SAFETY OF TRANSPORTATION

Benekohal R.F.
University of Illinois at Urbana-Champaign, USA

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

1. Transportation Safety Around the World
1.1. Comparing Traffic Safety in Different Countries
2. Transportation in the United States
2.1. Major Elements of the US Transportation System
2.2. Transportation Crashes in the United States
2.2.1. Cross-Modal Comparisons
2.2.2. Hazardous Material Incidents and Accidents
2.3. Highway Travel and Vehicle Registration Trends
2.3.1. Roadway Mileage by Functional Class
2.3.2. Vehicle Age and Its Role in Safety
2.3.3. Fatality Rates by Population, Vehicle, and Licensed Drivers
2.3.4. Fatalities and Injuries by Vehicle Type
2.4. Roadway-Related Factors
2.4.1. Location of Crashes and Numbers of Vehicles Involved
2.4.2. Crashes by Number of Lanes and Traffic Flow
2.4.3. Crash Relation to Intersections and Traffic Control Devices
2.4.4. Safety and Horizontal Curves
2.5. Driver-Related Factors
2.5.1. Crashes by Driver Age
2.5.2. Highway Crashes by Gender
2.5.3. Crashes and Blood Alcohol Concentration Level
2.6. Effects of Time and Environmental Conditions on Highway Crashes
2.6.1. Crash Rates by Month
2.6.2. Crash Rates by Day of Week and Hour of Day
2.6.4. Crashes by First Harmful Event
3. Conclusions
Glossary
Bibliography
Biographical Sketch

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.

<table>
<thead>
<tr>
<th></th>
<th>Fatalities</th>
<th>Injuries</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Percent</td>
</tr>
<tr>
<td>Pedestrians</td>
<td>14,355</td>
<td>22.6</td>
</tr>
<tr>
<td>Bicyclists</td>
<td>3,889</td>
<td>6.1</td>
</tr>
<tr>
<td>Mopeds</td>
<td>2,640</td>
<td>4.2</td>
</tr>
<tr>
<td>Motorcyclist</td>
<td>4,356</td>
<td>6.9</td>
</tr>
<tr>
<td>Car driver</td>
<td>19,863</td>
<td>31.2</td>
</tr>
<tr>
<td>Car Passenger</td>
<td>12,299</td>
<td>19.3</td>
</tr>
<tr>
<td>Other</td>
<td>6,176</td>
<td>9.7</td>
</tr>
<tr>
<td>Total</td>
<td>63,578</td>
<td>100.0</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Mode</th>
<th>Major defining elements</th>
<th>Components</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air</td>
<td>Airways and airport, airplanes, helicopters, and other flying craft for carrying passengers and cargo</td>
<td>Private airways: 6,416 airports; Airports serving large certificated carriers: 29 large hubs (57 airports), 383 million enplaned passengers; 33 medium hubs (66 airports, 38 million enplaned passengers); 50 small hubs (117 airports, 34 million enplaned passengers); 506 airports (593 airports, 14 million enplaned passengers); Aircraft: 5,537 certificated civil aircraft, 4.6 billion miles flown; Airports and freight companies: 86 carriers, 20 million domestic revenue passenger enplanements, 12.5 billion domestic ton-miles of freight; Summit: 171,000 aircraft, 2.9 billion miles flown</td>
</tr>
<tr>
<td>Rail*</td>
<td>Freight railroads and Amtrak</td>
<td>Railways: 155,792 miles of major (Class 1), 18,540 miles of regional, 1,750 locomotives, 21,000 employees; Amtrak: 2,111 miles, 15,299 employees; Class I-11 carriers, 104,725 employees, 1.3 trillion ton-miles of freight carried</td>
</tr>
<tr>
<td>Transit</td>
<td>Commuter trains, heavy-rail (rapid-rail) and light-rail (streetcar) transit systems, local transit buses, trolley cars, and other demand response vehicles, and for-hire vehicles</td>
<td>Vehicles: 43,703 buses, 172,200 passenger-miles; 5,049 rapid- and light rail, 11.2 billion passenger-miles; 4,149 commuter rail, 6.8 billion passenger-miles; 541,710 light rail, 1.8 billion passenger-miles; 88 ferries, 283 million passenger-miles; 37,826 demand response, 977 million passenger-miles</td>
</tr>
<tr>
<td>Water</td>
<td>Navigation, rivers, canals, the Great Lakes, St. Lawrence Seaway, Intracoastal Waterway, ocean shipping channels, ports, coastal and river shipping vessels, fishing vessels, and recreational boating</td>
<td>Water: 1,763 vessels, 180 billion ton-miles; Great Lakes: 2,110 vessels, 160 billion ton-miles; Ocean: 1,950 vessels, 460 billion ton-miles; Park: 362 terminals, 507 berths; inland: 1,950 terminals; Dredge: 1,778 terminals, 2,672 berths</td>
</tr>
<tr>
<td>Pipelines</td>
<td>Crude oil, petroleum product, and natural gas lines</td>
<td>Crude lines: 114,000 miles of pipe, 323 billion ton-miles transported; Product lines: 80,500 miles of pipe, 269 billion ton-miles transported; 161 companies, 14,000 employees; Gas: Transmission: 278,000 miles of pipe, 919,000 miles of pipe; Distribution: 10.7 billion cubic feet, 550 companies, 187,000 employees</td>
</tr>
</tbody>
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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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Bibliography


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.