ABOUT MIROS

The Malaysian Institute of Road Safety Research (MIROS) was established in 2007 as an agency under the Ministry of Transport Malaysia to serve as a central repository of knowledge and information on road safety. The findings derived from research and evidence-based intervention programs provide the basis for the formulation of new strategies, legislations, policies, and enforcement measures, governing road safety at the national level. Principally engaged in research, MIROS collaborates closely with local and international government agencies and private bodies to further the cause of road safety.

In 2014, the ASEAN Transport Ministers had appointed MIROS as the ASEAN Road Safety Centre. The aims of this centre are to promote and provide knowledge on road safety issues among ASEAN Member States which includes road traffic laws and regulations, data management, standards development, and road safety awareness and education.

ACKNOWLEDGEMENT

The Malaysian Institute of Road Safety Research (MIROS) would like to acknowledge the committee members from Motorcycle ABS Partnership, Global NCAP, Stop The Crash, Towards Zero Foundation, regional consultation participants, academicians and peer reviewers from all the ASEAN countries, for their participation, dedication and support in making this report a success.

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EXECUTIVE SUMMARY

Every year, nearly 1.35 million lives are lost due to road crashes across the globe. In ASEAN, more than half of the road fatalities were related to motorcycle usage. Thus, motorcycle-specific interventions are much needed to help address this motorcycle safety challenge.

Motorcycle Fleet in ASEAN

The motorcycle market in ASEAN is still growing, where small capacity bikes (below 250cc) dominate the market. Though considered vulnerable, motorcycle remains the most popular transport mode due to their economic factor and size advantage. Indonesia is leading the sales with annual sales volume beyond 6.5 million units, followed by Vietnam and Thailand.

Motorcycles constitute approximately 58% of the regional vehicle population and in six out of the 10 countries in ASEAN, motorcycles were overrepresented in the traffic, with the highest overrepresentation in Vietnam at 90%.

Road Safety Profile in ASEAN

In the ASEAN region, countries contributed nearly 30% to the global road crash fatalities with a mortality rate of more than 18.4 per 100,000 population despite being only 8.5% of the global population. Motorcyclist deaths accounted for approximately half or greater of all road fatalities in eight out of 10 countries in the region, excluding the Philippines and Brunei. Motorcyclists’ deaths consistently exceeded 75% of total road deaths in Cambodia and Indonesia. In Vietnam, motorcycle crash involvement accounted for 65% of the total road crashes. In Malaysia, and Laos, more than 60% of road deaths involved motorcyclists; Thailand and Singapore with fatalities in the range of 53 to 54%; Myanmar, 48% and the Philippines, at 31%. Brunei has the lowest rate, ranged from 1 to 4 cases each year, over the last half a decade.

Effectiveness of Motorcycle ABS

Motorcyclists are vulnerable due to the lack of protection as compared to car occupants. Due to this lack of protection, it is vital to focus efforts on crash avoidance technologies to increase motorcyclist safety. One of the most effective motorcycle safety technologies available to date is motorcycle anti-lock braking system (ABS). Research has shown a reduction of 26-33% in crash occurrence, and a greater than 30% and 20% reduction in rider fatalities and injuries, respectively.

Motorcycle ABS regulation and Consumer Awareness

Despite the availability and effectiveness of motorcycle ABS, penetration of the technology in ASEAN has been low due to the absence of government legislation and consumer awareness. It is estimated that the proportion of new motorcycles sold in ASEAN fitted with ABS vary between 1-5% and is predominately fitted to big engine motorcycles of 250cc and above, despite small engine capacity motorcycles below 250cc being the most popular type in the region and dominate the market in most ASEAN countries.
The use of motorcycle ABS has been mandated in some countries in the Asia Pacific region such as in India, Japan, Australia, and New Zealand. Currently, Thailand and Malaysia are the only ASEAN countries to mandate for motorcycle ABS to accelerate its uptake. Thailand has taken a bold step to announce the mandatory use of motorcycle ABS beginning 2024, and Malaysia has recently announced that mandatory ABS installation will begin in 2025 for motorcycles of 150cc and above. In other countries namely Indonesia, Myanmar, and Vietnam, adoption of motorcycle ABS is being considered.

There is great consumer demand for motorcycle ABS in ASEAN with a recent survey showing 75% of respondents believe all motorcycles should be fitted with ABS. Furthermore, almost 80% of respondents were supportive of a motorcycle ABS regulation to be introduced across ASEAN, with most supportive of the regulation being implemented immediately or within the next five years.

**Projected Number of Lives Saved**

The life saving potential of motorcycle ABS is significant. In Thailand, the use of motorcycle ABS is estimated to be able to save nearly 6,000 to 9,000 lives in the 5 years after the ABS regulation is implemented. In ASEAN, the implementation of an ABS motorcycle regulation in the region is likely to be able to save the lives of up to 8,000 motorcyclists every year.

In short, motorcycles provide a mobility solution in ASEAN, allowing people to seek opportunities further away from their places of residence. However, in doing so, the vulnerability of motorcyclists put them at a risk of deaths and injuries. Motorcycle ABS is an effective technology that can help keep motorcyclists safe and should be made available on all motorcycles.
SCOPE

ASEAN
ASEAN region or countries in this report referred to Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam only.

MOTORCYCLE
Motorcycle in this report is referred to powered-two-wheelers only.
1.0 INTRODUCTION

Every year, nearly 1.35 million lives are lost due to road crashes across the globe. Furthermore, road crashes were recognized as the 8th leading cause of total deaths worldwide with a fatality rate of 18.2 per 100,000 population. Even more worrying was the fact that road crashes had emerged as the number one cause of death for children and young adults in the 5-29 years age category (WHO, 2018).

1.1 ASEAN Road Traffic Status

The number of road fatalities in ASEAN countries topped other regions where more than 100,000 people were killed in 2016 with the worrying death rate not showing any sign of abating over the last decade. In terms of population volume, the ASEAN region accounted for only 8.5% of the global population. Nevertheless, ASEAN countries contributed nearly 30% to the global road crash fatalities with a high mortality rate of more than 18.4 per 100,000 population.

Road traffic crashes incur high economic losses to both the society and the country. Their impacts are felt by road users in the form of public property damage, a rise in health spending, and loss of productivity. In addition, road crashes trigger spending of around 2 to 7% from a country’s gross domestic product (GDP). Injuries and deaths due to road crashes can also affect the crash victims’ family, owing to the victims’ disability and inability to work.

![Figure 1: Rates of road traffic death per 100,000 population in 2016 (WHO, 2018).](image_url)
Table 1: Road traffic mortality rate and estimated road traffic deaths for ASEAN countries in 2016 (WHO, 2018).

<table>
<thead>
<tr>
<th>Country</th>
<th>Road Traffic Mortality Rate in 2016 (Per 100,000 Population)</th>
<th>Estimated Road Traffic Deaths in 2016 (WHO, 2018)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brunei</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Cambodia</td>
<td>17.8</td>
<td>2,803</td>
</tr>
<tr>
<td>Indonesia</td>
<td>12.2</td>
<td>31,726</td>
</tr>
<tr>
<td>Laos</td>
<td>16.6</td>
<td>1,120</td>
</tr>
<tr>
<td>Malaysia</td>
<td>23.6</td>
<td>7,374</td>
</tr>
<tr>
<td>Myanmar</td>
<td>19.9</td>
<td>10,540</td>
</tr>
<tr>
<td>Philippines</td>
<td>12.3</td>
<td>12,690</td>
</tr>
<tr>
<td>Singapore</td>
<td>2.8</td>
<td>155</td>
</tr>
<tr>
<td>Thailand</td>
<td>32.7</td>
<td>22,491</td>
</tr>
<tr>
<td>Vietnam</td>
<td>26.4</td>
<td>24,970</td>
</tr>
<tr>
<td>ASEAN</td>
<td>18.4</td>
<td>112,749</td>
</tr>
</tbody>
</table>

In the ASEAN region, Indonesia suffered losses amounting to USD17.5 billion in 2014 as a consequence of road crashes (Jusuf et al., 2014). Thailand, on the other hand, has had to deal with USD16.5 billion in losses (WHO, 2020) whereas the figure was USD2 billion for Malaysia (MIROS, 2018) and USD1 billion for Vietnam (affecting nearly 1.64% of its GDP) (Dong & Hoang, 2017). Overall, road traffic crashes have cost more than USD30 billion per year in the ASEAN region alone. Hence, investments in better road safety are the key that could reduce the number of road traffic injuries and fatalities, thereby, curtailing economic losses and boosting ASEAN countries’ GDP.

An important contributor to the high traffic injury rates is the high concentration of motorcycles in most ASEAN countries. While statistics indicate that motorcyclists are involved in 28% of all road deaths around the world, more than 70% of these fatalities have occurred in ASEAN countries (WHO, 2016). The larger percentage of motorcyclist deaths in the ASEAN region reflects the combined effects of the popularity of motorcycles in these countries and their increased vulnerability in crashes. Various studies on motorcycle crashes have revealed that motorcyclists are 30 to 35 times more likely to die or suffer serious injury in crashes compared to other vehicle occupants (Johnston, Brooks & Savage, 2008; National Center for Statistics and Analysis Research and Development, 2008; NHTSA, 2013). It would be very difficult for ASEAN countries to achieve the goal of a 50% reduction in road fatalities and serious injuries by 2030 recently adopted by the United Nation (UN), unless the specific challenges of motorcycle safety are addressed. For example, Malaysia have addressed their specific strategies in their Road Safety Plan 2022-2030.

1.2 Motorcyclist Fatalities in ASEAN Countries
Vulnerable road user often referred to as comprising pedestrians, cyclist and those using motorized two- or three wheelers, also referred to as motorcyclists. These groups of road users do not have a protective “shell” around them and are therefore more at risk than those in vehicles. Over the past few decades, the motorcycle has become the most preferred vehicle on the road in ASEAN due to its small size and affordable price. According to Abdul Manan et al (2012), motorcycles in ASEAN constitute almost 58% of the total number of vehicles in region. Furthermore, motorcycles have also emerged as the major contributor to road traffic deaths with an involvement of 43% of all road fatalities in the region (WHO, 2018). The following subsection of the report shall discuss the trends and events of motorcyclist deaths in road traffic crashes across the ASEAN region. The data on motorcycle registration, involvement in road crashes and numbers of casualties for year 2015 to 2019 were requested from each of the countries related agency. In cases whereby such information was not provided to the authors, the data sourced from WHO reports were referred.

1.2.1 Brunei Darussalam

Source of Data: Land Transport Department, Ministry of Transportation & Infocommunications Brunei Darussalam

Brunei Darussalam is the least populous among all ASEAN countries with 398,920 people as of 2010. Being a high-income country, Brunei’s traffic composition may differ to other developing and non-developed countries in ASEAN. Hence, the motorcycle is the least preferred mode of transport among Bruneians. From 2015 to 2018, the total registered vehicles in Brunei were between 215,984 to 264,887. Of the total figure, motorcycles made up only 1.3%, with the highest number of motorcycles registered in 2016 (refer Figure 2).

![Registered Vehicles (cumulative)](image)

Due to the limited volume of vehicles and small number of vulnerable road users, road traffic fatalities in Brunei only ranged between two to six cases between 2015 and 2019. Meanwhile, motorcyclist fatalities in the oil-rich country only reached a maximum of four cases in 2017 whereas 2016 recorded zero fatality among motorcyclists, as shown in Table 2.
In terms of casualties, motorcyclist fatalities in Brunei saw a tremendous increase in 2017, making up 80% of the overall casualties while the number of severely injured motorcyclists also rose to a maximum of 80% in 2018 (Figure 3).

