenditure levels would be:

Indonesia	US$ 137 million
Philippines	US$ 220 million
Pakistan	US$ 53 million
Cameroon	US$ 10 million
Vietnam	US$ 12 million
Ghana	US$ 7 million
Nepal	US$ 3 million
Malawi	US$ 2 million.

TABLE 14

Road accident fatalities and vehicles registered in the UK

Year	Road accident fatalities	Registered motor vehicles (millions)	Fatality rate (deaths per 10k motor vehicles)
1965/66	7985	13	6.1
1980	6000	19	3.2
1988	5000	23	2.2
1994	3600	25+	1.4

5. SURVEYS OF ROAD ACCIDENT VICTIMS

5.1 NATURE OF SURVEYS

In order to explore further the socio-economic impact of road accidents, interviews of road accident victims were undertaken in a number of developing countries where Ross Silcock, TRL, or both have current projects. The countries were not selected on any statistical basis, although they are believed to represent a range of conditions found in the developing world. Surveys were carried out in Bangladesh, Fiji, Ghana, Indonesia, Peru, Swaziland and Zimbabwe.

In Swaziland, data were extracted from insurance records, as the national motor vehicle insurance agency was particularly helpful. In this case, and for a small country, the data are nation-wide. In other countries the survey method was to carry out interviews of road accident victims in hospital.

The choice of hospital(s) was dictated by local interest and support, and is not intended to be a random selection. Resource constraints precluded statistically-based selection criteria, and no claims are made that the hospitals selected are representative of conditions throughout the country concerned. It is probable that, because most of the hospitals involved are based in large cities, their road accident victims are biased towards urban conditions. Where possible, comparisons have been made with national data.

The surveys were not intended to provide an accident database; in most of the countries involved such a data base is in the process of implementation as part of other road safety projects. The purpose of the surveys was to add additional information to the global analyses presented so far in this report, and to provide illustrations of the socio-economic costs involved in road accidents.

Table 15 lists the hospitals surveyed, and the number of interviews carried out. The interviews were conducted by local staff, under the supervision of either a member of TRL or Ross Silcock staff in the country concerned, or by a local professional with an interest in road safety.

The main advantage of a hospital-based survey is that it offers a concentration of accident victims, thus offering low-cost data capture. However, the result is a non-representative sample of accident victims as a whole; fatalities are obviously excluded, and minor injuries are not generally treated in hospital. Although fatalities are usually a small proportion of accident victims as a whole, they clearly have an important impact. Minor injuries are less important, as many will not impose serious costs or inconvenience on the victim.

The Swaziland insurance records covered road accident claims for a period of 5 years, 1990-1994 inclusive. The hospital interviews were all carried out in late 1995 or early 1996. The relatively small numbers achieved in Fiji are due to it being a small country.

5.2 RESULTS OF THE SURVEYS

5.2.1 Age and gender

Figure 10 compares the national population profile, by age and gender, with the age and gender of the accident victims who were interviewed. The most striking feature is the substantial over-representation amongst the accident victims of males in the economically active age range of 16-45. This is evident in all seven countries, with some also showing a similar peak, if smaller, amongst females.

Whilst the analyses of national road accident data presented earlier (Table 5) suggest that perhaps 15% of fatalities are children under 15, Figure 10 shows that a much smaller proportion of accident victims in the hospitals surveyed are

TABLE 15

Hospitals surveyed and numbers of interviews

Country	City	Hospital(s)	Number of interviews
Bangladesh	Dhaka	RIHD	205
Fiji	Suva	Colonial War Memorial Hosp.	31
	Lautoka	Lautoka Hospital	
Ghana	Kumasi	Komfo Anokye Teaching Hosp.	231
Indonesia	Bandung	R S Borromeus Hospital Hasan Sadikin Hospital	206
Peru	Lima	Hospital Nacional Cayetano Heredia	86
Swaziland	National data	From insurance records	421
Zimbabwe	Harare	Chitungwiza General Parirenyutwa Hospital	100

