# Increased Motorization and Highway Fatalities in the People's Republic of China

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**Highway accident, injury, and fatality data for 1985 for the 29 provinces and municipalities of the People's Republic of China were analyzed in terms of population, number of vehicles, and number of licensed drivers. China is clearly at the beginning of the "highway safety transition," as evidenced by high fatality-per-vehicle and low fatality-per-population rates. Although changes in fatality rates over time could not be analyzed, the number of fatalities per vehicle was found to decrease with increasing vehicle ownership in the provinces in accordance with Smeed's law. Growth in the number of vehicles is extremely rapid, and private ownership is being encouraged in the spirit of the new economic reforms. The costs due to traffic fatalities, injuries, and property damage must be included in the total price of developing the highway system that is so badly needed for China's economic development.**

A "highway safety transition," similar to the demographic transition, has been described by Haight (*1,2*). In this transition, the total number of highway fatalities increases, the fatalities-per-unit-travel decrease, and the fatalities-per-population remain stable over time as a country moves from "developing" to "industrialized" status (Figure 1). The implication of this transition, convincingly presented by Haight, is that the effects of any one traffic safety measure are nearly impossible to evaluate from aggregate data, such as a falling fatalities-per-vehicle-kilometer curve. In essence, what this natural evolution means is that as a traffic system matures and safety improves, travel also increases, so the burden imposed on the public health system remains the same. This burden can be masked by the use of transportation-based fatality and injury rates.

The objectives of this paper are to demonstrate that the People's Republic of China is at the beginning of this transition and to discuss the implications of this fact for the highway safety, transportation planning, and public health community in China.

The People's Republic of China is experiencing a phenomenal rate of growth and development. Despite setbacks suffered during the "Great Leap Forward" in 1960 and the Cultural Revolution of 1966–1976, the volume of passenger traffic on the roadways per $10^8$ person-km has increased 193 times between 1949 and 1985; while passenger-kilometer travel by rail, water, and civil aviation has increased 18, 11, and 65 times, respectively (*3*). The number of highway vehicles has increased almost 170 times from an estimated 51,000 in 1950 to 8.64 million in 1985 (*4*). These figures are somewhat misleading in that the greatest growth rates have occurred since 1979. For example, the number of passenger cars in the city of Guangzhou increased from fewer than 20,000 in 1979 to 114,000 in 1984 (*5*). Road construction has not kept pace with the increase in vehicles and passenger travel, resulting in increased congestion and decreased average travel speeds. However, one of the major goals of development is to remedy this situation, as illustrated in the province of Inner Mongolia, where 160 new roadways, covering 3,000 km, were built in 1985 alone. This construction was approximately equal to the total roadway construction in that province for the previous 38 years (*6*).

As expected, this increase in motorization has resulted in an increase of highway crashes, injuries, and fatalities. Unfortunately, these increases have not been as well documented as has the growth in vehicles and vehicular travel. Despite the paucity of crash data, sufficient information is now available to examine the status of the highway safety transition in China.

## METHODS

The total number of motor vehicle crashes, fatalities, and injuries and the total population in 1985 for the 26 provinces and 3 municipalities (29 units) administered by the Central Government of the People's Republic of China were obtained from the Chinese Statistical Bureau (*7*). In addition, the total numbers of registered motor vehicles and licensed drivers for the 29 units were obtained from the Ministry of Public Security. The estimates of passenger and freight volume by year for the country as a whole were obtained from the Chinese Automotive Industry Yearbook (*3*). From these, rates based on population, vehicles, and licensed drivers were calculated. More detailed data for the cities and suburban areas of Beijing and Tianjin were also obtained. Because vehicle and licensed driver data are not reported by city and suburban area, these rates could not be calculated.

To explore the relationship of increasing motorization upon fatalities, the number of vehicles per population was regressed on the number of fatalities per vehicle, according to what is known as "Smeed's law."