Table 2: Motorcyclist fatalities (Brunei)

<table>
<thead>
<tr>
<th>Year</th>
<th>Overall Fatalities</th>
<th>Motorcyclists</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>6</td>
<td>1 (16.7%)</td>
</tr>
<tr>
<td>2016</td>
<td>3</td>
<td>0</td>
</tr>
<tr>
<td>2017</td>
<td>5</td>
<td>4 (80%)</td>
</tr>
<tr>
<td>2018</td>
<td>4</td>
<td>3 (75%)</td>
</tr>
<tr>
<td>2019</td>
<td>2</td>
<td>1 (50%)</td>
</tr>
</tbody>
</table>

Figure 3: Trend of motorcyclist casualties (Brunei)

1.2.2 Cambodia

Source of Data: Cambodia Safety Solution Organization

Cambodia has the highest proportion of motorcycles in the ASEAN region. Within the five-year period (2015-2019), the proportion of motorcycles in Cambodia ranged between 83.7% and 88.4% in 2019 and 2016, respectively, at 342,076 and 540,621 units against the total number of registered vehicles as shown in Figure 4.

With regard to road traffic crashes in the country, motorcycles remained the most dominant mode of transport involved in crashes, with more than 91% of the cases each year. Generally, more than 5,700 vehicles were involved in road crashes every year in Cambodia (Figure 5).

From 2015 to 2019, Cambodia recorded between 1,852 to 2,201 fatalities, with the majority involving motorcyclists (refer to Table 3).
Over the 5-year period, motorcyclist fatalities showed a consistent upward trend, reaching 75% in 2019, with a slight decrease in 2018 as shown in Figure 6.
1.2.3 Indonesia

Source of Data: Direktorat Jenderal Perhubungan Darat, Kementerian Perhubungan Republik Indonesia

With a population of 260 million (WHO, 2018) Indonesia possesses a very high number of on-road vehicles in the region. Cumulatively, the total number of registered road vehicles in Indonesia ranged from 105 million to 133 million between 2015 and 2019, with a general ratio of vehicle ownership of 0.4 vehicle per person. Of that, motorcycles comprised over 84% of the vehicle population and their numbers have steadily grown each year (refer to Figure 7).
In terms of crash involvement, over 100,000 vehicles were involved in road traffic crashes every year in Indonesia. Over the five-year period, the involvement of motorcycles accounted for the highest proportion (73% each year). In 2019, 149,065 motorcycles were involved in road traffic crashes; the highest in the five-year period in terms of the number of motorcycle crashes. In 2019, which registered the highest cumulative number of vehicle crashes, motorcycles were found to be involved in over 75% of the total figure, as shown in Figure 8.

With a very high frequency of motorcycle crashes, the number of motorcyclist casualties was staggering. Although the absolute percentage of motorcyclist casualties was unable to be retrieved, based on the estimation by Politeknik APP Jakarta, motorcyclist casualties were estimated to be as high as 103,490 in 2019 due to slight injuries, and fatalities among these vulnerable road users were estimated to be from 18,000 to 22,000 between year 2015 and 2019 (Figure 9).
1.2.4 Laos

Source of Data: Ministry of Public Works and Transport, Laos P.D.R

Laos is one of eight middle-income countries in the ASEAN region (WHO, 2018). By 2016, over 1.8 million road vehicles were registered in Laos and the cumulative figure rose to more than 2.2 million by 2019. Throughout the years, motorcycles made up 76 to 77% of the overall registered vehicles, as shown in Figure 10.

In Laos, approximately 6,000 vehicles were involved in road crashes; with the figure steadily climbing since 2016. 2016 recorded the highest number and percentage of motorcycle crashes with 4,670 or 83.2% of the overall vehicle crashes. Meanwhile, 2017 had the lowest number of motorcycle crash involvement but in terms of proportion against the overall vehicles involved, 2019 had the lowest percentage with 59.1% (refer Figure 11).

The annual road traffic fatalities in Laos remained at approximately 1,000, with the most recent data (2019) registering the highest number. From this, there were between 700 and 900 motorcyclist deaths within the five-year period, as shown in Table 4.

Table 4: Motorcyclist fatalities (Laos)

<table>
<thead>
<tr>
<th>Year</th>
<th>Overall Fatalities</th>
<th>Motorcyclist</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>995</td>
<td>840 (84.4%)</td>
</tr>
<tr>
<td>2016</td>
<td>1,086</td>
<td>880 (81%)</td>
</tr>
<tr>
<td>2017</td>
<td>1,053</td>
<td>741 (70.4%)</td>
</tr>
<tr>
<td>2018</td>
<td>995</td>
<td>730 (73.4%)</td>
</tr>
<tr>
<td>2019</td>
<td>1,134</td>
<td>732 (64.6%)</td>
</tr>
</tbody>
</table>
With regard to motorcyclist fatalities in Laos, the percentage ranged between 65% to 84% of the total road fatalities over the five-year period. However, the percentage gradually fell from 2015 to 2019 with a slight increase seen between 2017 and 2018 (Figure 12).

### Malaysia

**Source of Data: Traffic Investigation & Enforcement Department, Royal Malaysian Police (RMP)**

With a population of 31 million, Malaysia remains one of the leading ASEAN countries with regards to automotive travel, including motorcycle travel. From 2015 to 2019, the number of cumulative registered vehicles (includes all types of vehicles) in Malaysia jumped from 26 million to 31 million (an increase of about 16%). Of the total registered vehicles, motorcycles accounted for a steady 45% except in 2018 where there was a slight rise to 48.1%, as shown in Figure 13.
In terms of crash involvement, over 31,000 vehicles were involved in road crashes in 2015 while the number climbed to over 34,000 in 2017 but gradually dipped in the following years until the number reached 27,822 in 2019. From 2015 to 2019, the involvement of motorcycles in road crashes in Malaysia recorded the lowest percentage in 2017 with 35.4% (12,232 motorcycles) but the proportion significantly climbed in 2019 with 48.2% (13,421 motorcycles).

From a broader perspective, as reported in the published annual national crash statistics report by the Royal Malaysian Police (RMP) Traffic Department, Malaysia recorded an average of 6,609 fatalities in road traffic crashes between years 2015 and 2019. Within the five-year period, the highest number of road traffic deaths was in 2016 at 7,152. Moreover, 2016 also saw the highest number of severe injuries (4,506) and the second highest number of minor injuries. With regards to injury severity, the definition severe and slight referred to as per definition defined under Section 320 Penal Code which refers to severe injuries as injuries which includes privation/destruction/permanent impaing of any member of body joints, lost
of ear or hearing, lost of sight, fracture or dislocation of bone. On the other hand, slight injuries as defined in the code refers to injuries other than the defined death and serious injuries.

Table 5: Motorcyclist casualties (Malaysia)

<table>
<thead>
<tr>
<th>Year</th>
<th>Overall Fatalities (F)</th>
<th>(F) Motorcyclist</th>
<th>Severe Injuries (SI)</th>
<th>(SI) Motorcyclist</th>
<th>Minor Injuries (MI)</th>
<th>(MI) Motorcyclist</th>
<th>(F+SI+MI) Overall</th>
<th>(F+SI+MI) Motorcyclist</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>6,706</td>
<td>4,203 (62.7%)</td>
<td>4,120</td>
<td>2,665 (64.7%)</td>
<td>7,434</td>
<td>4,853 (65.3%)</td>
<td>18,260</td>
<td>11,721</td>
</tr>
<tr>
<td>2016</td>
<td>7,152</td>
<td>4,485 (62.7%)</td>
<td>4,506</td>
<td>2,987 (66.3%)</td>
<td>7,415</td>
<td>5,082 (68.5%)</td>
<td>19,073</td>
<td>12,554</td>
</tr>
<tr>
<td>2017</td>
<td>6,740</td>
<td>4,348 (64.5%)</td>
<td>3,310</td>
<td>2,071 (62.6%)</td>
<td>6,539</td>
<td>4,298 (65.7%)</td>
<td>16,589</td>
<td>10,717</td>
</tr>
<tr>
<td>2018</td>
<td>6,284</td>
<td>4,128 (65.7%)</td>
<td>2,964</td>
<td>1,947 (65.7%)</td>
<td>5,377</td>
<td>3,738 (69.5%)</td>
<td>14,625</td>
<td>9,813</td>
</tr>
<tr>
<td>2019</td>
<td>6,167</td>
<td>3,959 (64.2%)</td>
<td>3,022</td>
<td>2,009 (66.5%)</td>
<td>5,855</td>
<td>4,028 (68.8%)</td>
<td>15,044</td>
<td>9,996</td>
</tr>
</tbody>
</table>

In terms of the total road traffic casualties within the five-year period, motorcyclist fatalities comprised between 62.7% to 65.7%, with the highest number recorded in 2018. There was an upward trend of motorcyclist deaths from 2015 to 2018 which later fell in 2019. Meanwhile, severely injured motorcyclists recorded a drop in 2017 but later increased from 2018 to 2019. However, all in all there is no improvement for motorcyclist casualties seen for Malaysia.

Figure 15: Trend of motorcyclist casualties (Malaysia)
1.2.6 Myanmar

Source of Data: Road Transport Administration Department, Ministry of Transport & Communications Myanmar

Since 2016, Myanmar has transitioned to become a middle income ASEAN country (WHO, 2016). With a population of 52 million in 2016, Myanmar has a relatively low number of registered vehicles with nearly six million or 0.12 vehicle per person. The motorcycle accounted for approximately 83% of the overall registered vehicles in the country.

The number of road fatalities in Myanmar increased by 30% from 2015 to 2019, to a total of 5,325. Of this number, approximately 2,000 motorcyclists died each year while around 12,000 were injured. With regards to injury information, the provided casualties data for Myanmar only describe the casualty levels by fatal and injured. No further details were given in terms of severity of the injuries (Table 5).

Figure 16: Registered motorcycles (Myanmar)

Table 6: Motorcyclist casualties (Myanmar)

<table>
<thead>
<tr>
<th>Year</th>
<th>Overall Fatalities (F)</th>
<th>Motorcyclist</th>
<th>Injuries* (I)</th>
<th>Motorcyclist</th>
<th>(F+I) Overall Casualties</th>
<th>Motorcyclist</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>4,074</td>
<td>1,915 (47%)</td>
<td>26,630</td>
<td>12,802 (48.1%)</td>
<td>30,704 (47.9%)</td>
<td>14,717</td>
</tr>
<tr>
<td>2016</td>
<td>4,887</td>
<td>2,277 (46.6%)</td>
<td>27,763</td>
<td>13,834 (49.8%)</td>
<td>32,650 (49.3%)</td>
<td>16,111</td>
</tr>
<tr>
<td>2017</td>
<td>5,250</td>
<td>1,538 (29.3%)</td>
<td>29,144</td>
<td>6,690 (23%)</td>
<td>34,394 (23.9%)</td>
<td>8,228</td>
</tr>
<tr>
<td>2018</td>
<td>5,184</td>
<td>2,376 (45.8%)</td>
<td>26,741</td>
<td>12,988 (48.6%)</td>
<td>31,925 (48.1%)</td>
<td>15,364</td>
</tr>
<tr>
<td>2019</td>
<td>5,325</td>
<td>2,260 (42.4%)</td>
<td>25,072</td>
<td>11,700 (42.4%)</td>
<td>30,397 (45.9%)</td>
<td>13,960</td>
</tr>
</tbody>
</table>

* Refers to severe and slight. No further segregation was given in terms of severity of the injuries
Over the five-year period, motorcyclist casualties in Myanmar registered a steady trend with around 42-47% fatalities recorded each year against the overall number of road fatalities. Meanwhile, around 46-49% of road injuries were recorded among these 2- and 3-wheeler users. However, the data showed a significant drop in both the proportion of motorcyclist fatalities and injuries for 2017, whereby the percentage of fatalities fell to 29% while injuries were recorded at 23%, as shown in Figure 17.