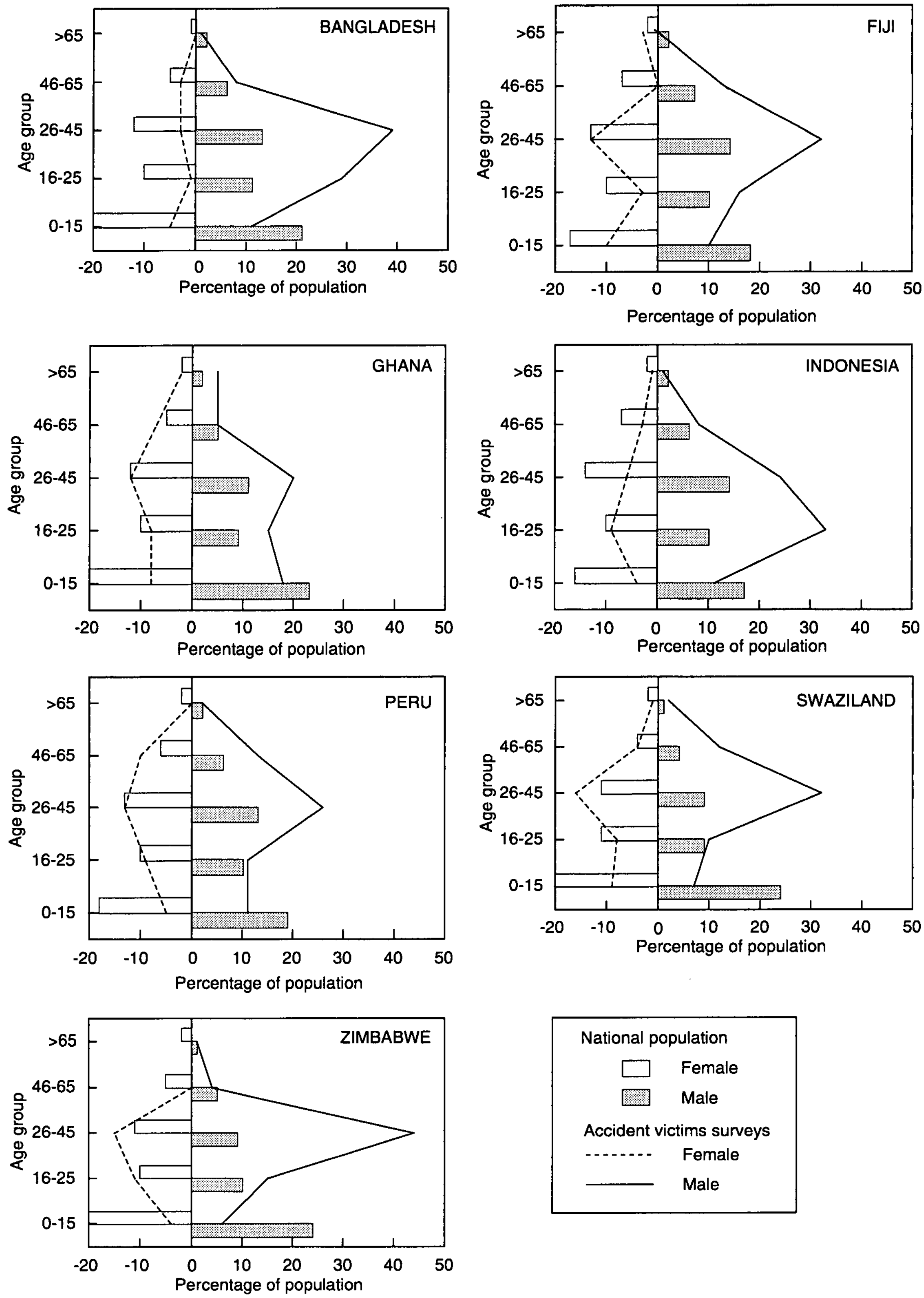

Fig. 10 Comparisons of age and gender distributions: National data and hospital victim surveys

in this age band - typically around 10%, with the exception of Ghana. There are many possible reasons for this about which we can only speculate. However, if it is assumed that the proportion of accident victims who die is independent of age (it is actually the frail and elderly who are most at risk), then one possible conclusion is that injured children are less likely to be taken to hospital than those in the economically active age ranges. It is also true that children figure strongly in pedestrian casualties, and the risk of death is greater for a pedestrian than a vehicle occupant. It may therefore be that child road accident victims die, rather than being treated in hospital.

5.2.2 Mode of travel

Table 16 shows the mode of travel of the accident victims surveyed, and Table 17 the other type of vehicle involved in the accident. As can be seen the proportion of victims who were pedestrians ranges from 30% in Fiji to 65% in Swaziland. Travelling in the back of a lorry (or pick-up) appears to be particularly risky in Fiji.

There was a high percentage of single vehicle accident victims in Ghana, with pedestrians being struck by a car being very prevalent in Swaziland, and to a lesser extent in Zimbabwe.

5.2.3 Family structure

Tables 18-21 summarise the family structure of accident victims who were interviewed in the hospital surveys. Victims were predominantly married and living with a family group. Only in Ghana (47%) and Indonesia (40%) was the proportion of victims interviewed who were dependants in a family group substantially above one quarter. This reflects the higher proportion of younger victims in these two surveys.

