MOTORCYCLE CRASHES IN MALAYSIA
- STATUS, RISK FACTORS AND INTERVENTIONS -

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5TH AUGUST 2015
MALAYSIA

- Population = 29 million
- Registered vehicle = 17.8 million
- GDP = 313 Billion USD, 6% growth
- Road length:
  - Expressway: 1.3%
  - Primary / arterial road: 13.6%
  - Secondary / collector road: 43.9%
  - Local streets: 34.8%
  - Minor roads: 6.4%
- Malaysia is a country with left-hand traffic
  - On 16 countries in the world

# GOOD NEWS?

<table>
<thead>
<tr>
<th>YEAR</th>
<th>REGISTERED VEHICLE</th>
<th>ROAD CRASHES</th>
<th>ROAD DEATHS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>22,702,221</td>
<td>462,423</td>
<td>6,917</td>
</tr>
<tr>
<td>2013</td>
<td>23,819,256</td>
<td>477,204</td>
<td>6,915</td>
</tr>
<tr>
<td>2014</td>
<td>25,101,192</td>
<td>476,196</td>
<td>6,674</td>
</tr>
</tbody>
</table>

*Source: PDRM (2014), analyzed by MIROS (2014)*
THE BIG PICTURE

- Road Crashes
- Road Deaths


Numbers on the y-axis: 0, 100,000, 200,000, 300,000, 400,000, 500,000, 600,000, 700,000, 800,000

IN REALITY...OUR NUMBER PLATE IS

MY 500 20 1

- 500 road death every month
- 20 road death everyday
- 1 road death every hour!!
- Price we had to pay: 9 billion/yr

Medical cost, lost of labor and skill worker and social disparities
IN REALITY

FIREARM RELATED DEATH RATE PER 100,000 POPULATION

1. Honduras: 64.80
2. Venezuela: 50.90
7. Colombia: 28.14
8. South Africa: 21.51
12. Mexico: 11.17
13. U.S.A.: 10.64

TRAFFIC CRASH RELATED DEATH RATE PER 100,000 POPULATION

Malaysia: 22.00

Source: WHO. (2013)
HOW BAD ARE WE IN THE WORLD

Road fatalities per 100,000 population per year

HIGH INCOME COUNTRY AND ASIAN COUNTRIES

Norway, Denmark, Sweden, Switzerland, United Kingdom, Spain, Iceland, Netherlands, Germany, Finland, Japan, France, Singapore, Austria, Australia, Canada, Italy, Luxembourg, Brunei Darussalam, Czech Republic, Belgium, New Zealand, Philippines, Portugal, South Korea, Bangladesh, United States, Nepal, Pakistan, Cambodia, Indonesia, Russia, India, Timor-Leste, Afghanistan, Laos, China, Kazakhstan, Malaysia, Vietnam, Thailand
MOTORCYCLE ROAD SAFETY SITUATION

A brief
MOTORCYCLES IN ASIA

Hanoi

Bangkok

Jakarta

Kuala Lumpur

Taipei
## Modes Ratio in Asian Countries

<table>
<thead>
<tr>
<th>City</th>
<th>Year</th>
<th>Car</th>
<th>M-cycle</th>
<th>Bus</th>
<th>Train</th>
<th>Paratransit</th>
<th>Others</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tokyo</td>
<td>98</td>
<td>54</td>
<td>04</td>
<td>42</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Seoul</td>
<td>02</td>
<td>27</td>
<td>26</td>
<td>35</td>
<td>40</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shanghai</td>
<td>04</td>
<td>28</td>
<td>0</td>
<td>49</td>
<td>9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>M. Manila</td>
<td>96</td>
<td>21</td>
<td>15</td>
<td>3</td>
<td>61</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Jakarta</td>
<td>02</td>
<td>17</td>
<td>23</td>
<td>58</td>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kuala Lumpur</td>
<td>97</td>
<td>56.6</td>
<td>23.7</td>
<td>18.1</td>
<td>1.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bangkok</td>
<td>03</td>
<td>35</td>
<td>27</td>
<td>26</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Taipei</td>
<td>04</td>
<td>29</td>
<td>31</td>
<td>20</td>
<td>12</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hanoi</td>
<td>05</td>
<td>3.5</td>
<td>82.7</td>
<td>7.8</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>HCMC (02)</td>
<td>1.9</td>
<td>91.4</td>
<td>91.4</td>
<td>91.4</td>
<td>91.4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Source: ITPS 2007 (STREAM project) with updated data
TRENDS IN ASIAN COUNTRIES