Figure 17: Trend of motorcyclist fatalities (Myanmar)

1.2.7 Singapore

Source of Data: Land Transport Authority Singapore

With some of the best public transport systems in the world to overcome its land limitations and traffic congestion, Singapore possesses the lowest number of vehicle population in ASEAN countries, as well as the lowest motorcycle ownership. From 2015 to 2019, Singapore’s new on-road vehicles recorded the highest number in 2017 with 125,788 whereas only 86,068 new vehicles were registered in 2015. Further, motorcycles only accounted for 7% to 8% of the total vehicle population until 2017 although the number rose as high as 17.6% in 2019 (refer Figure 18).

Despite having a relatively low percentage of motorcycles on the road as compared to other types of vehicles, the involvement of motorcycles in fatal and severe injury crashes was between 31.3% to 34.4% from 2015 until 2019.

Motorcyclist fatalities in Singapore ranged from 40 to 70 per year with the highest motorcyclist fatalities recorded in 2015 at 72. With regards to injury information, the provided casualties data for Singapore only describe the casualty levels by fatal and injured. No further details were given in terms of severity of the injuries. As shown in Table 7, approximately 5,000 motorcyclists were injured as a result of road traffic crashes.
Figure 18: Registered new motorcycles (Singapore)

Figure 19: Motorcycles involvement in crash (Singapore)

Table 7: Motorcyclist casualties (Singapore)

<table>
<thead>
<tr>
<th>Year</th>
<th>Overall Fatalities (F)</th>
<th>Motorcyclist</th>
<th>Injuries* (I)</th>
<th>Motorcyclist</th>
<th>Overall Casualties (F+I)</th>
<th>Motorcyclist</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>151</td>
<td>72 (47.7%)</td>
<td>10,412</td>
<td>4,928 (47.3%)</td>
<td>10,563</td>
<td>5,000 (47.3%)</td>
</tr>
<tr>
<td>2016</td>
<td>141</td>
<td>62 (44%)</td>
<td>10,687</td>
<td>5,102 (47.7%)</td>
<td>10,828</td>
<td>5,164 (47.7%)</td>
</tr>
<tr>
<td>2017</td>
<td>121</td>
<td>44 (36.4%)</td>
<td>9,953</td>
<td>4,803 (48.3%)</td>
<td>10,074</td>
<td>4,847 (48.1%)</td>
</tr>
<tr>
<td>2018</td>
<td>124</td>
<td>61 (49.2%)</td>
<td>10,018</td>
<td>4,839 (48.3%)</td>
<td>10,142</td>
<td>4,900 (48.3%)</td>
</tr>
<tr>
<td>2019</td>
<td>118</td>
<td>64 (54.2%)</td>
<td>9,833</td>
<td>5,010 (51%)</td>
<td>9,951</td>
<td>5,074 (51%)</td>
</tr>
</tbody>
</table>

* Refers to severe and slight. No further segregation was given in terms of severity of the injuries
Looking at the trend of casualties (as shown in Table 6), it can be seen that motorcyclist fatalities in Singapore dropped between 2015 and 2017, from 47.3% to 36.4%. The percentage later rose steadily to 54.24% in 2019. Contrastingly, the number of injured motorcyclists remained relatively unchanged throughout the years, as shown in the below Figure.

![Motorcyclist Casualties as a Percentage of All Road Casualties](image)

**Figure 20: Trend of motorcyclist casualties (Singapore)**

### 1.2.8 Thailand

*Source of Data: Royal Thai Police & Department of Disease Control Ministry of Public Health & Ministry of Transport Thailand*

Around 36 million vehicles were registered in Thailand in 2015 and the number grew to over 40 million in 2019 (an increase of 10.8%). Each year, around 3 million new road vehicles were registered in the country and motorcycles accounted for 65% of the total vehicle population. However, the proportion of new registered motorcycles saw a drop from 65.5% in 2015 to 61.8% in 2019 (refer Figure 21).

In terms of vehicle involvement in crashes, 2018 and 2019 saw the highest numbers at 208,509 and 194,410, respectively. The proportion of motorcycle crashes remained around 36 to 37% from 2015 until 2017, whereas there was a substantial drop between 2018 and 2019 with the crash involvement of motorcycles at 19% (Figure 22).

The highest number of road crash fatalities was recorded in 2016 and 2017 with over 21,000 cases. Meanwhile, the number of motorcyclist fatalities was the highest in 2017 at 12,173. Every year between 2015-2019, over 100,000 motorcyclists were severely injured as a result of road traffic crashes with 2019 leading the way with 211,424 cases.
Figure 21: Registered new motorcycles (Thailand)

Figure 22: Motorcycles involvement in crash (Thailand)

Table 8: Motorcyclist casualties (Thailand)

<table>
<thead>
<tr>
<th>Year</th>
<th>Overall Fatalities (F)</th>
<th>Motorcyclist</th>
<th>Severely Injured (SI)</th>
<th>Motorcyclist</th>
<th>Minor Injured (MI)</th>
<th>Motorcyclist</th>
<th>Overall Casualties (F+SI+MI)</th>
<th>Motorcyclist</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>19,960</td>
<td>5,896 (29.5%)</td>
<td>157,353</td>
<td>128,669 (81.8%)</td>
<td>778,223</td>
<td>606,461 (77.9%)</td>
<td>955,536</td>
<td>741,026 (77.6%)</td>
</tr>
<tr>
<td>2016</td>
<td>21,745</td>
<td>6,128 (28.2%)</td>
<td>207,296</td>
<td>170,706 (82.3%)</td>
<td>918,810</td>
<td>724,286 (78.8%)</td>
<td>1,147,851</td>
<td>901,120 (78.5%)</td>
</tr>
<tr>
<td>2017</td>
<td>21,607</td>
<td>12,173 (56.3%)</td>
<td>228,753</td>
<td>190,806 (83.4%)</td>
<td>941,746</td>
<td>745,053 (79.1%)</td>
<td>1,192,106</td>
<td>948,032 (79.5%)</td>
</tr>
<tr>
<td>2018</td>
<td>19,931</td>
<td>10,761 (54%)</td>
<td>207,101</td>
<td>172,661 (83.4%)</td>
<td>861,997</td>
<td>677,887 (78.6%)</td>
<td>1,089,029</td>
<td>861,309 (79.1%)</td>
</tr>
<tr>
<td>2019</td>
<td>19,904</td>
<td>10,799 (54.3%)</td>
<td>252,479</td>
<td>211,424 (83.7%)</td>
<td>911,803</td>
<td>721,631 (79.1%)</td>
<td>1,184,186</td>
<td>943,854 (79.7%)</td>
</tr>
</tbody>
</table>
While the trend of motorcyclist injuries remained unchanged within the five-year period as shown in Figure 23, the proportion of motorcyclist deaths doubled from 28.18% in 2016 to 56.34% in 2017. From 2017 until 2019, motorcyclist fatalities in Thailand remained around 53 – 54%.

![Figure 23: Trend of motorcyclist casualties (Thailand)](image)

1.2.9 The Philippines


No information on motorcycle registration and involvement in crashes was received for the relevant authority in The Philippines. Thus, the WHO report for 2010, 2013 and 2016 data (WHO 2013, WHO 2015 and WHO 2018) were referred. The data revealed that in 2016, motorcyclist fatalities accounted for 4.7% of the total 10,012 road deaths. However, the data for year 2013 seems to be incomplete with distinctive values of overall road fatalities as compared to 2010. Meanwhile, no further information on motorcycles fatalities were reported for 2010 data.

![Figure 24: Motorcyclist fatalities (Philippines)](image)
1.2.10 Vietnam

Source of Data: National Transport Safety Committee & Transport Safety Department, Ministry of Transport Vietnam

Vietnam’s population reached 95 million in 2016 (WHO, 2018). In terms of vehicle ownership, 51 million vehicles were registered in the same year, with a ratio of 0.53 vehicle per person. As shown in the graph provided by a local authority, motorcycles comprised 93% of the overall vehicle population in 2016, with the proportion unchanged through to 2019.

![Registered Motorcycles (Cumulative)](image)

Figure 25: Registered motorcycles (Vietnam)

With regard to vehicle crashes, motorcycles were involved in 68% to 70% of all road crashes from 2015 to 2017. However, a significant drop was seen in 2018 whereby motorcycle crash involvement was recorded at 60.25%; the lowest over the four-year period, as shown in Figure 26.

![Percentage of Motorcycle Crash Involvement per Overall Crashes](image)

Figure 26: Trend of motorcycles involvement in crash (Vietnam)
2.0 MOTORCYCLE VOLUME IN OVERALL FLEET

2.1 Total Number of Registered Motorcycles

Table 9: Registered motorcycles (cumulative) in ASEAN countries from 2015 to 2019 (in thousand).

<table>
<thead>
<tr>
<th>COUNTRY</th>
<th>2015</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brunei Darussalam</td>
<td>3.44</td>
<td>3.43</td>
<td>3.34</td>
<td>3.33</td>
<td>NA</td>
</tr>
<tr>
<td>Cambodia</td>
<td>342.08</td>
<td>464.97</td>
<td>381.40</td>
<td>502.70</td>
<td>540.62</td>
</tr>
<tr>
<td>Indonesia</td>
<td>88657.00</td>
<td>94532.00</td>
<td>100200.00</td>
<td>106658.00</td>
<td>112771.00</td>
</tr>
<tr>
<td>Laos</td>
<td>1327.00</td>
<td>1423.00</td>
<td>1513.00</td>
<td>1603.00</td>
<td>1697.00</td>
</tr>
<tr>
<td>Malaysia</td>
<td>12094.79</td>
<td>12677.04</td>
<td>12897.50</td>
<td>13217.06</td>
<td>14322.02</td>
</tr>
<tr>
<td>Myanmar</td>
<td>4504.81</td>
<td>5122.70</td>
<td>5640.07</td>
<td>5997.52</td>
<td>6056.83</td>
</tr>
<tr>
<td>Philippines</td>
<td>4623.00</td>
<td>5330.00</td>
<td>6174.00</td>
<td>7162.00</td>
<td>7162.00</td>
</tr>
<tr>
<td>Singapore</td>
<td>143.00</td>
<td>143.00</td>
<td>142.00</td>
<td>137.00</td>
<td>137.00</td>
</tr>
<tr>
<td>Thailand</td>
<td>20519.50</td>
<td>20497.30</td>
<td>20717.65</td>
<td>21099.53</td>
<td>22976.24</td>
</tr>
<tr>
<td>Viet Nam</td>
<td>44129.00</td>
<td>47132.00</td>
<td>54063.00</td>
<td>58169.00</td>
<td>61728.00</td>
</tr>
</tbody>
</table>

From 2008 to 2018, the number of motorcycles grew rapidly, pointing to a boom in ownership especially concentrated in four ASEAN countries namely Indonesia, Viet Nam, Thailand, and Malaysia. With an estimated regional motorcycle population of over 150 million, having one or more motorcycles in a household was extremely common. The highest number of registered motorcycles was in Indonesia with more than 112 million units, followed by Vietnam and Thailand with over 61 million and 22 million units. In Malaysia, the total number of registered motorcycles reached around 14 million units. In addition, the country with the lowest motorcycle registration was Brunei with less than 4,000 units. In terms of a rise in ownership, the country with the biggest motorcycle registration increase was Cambodia with 158% between 2015 and 2019. For Singapore, the rate of motorcycle ownership fell by about 4.2%.