Sole earners (Table 20) were predominantly male. The proportion of victims who were the family group's sole earner ranged from 9% in Indonesia to 46% in Bangladesh, reflecting the wide variations in social structure and economic circumstances in the countries surveyed. The relatively high proportion of victims living alone in Swaziland and Zimbabwe (Table 19) may reflect the tendency for migrant workers to reside in the urban areas, away from their rural based families, in these countries.

5.2.4 Numbers of dependants

Many accident victims have others dependent upon them. Absence from work and/or the family can have far reaching effects, well beyond the immediate costs of the treatment which may be needed and other monetary costs of the accident. Figure 11 shows the numbers of dependants of the accident victim interviewed, as a cumulative percentage of interviewees.

As can be seen the highest levels of dependency were observed in Bangladesh, the lowest in Indonesia. In Bangladesh only 17% of victims had no-one wholly dependent upon them, rising to 67% in Ghana.

TABLE 16

Travel mode of victim - hospital surveys (Percentage of reported values)

	B'desh	Fiji	Ghana	Indonesia	Peru	Swaziland	Zimbabwe
pedestrian	32	30	48	37	37	65	33
bicycle	6	0	5	13	2	1	7
paratransit	31	0	1	13	31	0	4
bus	11	0	14	8	3	2	12
car	0	13	11	8	13	30	32
lorry	6	57	9	2	0	1	5

TABLE 17

Other vehicle involved in accident - hospital surveys (Percentage of known values)

	B'desh	Fiji	Ghana	Indonesia	Peru	Swaziland	Zimbabwe
none	0	23	20	0	5	1	14
paratransit	25	0	1	28	31	0	4
bus	18	0	8	21	13	6	20
car	8	26	22	31	35	85	41
truck	41	51	44	15	6	7	16

TABLE 18

Marital status of accident victims - hospital surveys (Percentage of valid responses from those aged over 15)

Marital status	B'desh	Fiji	Ghana	Indonesia	Peru	Swaziland	Zimbabwe
single	33	28	36	47	21	42	26
married	64	68	55	45	56	51	57
separated	1	0	4	2	5	3	12
widowed	2	4	5	5	3	4	4

TABLE 19

Nature of residential group of accident victims - hospital surveys (Percentage of valid responses)

Living with	B'desh	Fiji	Ghana	Indonesia	Peru	Swaziland	Zimbabwe
alone	7	0	3	1	4	25	22
friends	5	0	4	6	1	1	6
family	88	100	93	93	95	74	71

TABLE 20

Family responsibility of accident victims - hospital surveys (Percentage of valid responses)

Responsibility	B'desh	Fiji	Ghana	Indonesia	Peru	Swaziland	Zimbabwe
sole earner	46	42	10	9	39	25	31
earner	26	26	28	31	5	50	29
supporter	7	6	15	21	30	1	15
dependant	22	26	47	40	27	24	25

TABLE 21

Family responsibility of accident victims aged over 15, by gender - hospital surveys
(percentage of valid responses)

Responsibility *male/female*	B'desh	Fiji	Ghana	Indonesia	Peru	Swaziland	Zimbabwe
sole earner	52/0	63/17	15/13	14/0	62/12	36/16	36/21
earner/support	35/38	26/67	60/58	58/65	31/64	57/68	50/47
dependant	12/62	11/17	25/30	28/35	7/24	7/17	14/32

5.2.5 Time away from normal life

Road accident victims were asked how long they had been away from normal life as a result of their accident, and how long they expected it to be before their life was back to normal. Answers to these questions were often vague and comparable results are not available for all surveys. In some cases the reported time to recovery was very long, for example in Ghana 40% reported 4 weeks or more to return to normal life, and in Zimbabwe the comparable figure was 35%. In contrast, in Peru, only 7% expected to be away from normal life for more than 4 weeks.

5.2.6 Payment of Hospital costs

Accident victims were asked a number of questions regarding hospital costs. Table 22 shows the responses to the question, who pays your hospital costs? There is a very wide range of responses, with a predominance of self or family finance in most countries. Only in Indonesia (74%