- Vietnam: M-cycle rapidly accelerating
- Indonesia: M-cycle increasing with income
- Thailand: M-cycle declining
- Malaysia: GDP/cap = 15,000~25,000$, M-cycle declined
- Japan
- S. Korea
MOTORCYCLE COMPOSITION IN MALAYSIA

- **Moped class 1**: 40.0%
- **Moped class 2**: 33.5%
- Power-scooter: 3.6%
- Custom: 0.2%
- Sport touring: 0.5%
- On/Off Road: 18.9%
- Enduro/Cross: 137
- Superbike: 217
- Touring: 378
- Standard / Naked bike: 443

- **Source**: JPJ (2014) – registered motorcycle
% OF MC ACCIDENT FATALITIES IN THE WORLD

Percentage of MC accident fatalities from the total of road fatalities

Rank 5th highest in the World

MALAYSIAN ROAD TRAFFIC FATALITIES BY TYPE OF ROAD USER

Source: PDRM (2013), analyzed by MIROS (2014)

Average rate of increase is 5% (2005 – 2013) and overly represented

Motorcycle (Motorized 2-3 wheelers)

Passenger cars

Non-motorized

Heavy vehicles

Source: PDRM (2013), analyzed by MIROS (2014)
### MC SINGLE AND MULTI-CRASHES

<table>
<thead>
<tr>
<th>Motorcycle fatal crash based on the number of vehicles involved</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crash cases</td>
<td>% fatal of all cases</td>
<td>Crash cases</td>
</tr>
<tr>
<td>Motorcycle single-vehicle crash</td>
<td>22,355</td>
<td>5.3%</td>
<td>20,689</td>
</tr>
<tr>
<td>Motorcycle crash involving another (one) vehicle</td>
<td>60,269</td>
<td>2.6%</td>
<td>56,399</td>
</tr>
<tr>
<td>Motorcycle crash involving two or more other vehicles</td>
<td>4,474</td>
<td>18.6%</td>
<td>4,188</td>
</tr>
<tr>
<td>All crash case</td>
<td>87,098</td>
<td>4.1%</td>
<td>81,276</td>
</tr>
</tbody>
</table>

Source of crash data: Royal Malaysian Police (2010 – 2012), analysis done by MIROS
Note: Crash cases refers to all types of road traffic crash which resulted in fatal injury, serious injury, slight injury and/or damage to the vehicle.

MC multi-crash accidents is a problem!**

- Single motorcycle accident – 5% to 6% resulted in fatal crashes
- Multi vehicle accident involving motorcycle – 14% to 19% resulted in fatal crashes

MC CRASH AT INTERSECTIONS (1/3)

• >50% of Malaysia traffic death is among MC *
  • 66% of MC fatal crashes occurs on straight road section **

• BUT
  • 3-legged and 4-legged is the next most common (18.5%) *

* Source: PDRM (2013), analyzed by MIROS (2014)
MC CRASH AT INTERSECTIONS (2/3)

The percentage of motorcycle fatal crashes at intersections based on the total reported crash cases (source: PDRM (2011), analyzed by MIROS).

<table>
<thead>
<tr>
<th>Intersection type</th>
<th>Signalized</th>
<th>Un-signalized</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-legged</td>
<td>23.9% * (n = 522)</td>
<td>17.4% * (n = 1,404)</td>
</tr>
<tr>
<td>3-legged</td>
<td>19.8% * (n = 334)</td>
<td>15.9% * (n = 5,326)</td>
</tr>
</tbody>
</table>

n: Total number of reported crash cases involving motorcycle since 2010 – 2011.
* Statistically significant difference according to Chi-sq. test (p < 0.05)

• **All type of signalized intersections** have a higher motorcycle fatal crash rate (23.9%: 4-legged, 19.8%: 3-legged) compare to the un-signalized intersections (p<0.01),
  • despite both un-signalized 4-legged and 3-legged intersection have a higher number of reported crash cases.
Motorcycle fatal crash rates based on various location types, various road jurisdiction classifications and various area type, signalized intersection are shown to have a statistically significantly higher fatality risk (i.e. fatality rate) than un-signalized intersection (p<0.05).