## LIMITATIONS OF THE DATA

As has been discussed in numerous previous studies of crash rates in developing countries (*1,2,8*), these rates must be viewed

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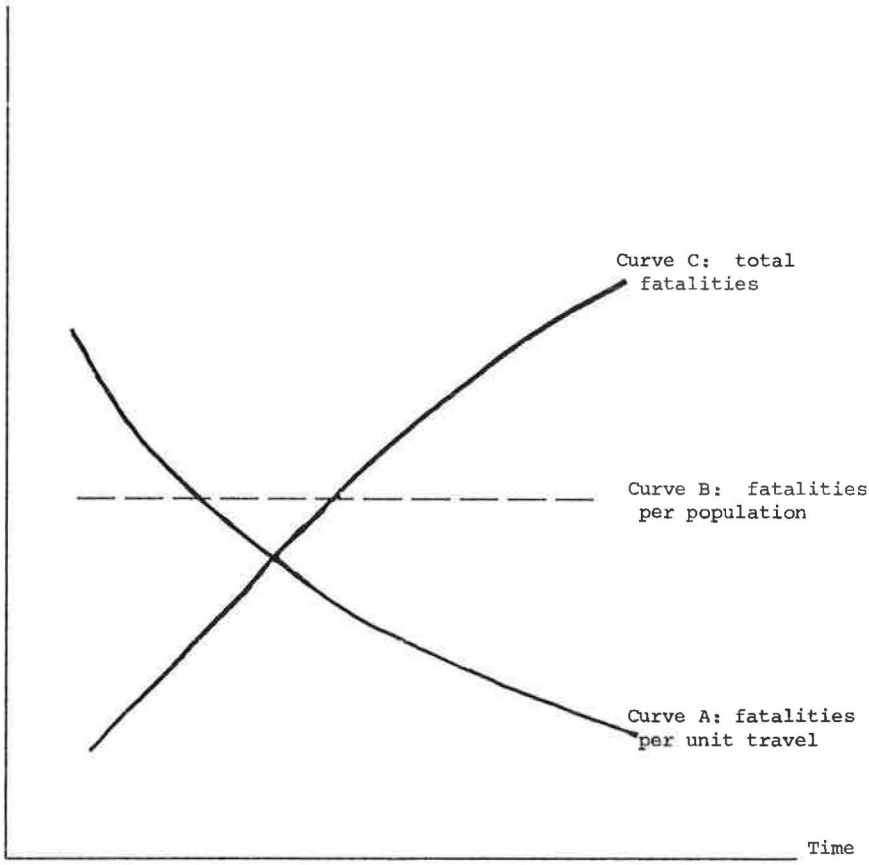


**FIGURE 1 Highway safety transition [adapted from work by Haight (*1*)].**

as very preliminary. The difficulties of obtaining accurate reports, especially of crashes and injuries, must be kept in mind. Although data were analyzed across provinces and not across time, the more developed and industrialized provinces may have more accurate and uniform data collection systems because they have been reporting crashes for a longer time. Higher numbers of crashes reported from these provinces may thus be influenced by reporting differences.

Although mortality is generally considered to be more accurately reported than morbidity for all diseases and injuries, the fatalities reported here should also be considered underestimates because of the lack of reliability of the reporting system. Further, a motor vehicle fatality in China is defined as one that has occurred within 7 days of the crash. Although this definition will yield an underestimate when compared with those of countries that use a 30-day or longer period (*9*), the magnitude of this underestimate is less for such countries as China in which an emergency medical services system is in its infancy.

A more significant problem with the data is that the number of bicycles registered in each unit could not be obtained, nor are crash data enumerated by type of vehicle involved. The total number of bicycles in China is estimated to be at least 200 million. The exclusive use of bicycles for commuting to work, transporting goods and people, and achieving pleasure and recreation by a large segment of the Chinese population (*10*) and the lack of helmets (*11*) are well known. On the basis of experience in the United States, the majority of the bicycle-related fatalities can be assumed to have involved at least one motor vehicle (*12*). The vehicle-based total crash and injury rates, however, are more severely overestimated as a result of the underenumeration of total vehicles on the road. The rates based on licensed drivers are also overestimates because the number of crashes involving only bicycles is unknown. Again, the fatalities per licensed driver are probably the least affected by this error as a result of the low number of fatal bicycle-only crashes.

In addition to the problems due to lack of bicycle data, the exact definitions of "accident" and "injury" used by the Chinese are unknown. For these reasons, the more detailed analyses were limited to the fatality data. The lack of information regarding the crash reporting system process imposes severe limitations on the conclusions that may be drawn from the data.