2.2 Total Motorcycle Production & Sales in ASEAN

Motorcycle sales by nations throughout the world were USD30.4 billion in 2020, with exports increasing by 44.2 percent from 2016. China, Germany, Japan, Thailand, and India are the leading exporting nations, accounting for more than half (57.2%) of total foreign motorcycle sales. In the ASEAN region. The average number of motorcycle production annual from 2015 to 2020 was approximately 12.9 million units. According to The Federation of ASIAN Motorcycle Industries (FAMI), The regional motorcycle fleet is estimated to be over 150 million in these seven countries and the number is projected to grow (FAMI, 2022). Vietnam has produced the highest number of fleets yearly as compared to the other countries. Figure 28 shows the number of motorcycles produced in the ASIAN and also ASEAN region.
Figure 27: Total number of motorcycles sold in ASIAN (source: https://www.famimotorcycle.org/databases/).

Figure 28: Total number of motorcycle production in ASIAN.
In terms of motorcycle sales, Indonesia recorded the highest number with 5.8 million units on average each year followed by Vietnam with 3.1 million units. Further, around 450,000 motorcycle units are sold in Malaysia each year.

2.3 Small Engine Capacity Motorcycle: The Main Contributor to Motorcyclist Deaths in ASEAN

It is estimated that there are 313 million motorcycles in the world, with 80% of them in Asia, 5% in Latin America, and 2% in North America (Wanna Y. 2019). Figure 29 shows the concentration of motorcycle ownership globally. Motorcycles are becoming more popular around the world with Asia seeing the biggest jump in motorcycle ownership. There are a lot of motorcycle variations but the most popular type in the ASEAN region is the small-engine capacity (less than 250cc) motorcycle comprising the underbone/moped and scooter types. Statistics indicate that these motorcycle types dominate the market in most ASEAN countries, with over 80% of the market in Thailand and over 90% in Malaysia (WHO, 2020; Abd Manan et al 2016).

Figure 29: Percentage of motorcycle ownership in the world

The characteristics of these small-engine motorcycles have been well-explained in various research (Grava, 2003; ACEM, 2004). From a positive perspective, the small-engine motorcycle type is popular due to its agility in traffic, accessibility, and easy operation. However, from a safety aspect, the machine lacks stability as opposed to a four-wheeled vehicle, is less visible due to its size, and lacks protection for riders in the event of a crash. And, like motorcycles with higher engine capacity, they can be ridden at high speeds and pose difficulty in braking (Nguyen 2013; ASEAN NCAP 2019; APEC 2010). For example, a study in Thailand, where most motorcycles are small engines, showed that almost half of the riders...
did not apply brake at all during crashes while for those who attempted to brake, most of them applied the brakes wrongly (for example 41.2% used only the rear brake, and 36.6% decided to only swerve the motorcycle without applying the brakes (Kasantikul, 2001).

2.4 Risk Factors of Motorcycles in the ASEAN Region

Motorcycles and powered two- and three-wheelers (PTW) are significant components of the transport system because they provide improved mobility at a lower cost and a unique sense of pleasure (Yannis, 2020). Motorcycles are the most popular mode of transport in ASEAN countries, where motorization is rapidly growing. In several Asian cities, the average number of motorcycles per thousand people is around 196, or seven times the global average (Metin SENBIL, 2007). However, motorcycle users are classified as vulnerable road user (VRU) due to the lack of structural protection and their involvement in over 50% of all road fatalities (WHO, 2017).

Motorcyclists register the highest injury and fatality rates compared to drivers of other vehicle types. Road crashes involving motorcyclists often result in death and severe injuries (Liping Li, 2016). A number of studies have explored the factors impacting the severity of motorcycle crashes to prevent the risks to motorcycle users. The correlation of common causes of motorcycles crashes (including failure to follow traffic laws such as speeding and being unhelmeted, alcohol and drug use, infrastructure, and weather) and injury severity has been examined in various studies (C.J. Robbins, 2020) (Zewdie Oltaye, 2021) (Mau-Roung Lin, 2009) (Athanasios Theofilatos, 2015) (Deogratias Eustace V. K., 2011) (Dan Wu, 2018). Most
motorcycle crashes involved frontal crashes (Deogratias Eustace S., 2016), occurring at residential and commercial areas, during fine weather (Ziakopoulos A., 2018) and were more fatal especially on rural roads (Padmanaban, NA) (Michael D. Keall, 2012) (Muhammad Marizwan Abdul Manan, 2012).

Helmet use has been found to affect crash severity (Carlos V.R. Brown, 2011) as fatal crashes are more likely to be caused by injuries to the motorcycle user’s head (Francis Faduyile, 2017). Therefore, helmets and helmet-wearing legislation are important means in reducing and preventing head injuries and deaths in motorcycle crashes (Mau-Roug Lin, 2009) (Wisconsin, 1994). Another key factor in motorcycle road crashes are motorcycle maneuver and rider behaviour (Shaheed, 2011). Risk taking and sensation seeking are typical rider behaviours that are usually expressed through speeding, disobeying traffic signals and signs and unsafe lane changes or turning (Md. Mazharul Haquea, 2010).

Motorcycle riders are also frequently involved in road crashes at intersections due to failure by an approaching vehicle driver to yield the right of way (Natalia Kovacsova, 2020). Hence, motorists may be able to avoid a collision by executing a proper evasive maneuver. Further, motorcycle crashes with fixed objects account for the majority of fatal cases (Michael R. Bambach, 2011). Investigation data also found that roughly 90% of motorcycle crashes involved passenger vehicles as the crash partners (A.N.S.Zainal Abidin, 2018). Lastly, most fatal crashes involved male motorcyclists (A.N.S.Zainal Abidin, 2018) (Muhammad Marizwan Abdul Manan, 2012) while young motorcyclists were less likely to be seriously injured in crashes than older riders (Ahmed Farid, 2021).
3.0  MOTORCYCLE ANTI-LOCK BRAKING SYSTEM (ABS)

3.1  Capabilities to Reduce Motorcycle Crashes and Death

The Anti-lock Braking System (ABS) is a safety mechanism preventing the wheels from locking (stops spinning) while the vehicle is in motion. The system ensures the driver to have control of the car. As the wheels continue to rotate, the car can move in whatever direction the driver is steering. Initially introduced on high-end vehicles in 1978, ABS has been required on all new passenger cars sold in the European Union (EU) since 2007.

Similarly, ABS for motorcycle was introduced in the late 1980s. The technology has now sufficiently matured and the cost to install ABS has dropped tremendously. Many countries around the world such as European Union (EU) countries, India, Japan, Australia, Thailand and recently, Malaysia, have mandated the use of ABS due to its effectiveness in reducing crashes and avoiding road fatalities.

Previous studies in Germany, India and Indonesia show that ABS can reduce motorcycle crashes with personal injuries (slightly, severely or fatally injured) by 26%, 33%, and 26% respectively (Lich et. al., 2016; Kumaresh et. al., 2017). In Thailand, it is projected that within three years of implementation, the mandatory installation of motorcycle ABS in 2024 will save between 1,200 and 1,800 lives with an economic return of THB31-46 billion (WHO, 2020). Furthermore, retrospective benefit studies available shows a reduction of severe and fatal crashes i.e., for Spain and Sweden by 34% and 42% respectively (Rizzi et al., 2015).

3.2  A Technical Comparison of Effectiveness for Motorcycle ABS and Motorcycle Combined Braking System (CBS)

In terms of technical effectiveness, a study by Koetniyom et al. (2019) showed that a motorcycle with ABS would provide better braking performance especially on a low friction surface compared to non-ABS and CBS motorcycles. Furthermore, in the braking maneuver experiment, an ABS-equipped motorcycle demonstrated that the rider could avoid obstacle without losing control of the motorcycle. In contrast, the rider of non-ABS and CBS motorcycles failed the braking maneuver experiment due to the loss of lateral force at the front wheel due to wheel lock-up. Figure 31 shows the comparison of results for the braking maneuver experiment, with the middle and final pictures showing engagement of the outriggers for motorcycles without ABS, even when equipped with CBS (Koetniyom al., 2019).

As ABS motorcycles showed better brake performance with increased stability, this could help mitigate injuries caused by human error and behaviour especially when riding on a wet surface and during challenging riding conditions (WHO 2017). ABS for motorcycles would help address the improper braking that is prevalent in motorcycle crashes. Although some argue that ABS is unnecessary for small engine motorcycles, the evidence as cited earlier indicates that such motorcycles are ridden at high speeds and pose the same braking problems that result in crashes and injuries as larger motorcycles. Thus, ABS is appropriate for any motorcycle that can achieve speeds above 50km/h. However, the study also showed that approximately half of the accident-involved riders were unlicensed, and none had any
formal training in motorcycle riding techniques and collision avoidance strategies (Kasantikul, VOL.II, p.7, 2001).

Figure 31: Braking maneuver experiment results of ABS, Non-ABS and CBS motorcycles.

3.3 Projected Number of Fatalities and Serious Injuries That Can Be Avoided with Motorcycle ABS

This section describes the findings from various studies in terms of the projected number of fatalities and serious injuries that can be prevented with the motorcycle ABS as well as the proportion of motorcycle-related fatalities and serious injuries that would have benefitted from motorcycle ABS. Table 10 summarises the findings from numerous research papers on the benefits of ABS and they are categorised further by the objectives, data types used and findings of each study. Generally, there has been limited published research on ABS in the ASEAN region. Hence, this section also includes findings from the rest of the world.
Table 10: Summary of findings from published paper related to ABS effectiveness

<table>
<thead>
<tr>
<th>Author</th>
<th>Objective</th>
<th>Method</th>
<th>Findings</th>
</tr>
</thead>
</table>
| Monash University Accident Research Centre, Australia (2015)           | to address a number of objectives related to the use of ABS (Anti-lock Braking Systems) technology as a safety feature on LC category motorcycles with an engine capacity greater than 125cc                                                                 | a statistical analysis of national road crash data as well as trend data in vehicle sales and ABS fitment for motorcycles                                                                                                         | ABS technology on LC>125 motorcycles (no scooters) resulted in
- a 33% reduction in all injury crash severities and
- a 39% reduction in severe injury crashes for sensitive crashes
- 31% benefits across all motorcycle crashes in Australia
ABS and CBS were identified together, the effectiveness rose slightly to 44% |
| Evaluation Of The Effectiveness Of Anti-Lock Braking Systems On Motorcycle Safety In Australia | the effectiveness of ABS in reducing motorcycle crashes and injuries to motorcyclists, both in Australia and within an international context, and the relevance and effectiveness of motorcycle ABS to specific crash types to identify future trends of motorcycle and ABS fitment growth and the likely benefits in terms of future injury savings and what the economic cost of the technology is expected to be |                                                                                                                                                                                                      |                                                                                                                                                                                                       |
| Insurance Institute for Highway Safety, USA (2013)                    | The purpose of the current study was to update Teoh (2011) with the most recent data                                                                                                                                                                      | Motorcycle drivers involved in fatal crashes per 10,000 registered vehicle years during 2003-11 were examined for 13 motorcycle models offering optional ABS. Fatal crash rates for motorcycles with ABS were compared to rates for the same models without AB | ABS was associated with a 31 percent reduction in the rate of fatal motorcycle crashes per 10,000 registered vehicle years. The 95 percent confidence interval for this effectiveness estimate was (9 percent, 48 percent). Both the updated estimate and its confidence interval were within the confidence interval of the 2003-08 estimate due largely to the precision afforded by larger sample size |
| Effects of Antilock Braking Systems on Motorcycle Fatal Crash Rates: An Update |                                                                                                                                                                                                                                                       |                                                                                                                                                                                                      |                                                                                                                                                                                                       |
| Matteo Rizzi, Johan Strandroth, Anders Kuligren, Claes Tingvall, Brian Fildes | This study set out to evaluate the effectiveness of motorcycle antilock braking systems (ABS) in reducing real-life crashes                                                                                                                                 | this study used police reports from Spain (2006-2009), Italy (2009), and Sweden (2003-2012) in order to analyze a wide range of the effectiveness of motorcycle ABS in reducing injury crashes
• Italy: from 24% (95% confidence interval [CI], 12-36) |                                                                                                                                                                                                       |

**Effectiveness of motorcycle antilock braking systems (ABS) in reducing crashes, the first cross-national study**

Motorcycles, including scooters, and compare countries with different motorcycling habits. The statistical analysis used odds ratio calculations with an induced exposure approach.