### Intersection at various location type

<table>
<thead>
<tr>
<th>Location Type</th>
<th>Signalized</th>
<th>Un-signalized</th>
</tr>
</thead>
<tbody>
<tr>
<td>City</td>
<td>20.7% * (n = 87)</td>
<td>15.1% * (n = 411)</td>
</tr>
<tr>
<td>Town</td>
<td>26.3% * (n = 243)</td>
<td>15.4% * (n = 978)</td>
</tr>
<tr>
<td>Small Town</td>
<td>23.6% * (n = 174)</td>
<td>18.4% * (n = 1,469)</td>
</tr>
<tr>
<td>Rural</td>
<td>19.3% * (n = 352)</td>
<td>15.7% * (n = 3,872)</td>
</tr>
</tbody>
</table>

n: Total number of reported crash cases involving motorcycle since 2010 – 2011.
Location type: City is classified as an area that has a population > 100,000, Town is classified as 100,000 < population < 50,000, Small Town is classified as 50,000 < population < 5,000, Rural is classified as population < 5,000.
* Statistically significant difference according to Chi-sq. test (p < 0.05)

### Intersection at various road jurisdiction

<table>
<thead>
<tr>
<th>Jurisdiction</th>
<th>Signalized</th>
<th>Un-signalized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Federal</td>
<td>20.0% * (n = 436)</td>
<td>15.8% * (n = 2,247)</td>
</tr>
<tr>
<td>State</td>
<td>26.8% * (n = 164)</td>
<td>15.2% * (n = 1,866)</td>
</tr>
<tr>
<td>Municipal</td>
<td>23.7% * (n = 249)</td>
<td>17.0% * (n = 2,004)</td>
</tr>
<tr>
<td>Others</td>
<td>19.4% * (n = 36)</td>
<td>16.4% * (n = 671)</td>
</tr>
</tbody>
</table>

n: Total number of reported crash cases involving motorcycle since 2010 – 2011.
Others: Private roads or local roads
* Statistically significant difference according to Chi-sq. test (p < 0.05)

### Intersection within the vicinity of various area type

<table>
<thead>
<tr>
<th>Area Type</th>
<th>Signalized</th>
<th>Un-signalized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>25.0% * (n = 164)</td>
<td>16.5% * (n = 1,664)</td>
</tr>
<tr>
<td>Commercial</td>
<td>22.0% * (n = 205)</td>
<td>18.1% * (n = 930)</td>
</tr>
<tr>
<td>Industrial</td>
<td>33.3% * (n = 33)</td>
<td>30.4% * (n = 191)</td>
</tr>
<tr>
<td>School</td>
<td>17.4% * (n = 23)</td>
<td>12.1% * (n = 248)</td>
</tr>
<tr>
<td>No development</td>
<td>20.5% * (n = 448)</td>
<td>14.9% * (n = 3,819)</td>
</tr>
</tbody>
</table>

n: Total number of reported crash cases involving motorcycle since 2010 – 2011.
No development signify an area with very few population, e.g. plantation, forest, etc.
* Statistically significant difference according to Chi-sq. test (p < 0.05)
MC BEHAVIOR IN MALAYSIA
MC SPEED

- Motorcycle (MC) speed is statistically significantly different than passenger cars (PC) – all road hierarchy types\(^{(a \& b)}\)

- Motorcycle maintains their speed even when ADT on the road is high \(^{(b \& c)}\)

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c. Abdul Manan, M. M. (2014). Motorcycles entering from access points and merging with traffic on primary roads in Malaysia: Behavioral and road environment influence on the occurrence of traffic conflicts. *Accident Analysis & Prevention, 70, 301-313*
MC MEAN SPEED VS. ADT (NEGERI 9)

When Average Daily Traffic (ADT) volume increases, MC mean speed increases.

Motorcycle:
\[ y = -0.0007x + 56.877 \]
\[ R^2 = 0.0479 \]

Passenger Car:
\[ y = -0.0015x + 64.757 \]
\[ R^2 = 0.1665 \]

2 lane dual carriageway

### VEHICLE EXCEEDING SPEED LIMIT VS. ADT AND MC RATIO (NEGERI 9)

<table>
<thead>
<tr>
<th>ADT (2 lane single carriageway)</th>
<th>Motorcycle ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 5%</td>
</tr>
<tr>
<td>&lt; 5,000 (n=5,935)</td>
<td>9.4%</td>
</tr>
<tr>
<td>5,001 - 10,000 (n=3,088)</td>
<td>15.8%</td>
</tr>
</tbody>
</table>

* MC only contributed to less than 14% on each percentage of vehicle exceeding speed limit

- When **% of MC is higher**, other vehicle tend to **exceed speed limit**.
MC RIDING BEHAVIOR (1/4)

• Helmet and Headlight usage
  • Motorcyclists had a 66% to 74% compliance rate
  • However, female motorcyclists had a lower rate of helmet usage compared to men. This situation was observed more in the rural areas