## RESULTS

The crash, injury, and fatality rates based on population, vehicles, and licensed drivers are presented in Tables 1, 2, and 3. The fatality rate per 100,000 people for the country as a whole was 3.9, compared with the U.S. rate of 18.3 (*13*). The five highest rates ranged from 9.8 to 6.7 in western and northern provinces of Qinghai, Tibet, Mongolia, and Xinjiang and in the municipality of Beijing. The rates for Beijing probably reflect better reporting. Two of the four lowest rates are also found in northern provinces, Inner Mongolia and Heilongjiang. Quick explanations of these rates are thus difficult,

TABLE 1 TOTAL MOTOR VEHICLE ACCIDENTS, INJURIES, AND DEATHS/10,000 POPULATION, 1985

| Province and municipality | Acc/10,000 population | Inj/10,000 population | Deaths/10,000 population |
|---|---|---|---|
| Beijing* | 8.3271 | 5.1219 | 0.7917 |
| Tianjin* | 5.2005 | 3.4022 | 0.6448 |
| Hebei | 1.6581 | 1.0101 | 0.3551 |
| Shanxi | 2.4937 | 1.6913 | 0.6437 |
| Neimeng | 1.4141 | 0.8615 | 0.2980 |
| Liaoning | 4.6408 | 3.1799 | 0.5269 |
| Jilin | 1.6258 | 1.0335 | 0.3407 |
| Heilongjiang | 0.6442 | 0.3818 | 0.2609 |
| Shanghai* | 5.8513 | 4.7067 | 0.5629 |
| Jiangsu | 1.0765 | 0.6895 | 0.2945 |
| Zheiiang | 2.3467 | 1.9395 | 0.5476 |
| Anhui | 1.1676 | 0.8103 | 0.2799 |
| Fujian | 2.199 | 1.6922 | 0.4360 |
| Jiangxi | 1.3812 | 0.8991 | 0.3474 |
| Shandong | 1.6938 | 0.9771 | 0.3845 |
| Henan | 1.7574 | 1.0589 | 0.3327 |
| Hubei | 1.6321 | 1.1452 | 0.4537 |
| Hunan | 2.1789 | 1.4708 | 0.3801 |
| Guangdong | 2.9859 | 1.7956 | 0.3793 |
| Guangxi | 1.1407 | 0.7756 | 0.3349 |
| Sichuan | 1.5165 | 1.1632 | 0.3968 |
| Guizhou | 1.8747 | 1.2433 | 0.3312 |
| Yunnan | 2.0085 | 1.6850 | 0.4328 |
| Tibet | 2.8543 | 2.2714 | 0.9347 |
| Shaanxi | 2.0247 | 1.4117 | 0.4530 |
| Gansu | 1.1053 | 0.8354 | 0.3484 |
| Qinghai | 5.8108 | 3.6093 | 0.9828 |
| Ningxia | 3.3976 | 1.8482 | 0.6699 |
| Xinjiang | 3.7869 | 2.0705 | 0.6819 |
| Country as a whole | 2.0119 | 1.3551 | 0.3997 |