<table>
<thead>
<tr>
<th>Country</th>
<th>Reduction in Severe and Fatal Crashes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spain</td>
<td>34% (95% CI, 24-44) in Spain</td>
</tr>
<tr>
<td>Sweden</td>
<td>42% (95% CI, 23-61) in Sweden</td>
</tr>
</tbody>
</table>

#### Summary

In Table 10, it can be summarised that most of the studies used national crash data to estimate the effectiveness of motorcycle ABS in reducing fatal crashes, total crashes and injuries. Although the studies used national crash data, the data were specific to crashes in various configurations which excluded head-on, overtaking, U-turning, entering and leaving a parking place, collision with a fixed object and cutting in collisions. There was only one study mapping of crash data to determine the effectiveness of ABS. All in all, it was concluded that the ABS study in Germany, India and Indonesia showed that the motorcycle ABS could help prevent motorcycle crashes by 26, 33, and 26% respectively.
4.0 PREPAREDNESS TOWARDS SAFER MOTORCYCLES

4.1 Current Status of the Introduction of Motorcycle ABS Regulation

The effectiveness of ABS in reducing motorcycle crashes is definitely the reason why many countries in the world have mandated its use. The European Union (EU) comprising 27 countries was the first to implement such a ruling in January 2016. Since then, the fitment of ABS on motorcycles has increased tremendously. The wide range of motorcycle sizes in relation to ABS usage has been verified using police reports from various European countries including Spain, Italy and Sweden (Rizzi et al., 2015).

UN Regulation No. 78 that is related to the braking of vehicles in categories L1, L2, L3, L4 and L5 (tricycles) is currently applied by the EU, Russia, Japan, Turkey, Ukraine, Australia and the United Kingdom.

Looking at a larger framework, the Global Technical Regulations (GTR) under the 1998 Agreement has listed Motorcycle Brake as its third regulatory subject (UNECE, 1998). Most of the information in the regulations is related to Motorcycle ABS. The GTR No. 3 has been applied by Canada, EU, Japan and Russia.

Successful implementation of the law in the EU has convinced many other countries especially the signatory parties to WP29 to join this movement. These countries have also carried out extensive research before deciding to enact such a legislation. Japan announced its implementation starting in October 2018, requiring all new motorcycles over 125cc to be equipped with ABS. For all motorcycles above 50cc and under 125cc, it is also mandated to install ABS or CBS. Taiwan has since followed by announcing the implementation of the law starting January 2019.

Suffering many losses from motorcycle crashes, India has also mandated for motorcycles above 125 cc to be fitted with ABS starting April 2019 (Parekh, 2019), whereas in Brazil, the requirement for the motorcycle ABS has been raised to 300cc and above while motorcycles below 300cc can be fitted with either ABS or CBS.

China and South Korea have also mandated ABS installation to their motorcycle. China mandated ABS installation for motorcycles above 250cc for all new models starting July 2019, while for all models, starting on July 2020. Furthermore, for models above 150cc and under 250cc, it is either ABS or CBS. Meanwhile for South Korea, ABS installation is compulsory for motorcycle above 125cc for all new models, starting January 2020.

In the Australasian region, both Australia and New Zealand have already implemented the motorcycle ABS regulation. In Australia, this has been in place since November 2019. In New Zealand, with reference to the Land Transport Rule for Light-vehicle Brakes Amendment (No 2) 2019, the requirement has been gazetted on 1 April 2020. The requirement compels all existing motorcycle over 125cc to be fitted with ABS from 1 November 2021. For all motorcycles above 50cc and under 125cc, it is also mandated to install ABS or CBS. (Ministry of Transport New Zealand, 2020).
Nevertheless, although it is understood that ABS is an excellent safety feature for motorcycles, the technology still remains an option in the United States. However, the US National Transportation Safety Board (NTSB) in 2018 has urged the National Highway Safety Safety Administration to introduce and enforce the ABS law on the country’s motorcycle industry (Greening, 2018).

4.2 ABS Regulation in ASEAN Countries

Every day, around 60 people in Thailand are involved in road crashes (WHO, 2020) with motorcycle riders accounting for 74% of the number. The total number of road traffic fatalities in 2016 stood at 21,745. In the review report for 2020 (WHO, 2020), it was concluded that a fundamental change was required to effectively bring down the road-related trauma in Thailand. With the support from the Government, Thailand has become the first country in ASEAN to announce the motorcycle ABS regulation to be implemented in 2024 (Galang, 2021). The document has been signed by the Department of Land Transport, after the decision by the Government following the recommendations of the National Motorcycle Working Group consisting of stakeholders from private & public sector, NGOs & academia, on 9 April 2021 stating that all new motorcycles from the year of 2024, with the capacity of above 125 cc (or 11kW) must be equipped with ABS. As for the existing models, OEMs will not be able to sell the models if they are not equipped with ABS starting 1 January 2026.

In Malaysia, the total number of road fatalities fell 2% from 6,617 in 2018 to 6,284 in 2019 (Ministry of Transport Malaysia, 2021). However, the number of crashes for 2019 climbed to 567,516 cases. Motorcyclists accounted for the largest number of road users caught in road crashes, with an involvement in almost two-thirds of road fatalities. Although there have been a significant increase to the vehicle safety level in Malaysia, most of the changes involve passenger cars. Aside from VTA requirements, ASEAN NCAP has raised the safety level of passenger cars in the country to be at par with international standards. Nevertheless, there is still a wide gap in terms of motorcycle safety. On 16 March 2021, MIROS announced a new assessment program called the Malaysian Motorcycle Assessment Program or MyMAP (MIROS, 2021). Together with Malaysia Automotive Robotics and IoT Institute (MARii), this initiative is based on The National Automotive Vision and The National Automotive Policy as announced by the Malaysia Government in 2020. The goal of MyMAP is to become the starting point for raising motorcycle safety level particularly through technical and technological means. The motorcycle ABS regulation is clearly one of the main targets of MyMAP.

Similar to NCAP, MyMAP is not a rule-setting body. Hence, implementation of the motorcycle ABS in the country will not be fully achievable in the imminent future. Nevertheless, MIROS as the leader in road safety planning in Malaysia included the motorcycle ABS implementation as one of its Strategic Plans. The new Road Safety Plan 2022-2030 for Malaysia was announced in December 2021. Very recently, the Minister of Transport Malaysia announced that ABS mandatory installation will be started in 2025 for motorcycle with engine capacity of 150cc and above, and two years afterwards, to 125cc above category.

Clearly, there have been significant moves by the two countries (Thailand & Malaysia) in terms of introducing the motorcycle ABS regulation. Although Indonesia also faces a similar
issue as regards road safety with motorcyclist fatalities amounting to about 75.31% (INTP data, 2019), the Indonesia Government has made no move in relation to the motorcycle ABS ruling. Going through their latest road safety plan ‘Rencana Umum Nasional Keselamatan Jalan (RUNK) Jalan 2011 – 2035’ (RUNK, 2011) there is no mention of the ruling on motorcycle ABS in the document. Hence, more efforts are needed to convince Indonesia to adopt a similar stance regarding the motorcycle ABS. One prominent issue is that there is no dedicated agency or body in Indonesia that can be approached to pave the way for the motorcycle ABS to be mandated by the Government.

As for Vietnam, Myanmar and Laos, there are concrete plans to introduce the motorcycle ABS regulations although until now, no specific date has been mentioned. The Ministry of Transport Vietnam (MOT) says that the country aims to implement the motorcycle ABS ruling in line with its National Strategy for Road Traffic Safety 2021-2030, whereby regulations on the motorcycle Anti-lock Braking System (ABS) will be developed by MOT departments including the Vietnam Register, Science & Technology Department, Transport Safety Department and other related agencies. In the 2021-2025 period, MOT Vietnam will develop the regulations for motorcycle ABS and CBS. The MOT also mentions that currently, several motorcycle manufacturers in Vietnam have installed ABS on their vehicles but only for the high-end bike series.

For Laos, the regulatory agency for developing vehicle legislations is The Division of Vehicle Management and Machinery, The Department of Transport, under The Ministry of Public Works and Transport. They state that the UN Regulation will be adopted in 2025 although the specific details are yet to be announced.

Meanwhile for Myanmar, vehicle legislation comes under the purview of The Road Transport Administration Department under The Ministry of Transport. As mentioned earlier, Myanmar aims to introduce motorcycle ABS in its road transport regulations but the date of implementation is still unconfirmed. According to a source, the relevant parties will improvise the country’s 2020 Road Safety and Vehicle Management Law to include the motorcycle ABS regulation.

An inquiry with The Land Transport Authority (LTA) of Singapore has produced the following official response: Motorcycle Anti-lock Braking System (ABS) will not be mandatory in Singapore. However, if a certain motorcycle comes fitted with such a feature, it will be required to comply with internationally recognized vehicle safety standards such as the UNECE or Japanese Safety Regulations.

Meanwhile, a check with the related parties in The Philippines, Brunei and Cambodia concludes that the three ASEAN countries do not plan to introduce any motorcycle ABS law in the near future.

4.3 Penetration of Motorcycle ABS in the Current Fleet

There are two types of motorcycles on the ASEAN market particularly in Malaysia, Thailand, Indonesia and Vietnam, namely ABS-equipped motorcycles and non-ABS motorcycles. Based
on the market study conducted, most big engine motorcycles (250cc and over) come with ABS units, whether single (front wheel) or double channel (front and rear wheel).

Top brands including Yamaha, Honda, Kawasaki and Suzuki are all equipped with the technology. However, only a few smaller engine motorcycles (below 250cc) are fitted with ABS. Looking closely at the regional motorcycle market, the majority of buyers can only afford the smaller engine motorcycles due to the price. Hence, motorcyclists in this category make up 90% of the total number of motorcycle users in Malaysia, 80% in Thailand and 90% in Indonesia.

Most smaller motorcycles especially the cub (underbone) type, which is famously known as the “kapcai”, do not come with ABS. Only a few models have ABS but most of them are in the scooter category. Even bigger market players in Thailand and Indonesia have not introduced ABS to their cub type motorcycles. In Malaysia, well-known brands such as Honda and Yamaha have not equipped most of their smaller-engine bikes (the cub type) with ABS, although some smaller-engine scooters are fitted with the technology.

Several years ago, a particular motorcycle manufacturer, MFORCE redrew the boundaries by equipping its cub type bikes with ABS. More recently, Honda has released their new model in December 2021, Honda RSX and equipped with ABS. Looking at this trend, Malaysia will likely have more cub type motorcycles with ABS in the coming one or two years. Nevertheless, Thailand has already announced that smaller engine motorcycles (above 125cc) sold in the country must be installed with ABS by 2024. Hence, it would be wise for other ASEAN countries to follow in Thailand’s footsteps. The regional market will normally take a cue from the big players in both Thailand and Indonesia as there is high demand in these two countries, prompting bigger volume and production of the smaller engine two-wheelers. Once Thailand and Indonesia start mandating the use of ABS on all the motorcycles sold in their country, other smaller players will likely follow suit.

4.4 Supply And Manufacture of the ABS Module And System

With Thailand announcing that ABS will need to be installed on all motorcycles for the local market by 2024, it is expected that most ABS products from ABS OEMs will be manufactured in those countries. According to several ABS suppliers, there are already plans for an ABS manufacturing line in their factories in Thailand. In addition, some OEMs are also looking at potential strategic locations to set up ABS manufacturing plants.