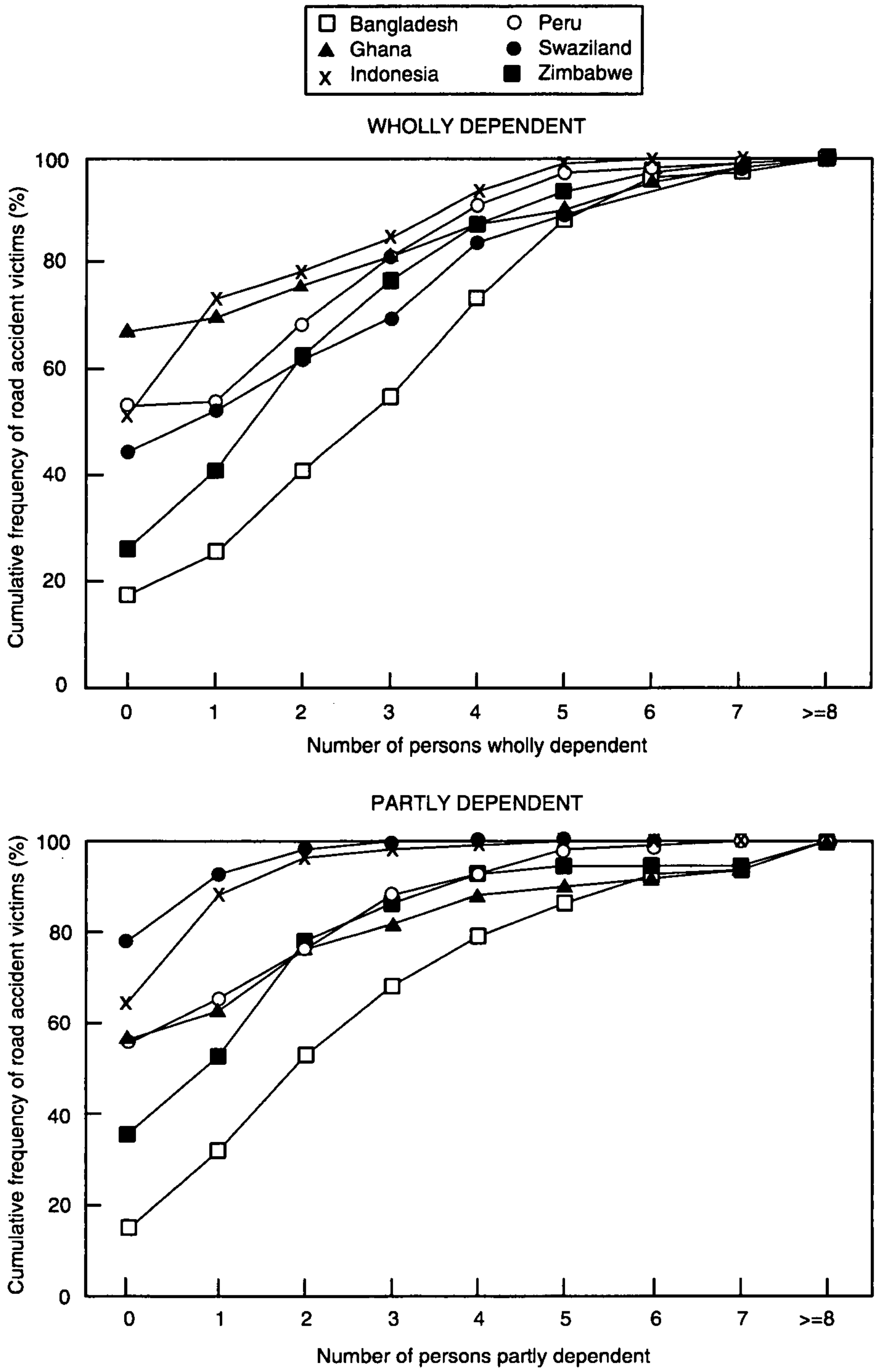

Fig. 11 Number of persons wholly or partly dependent on road accident victims *(source: hospital surveys)*

TABLE 22

Responsibility for hospital costs - hospital surveys (Percentage of valid responses)

	B'desh	Fiji	Ghana	Indonesia	Peru	Swaziland	Zimbabwe
Self/family	40	97	82	18	49	89	29
Self + state	55	0	1	1	6	1	2
Self + other	0	0	1	7	17	0	1
State	5	0	2	0	1	3	25
Insurance	0	3	1	74	1	6	22
Other	0	0	3	0	25	1	21

insurance) and Zimbabwe (25% state, 22% insurance and 21% other) was there any evidence that the bulk of costs fell elsewhere than on the victim and his/her immediate family.

Accident victims were also asked who pays for their journey to hospital. The results are shown in Table 23. There is a wide spread of responses, with other drivers also having a significant role.

5.2.7 Income distribution of victims

It is acknowledged that interviewees are often reluctant to report incomes, however a reasonable degree of success in this respect was achieved during the hospital surveys. Figures 12a and 12b presents the income data in a way which is intended to reflect the nature of the survey and to permit comparisons between countries with wide variations in their economies and absolute values of incomes. The results of each survey are presented as a cumulative frequency distribution of reported incomes, relative to the highest single value reported in that survey. Thus, for example, in Bangladesh 50% of reported incomes were 10% or less of the highest reported level; whereas in Peru this median value was 40% of the maximum reported. In other words, the income distribution of those surveyed was much more skewed in Bangladesh than in Peru.