* Municipality

TABLE 2 TOTAL MOTOR VEHICLE ACCIDENTS, INJURIES, AND DEATHS/10,000 VEHICLES, 1985

| Province and municipality | Acc/10,000 vehicles | Inj/10,000 vehicles | Deaths/10,000 vehicles |
|---|---|---|---|
| Beijing* | 25.6000 | 15.7190 | 2.4300 |
| Tianjin* | 38.8000 | 25.3880 | 4.8120 |
| Hebei | 13.3000 | 8.0850 | 2.8420 |
| Shanxi | 21.8000 | 14.8060 | 5.6350 |
| Neimeng | 13.4000 | 8.1510 | 2.8190 |
| Liaoning | 36.6000 | 25.1110 | 4.1610 |
| Jilin | 18.6000 | 11.8340 | 3.9020 |
| Heilongjiang | 7.6000 | 4.5120 | 3.0840 |
| Shanghai* | 68.2000 | 54.8310 | 6.5570 |
| Jiangsu | 29.0000 | 18.5770 | 7.9360 |
| Zheiiang | 34.2000 | 28.2270 | 7.9710 |
| Anhui | 38.7000 | 26.8420 | 9.2710 |
| Fujian | 38.0000 | 29.2380 | 7.5340 |
| Jiangxi | 37.0000 | 24.1430 | 9.3280 |
| Shangdong | 21.7000 | 12.5470 | 4.9380 |
| Henan | 20.8000 | 12.5340 | 3.9380 |
| Hubei | 18.1000 | 12.7150 | 5.0370 |
| Hunan | 76.6000 | 51.6800 | 13.3560 |
| Guangdong | 29.9000 | 18.0000 | 3.8030 |
| Guangxi | 24.8000 | 16.8880 | 7.2910 |
| Sichuan | 23.7000 | 18.1680 | 6.1980 |
| Guizhou | 46.7000 | 31.0020 | 8.2590 |
| Yunnan | 22.0000 | 18.4180 | 4.7310 |
| Tibet | 22.4000 | 17.8440 | 7.3430 |
| Shaanxi | 12.7000 | 8.8550 | 2.8420 |
| Gansu | 5.2000 | 3.9040 | 1.6280 |
| Qinghai | 20.4000 | 12.6850 | 3.4540 |
| Ningxia | 18.6000 | 10.1130 | 3.6650 |
| Xinjiang | 36.5000 | 19.9780 | 6.5790 |
| Country as a whole | 24.2000 | 16.300 | 4.8000 |

* Municipality

TABLE 3 TOTAL MOTOR VEHICLE ACCIDENTS, INJURIES, AND DEATHS/1,000 LICENSED DRIVERS, 1985

| Province and municipality | Acc/100 licensed drivers | Inj/100 licensed drivers | Deaths/100 licensed drivers |
|---|---|---|---|
| Beijing* | 3.9349 | 2.4203 | 0.3741 |
| Tianjin* | 5.7807 | 3.7818 | 0.7167 |
| Hebei | 3.4848 | 2.1229 | 0.7463 |
| Shanxi | 4.2951 | 2.9130 | 1.1087 |
| Neimeng | 2.0681 | 1.2600 | 0.4358 |
| Liaoning | 6.0168 | 4.1227 | 0.6831 |
| Jilin | 1.1187 | 0.7111 | 0.2345 |
| Heilongjiang | 0.9758 | 0.5783 | 0.3953 |
| Shanghai* | 6.9051 | 5.5543 | 0.6642 |
| Jiangsu | 3.3915 | 2.1725 | 0.9280 |
| Zheiian | 11.9598 | 9.8845 | 2.7911 |
| Anhui | 4.3747 | 3.0361 | 1.0486 |
| Fujian | 9.2316 | 7.1040 | 1.8305 |
| Jiangxi | 4.8922 | 3.1847 | 1.2305 |
| Shangdong | 4.5258 | 2.6108 | 1.0274 |
| Henan | 4.2284 | 2.5476 | 0.8004 |
| Hubei | 4.6085 | 3.2336 | 1.2810 |
| Hunan | 7.5698 | 5.1098 | 1.3205 |
| Guangdong | 6.6592 | 4.0046 | 0.8460 |
| Guangxi | 4.2886 | 2.9160 | 1.2590 |
| Sichuan | 6.0080 | 4.6085 | 1.5722 |
| Guizhou | 7.8467 | 5.2039 | 1.3863 |
| Yunnan | 7.1770 | 6.0208 | 1.5464 |
| Tibet | 2.4447 | 1.9454 | 0.8006 |
| Shaanxi | 4.2951 | 2.9130 | 1.1087 |
| Gansu | 2.6925 | 2.0349 | 0.8486 |
| Qinghai | 5.5051 | 3.4195 | 0.9311 |
| Ningxia | 6.1839 | 3.3639 | 1.2192 |
| Xinjiang | 4.6422 | 2.5382 | 0.8358 |
| Country as a whole | 4.5323 | 3.0526 | 0.9004 |

* Municipality

as both groups of provinces are sparsely settled, mountainous regions.

