Motorcycle Crashes and its Implications to Local Roads

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Agenda

• Overview of Puerto Rico
• Road safety fundamentals
• Motorcycle research methodology
• Trends in motorcycle registrations and fatalities in Puerto Rico
• Comparison of motorcycle-related crash elements in California and Puerto Rico
• Relevant motorcycle crashes statistics in US Southeast Region and Puerto Rico
• Contributory factors of motorcycle crashes in local roads
• Safety countermeasures and recommendations

An Overview of Puerto Rico

• 3,500 sq. mi.
• 2.3 million licensed drivers
• 115,000 registered motorcycles
• 504 road fatalities
• 3.84 million inhabitants
• 2.8 million registered motor vehicles
• 26,647 kilometers of roads

Puerto Rico’s Highway System

80% urban roads  77% local roads
OUR MISSION

plan, design, operate, and maintain streets and highways

provide a balanced system for the movement of people and goods

safe, rapid, comfortable, convenient, economical, and environmentally compatible

When does a road can be considered **SAFE for motorcycle riders**

How to Measure Road Safety

- **Nominal safety** – determined by compliance with design guidelines and standards
- **Objective safety**
  – Measured with crashes
  – Likelihood of crash on the road for a particular driver
- **Subjective / perceived safety**
  – Safety as perceived and interpreted by drivers
  – Driver behavior / speed selection

Pyramid of Highway Traffic Events

- Serious Conflicts
- Slight Conflicts
- Potential Conflicts
- Undisturbed passages

Crashes

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Crash type</td>
<td>2.6% property damage only (PDO) 97.4% injury or fatal</td>
<td>40.1% property damage only (PDO) 59.9% injury or fatal</td>
</tr>
<tr>
<td>Area type</td>
<td>9.4% occurred in a rural area</td>
<td>18.5% occurred in a rural area</td>
</tr>
<tr>
<td>Road classification</td>
<td>55.9% occurred on arterial highways</td>
<td>29.7% occurred on arterial highways</td>
</tr>
<tr>
<td>Crash location</td>
<td>59.7% occurred in roadway segments</td>
<td>75.2% occurred in roadway segments</td>
</tr>
<tr>
<td>Roadway alignment</td>
<td>81.3% on straight and level segment</td>
<td>75.7% on straight and level segment</td>
</tr>
<tr>
<td>Maneuver type</td>
<td>29.5% right angle crashes</td>
<td>17.5% side crashes in same direction</td>
</tr>
<tr>
<td>Traffic control type</td>
<td>25.5% in signalized intersections</td>
<td>8.9% in signalized intersections</td>
</tr>
<tr>
<td>Roadway defects</td>
<td>2.0% were caused by roadway defects</td>
<td>3.0% were caused by roadway defects</td>
</tr>
<tr>
<td>Gender of riders</td>
<td>97% of motorcycle riders were men</td>
<td>95% of motorcycle riders were men</td>
</tr>
<tr>
<td>Age of riders</td>
<td>62.6% between 17-26 years old</td>
<td>35.6% between 26-35 years old</td>
</tr>
<tr>
<td>Fatality rate (2006)</td>
<td>6.90</td>
<td>19.83</td>
</tr>
</tbody>
</table>
Relevant Motorcycle Crash Statistics
Southeastern Region of U.S. and Puerto Rico

Source: NHTSA, 2006. Motorcycle Safety Plan


Source: NHTSA, 2006. Motorcycle Safety Plan

Motorcycle Rider Fatality Rate Per 10,000 Registered Motorcycles by State

<table>
<thead>
<tr>
<th>Rank</th>
<th>State / U.S. Territory</th>
<th>Motorcycle Fatalities</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>California</td>
<td>432</td>
</tr>
<tr>
<td>2</td>
<td>Florida</td>
<td>432</td>
</tr>
<tr>
<td>3</td>
<td>Texas</td>
<td>285</td>
</tr>
<tr>
<td>4</td>
<td>Pennsylvania</td>
<td>158</td>
</tr>
<tr>
<td>5</td>
<td>Illinois</td>
<td>157</td>
</tr>
<tr>
<td>6</td>
<td>New York</td>
<td>150</td>
</tr>
<tr>
<td>7</td>
<td>North Carolina</td>
<td>134</td>
</tr>
<tr>
<td>8</td>
<td>Ohio</td>
<td>134</td>
</tr>
<tr>
<td>9</td>
<td>Arizona</td>
<td>119</td>
</tr>
<tr>
<td>10</td>
<td>Puerto Rico (2006 update)</td>
<td>115</td>
</tr>
<tr>
<td>11</td>
<td>Georgia</td>
<td>111</td>
</tr>
</tbody>
</table>

Source: NHTSA, 2006. Motorcycle Safety Plan

Nine (9) of the top 21 states with highest motorcycle fatality rate are located in the southeastern states of U.S. (43%)
Motorcycle Riding Behavior in Puerto Rico

Contributory Factors

<table>
<thead>
<tr>
<th>Factors</th>
<th>Percentage of Contributory Factors in Highway Fatalities by Year</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2001</td>
</tr>
<tr>
<td>Motorcycle riders</td>
<td>9</td>
</tr>
<tr>
<td>Alcohol-related</td>
<td>52</td>
</tr>
<tr>
<td>Speeding</td>
<td>48</td>
</tr>
<tr>
<td>Roadway departure</td>
<td>45</td>
</tr>
<tr>
<td>Single vehicle</td>
<td>68</td>
</tr>
<tr>
<td>Pedestrians</td>
<td>34</td>
</tr>
<tr>
<td>Total Road Fatalities</td>
<td>495</td>
</tr>
</tbody>
</table>