Figures 12a and 12b show the reported incomes of both male and female accident victims, and the national average income is also shown for those countries where a reasonable estimate is available. In all cases the median income of road accident victims is above the national average. All male victims' median incomes are above the national average, and although only limited data are available for female victims' incomes, there is some evidence that the female median is also above the national average income.

At face value this suggests that the conventional methods of costing road accidents, based on average national wage rates, may be underestimating the costs involved. However a note of caution is necessary. The surveys were largely based in the national capitals, where above average incomes may be expected. Also, it may well be that the poorer accident victims do not present themselves at hospital - which they cannot afford. Further, more detailed research is needed to explore such hypotheses.

In those surveys where sufficient data were available, victims' incomes by mode of travel were analyzed. As might be expected, for example in Peru, car users' incomes were higher than pedestrians'. Surprisingly, in Ghana, this was reversed, although the differences between modes were not large.

5.2.8 Hospital costs

Figure 13 presents the reported hospital costs in a similar manner as incomes, relative to the highest reported value in the survey. There are only small differences between the costs for males and females (shown in the figure) and by age (not shown). Table 24 summarises the reported costs in terms of the number of months' income to meet them. In most countries the majority of direct costs fall within one month's income, but it would of course take many months to accumulate this from disposable income after other demands are met.

6. CONCLUSIONS

Fatalities as a result of road accidents have become more significant in LDCs in recent years. For example, in Africa, road accident fatalities have risen by over 300 per cent since 1968, while over the same time period road accident fatalities in industrialised countries have fallen.

There are some 500,000 road accident fatalities per annum, worldwide, of which around 70% occur in the developing world.

Annual fatalities per registered vehicle exceed 100 in some developing countries; compared with rates less than 2 in most industrialised countries. Typically, LDCs are 10 to 20 times worse than the best ICs in these terms.

TABLE 23

Responsibility for costs of journey to hospital - hospital surveys (Percentage of valid responses)

	B'desh	Fiji	Ghana	Indonesia	Peru	Swaziland	Zimbabwe
Self/family	63	17	45	14	34	0	36
Friends	3	0	5	6	4	0	10
State	3	83	2	0	0	0	16
Insurance	3	0	0	0	0	0	10
Other driver	0	0	36	0	30	0	10
Other	29	0	9	80	32	0	1
No-one	0	0	3	0	0	n/a	19

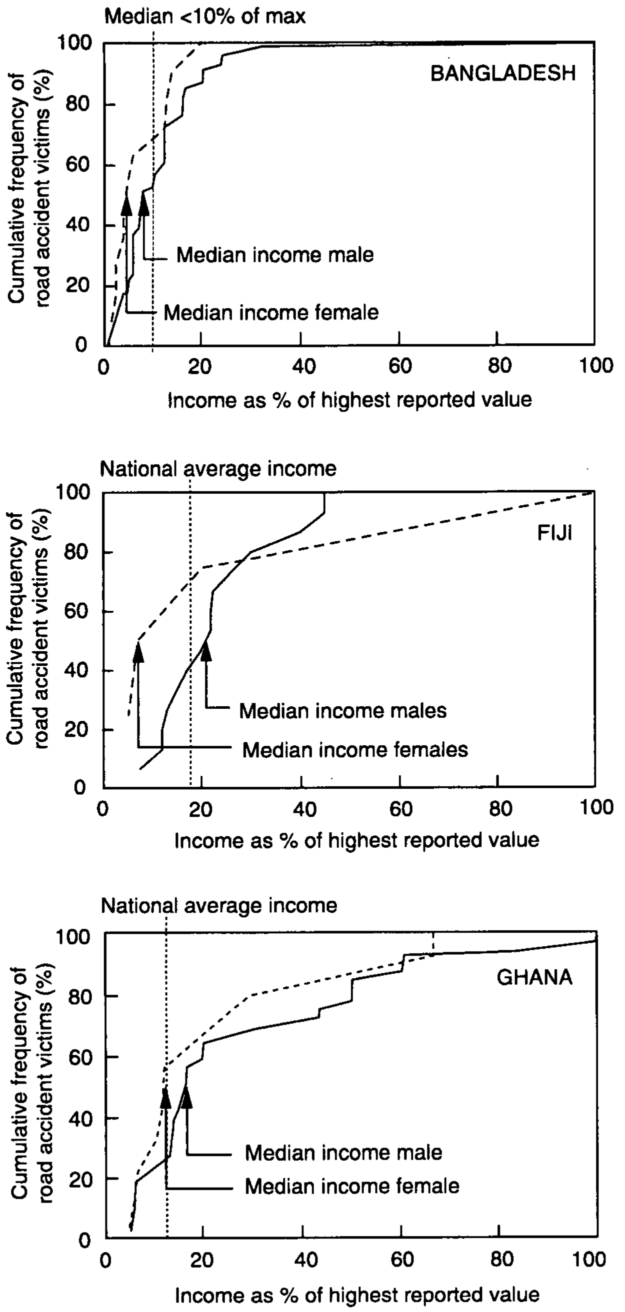

Fig. 12a Income distribution by gender of hospital victims *(source: hospital surveys)*