• Riding patterns
  • Motorcyclists rode equally in the middle of the lane and near the shoulder regardless of the traffic volume.
  • Moreover, female riders were inclined to ride close to the shoulder more compared to male riders.
• The percentage of motorcyclists who did not slow down while riding near the road shoulder, was much higher when there was a vehicle on the approach to the access point as compared to when there was no vehicle on the approach to the access point (p<0.05)
MC RIDING BEHAVIOR (3/4)

- On the high volume site, and when there is a vehicle waiting at the access point, motorcycles travel at higher speeds than other vehicles in both the near and far side lanes (p<0.05).
MC RIDING BEHAVIOR (4/4)

- The Opposite Indirect Right Turn (OIRT)
  - 18% to 26% of right turning motorcyclists
  - Majority of motorcyclists do not stop at the stop line
  - Accept shorter gap ($t_G < 4s$) at high traffic volume
- BUT low rate of serious traffic conflict! compared to normal right turn movement
OPPOSITE INDIRECT RIGHT TURN
OPPOSITE INDIRECT RIGHT TURN
OPPOSITE INDIRECT RIGHT TURN
MC RISK FACTORS
## MC RISK FACTORS (1/3)

<table>
<thead>
<tr>
<th>The factors /category which has the highest number of motorcycle accident fatalities in Malaysia</th>
<th>Percentage of the total motorcycle accident fatalities (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td></td>
</tr>
<tr>
<td>Area type</td>
<td>Rural</td>
</tr>
<tr>
<td>Road Hierarchy</td>
<td>Primary or arterial roads</td>
</tr>
<tr>
<td>Road geometry</td>
<td>Straight section</td>
</tr>
<tr>
<td>Traffic control</td>
<td>Access point / un-signalized junction</td>
</tr>
<tr>
<td>Collision</td>
<td>By type</td>
</tr>
<tr>
<td>Angular or side</td>
<td>28</td>
</tr>
<tr>
<td>Passenger car</td>
<td>28</td>
</tr>
<tr>
<td>With vehicle</td>
<td></td>
</tr>
<tr>
<td>Day, Time</td>
<td>Saturday, Sunday, Monday &amp; Tuesday</td>
</tr>
<tr>
<td>Between 4pm to 10pm</td>
<td>35</td>
</tr>
<tr>
<td>Light condition</td>
<td>Daylight</td>
</tr>
<tr>
<td>Clear weather</td>
<td>93</td>
</tr>
<tr>
<td>Weather</td>
<td>Males</td>
</tr>
<tr>
<td>Gender</td>
<td>16 to 20</td>
</tr>
<tr>
<td>Age group</td>
<td>Rider only</td>
</tr>
<tr>
<td>License</td>
<td>Full licence</td>
</tr>
<tr>
<td>Occupancy</td>
<td></td>
</tr>
<tr>
<td>Rider only</td>
<td></td>
</tr>
<tr>
<td>Wearing helmet properly</td>
<td>76</td>
</tr>
<tr>
<td>Helmet wearing</td>
<td>Wearing helmet properly</td>
</tr>
<tr>
<td>Injury type</td>
<td>Head injury</td>
</tr>
</tbody>
</table>

MC RISK (2/3)

• Motorcyclists’ behavior when entering the primary road from the access point (n=800)
  • Majority of motorcyclists do not comply to the stop line rule
  • Motorcyclists turn their heads more in the opposite direction to their turning movement.

• Motorcyclists entering primary road from the access point are likely to be involve in a serious traffic conflict if…
  • Enter by accepting shorter gaps $t_G < 4s$
  • Enter into a narrow lane road
  • Enter by stopping at the stop line

** Abdul Manan, M. M. (2014). Motorcycles entering from access points and merging with traffic on primary roads in Malaysia: Behavioral and road environment influence on the occurrence of traffic conflicts. Accident Analysis & Prevention, 70, 301-313
## MC RISK FACTORS (3/3)

<table>
<thead>
<tr>
<th>Motorcycle fatal crash based on the number of vehicle involved</th>
<th>Road Characteristics</th>
<th>Road Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motorcycle single-vehicle fatal crash (MCF1V)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motorcycle fatal crash involving two or more vehicles (MCF3V)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motorcycle fatal crash involving another vehicle (MCF2V)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Road Characteristics**
  - Curve road sections
  - No road marking
  - Smooth
  - Rut
  - Corrugations

- **Road Environment**
  - 00am – 6am
  - 6am – 9am
  - 9am – 12pm
  - 7pm – 12am