Top 15 States for motorcycle operator fatality rate by operator BAC (BAC > 0.01) per 10,000 registered motorcycles by State.
Motorcycle Crashes per Day

**48% of Injuries and Fatalities During Weekends**

Annual Motorcycle Crashes and Number of Vehicles Involved

<table>
<thead>
<tr>
<th>Day</th>
<th>Total Crashes</th>
<th>Vehicles Involved</th>
<th>Injuries and Fatalities / 100 Crashes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sunday</td>
<td>72</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monday</td>
<td>49</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tuesday</td>
<td>52</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wednesday</td>
<td>51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thursday</td>
<td>53</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Friday</td>
<td>54</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Saturday</td>
<td>64</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Legend of Motorcycle Riders Survey:
- Total Crashes
- Vehicles Involved
- Injuries and Fatalities / 100 Crashes

Human Factors of Motorcycle Crashes in Puerto Rico

- Male, 92%
- Female, 5%
- Unknown, 3%

Survey of Motorcycle Riders

- 500 motorcycle riders surveyed
- 78% of municipalities

Characteristics of Survey Sample:

**Gender**
- Male 67%
- Female 13%

**Education**
- 31% High School
- 30% Technical Degree
- 28% Bachelor
- 13% Graduate
- 8% Other

**Age Groups**
- 29% 16-19
- 18% 20-25
- 16% 26-35
- 10% 36-50
- 7% 51-59

**Motorcycle Type**
- 26% Sport
- 25% Cruiser
- 20% Standard
- 10% Other
- 5% Scooter

- <16: 1%
- 16-19: 10%
- 20-25: 18%
- 26-35: 30%
- 36-50: 5%
- >51: 7%
Stated Motorcycle Use

Preferred Day for Using Motorcycle

- All days: 49%
- Weekend: 30%
- Holidays: 9%
- Monday to Friday: 4%
- Other: 2%
- Weekend & Holidays: 6%

Primary Motorcycle Use

- Recreation: 24%
- Go to School or Work: 5%
- To Work: 4%
- Other: 67%

Perception of Contributing Road Factor to Motorcycle Crashes

- Pavement
- Absence of Illumination
- Presence of Gravel or Sand in the Pavement
- Bad Weather
- Pavement Marking
- Obstacle Blocking Visibility
- Lane Width
- Sleep Grades
- Sharp Curves
- Other

Perception of Contributing Factor of Human Behavior in Motorcycle Crashes

- Don't Know
- Does not contribute
- Partially Contributes
- Significantly Contributes

Twelve Contributory Factors to Motorcycle-related Crashes

1. Untrained and inexperienced riders
2. Risk acceptance (speed differential, etc.)
3. Driving under the influence - DUI (alcohol, drugs, etc.)
4. Lack of safety garment (severity-related)
5. Highway geometry (sharp curvature)
6. Hidden driveways and sight distance restrictions
7. Pavement markings at crosswalks and stop bars approaching an intersection
8. Pavement conditions
9. Climatic conditions
10. Inadequate nighttime illumination
11. Inadequate transition tapers at work zones
12. Inadequate road signage
Ten Contributory Factors to Motorcycle-related Crashes at Local Roads

1. Transition from high-speed to low-speed roads
2. Abrupt changes in geometry
3. Limited sight distances
4. Hidden driveways
5. Vegetation / Lack of roadside maintenance
6. Obsolete roadside safety features
7. Loose gravel on pavement surface and intersections
8. Pavement conditions (rutting, shoving, polished aggregate, lane shoulder drop-offs)
9. First-time drivers at tourism and recreational areas
10. Inadequate advanced warning signs

1. General Safety Countermeasures
   - Exclusive motorcycle lanes
   - Advanced stop bars
   - Improve road signage
   - Pavement maintenance
   - Forgiving roadside
2. Recommended Motorcycle Training for Riding on Horizontal Curves

- $H_{\text{eye}} = 1.3$ m
- $H_{\text{eye}} \geq 0.6$ m

3. Improve warning signs to address local prevailing conditions

- Grooved shoulder warning sign

4. Recommended Advanced Markings at Intersections
4. Experimental Motorcycle
Advanced Stop Line at Intersections

5. Enforcement, Education, Training, Engineering, and Administrative-related Recommendations

<table>
<thead>
<tr>
<th>Thrust Areas</th>
<th>Short (S), Medium (M) and Long (L) Term Recommendations to Reduce Motorcycle Crash Potential</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enforcement</td>
<td>Increase fines of motorcycle traffic-related violations (S)</td>
</tr>
<tr>
<td>Education</td>
<td>Education campaign on helmet and safety clothing, increasing risk perception, crash consequences that results in impairment that affects your future quality of life, etc. (M-L)</td>
</tr>
<tr>
<td>Training</td>
<td>Implement a motorcycle training and riding test for motorcycle licensing (S-M)</td>
</tr>
<tr>
<td>Engineering</td>
<td>Provide effective and preventive maintenance to highways (M-L)</td>
</tr>
<tr>
<td>Administrative</td>
<td>Legislative action to establish 18-years old as minimum age to obtain a motorcycle license (S) Include specifications for motorcycles in roadway and roadside design manuals and Manual of Uniform Traffic Control Devices (MUTCD)</td>
</tr>
</tbody>
</table>

Thank you for the opportunity!

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