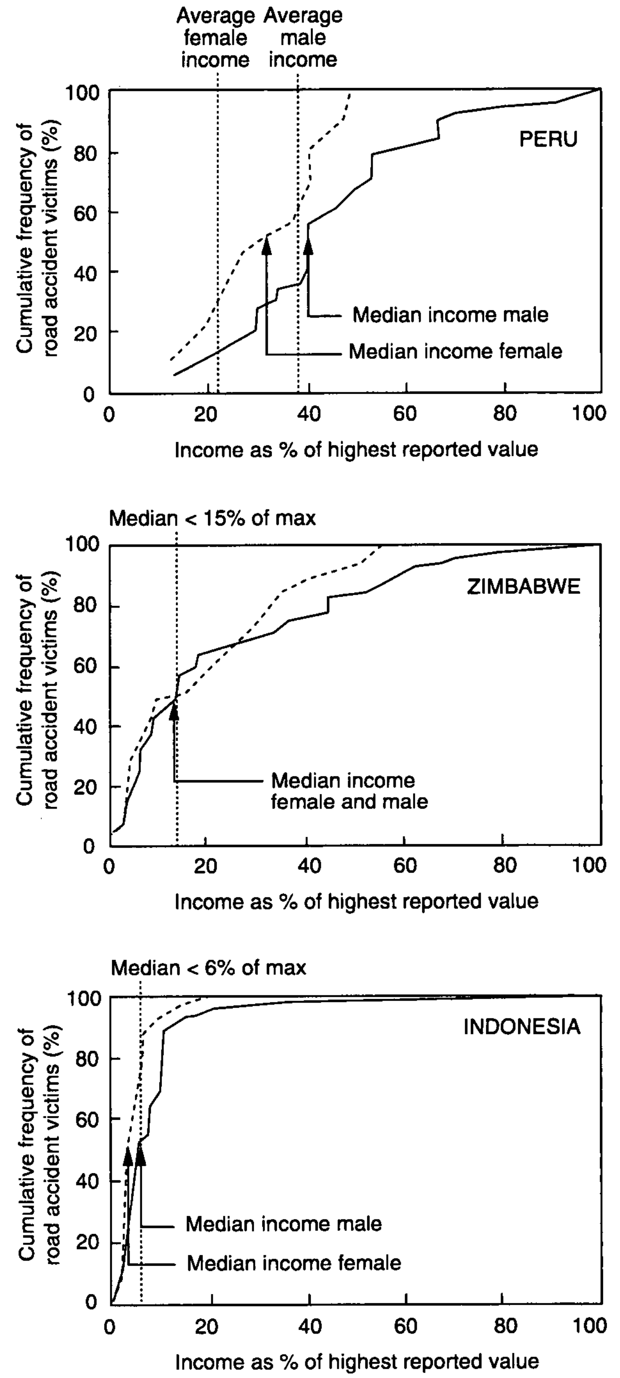

Fig. 12b Income distribution by gender of hospital victims *(source: hospital surveys)*

TABLE 24

Hospital costs relative to income - hospital surveys (Percentage of valid responses)

months of income to cover costs *male/female*	B'desh	Fiji	Ghana	Indonesia	Peru	Zimbabwe
0	1/0	-	28/11	-	24/33	36/20
0-1 month	12/14	100/100	43/22	94/91	65/67	64/80
1-2 months	12/14	-	23/44	3/0	5/0	-
2-3 months	13/0	-	3/0	-	3/0	-
>3 months	62/71	-	5/22	3/9	3/0	-