The high vehicle-based rates are also those expected in the first stages of motorization. The fatality rate per 10,000 vehicles was 48.2 for the country as a whole, compared with 2.5 for the United States (*13*). The four highest rates ranged from 82.5 to 133.5 in a belt of provinces in the south extending from Guizhou to Anhui. The lowest, ranging from 24.3 to 28.4, are seen in the northern provinces of Ningxia, Inner Mongolia, and Hebei and in the municipality of Beijing. Fatalities per 1,000 licensed drivers follow a similiar pattern: 9.0 for the country compared with the U.S. rate of 0.28 in 1985 (*13*). The highest rates were experienced in the southern provinces of Sichuan, Yunnan, Zheiiang, and Fujian (ranging from 15.5 to 27.9) and the lowest, in the northern provinces of Inner Mongolia, Heilongjiang, Jilin, and in the municipality of Beijing (ranging from 2.3 to 4.3). A comparison of these summary rates for China and various other countries is given in Table 4.

Population data for the municipalities of Beijing and Tianjin were available by inner city and suburbs. Population-based crash, fatality, and injury rates are shown in Table 5. In Beijing, the distribution is what would be expected: the rates of total crashes and injuries are higher in the more congested central city than in the suburbs; however, the rate of fatal crashes is much higher in the suburbs than in the city. In Tianjin, however, the pattern is reversed: the crash rates for all categories are much higher in the suburbs than in the inner city. Although this could be due to differences in reporting practices, no conclusive explanations for this reversal are apparent.

Sufficient data for year-to-year comparisons of crash rates could not be obtained. Because of the year-to-year fluctuations in traffic crashes and deaths known to occur in all countries and the inability to separate the effect of any one change in a highway system from the decline in crashes that appears to occur over time as a traffic system matures (*1,2*), time-series analyses should be used to analyze traffic crash data. Even 2- or 3-yr comparisons can yield very misleading conclusions about whether highway mortality and morbidity are getting "better" or "worse."

Although comparisons over time could not be made, the differences in the stages of development within the provinces and cities of China provide an opportunity for a cross-sectional analysis of the effects of motorization on fatality rates. The number of deaths ($D$) per motor vehicles ($V$) has been found to be related to the number of motor vehicles per person ($V/P$) according to Smeed's formula (*9*):

$$D/V = 0.0003\ (V/P)^{-0.667} \quad (1)$$

In a similar analysis for 32 developing countries using data

TABLE 4 VEHICULAR AND POPULATION-BASED MOTOR VEHICLE ACCIDENT RATES FOR SELECTED COUNTRIES AND YEARS

| Motor vehicle accident rates | Country | | | | | | |
|---|---|---|---|---|---|---|---|
| | China | USA | | Kuwait | | Zambia(d) | |
| | 1985 | 1913(a) | 1985(b) | 1977(c) | 1960 | 1969 | 1974 |
| deaths/100,000 population | 3.99 | 4.40 | 18.34 | 31.70 | 6.70 | 15.30 | 18.70 |
| deaths/1000 vehicles | 48.16 | 33.38 | 0.25 | 10.85 | 45 | 62 | 57 |
| deaths/1000 licensed drivers | 9.00 | -- | 0.28 | -- | -- | -- | -- |
| Vehicles/1000 population | 8.29 | 13.62 | 740.00 | 350 | 15.00 | 24.60 | 33.20 |

(a) National Safety Council, Accident Facts 1987, Chicago, National Safety Council 1988.

(b) National Highway Traffic Safety Administration, Fatal Accident Reporting System, 1985. DOT/HS/ 807 071, Washington, D.C., U.S. Department of Transportation February, 1987.

(c) Bayowmi, A., The epidemiology of fatal motor vehicle accidents in Kuwait. Accid Anal Prev. 13(4): 339-348, 1981.

(d) Emoenalo, S., et al, Analysis of road traffic accidents data in Zambia. Accid Anal Prev. 9: 81-91, 1977.

TABLE 5 TOTAL MOTOR VEHICLE ACCIDENT, INJURY, AND FATALITY RATES[a] FOR BEIJING AND TIANJIN, BY CITY AND SUBURBAN AREAS, 1985

| Beijing | City | Suburbs |
|---|---|---|
| Total accident | 107 | 75 |
| Injuries | 64 | 47 |
| Fatalities | 4 | 9 |
| **Tianjin** | **City** | **Suburbs** |
| Total accident | 26 | 105 |
| Injuries | 20 | 61 |
| Fatalities | 2 | 15 |