In this regard, it is expected that the move to mandate the installation of ABS on all types of motorcycles in ASEAN will not pose a major problem in regard to ‘supply and demand’. In fact, if the resolution on motorcycle ABS is implemented in the near future, countries such as Indonesia, Thailand and Malaysia are seen to be more than ready.

4.5 Proportion of New Motorcycles Equipped with Motorcycle ABS

The ASEAN region remains one of the main markets for motorcycle manufacturers due to increasing demand for mobility, aided by rapid economic growth. Figure 32 shows the total motorcycle sales by countries in the ASEAN region for 2019. The largest market in the region
was Indonesia with about 6,487,460 units sold, hence, representing nearly half of the total motorcycle sales in the ASEAN region. Vietnam and Thailand were the second and third largest markets respectively.

![ASEAN Motorcycle Sales 2019](image)

**Figure 32: Number of motorcycle sales in ASEAN in 2019 (Source: Federation of Asian Motorcycle Industries, FAMI)**

Vietnam boasted the highest percentage of motorcycles in its vehicle population with two- or three-wheeler representing 95% of all registered vehicles, while approximately 7,500 new motorcycles were registered each day (WHO, 2010). In Thailand, an average 1.6 million motorcycles were registered each year over the last decade; whereas the number rose to 1.8 million in 2018. In the country, 94% of the motorcycles are under the “small engine capacity” category of under 250cc (WHO, 2020). Similarly, based on the total industry volume (TIV) motorcycle production data in Malaysia (Figure 33), about 99% of the motorcycles produced are under 250cc.

Considering the limitations in accessing very detailed sales records (by model and engine size) from motorcycle manufacturers, the effort to estimate ABS & non-ABS motorcycle sales volume was made using secondary data from the open market. Based on Indonesia’s sample motorcycle sales data provided by MotorCyclesData.com, ABS and non-ABS motorcycle models were identified and subsequently were proportionated. Based on the data, it is estimated that only 4% to 5% of new motorcycles sold are equipped with ABS with the majority of them from the models above 250cc.

In the ASEAN region, information from market intelligence indicated that most motorcycle models above 250cc are equipped with ABS units. Nevertheless, as the majority of ASEAN countries such as Thailand and Malaysia are dominated by small capacity engine motorcycles without ABS, it is expected that the proportion of new motorcycles sold with ABS is rather low. Taking an example from Malaysia data as shown in Figure 33, it is estimated that the proportion of new motorcycles with ABS sold in Malaysia is only about 1% because 99% of the motorcycle production in the country is the motorcycle models below than 250cc. Thus,
based on this estimation from Indonesian and Malaysian data, it is estimated that the proportion of new motorcycles with ABS sold in the ASEAN region may vary between 1 – 5%.

Figure 33: Total industry volume (TIV) motorcycle production in Malaysia.
5.0 CONSUMER AWARENESS AND DEMAND

5.1 Level of Consumer Awareness and Demand for Motorcycle ABS

This study was carried out through an online survey method. It employed convenience sampling where the respondents in the survey were reached through various social media platforms. The inclusion criterion was that a respondent must be a motorcyclist. This study was conducted over a one-month period (from September to October 2021). The questionnaires comprised nine parts. Part 1: Socio-demographic Information included questions on gender, age, education background, work information, and vehicle ownership. Meanwhile, Part 2: Motorcycle Ownership featured questions on the type of bike owned, motorcycle usage information, license status and riding experience. The questionnaires were designed using a google survey form. Part 3 dealt with risk assessment. Only riders who had been involved in road crashes needed to complete this section. Part 4 included questions related to the existing technology available on the respondents’ motorcycle. Finally, Part 5 consisted of questions related to the respondents’ knowledge of ABS technology as well as the requirement and demand for ABS on motorcycles.

5.1.1 Respondents Demographics

Nearly 1,203 motorcyclists from all ASEAN countries responded to the online survey. Figure 34 below shows the proportion of respondents. The findings showed that almost 41.7% of the respondents were from Malaysia. This was followed by Indonesia and Thailand, with 32.6% and 11.6% of the respondents, respectively.

Further distribution of the respondents is presented in Table 11 below. The findings indicated that the majority of motorcyclists were male (90.8%) and worked in a private sector (42.6%)
or in the government sector (26.6%). Most of the respondents (71.0%) were degree holders while secondary school leavers accounted for 26.9%. Only 1.5% of the respondents were primary school leavers. The distribution by locality revealed that about 42.3% of the respondents lived in the city area, whereas another 35.2% lived in the urban area.

Over 98% of respondents owned a motorcycle. Table 12 below presents the details of the respondents’ motorcycle. The result indicated that most respondents used either a standard/under bone or scooter type motorcycle, with 42.0% and 37.9% respectively. This is probably because most of these motorcycle types are easily available in the market and sold at an affordable price. In the survey, most respondents stated their motorcycle was 101 to 250cc (81.4%). The study also found 91.4% of them had a full license. Most motorcyclists developed their riding skills on their own. 35.7% of the respondents stated they were self-taught when they first rode a motorcycle. As the small motorcycle was cheap, easy to maintain and reliable, it was used as the main mode of transport (66.3%) and for daily commute (71.9%). For some, the motorcycle was used for leisure or recreation (21.0%) while others rode it 2-3 days per week (16.5%). The respondents also maintained their motorcycle by visiting the workshop (78.1%) rather than performing self-maintenance (21.9%).

Table 11: Respondents demographic

<table>
<thead>
<tr>
<th>Variables</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1,092 (90.8)</td>
</tr>
<tr>
<td>Female</td>
<td>111 (9.2)</td>
</tr>
<tr>
<td><strong>Occupation</strong></td>
<td></td>
</tr>
<tr>
<td>Government</td>
<td>320 (26.6)</td>
</tr>
<tr>
<td>Private</td>
<td>512 (42.6)</td>
</tr>
<tr>
<td>Self-employed</td>
<td>130 (10.8)</td>
</tr>
<tr>
<td>Student</td>
<td>203 (16.9)</td>
</tr>
<tr>
<td>Retiree</td>
<td>6 (0.5)</td>
</tr>
<tr>
<td>Not working</td>
<td>32 (2.7)</td>
</tr>
<tr>
<td><strong>Education Background</strong></td>
<td></td>
</tr>
<tr>
<td>None</td>
<td>7 (0.6)</td>
</tr>
<tr>
<td>Primary</td>
<td>18 (1.5)</td>
</tr>
<tr>
<td>Secondary</td>
<td>324 (26.9)</td>
</tr>
<tr>
<td>Higher education</td>
<td>854 (71.0)</td>
</tr>
<tr>
<td><strong>Locality</strong></td>
<td></td>
</tr>
<tr>
<td>Urban</td>
<td>424 (35.2)</td>
</tr>
<tr>
<td>City</td>
<td>509 (42.3)</td>
</tr>
<tr>
<td>Rural</td>
<td>270 (22.4)</td>
</tr>
</tbody>
</table>
Table 12: Motorcycle ownership

<table>
<thead>
<tr>
<th>Variables</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motorcycle Ownership</td>
<td>1,183 (98.3)</td>
</tr>
<tr>
<td>Yes</td>
<td>1,163 (98.3)</td>
</tr>
<tr>
<td>No</td>
<td>20 (1.7)</td>
</tr>
<tr>
<td>Types</td>
<td></td>
</tr>
<tr>
<td>Standard/Under Bone</td>
<td>505 (42.0)</td>
</tr>
<tr>
<td>Scooter</td>
<td>456 (37.9)</td>
</tr>
<tr>
<td>Sport Bike</td>
<td>87 (7.2)</td>
</tr>
<tr>
<td>Cross/Off-road</td>
<td>13 (1.1)</td>
</tr>
<tr>
<td>Chopper</td>
<td>1 (0.1)</td>
</tr>
<tr>
<td>Touring</td>
<td>84 (7.0)</td>
</tr>
<tr>
<td>Naked</td>
<td>57 (4.7)</td>
</tr>
<tr>
<td>Engine capacity (cc)</td>
<td></td>
</tr>
<tr>
<td>Not so sure</td>
<td>15 (1.2)</td>
</tr>
<tr>
<td>&lt;100cc</td>
<td>102 (8.5)</td>
</tr>
<tr>
<td>101 – 250cc</td>
<td>979 (81.4)</td>
</tr>
<tr>
<td>251 – 500cc</td>
<td>40 (3.3)</td>
</tr>
<tr>
<td>501- 1,000cc</td>
<td>52 (4.3)</td>
</tr>
<tr>
<td>&gt;1,000cc</td>
<td>16 (1.3)</td>
</tr>
<tr>
<td>License status</td>
<td></td>
</tr>
<tr>
<td>Full license</td>
<td>1,100 (91.4)</td>
</tr>
<tr>
<td>Probationary &amp; Learner’s Permit</td>
<td>32 (2.7)</td>
</tr>
<tr>
<td>No license</td>
<td>71 (5.9)</td>
</tr>
<tr>
<td>Who teach you riding motorcycle for the first time</td>
<td></td>
</tr>
<tr>
<td>Trainer/Instructor</td>
<td>123 (10.2)</td>
</tr>
<tr>
<td>Self-taught</td>
<td>430 (35.7)</td>
</tr>
<tr>
<td>Friend</td>
<td>129 (10.7)</td>
</tr>
<tr>
<td>Family/Relative</td>
<td>521 (43.3)</td>
</tr>
<tr>
<td>Use of motorcycle</td>
<td></td>
</tr>
<tr>
<td>Main mode of transport</td>
<td>797 (66.3)</td>
</tr>
<tr>
<td>Leisure &amp; recreation</td>
<td>253 (21.0)</td>
</tr>
<tr>
<td>For working (delivery goods or food)</td>
<td>140 (11.6)</td>
</tr>
<tr>
<td>Sport</td>
<td>12 (1.)</td>
</tr>
<tr>
<td>Frequency of use</td>
<td></td>
</tr>
<tr>
<td>Everyday</td>
<td>865 (71.9)</td>
</tr>
<tr>
<td>2-3 days per week</td>
<td>198 (16.5)</td>
</tr>
<tr>
<td>One a week</td>
<td>62 (5.2)</td>
</tr>
<tr>
<td>Not at all. Just for leisure</td>
<td>73 (6.1)</td>
</tr>
<tr>
<td>Motorcycle maintenance</td>
<td></td>
</tr>
<tr>
<td>Self-maintenance</td>
<td>263 (21.9)</td>
</tr>
<tr>
<td>Motorcycle workshop</td>
<td>940 (78.1)</td>
</tr>
</tbody>
</table>

5.1.2 Risk Evaluation

The motorcycle ABS helps to prevent the wheels from locking up and therefore the rider will be kept upright. Therefore, this study also assessed the risks to motorcyclists based on the respondents’ experience of road crashes. The results found 66.2% of the respondents had
been involved in a road crashes (Table 13) while 76.0% of them had sustained minor injuries. The results also revealed 59.2% of the road crashes involved other motorized vehicles. Meanwhile, 34.55% of them had experienced road crashes not involving other vehicles or objects. Side-swipe and out-of-control road crashes represented the highest percentage of motorcycle collision types at 32.5% and 30.3%, respectively. Most motorcycle road crashes occurred during day-time (75.0%), on a straight road (52.1%) and collector/local street road (68.7%).

