SAFETY OF TRANSPORTATION

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Keywords: transportation safety, traffic safety, highway accidents, road fatality and injury, roadway crashes, driver risk, pedestrian accident, bicycle and motorcycle accidents, truck safety, automobile safety

Contents

Summary

This article discusses the safety of different transportation modes around the world and compares them in terms of relative safety. Motor vehicle crashes are classified as *fatal*, nonfatal injury (*injury*), and *property damage only* (PDO) incidents, according to the most severe injury/damage resulting. An overwhelming majority of accidents are related to the highway transportation mode. Naturally, most of the article is used to discuss the

characteristics of these accidents and their aggregate levels. Historical trends indicated for most of the factors, and current data is used when available. First the worldwide statistics are presented; different modes of transportation in the United States are then discussed; finally, accident data for highway users are considered. The word "highway" is used to refer to a wide range of roads (from local street to freeways) used by vehicles with rubber tires.

1. Transportation Safety Around the World

The total number of transportation fatalities around the world is hard to determine, due to differences in reporting systems and a lack of systematic data gathering in some countries. However, from the reported data it is estimated that annual worldwide transportation fatalities exceed 200,000. In 1996, the numbers of fatalities and injuries in Australia were 1970 and 21,456, respectively; in Canada 3082 and 230,885; in Japan 15,176 and 936,974; and in the United States 42,065 and 3,511,000. In 1996 there were 63,578 traffic fatalities and 1,940,753 traffic injuries in 28 of the countries that belong to the European Conference of Ministers of Transport (ECMT). These 28 countries are Austria (A), Belgium (B), Belarus (BLR), Bulgaria (BG), Croatia (HR), Czech Republic (CZ), Denmark (DK), Estonia (EST), Finland (FIN), France (F), Germany (D), Hungary (H), Italy (I), Latvia (LV), Lithuania (LT), Luxembourg (L), Moldova (MD), The Netherlands (NL), Norway (N), Poland (PL), Portugal (P), Romania (RO), Slovenia (SLO), Spain (E), Sweden (S), Switzerland (CH), Turkey (TR), and the United Kingdom (UK). Furthermore, when the fatality and injury statistics for seven other ECMT countries were added to this data, the number of people killed in traffic accidents in 35 ECMT member countries was 101,990 and the number injured 2,149,483. These additional seven countries are Albania (ALB), Azerbaijan (AZE), Greece (GR), Ireland (IRL) Macedonia (MKD), the Russian Federation (RUS), and Slovakia (SK).

A breakdown of the accidents in the 28 ECMT countries that reported detailed data is given in Table 1. Out of the 63,578 fatalities, 23% were pedestrians, 31% drivers, 19% passengers, 6% bicyclists, 4% moped riders, 7% motorcyclists, and 10% others. There are significant variations between countries in terms of accident types and frequency. Adding up fatality and injury numbers would provide the total number of casualties.

	Fatalities		Injuries	
	Number	Percent	Number	Percent
Pedestrians	14,355	22.6	226,799	11.7
Bicyclists	3,889	6.1	152,108	7.8
Mopeds	2,640	4.2	136,679	7.0
Motorcyclist	4,356	6.9	128,182	6.6
Car driver	19,863	31.2	691,519	35.6
Car Passenger	12,299	19.3	452,076	23.3
Other	6,176	9.7	153,390	7.9
Total	63,578	100.0	1,940,753	100.0

Based on Statistical Report on Road Accidents, European Conference of Ministers of Transport (ECMT), 2000.

Table 1. Breakdown of accidents in 28 ECMT countries

1.1. Comparing Traffic Safety in Different Countries

A simple comparison of fatality rates in different countries could be misleading unless appropriate accident-exposure measures are used. Among other factors, the degree of motorization, the extent of travel by car, the quality and extent of road network infrastructure, road users' driving habits, traffic laws and regulations, and the degree to which road users adhere to these laws all have to be considered in such comparisons. This makes it difficult to compare fatality and injury rates directly from one country to another. The relationship between the number of fatalities per million people (fatality rate) and the number of motor vehicles per thousand population (degree of motorization) is not obvious, as Figure 1 indicates. Countries with similar degrees of motorization can display significantly different fatality rates. For instance, the motor vehicle ownership rate for Portugal is similar to the rates for France and Germany, but the fatality rate for Portugal is much higher. It seems that countries with a similar degree of motorization and roadway infrastructure have broadly similar fatality rates: for example, the fatality rates for France and Germany are comparable.