(a) Per 100,000 population

for 1968, Jacobs and Bardsley (*14*) found the relationship to be expressed by the following equation:

$$D/V = 0.0007(V/P)^{-0.43} \quad (2)$$

The motorization rate ($V/P$) for all of China in 1985 was 8.29 vehicles per 1,000 population, ranging from 2.84 per 1,000 in the province of Hunan to 32.58 per 1,000 in the municipality of Beijing. Deaths per 1,000 motor vehicles for the entire country in 1985 were 4.80, ranging from 1.63 in the province of Gansu to 13.40 in the province of Hunan. Smeed's formula for China for 1985 is

$$(D/V) = 0.00025(V/P)^{-0.633} \quad (3)$$

which is significant at the $p$ equals 0.0001 level. The adjusted $R^2$ equals 0.645.

## DISCUSSION

As would be expected in a country where the majority of the population still is not exposed to motor vehicle travel as a routine part of daily living, population-based crash, injury, and fatality rates are relatively low (Table 1). The 43.15 reported fatalities per 100,000,000 person-km traveled (*3*) is also the rate expected in the first stages of motorization. The methods by which person-kilometers are estimated in China are unknown, so the figure should be considered a very rough estimate. The use of person-kilometers instead of vehicle-kilometers is much more appropriate because single-occupant trips are the exception in China, as in most developing countries (*2*).

The relationship between motorization and fatalities, commonly known as Smeed's law, was originally developed using 1938 data for 20 countries (16 European countries, the United

States, Canada, Australia, and New Zealand). It has since been applied to these same countries and been found to remain very stable (*14*). In a group of 32 developing countries, however, the fatality rates increased by 24 percent for similar levels of vehicle ownership over the period 1968–1971 (*14*); and in a group of 34 developing countries, the rate "increased markedly" over the period 1965–1978 (*15*). On further investigation (*14*), it was found that the proportion of motorcycles (as a percentage of all vehicles), the proportion of pedestrian fatalities (as a percentage of all fatalities), and the number of fatalities per crash due to increased overloading of vehicles had all increased during the 3-yr period. The usefulness of the formula in the identification of inconsistent changes in fatalities per vehicle was thus demonstrated.

The results reported here indicate that a doubling of vehicle ownership across the provinces yields a 35 percent decrease in fatalities per vehicle, within 2 percent of what was shown earlier for the developed countries (33 percent) and developing countries (37 percent). Smeed's formula can also be expressed as

$$D/P = -0.70(V/P)^{0.37} \quad (4)$$

which directly relates the rate of increase in fatalities per population to the degree of motorization ($R^2 = 0.37$). These results show that for every doubling of vehicle ownership there is a 29 percent increase in fatalities per person. Although Smeed's law is rarely presented this way, but rather is used to indicate the much more positive decrease in fatalities per vehicle, a doubling of vehicle ownership was reported to be accompanied by a 181 percent increase in fatalities per population over the period 1964 to 1974 in Zambia (*16*).

Besides the use of Smeed's law to present only the positive impacts of increased motorization, a second criticism is the inability to separate the various factors influencing each of the aggregate rates within the equation (*8,17*). Haight cautioned against the use of the law as an objective standard by which to judge whether an area is "safe" (*1*). His criticism of the formula as a means to compare developing countries because of its sensitivity to political decisions affecting the import or manufacture of certain vehicles (*2*) is also very appropriate for China. Total vehicle registration and manufacturing quotas by area are being used to control motorization; however, the importance of the differing vehicle safety standards available in vehicles manufactured by different countries does not appear to be recognized by the Chinese.

The fit of the data presented here indicates that the provinces and municipalities within China can be considered separate entities in different stages of motorization. Indeed, the populations of most of the individual provinces and municipalities far exceed the total population of the developing countries analyzed by Jacobs (*14*) and are as diverse as these countries with regard to ethnic heritage, climate, and terrain. One of the greatest challenges facing the Chinese government is developing traffic safety programs that will be effective across the country as a whole.

Despite the problems with Smeed's formula, finding a significant relationship between motorization rates and vehicle fatality rates does provide a basis for examination of some of the differences seen among the 29 units within China.