<table>
<thead>
<tr>
<th>Variables</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Road crashes experience</td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>796 (66.2)</td>
</tr>
<tr>
<td>No</td>
<td>407 (33.8)</td>
</tr>
<tr>
<td>Injuries</td>
<td></td>
</tr>
<tr>
<td>Not injured</td>
<td>51 (6.4)</td>
</tr>
<tr>
<td>Minor injured</td>
<td>605 (76.0)</td>
</tr>
<tr>
<td>Seriously injured (admitted to ward)</td>
<td>140 (17.6)</td>
</tr>
<tr>
<td>Type of accident</td>
<td></td>
</tr>
<tr>
<td>Alone</td>
<td>275 (34.5)</td>
</tr>
<tr>
<td>Involves other vehicle</td>
<td>471 (59.2)</td>
</tr>
<tr>
<td>Involves pedestrian</td>
<td>11 (1.4)</td>
</tr>
<tr>
<td>Involves animal or other object</td>
<td>39 (4.9)</td>
</tr>
<tr>
<td>Collision types</td>
<td></td>
</tr>
<tr>
<td>Head on</td>
<td>91 (11.4)</td>
</tr>
<tr>
<td>Rear</td>
<td>124 (15.6)</td>
</tr>
<tr>
<td>Side swipe</td>
<td>259 (32.5)</td>
</tr>
<tr>
<td>Angular</td>
<td>81 (10.2)</td>
</tr>
<tr>
<td>Out of control</td>
<td>241 (30.3)</td>
</tr>
<tr>
<td>Time of road crashes</td>
<td></td>
</tr>
<tr>
<td>Day time (6am-7pm)</td>
<td>597 (75.0)</td>
</tr>
<tr>
<td>Night-time (7pm-6am)</td>
<td>199 (25.0)</td>
</tr>
<tr>
<td>Road geometry</td>
<td></td>
</tr>
<tr>
<td>Straight road</td>
<td>415 (52.1)</td>
</tr>
<tr>
<td>Bend</td>
<td>180 (22.6)</td>
</tr>
<tr>
<td>Cross junction or intersection</td>
<td>180 (22.6)</td>
</tr>
<tr>
<td>Roundabout</td>
<td>21 (2.6)</td>
</tr>
<tr>
<td>Road type</td>
<td></td>
</tr>
<tr>
<td>Expressway</td>
<td>249 (31.3)</td>
</tr>
<tr>
<td>Other/federal road/state road etc.</td>
<td>547 (68.7)</td>
</tr>
</tbody>
</table>

5.1.3 Motorcyclists’ Awareness on Safety Technology

Various types of motorcycle safety features have been introduced to assist in motorcycle riding and handling. This section aims to determine the respondents’ knowledge of motorcycle safety. The study posed the question, “Have you heard or had knowledge of motorcycle safety features?” The survey included several questions whereby the answers were based on the “Yes, No and Not sure” response. Figure 35 below shows the list of respondents’ feedback on motorcycle safety features. The result showed most of them knew
about anti-lock braking system (ABS), traction control (TC), low-pressure tire indicator, combine brake (CB) and motorcycle electronic stability control (ESC).

![Motorcycle Safety Features](image)

Figure 35: Respondents knowledge on motorcycle safety features.

5.1.4 Rider opinion on Antilock Braking System (ABS) technology

This section shall describe the respondents’ opinion on anti-lock braking system (ABS) technology for motorcycles in ASEAN countries. Several statements were developed in the survey that required the “Yes, No and Not Sure” mandatory response. The results found 69.2% of the respondents stating their motorcycle were not equipped with ABS. However, when asked whether they had an experience using ABS while riding, there was equal distribution for both “Yes” and “No” answers, with 45.0% and 44.4% respectively. Most respondents also stated they knew how ABS functioned (81.0%) and gave a positive feedback when stating that it was necessary for all motorcycles to be equipped with ABS (78.5%). Most of them also believed ABS could reduce the risk of road crashes (83.9%), decrease the risk of injuries or death in road crashes (77.4%), prevent the motorcycle from skidding (80.1%), prevent crashes (56.1%) and avoid the wheels from locking (84.2%). Nevertheless, they also believed the fitment of ABS would increase the price of motorcycles (80.7%). When the survey posed the question, “Does your country have any regulation on ABS?”, the respondents were equally divided between the “Yes”, “No” and “Not sure” answers. This study also revealed that most motorcyclists agreed for the motorcycle ABS regulation to be introduced across ASEAN (79.1%).
Table 14: Rider opinion on ABS technology

<table>
<thead>
<tr>
<th>Statement</th>
<th>Yes</th>
<th>No</th>
<th>Not Sure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Does your motorcycle have antilock braking system technology (ABS)?</td>
<td>271 (22.5)</td>
<td>832 (69.2)</td>
<td>100 (8.3)</td>
</tr>
<tr>
<td>2. Have you experienced ABS while riding?</td>
<td>541 (45.0)</td>
<td>534 (44.4)</td>
<td>128 (10.6)</td>
</tr>
<tr>
<td>3. Do you know how ABS works?</td>
<td>974 (81.0)</td>
<td>143 (11.9)</td>
<td>86 (7.1)</td>
</tr>
<tr>
<td>4. Do you feel all motorcycles need to have ABS?</td>
<td>944 (78.5)</td>
<td>163 (13.5)</td>
<td>96 (8.0)</td>
</tr>
<tr>
<td>5. Do you feel the use of ABS can reduce the risk of road crashes?</td>
<td>1,009 (83.9)</td>
<td>90 (7.5)</td>
<td>104 (8.6)</td>
</tr>
<tr>
<td>6. Do you think the use of ABS is able to reduce the risk of injuries or death caused by road crashes?</td>
<td>931 (77.4)</td>
<td>142 (11.8)</td>
<td>130 (10.8)</td>
</tr>
<tr>
<td>7. ABS can prevent from skidding?</td>
<td>964 (80.1)</td>
<td>104 (8.6)</td>
<td>135 (11.2)</td>
</tr>
<tr>
<td>8. ABS can prevent from crash?</td>
<td>675 (56.1)</td>
<td>317 (26.4)</td>
<td>211 (17.5)</td>
</tr>
<tr>
<td>9. ABS is to prevent the wheels from locking?</td>
<td>1,013 (84.2)</td>
<td>78 (6.5)</td>
<td>112 (9.3)</td>
</tr>
<tr>
<td>10. Fitment of ABS will increase the price of motorcycle?</td>
<td>971 (80.7)</td>
<td>89 (7.4)</td>
<td>143 (11.9)</td>
</tr>
<tr>
<td>11. Does your country have any regulations on ABS?</td>
<td>331 (27.5)</td>
<td>469 (39.0)</td>
<td>403 (33.5)</td>
</tr>
<tr>
<td>12. Agree to Regulate ABS?</td>
<td>952 (79.1)</td>
<td>102 (8.5)</td>
<td>149 (12.4)</td>
</tr>
</tbody>
</table>

5.2 The ‘4 Ws’ that should be asked

As the first step toward implementing the motorcycle ABS regulation in the ASEAN region, this study believes the “4W: who, what, when, why” questions should be posed.

5.2.1 Who

The survey respondents were highly supportive of all motorcycle segments to be equipped with ABS if such a regulation were to be implemented in their country. This is shown in Figure 36 below where, on average, over 75% of the respondents agreed that all motorcycles should be fitted with ABS.

5.2.2 When

Figure 37 below shows most respondents feel the motorcycle ABS regulation should be implemented immediately or within the next 5 years (83%). Meanwhile, 2% of the respondents feel the regulation should be implemented within the next 5 to 10 years. However, 15% of them were unsure of the appropriate time to implement the motorcycle ABS regulation in ASEAN.
5.2.3 What

When a new technology emerges, there will definitely be financial implications to the price of a motorcycle. The respondents were asked about their willingness to pay for a newer technology for motorcycles. Figure 38 below shows 72% of the respondents are willing to pay below USD100 for the fitment of ABS on a motorcycle.
5.2.4 Why

The respondents also believed motorcycles without ABS posed a higher risk as opposed to motorcycles with ABS in road crashes (Figure 39). Therefore, this was why ABS should be fitted on motorcycles.

5.3 Affordability - Cost Of Motorcycle ABS as Sold To Consumers

The aim of transportation is to allow users to travel between destinations with ease and convenience. As technology changes, convenience becomes relative, hence, leading to the development and growth of various methods of transportation to fulfil the same goal. Motorcycles are considered the ‘easiest and quickest’ way to get around places. Its two wheeled design along with the ease of body control, fuel economy, abundance of parking
areas and most importantly cost, have pushed consumers to buy the vehicle despite its many
downfalls. This being said, the rise of average income over the past few decades has led to an
increase in car sales. Although the use of a car provides greater safety to the driver, the
increased congestion and traffic on roads pose a threat to motorcycle users. A collision
between the two vehicle categories could result in the rider to be fatally injured whereas the
driver to be unharmed.

Affordable motorcycles used by the average consumer lack many of the features that may be
available in a high-end motorcycle. Although allowing differentiation between models and
brands enable a boost in the business aspect, it is believed that basic safety features should
be present throughout all models. One of the features in concern is the Anti-lock Braking
System (ABS). The benefits of this technology are greatly seen especially under various
weather conditions in the ASEAN region.

It is understood for any vehicle that requires additional features would involve the incurrence
down the cost of installation of ABS to be around TBH 3500-700 (around 100-200 Euro @ USD
120-240 per unit), causing the price of the motorcycle to increase by 10%. A comparative
study on the price difference in motorcycles with and without ABS across different markets
was conducted by the Malaysian Institute of Road Safety Research (MIROS). The study was
based on motorcycles under 200cc and the results are as shown in the table 15.

From the data shown, having ABS fitted on the motorcycle by the manufacturer causes an
additional increase of 13%-22% to the price of the motorcycle. The purchase of the ABS model
comes down to willingness and the ability of the consumer to afford the price difference,
especially considering the target market (in lower to middle income countries). The question
then comes down to whether it is possible to further reduce the price of these models with
ABS to make them more attainable by people of all income groups. MIROS had further dived
into researching and investigating the cost of the ABS module from the vendor to the final
product fitted on the motorcycle. Table 16 shows this breakdown.

In-depth study shown that the cost of the ABS module sold by the vendor ranges between
USD70-95, averaging at USD83 per unit. This is then purchased by the motorcycle
manufacturer and implemented into the vehicle system. The end result would cost the
consumer between USD240-360, averaging at USD360, or more than 4 times the original price
sold by the vendor. It is understood that upon purchase, the manufacturer incurs other costs
in terms of assembly and labour charges. Although this being the case, manufacturers do have
added benefits such as bulk purchase discounts which could be considered to further reduce
the price of the ABS model provided. The price jump of the module from the vendor compared
to when it is fitted to the motorcycle is yet to be fully justified but considering the importance
of the ABS module in terms of safety of the road users, an agreement between manufacturers
and regulatory bodies is highly recommended and best suited to help mandate this safety
feature and allow an affordable price which could reduce road user mortality across the
ASEAN region.
Table 15: Cost comparison of motorcycles with and without ABS

<table>
<thead>
<tr>
<th>Country</th>
<th>Model</th>
<th>With ABS</th>
<th>Without ABS</th>
<th>Difference (RM)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Malaysia</strong></td>
<td>SYM VF3i 185cc</td>
<td>RM 9,338</td>
<td>RM 8,288</td>
<td>1,100</td>
</tr>
<tr>
<td></td>
<td>Modenas RS200</td>
<td>RM 9,990</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yamaha XMAX 250</td>
<td>RM 21,500 (2020)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Yamaha NVX 155cc</td>
<td>RM 10,998</td>
<td>RM 8,998</td>
<td>2,000</td>
</tr>
<tr>
<td><strong>Thailand</strong></td>
<td>Yamaha Aerox 155cc</td>
<td>78,500 Baht@RM10,100</td>
<td>67,500 Baht@RM8,610</td>
<td>1,490</td>
</tr>
<tr>
<td></td>
<td>Yamaha Aerox 155cc</td>
<td>Rp. 29,000,000@RM8,219</td>
<td>Rp. 25,000,000@RM7,230</td>
<td>989</td>
</tr>
<tr>
<td><strong>Indonesia</strong></td>
<td>Honda PCX 160cc</td>
<td>Rp. 34,445,000</td>
<td>Rp. 30,845,000</td>
<td>1,056</td>
</tr>
<tr>
<td></td>
<td>CB150R</td>
<td>Rp. 40,180,000</td>
<td>Rp. 36,180,000</td>
<td>1,173</td>
</tr>
<tr>
<td></td>
<td>Honda ADV 150cc</td>
<td>Rp. 38,251,000</td>
<td>Rp. 35,186,000</td>
<td>899</td>
</tr>
<tr>
<td><strong>Vietnam</strong></td>
<td>Yamaha NVX 155cc</td>
<td>VND 68444739@RM12,717</td>
<td>VND 61600265@RM11,445</td>
<td>1,272</td>
</tr>
</tbody>
</table>

Table 16: Cost difference of ABS module from vendor to motorcycle fitted

<table>
<thead>
<tr>
<th>ABS VENDOR</th>
<th>ABS SPARE PART</th>
<th>MOTORCYCLE FITTED (REACHED CONSUMER)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Range</strong></td>
<td>USD 70-95</td>
<td>USD 190-350</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td>USD 83 @ RM352</td>
<td>USD 270 @ RM1140 (3 TIMES)</td>
</tr>
</tbody>
</table>
6.0 HOW WOULD ASEAN BENEFIT FROM MOTORCYCLE ABS IMPLEMENTATION?