MC ROAD SAFETY MEASURES INTERVENTION
CURRENT LAWS FOR MC THAT EFFECT ROAD SAFETY

  - **No license** (Max. pen: 75 EUR), Permitting minors (Max. pen: 250 EUR)
  - Exceeding National road speed limit (Court & Max. pen: 75 EUR)
  - Reckless riding and cause fatality (Court & Max. pen: 5,000 EUR)
  - **Riding under influence** (Court & Max. pen: 250 EUR)
  - Overloading (goods and passenger) (Max. pen: 65 EUR)
  - Illegal racing (Court & Max. pen: 500 EUR)
  - **Not riding on the left of the lane** (Max. pen: 250 EUR)
  - **Not wearing helmet** (Max. pen: 75 EUR)
  - **No daylight running headlight** & No nighttime headlight (Max. pen: 40 EUR)
  - Not stopping on the stop line (Max. pen: 75 EUR)
  - Using hand phone (Max. pen: 75 EUR)
  - **No side mirrors** (Max. pen: 40 EUR)
  - Exhaust too loud (Max. pen: 65 EUR)
**MC ROAD SAFETY MEASURES (1/2)**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>PHOTO</th>
<th>CRITERIA</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exclusive Motorcycle Path</strong> (EMCL)</td>
<td></td>
<td>Width</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Separator</td>
</tr>
<tr>
<td><strong>Non-exclusive Motorcycle Lane</strong> (NEMCL) – Dedicated lane</td>
<td></td>
<td>Width</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Separator</td>
</tr>
</tbody>
</table>

Even with the segregation, motorcycle crashes are still unavoidable and these crashes include both multiple and single motorcycle crashes (b)

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## MC ROAD SAFETY MEASURES (2/2)

<table>
<thead>
<tr>
<th>MC lane facilities</th>
<th>Path (Exclusive)</th>
<th>Lane (Non-exclusive)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Path (Exclusive)</td>
<td>Makes up less than 1% of the whole length of primary roads (Federal Roads), whereas</td>
<td>May reduce the crash risk by 80% among motorcyclists as compared to section without.</td>
</tr>
<tr>
<td>Path (Exclusive)</td>
<td>MC accident reduce to 39%(^{a})</td>
<td>Account for about 20% of the whole primary road network</td>
</tr>
<tr>
<td>Lane (Non-exclusive)</td>
<td>Makes up less than 1% of the whole length of primary roads (Federal Roads), whereas</td>
<td></td>
</tr>
<tr>
<td>T2: Presence of auxiliary lane for acceleration on the motorcycle lane</td>
<td>May reduce the crash risk by 80% among motorcyclists as compared to section without.</td>
<td></td>
</tr>
<tr>
<td>T4: Entry angle &lt;90 degree, length of slip lane &gt;15m</td>
<td>Account for about 20% of the whole primary road network</td>
<td></td>
</tr>
</tbody>
</table>

---


Exclusive motorcycle path (Egress)
Exclusive motorcycle path (Ingress)
CURRENT MC RESEARCH IN MALAYSIA

- Motorcycle speeding behavior (on-going)
- Motorcycle compliance to non-exclusive motorcycle lane
- Evaluating the design of motorcycle exclusive motorcycle lane
- MC Red Light Running
FUTURE RESEARCH IN MALAYSIA

- Motorcycle and motorcyclists anthropometry
- Motorcycle behavior at pedestrian crossing
- Motorcycle safety performance function on urban highways
- Naturalistic road safety observation and reporting
- Regulating the *Opposite Indirect Right Turn Movement*
- Development of Motorcycle crash barrier
MOTORCYCLE AND RIDER ANTHROPOMETERS

- Rider eye height
- Rider angle of vertical sight
- Rider angle of horizontal sight
- MC height
- MC width
- MC turning width
- MC foot height
- Rider blind spot
- MC side friction, f
- MC turning radius
- MC turning angle
BIG CONCLUSION

• We **encourage segregation** of MC away from other vehicles
  • MC risk taking behavior is evident based on the fact that MC maintains their speed even when ADT on the road is high

• But **segregation** should be carried out **properly** considering the fact that
  • MC behave differently in the vicinity of access points – at risk of accidents

• **Protective clothing?** – Malaysia is hot and humid, need better alternative

• Our road traffic accident database needs better **reporting**

• Enforcement of the traffic law is still poor – Motorcyclists in Malaysia is fearless?

• We need **better technology**, e.g. ABS, EBD, etc. in our motorcycle
THANK YOU...QUESTION