Some possible explanations for the differences are that those areas in which the vehicles-per-capita rate is higher are also assumed to have greater numbers of more experienced drivers, a more experienced population with regard to sharing motorways with motor vehicles, and decreased use of bicycles and cycle-rickshaws. Not surprisingly, vehicles-per-capita is strongly associated with licensed drivers-per-capita ($r = 0.70$, $p = 0.0001$); however, amount of experience or how long ago the license was obtained cannot be inferred from these data. Again, time-series analyses are needed. For the second assumption, no support can be derived either way from the data presented here. The number of vehicles by type registered per year for each unit for as many years as possible would have to be examined. A second indicator of support for this assumption would be the percent of total fatalities that occur among pedestrians; however, the fatality data are not routinely summarized by type. The third assumption is actually false, at least with regard to bicycles. Although no bicycle registration data were readily available by unit, bicycle ownership-per-100 households has increased from 31 to 74 from 1978 to 1984 for the country as a whole (*18*). Although it could be assumed that the number of cycle-rickshaws would decrease with increased vehicle ownership, this may not necessarily be the case. Ownership of a cycle-rickshaw could also be a possible first step in the entrepreneurship encouraged by the new economic reforms.

Although lack of information regarding driving experience and vehicle type limits the development of explanations for the findings shown here, the decrease in fatalities may represent nothing more than a response to a decrease in vehicle speeds due to the congestion caused by increased vehicle ownership. A primary goal of the Traffic Bureau is to decrease this congestion, which clearly is a major obstacle to the current program of economic development. The implications of this policy need to be examined in light of the role of vehicle speeds in crash and fatality rates. The cost of traffic-related mortality, morbidity, and property damage acceptable to Chinese society will be higher than that acceptable to a fully industrialized society as a justifiable cost of development. In developed countries, however, the costs of traffic safety have all too often been conveniently excluded from the calculation of the "true" costs of the development of a highway system, especially in comparison with other transport systems (*2*). It is hoped that the Chinese will not follow this pattern of economic analysis.

Although sufficient data to examine the effect of speed were not available, the effects of population density and vehicle density on fatality rates were examined. The ratio of fatalities to expected fatalities was found to decrease as population per area increased for states in the United States in 1963 (*9*). This relationship was not found to hold for other countries, however, nor was it found here for China. Clearly, the United States was at a stage of motorization in which the congestion of built-up areas influenced fatalities differently than it did in the other countries examined.

Motorization can roughly be divided into two stages (*2*): a "honeymoon" of maximum fascination for, and growth of, vehicle ownership; and when "the honeymoon is over," a period during which motor vehicle ownership is taken for granted as an often aggravating but necessary part of daily living. The first stage is characterized by high vehicle and vehicle-unit-travel fatality rates, as appreciation of the forces

exerted in motor vehicle collisions is so low as to be nonexistent. It is during this phase that several interventions have been shown to be effective:

- Standardizing regulations and ordinances with regard to the roadway, vehicle, and driver;
- Maximizing driver skill and performance as opposed to changing attitudes or increasing knowledge of regulations; and
- Increasing the beliefs held by the total population regarding the real dangers due to motor vehicle usage. The use of "horror" stories was found to start this process effectively (*1,2*).

The first of these interventions is taken for granted; but the second two now are believed to be ineffective, to the point of being ridiculed, in those countries well into the second phase of motorization. The danger for developing countries is that they and their advisors may fail to place their current traffic crash patterns in a historical perspective.

The People's Republic of China is experiencing an explosive period of growth and development and, in doing so, is looking to the developed nations for advice and technology. The tables and figures presented here show that China appears to exhibit the same patterns as have been seen in the developed countries in the first stage of motorization: fatalities per vehicle and driver are high, whereas fatalities per population are low. Growth in the number of vehicles is extremely rapid and, more important, private ownership of vehicles is being encouraged in the spirit of the new economic reforms. For example, in 1980, in the city of Beijing there were 4 taxi companies that owned a total of 4,200 vehicles. In 1987, the number of companies had increased to 252 and the total number of cabs to 13,000 (*19*). What is not apparent from the numbers, but is apparent from even a brief visit to China, is that the Chinese clearly have entered the period of infatuation not only with the automobile but with mobility itself.