6.1 Life Benefits

Several studies have shown that ABS has an estimated effectiveness of 26-39% in reducing collisions as well as injuries and deaths among motorcyclists. Rider fatalities can be avoided in several crash configurations including motorcycle skidding, side collision, collision at intersections, braking error, rear-ending another vehicle, or hitting a pedestrian.

The possibility of reducing a road crash as well as motorcyclist injury severity through the use of ABS has also been discussed in several previous studies. In Thailand, the use of motorcycle ABS is estimated to be able to save nearly 6,000 to 9,000 lives in the 5 years after the ABS regulation is implemented. In Indonesia, a report suggests that ABS-equipped motorcycles will be able to reduce crashes by 26% with thousands of motorcyclists’ lives saved (Kumares et. al., 2017). Similar studies in Malaysia estimate that the installation of ABS can reduce motorcycle-related crashes and motorcyclist fatalities by 33%. It is believed that this projection also holds true for other countries in the ASEAN region. Hence, with an estimated effectiveness of 26-39%, implementation of the ABS motorcycle regulation in the ASEAN region is likely to be able to save up to 8,000 motorcyclists’ lives every year.

6.2 Economics Benefits

In parallel with the number of lives saved as well as the reduction of serious injuries among road users, economic returns can be gained by introducing regulations on the motorcycle ABS. Based on the value of statistical life (VOSL) of RM3.12 million in Malaysia as estimated by MIROS (MIROS, 2018), with the reduction of road deaths, the country is able to save around RM 2 billion a year, not including savings due to the reduction of injuries that will eventually allay the economic impact borne by the country as a result of road crashes.

In Thailand, the estimated VOSL is USD 0.18 to 0.23 million, whereas the value of statistical injury (VOSI) is USD 0.08 to 0.11 mil (Puttawong & Chaturabong, 2020). With the announcement of the impending motorcycle ABS ruling, the country is projected to save around USD 0.3 to 0.45 billion a year or USD4.5 to 6 billion in the following 5 years from a reduction of road crashes involving motorcyclists. Assuming the same in all ASEAN countries, the introduction of ABS ruling across the region will benefit ASEAN’s economy with an estimated boost to each country GDP of more than 1%.
OTHER VEHICLE SAFETY TECHNOLOGIES THAT CAN REDUCE MOTORCYCLE CRASHES

While there are various vehicle safety technologies being introduced, we should put more focus on the implementation of motorcycle ABS. The effectiveness of this technology in reducing road crashes involving motorcyclists must be highlighted for the Governments across the ASEAN region to support the implementation of motorcycle ABS regulation.

One of the issues in mandating the installation of ABS on motorcycles is the cost of the technology. ABS for motorcycle is still considered expensive and can increase the price of small-engine motorcycles on the market. Eventually, this will affect ASEAN consumer purchasing power. This is the reason why several countries are allowing CBS to be part of the regulations regarding lower capacity motorcycles (below 125cc).

Hence, the mandatory use of ABS technology on motorcycles faces the biggest challenge in relation to the costs to be borne by the consumers. Aside from the motorcycle ABS, another suitable technology to increase motorcyclists’ safety is the motorcycle blind spot mirrors (The Sun Daily, 2021). With this equipment, the rider can sense the impending danger immediately. The motorcycle mirrors will display warning at a given time while detecting other vehicles in the blind spot zone. The device will be able to alert the rider against the risk of collision with another vehicle. However, currently the system is only available on high-powered motorcycles produced by BMW, Ducati and KTM.

As with passenger cars, adaptive headlights should also be recommended for motorcycle use. Most motorcycles especially the lower engine capacity types are fitted with fixed low-beam headlights. By using the adaptive headlights, motorcyclists will be able to see better, especially in dark surroundings and when approaching corners. Interestingly, the adaptive headlights technology can be fitted by the buyers as an aftermarket device in addition to being readily installed by OEMs.

Another regular equipment in passenger cars is the Tire Pressure Monitor System (TPMS). This technology ensures the tire has the right pressure because low tire pressure will reduce driving ability. By installing the technology on a motorcycle, the rider will have better handling of his or her vehicle where the tire pressure shall always be maintained at the necessary optimum level.

In terms of its size, the motorcycle is smaller than other motorized vehicles. Hence, the motorcycle is difficult to be spotted by other vehicle drivers. Although Blind Spot Technology (BST) is currently supplied in passenger cars as standard equipment, there are other means for a vehicle driver to detect the presence of a nearby motorcycle. One such device is the vehicle-to-vehicle communication technology or V2C/V2X technology. This technology will ensure the presence of a motorcycle is known by other vehicle drivers on the road. Possibly, with the existing advanced smartphone technology, vehicle-to-vehicle communication technology can also be installed on motorcycles without significantly resulting in a price increase for motorcycles. Nevertheless, dedicated research needs to be conducted first to avoid misjudgement and others potential weaknesses.
As of April 2018, all new EU passenger cars were required to have eCall installed. The move was made to ensure that integrated emergency call would be able to alert the first responder. Like on passenger cars, the eCall system might be needed for motorcycles (acem, 2021). Nevertheless, the motorcycle presents a totally different and complex circuitry compared to the passenger car.

A motorcycle airbag might not be able to prevent a road collision. However, it could lower the risk of injury sustained by a motorcyclist in the crash. Similar to the airbag in passenger cars, a motorcycle airbag will be deployed as the sensor detects a high impact force from a collision. Unfortunately, the use of airbag jacket may not be popular in ASEAN due to the hot temperature and inclement weather.

Fundamentally, we must emphasize the most basic motorcycle safety equipment that is the motorcycle helmet. It is important for the helmet to be produced according to the standards of each country. A good helmet should not be expensive and must be certified such as according to UN Regulation 22.05. The FIA team has developed an affordable helmet that adheres to the UN Rules (FIA, 2020). Furthermore, the helmet must be suitable to be worn in the hot and humid climate of ASEAN.
8.0 CONCLUSIONS

Motorcycle market in the region is still growing, and motorcycles are still consistently in high demand in many countries in ASEAN and the sales trend is predicted to continue for years to come. Motorcycle annual sales in the ASEAN region have reached 10 million units with small engine capacity motorcycles (below 250cc) dominated the market. The economic factor and size advantage of these small-engine motorcycles undermine the inherent risks they pose. Indonesia is leading with sales volume beyond 6.5 million units, followed by Vietnam and Thailand.

By volume, motorcycle constitutes about 58% of the regional vehicle population while motorcyclists contributed around 43% to the total road traffic deaths in the region. Motorcycles are dominating the traffic and has been the main mode of land transport in the region, with six out 10 countries in ASEAN showed a big majority of motorcycles in their vehicle registration records. Vietnam led the region with more than 90% motorcycle in their traffic system, closely followed by Cambodia, Indonesia and Myanmar with motorcycle representing greater than 80% of the vehicle population. Laos and Thailand were 77% and 65% respectively, with Malaysia has quite a balance ratio of about 45%. The Philippines, Singapore and Brunei have relatively smaller fleet of motorcycles in their traffic system.

Motorcyclists’ deaths made up around half or greater, of all road fatalities, in eight out of 10 countries in the region with exception of Philippines and Brunei. Motorcyclists’ deaths consistently exceeded 75% of total road deaths in Cambodia and Indonesia (more than nine thousand fatally injured). In Vietnam, motorcycle crash involvement accounted for 65% of the total road crashes. In Malaysia, and Laos, more than 60% of road deaths involved motorcyclists. In Thailand and Singapore, motorcycle crash involvement accounted for 36% and 33% respectively, with fatalities in the range of 53 to 54%. In Myanmar, motorcyclist fatalities accounted for 48%. In the Philippines, there have been 31% fatalities involving motorcyclists. In Brunei, motorcyclist fatalities ranged from 1 to 4 cases each year, over the last half a decade.

The ABS technology has been around for many years and is known to provide crash prevention potential for motorcycles. Studies in Germany and India indicated a reduction of 26-33% in terms of crash occurrences for motorcycles equipped with ABS. Similarly, a projection in Indonesia and Thailand further reaffirms the benefits of the motorcycle ABS in crash reduction which can save more than 1,200 lives in three years. Elsewhere, studies of ABS for motorcycles have also indicated a positive outcome, with reduction greater than 30% in fatal crash rate and greater than 20% for injury crash rate. Comparatively, the motorcycle ABS provides superior performance in braking especially under low friction surface and stability, relative to CBS and conventional brake system. To gauge motorcycle consumer demand, a recent online survey indicated ABS awareness to be the greatest among the respondents (90%) compared to other safety features for motorcycles. The respondents’ knowledge of ABS was encouraging and almost 80% of them agreed for the use of motorcycle ABS to be mandated in ASEAN.

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The initiative to legislate the use of motorcycle ABS in the greater Asian region was led by India and Japan and were followed by Taiwan, Australia and New Zealand. Over in ASEAN, the progress to adopt motorcycle ABS was less aggressive. In exception to Thailand, which has taken a bold step to announce the mandatory use of motorcycle ABS beginning 2024, other countries remain quiet. Malaysia recently also announced that the mandatory installation of ABS to motorcycle 150cc and above will begin in 2025. On top of that, Malaysia also is employing a different approach using a consumer-based program called MyMAP, to increase the demand for safer motorcycles. In other countries namely Indonesia, Myanmar, and Vietnam, market intelligence indicates that the intention to adopt motorcycle ABS in their national road safety agenda is being considered, although the official announcement is yet to be made. Nevertheless, Laos has postponed its adoption of the UN Regulation on motorcycle ABS to 2025. Singapore, on the other hand, will not mandate the fitment of motorcycle ABS but will regulate the compliance of models fitted with the technology. There is no indication to adopt the motorcycle ABS in The Philippines, Brunei, and Cambodia.

9.0 RECOMMENDATIONS

With the increasing trend in motorcycles sales and the consistent growth in motorcycle volumes in the ASEAN, putting some sort of controls either to slow down, halt or reverse the pattern could be challenging to the region economy. Among the option to curb and improve on motorcycle safety is by introducing policy for new motorcycles that come into the market, such as mandating the use of motorcycle ABS, among other safety interventions.

Given the vulnerability of motorcyclists when on the roads, prevention of crashes is the most practical way, moving forward. It is firmly believed that the ABS for motorcycle will make a significant difference in improving motorcycle safety and should be made mandatory in all ASEAN countries. Hence, manufacturers should provide ABS as standard safety equipment on all motorcycles regardless of engine size.
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