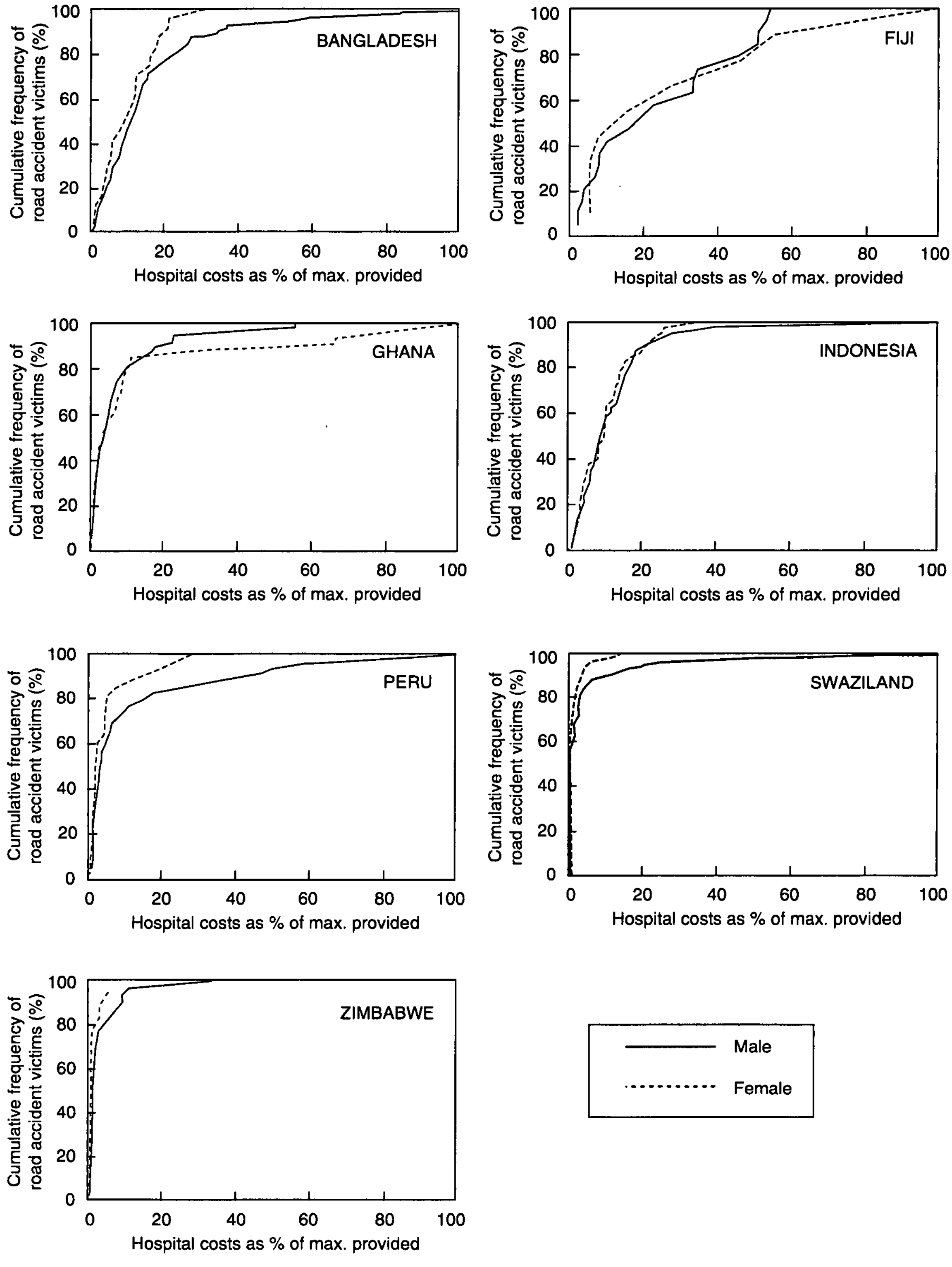

Fig. 13 Distribution of hospital costs *(source: hospital surveys)*

The global cost of road accidents, in 1990, is estimated to be US$230 Billion, with the cost to the LDCs being around US$36 Billion.

Much higher proportions of (reported) road accident victims die in the developing world; 10 or 20 times higher on the basis of official statistics. There appear to be a clear relationship between this fatality index and the numbers of nurses and hospital beds in a country.

Children under 15 form a high percentage of road accident fatalities in LDCs, typically 15 per cent compared with under 6 per cent in ICs.

The numbers of years of life lost per road accident fatality in a sample of developing countries is typically twice the number of years lost due to the more common diseases.

Interviews in hospitals in a number of developing countries suggests that the age distribution of road accident victims in hospital is heavily biased towards the economically active age ranges, particularly of males. The proportion of those under 15 in hospital as a result of road accidents appears to be much less than would be expected from either national demographic or national road accident statistics.

Between one-third and one-half of those surveyed were pedestrians, in line with expectations in the predominantly urban environments of the hospitals concerned.

Road accident victims in the surveys were predominantly married and living as part of a family group. Between 40 percent and 75 percent of hospitalised victims were contributing an income from paid employment to the family group; between 9 and 46 percent were the sole earner. In Bangladesh, only 17 percent of victims surveyed did not have any dependants.

Most road accident victims are responsible for their own hospital costs, either personally or through their family group.

Reported median incomes in our hospital surveys were above average for the countries concerned, particularly for males, but also for females. This may reflect the hospital-based nature of the survey; ie only those who can pay are hospitalised, but could also reflect the predominantly urban nature of the surveys, with an above average (in terms of income) population involved. This finding implies that road accidents may be under-valued by methods using national average data. More research is needed to investigate this.