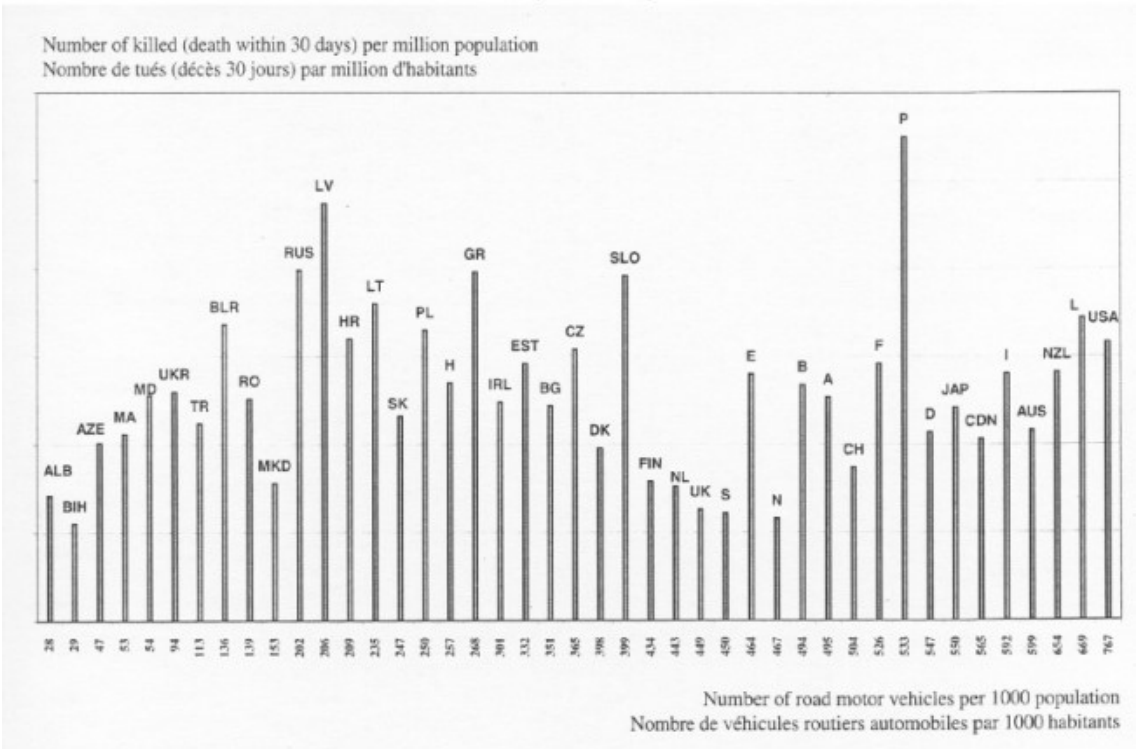

Figure 1. Relationship between numbers of fatalities and numbers of motor vehicles

2. Transportation in the United States

2.1. Major Elements of the US Transportation System

The United States has the largest transportation system in the world and transportation is a major component of the US economy, accounting for 11% of its gross domestic product (GDP). Transportation and related industries employ 9.9 million people in the

United States. The major elements of US transportation systems are given in Table 2. They include over 3.9 million miles of roads and 170,000 miles of railroads. There are over 210 million cars, trucks, and buses traveling over 2.5 trillion miles every year. Such a huge transportation system has some costs in terms of human casualties, fuel consumption, congestion, pollution, and operations and maintenance.