One of the primary goals of economic and social development is improved movement of goods and people. How to increase such movement to the maximum possible while keeping any resultant loss of life and property to a minimum has been the subject of decades of study costing billions of dollars. Traffic safety, public health, and transportation planning professionals in developing countries need to be able to judge whether or not the lessons learned from these studies can be applied to conditions on their roadways. If relationships between the patterns of increased motorization that result from development and the patterns of subsequent motor vehicle crashes do not exist across nations, then each country will be forced to examine the methods needed to reduce motor vehicle mortality and morbidity among its own individual•population (*20*). Work by Wintemute (*20*) and the extensive work by the Overseas Unit of the United Kingdom Transport and Road Research Laboratory [*21–24*, each cited by Jacobs and Sayer (*15*)] have determined that such relationships do exist. However, these relationships "vary greatly among groups of developing nations and between the developing and developed nations as groups" (*20*). The assumption by any country that the interventions that proved successful elsewhere can simply be applied to its own situation could result in a tremendous loss of resources, time, and, of course, productive years of life.

The similarities between the developed countries and China reported here are not meant to imply that such an assumption could or should be made. No conclusions can be drawn from these limited analyses as to whether these patterns of similarity will continue. The continuing debate regarding the usefulness of Smeed's work is also recognized (*1,8,17,25,26*). These results are clearly preliminary and do little more than identify the need for more and better data. Indeed, it is hoped that these results will highlight two important areas that must be addressed by the Chinese before their highway safety transition can occur. First is the need for a well-designed and implemented data collection system. China has an advantage in that one bureau is responsible for registering vehicles, issuing driver's licenses, and recording crashes for the entire country. A consistent set of definitions and practices can thus be used; however, the degree of uniformity with which this system is being implemented across the country is unknown. In addition, there appears to be little communication among the different units within the bureau with regard to crash reporting so that highway safety priorities can be determined or programs evaluated.

The second issue is also related to communication between governmental units. The Chinese have stated that reliance on the functions of one government agency cannot solve all of their traffic-related problems (*27*). The functions listed as necessary by Fang (*27*), however, currently are all performed by one government ministry. Notable in their absence are the Statistical Bureau and the Ministry of Public Health. It appears that the Ministry of Public Health currently has little to no involvement in traffic casualty prevention. Trauma data are not routinely reported by type, and thus the role of traffic deaths in comparison with all deaths, or even injury deaths, cannot easily be ascertained (*28*). In addition, the burden that traffic injury places on the health care delivery system in China is currently very difficult to determine. Information from the Ministry of Public Health could assist the Transportation Bureau in its attempts to balance the pressures for rapid development with the need to minimize the traffic-related deaths and injuries that will accompany that development. In addition, health professionals could provide personnel, expertise, and resources to augment those of the Transportation Bureau.

The effects of the failure of the developed countries, and especially the United States, to come to terms with whether traffic safety is a health or a transportation problem are presented by Haight (*2*). The current emphasis in the United States on highway death as a matter of concern to public health professionals may be the result of the unspoken belief that further decreases in the number of fatalities-per-kilometer traveled will come about only with very costly changes in the vehicle or highway system; it is thus up to the medical community to convince people that prevention of highway deaths is up to them as individuals, that they must "change their life style." Even if this is the case, there still can be tremendous positive results from the incorporation of an entire body of professionals into the highway safety effort. Traffic safety personnel need to consider themselves health professionals, and health professionals need to understand the means of preventing traffic-related injuries and deaths and to incorporate this understanding into their practice. It is hoped that in China, as well as in all developing countries, this need will

not be recognized at as late a stage in the motorization process as has occurred in the United States.

## SUMMARY

Based on an analysis of very preliminary data, it has been shown that the People's Republic of China is at the beginning of the highway safety transition. Increases in the number of highway fatalities can be expected to coincide with the increased motorization due to economic development. To be able to predict and respond to changes in highway fatality rates, a uniform, accurate, and integrated reporting system is needed for crash, vehicle, and driver data. In addition, traffic crashes need to be recognized as a health problem so that the resources and expertise of the public health community can be enlisted in the prevention of these needless deaths and injuries.

## ACKNOWLEDGMENT

Zhao-Sheng Yang co-authored this paper at the University of Illinois while he was a visiting scholar from Jilin University, Changchun, the People's Republic of China.

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*Publication of this paper sponsored by Committee on Traffic Records and Accident Analysis.*