Overall the research has identified that road traffic accidents have substantial economic and social impacts in developing countries. In economic terms alone there is a strong case for devoting much more resources to their prevention.

7. ACKNOWLEDGEMENTS

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General Reference Documents

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World Health Statistics (1990 and 1993)

International Marketing Data and Statistics (1995) Euromonitor Marketing Handbooks

Table 1: Sources and Countries

International Road Federation World Year Book 1993
World Health Organisation Statistics 1993
Road Accidents Great Britain (1994)
Road Accidents in Europe and North America (1995)
United Nations sources
TRL Reports and Publications

Europe:	Austria, Belgium, Cyprus, Czechoslovakia, Denmark, Eire, Finland, France, Germany, Great Britain, Greece, Hungary, Iceland, Italy, Lithuania, Luxembourg, Netherlands, Norway, Poland, Portugal, Romania, Spain, Sweden, Switzerland, Turkey.
Africa:	Botswana, Cameroon, Central African Republic, Ethiopia, Ivory Coast, Liberia, Mauritius, Morocco, Niger, Rwanda, Seychelles, South Africa, Swaziland, Tanzania, Tunisia, Uganda.
North America:	Canada, USA.
South America:	Barbados, Brazil, Chile, Colombia, Costa Rica, Ecuador, Honduras, Jamaica, Mexico, Surinam.
Asia/Middle East:	Bahrain, Brunei, China, Hong Kong, India, Indonesia, Iraq, South Korea, Kuwait, Malaysia, Nepal, Pakistan, Philippines, Saudi Arabia, Singapore, Sri Lanka, Taiwan, Thailand, Yemen Arab Republic.
Oceania:	Australia, Fiji, New Zealand, Papua New Guinea.

Countries used for Smeed analyses:

Botswana, Cameroon, Central African Republic, Ethiopia, Ivory Coast, Liberia, Mauritius, Morocco, Niger, Rwanda, Seychelles, Swaziland, Tanzania, Tunisia, Uganda, Chile, Colombia, Costa Rica, Ecuador, China, India, Indonesia, Pakistan, Taiwan, Philippines, Papua New Guinea, Austria, Belgium, Denmark, France, Germany, UK, Netherlands, Norway, Spain, Sweden, Australia, New Zealand.

Table 8: Countries

Belgium, Canada, Denmark, France, Italy, Spain, Brazil, Chile, Costa Rica, Ecuador, El Salvador, Mauritius, Mexico.

APPENDIX A: SCHEMATIC REPRESENTATION OF THE EFFECTS OF SMEED RELATIONSHIP ROTATION

Section 2.4 discussed the Smeed relationship with respect to developing and industrialised countries. The Smeed relationship relates vehicle ownership rates to the annual number of fatalities per licensed vehicle, and takes the form:

$$\log \frac{F}{V} = i + g \log \frac{V}{P}$$

Where F = fatalities per annum

V = number of licensed vehicles

P = population

I = constant (y-axis intercept)

g = gradient

In the context of this discussion it was shown that for developing countries the Smeed relationship is rotating about the y-axis intercept over time. It was argued that this implies a degradation of the road safety situation for these countries. The logic behind this argument is outlined below:

Figure A.1 represents the rotation of the Smeed relationship between time *t1* and a later time *t2*. At *t1*, one particular country has a vehicle ownership rate *O1*, and an associated fatality rate of *b*. At *t2*, the country has an increased vehicle ownership rate of *O2*. With a stable Smeed relationship, we would therefore expect to see a decrease in fatality rate, from *b* to *c*. Due to the rotation, however, the country actually experiences an increase from *b* to *a* in fatality rate. The road safety situation has therefore deteriorated.

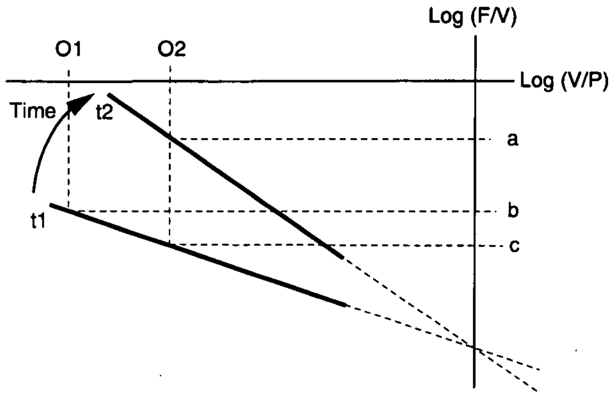

Fig. A.1 Graphical representation of the effects of Smeed relationship rotation (schematic)