MAJOR ELEMENTS OF THE TRANSPORTATION SYSTEM, 1995

Mode	Major defining elements	Components
Highways[a]	Public roads and streets; automobiles, vans, trucks, motorcycles, taxis, and buses (except local transit buses) operated by transportation companies, other businesses, governments, and households; garages, truck terminals, and other facilities for motor vehicles	*Roads* 45,744 miles of Interstate highway 111,237 miles of other National Highway System roads 3,755,245 miles of other roads *Vehicles and use* 136 million cars, driven 1.5 trillion miles 58 million light trucks, driven 0.7 trillion miles 6.9 million freight trucks, driven 0.2 trillion miles 686,000 buses, driven 6.4 billion miles
Air	Airways and airports; airplanes, helicopters, and other flying craft for carrying passengers and cargo	*Public use airports* 5,415 airports *Airports serving large certificated carriers*[b] 29 large hubs (67 airports), 393 million enplaned passengers 33 medium hubs (59 airports), 86 million enplaned passengers 58 small hubs (73 airports), 34 million enplaned passengers 561 nonhubs (593 airports), 14 million enplaned passengers *Aircraft* 5,567 certificated air carrier aircraft, 4.6 billion miles flown* *Passenger and freight companies* 86 carriers, 506 million domestic revenue passenger enplanements, 12.5 billion domestic ton-miles of freight* *General aviation* 171,000 aircraft, 2.9 billion miles flown[c]
Rail[d]	Freight railroads and Amtrak	*Railroads* 125,072 miles of major (Class I) 18,815 miles of regional 26,546 miles of local *Equipment* 1.2 million freight cars 18,812 locomotives *Freight railroad firms* Class I: 11 companies, 188,215 employees, 1.3 trillion ton-miles of freight carried Regional: 30 companies, 10,647 employees Local: 500 companies, 13,269 employees *Passenger (Amtrak)* 23,646 employees, 1,921 passenger cars, 356 locomotives, 20.7 million passengers carried
Transit[e]	Commuter trains, heavy-rail (rapid-rail) and light-rail (streetcar) transit systems, local transit buses, vans and other demand response vehicles, and ferryboats	*Vehicles* 43,723 buses, 17.2 billion passenger-miles 9,046 rapid rail and light rail, 11.5 billion passenger-miles 4,349 commuter rail, 8.0 billion passenger-miles 86 ferries, 243 million passenger-miles 12,828 demand response, 377 million passenger-miles
Water	Navigable rivers, canals, the Great Lakes, St. Lawrence Seaway, Intercoastal Waterway, ocean shipping channels; ports; commercial ships and barges, fishing vessels, and recreational boating	*U.S.-flag domestic fleet*[f] Great Lakes: 698 vessels, 60 billion ton-miles Inland: 31,910 vessels, 306 billion ton-miles Ocean: 7,033 vessels, 440 billion ton-miles *Ports*[g] Great Lakes: 362 terminals, 507 berths Inland: 1,811 terminals Ocean: 1,578 terminals, 2,672 berths
Pipeline[h]	Crude oil, petroleum product, and natural gas lines	*Oil* Crude lines: 114,000 miles of pipe, 323 billion ton-miles transported Product lines: 86,500 miles of pipe, 269 billion ton-miles transported 161 companies, 14,900 employees *Gas* Transmission: 276,000 miles of pipe Distribution: 919,000 miles of pipe 19.7 trillion cubic feet, 150 companies, 187,200 employees

[a] U.S. Department of Transportation, Federal Highway Administration, *Highway Statistics 1995* (Washington, DC: 1996).
[b] U.S. Department of Transportation, Bureau of Transportation Statistics, Office of Airline Information, *Airport Activity Statistics of Certificated Air Carriers, 12 Months Ending December 31, 1995* (Washington DC: 1996).
[c] Data for 1994.
[d] All numbers are from Association of American Railroads, *Railroad Facts* (Washington, DC: 1996), except Amtrak figures from National Railroad Passenger Corporation, *1995 Annual Report* (Washington, DC: 1996).
[e] Data for 1994. U.S. Department of Transportation, Federal Transit Administration, *National Transit Summaries and Trends for the 1994 National Transit Database, Section 15 Report Year* (Washington, DC: 1996). Figures exclude transit for nonurbanized areas (Section 18, Federal Transit Act).
[f] Vessel data from U.S. Army Corps of Engineers, *Transportation Lines of the United States* (New Orleans, LA: 1996); ton-miles data from U.S. Army Corps of Engineers, *Waterborne Commerce of the United States 1995* (New Orleans, LA: 1996).
[g] Ports data from U.S. Department of Transportation, Maritime Administration, *A Report to Congress on the Status of the Public Ports of the United States 1994–1995* (Washington, DC: October 1996).
[h] Data for 1994.

*Preliminary data.

SOURCE: Unless otherwise noted, U.S. Department of Transportation, Bureau of Transportation Statistics, *National Transportation Statistics 1997* (Washington, DC: 1996).

From: US Department of Transportation, Transportation in the United States; A Review, Washington, DC, 1997

Table 2. Major elements of the US transportation system in 1995

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Biographical Sketch

Dr. Rahim F. (Ray) Benekohal is Professor of Civil Engineering at the University of Illinois at Urbana-Champaign. Prior to joining the University he worked for the consulting firm RKA, Inc. He received his B.Sc., M.Sc., and Ph.D. degrees from the Ohio State University. He teaches and does research in traffic flow modeling, ITS evaluation, transportation safety, and transportation systems analysis. He has conducted several research projects for IDOT, FHWA, and FAA. He has published over 100 articles, papers, and reports, and has won the ASCE Arthur Wellington Award for Best Paper. He is the editor of a book entitled *Traffic Congestion and Traffic Safety in the Twenty-First Century*. He has been awarded an honorary professorship at Harbin University of Civil Engineering, China. Dr. Benekohal is the Director of Traffic Operations Laboratory at the University of Illinois. He is also Director of Illinois Traffic Engineering and Safety Conference. Illinois Section of ITE has awarded him the Past President Award for exceptional service to the profession.