Deliverable 1.2

Accident Parameters Description for the Chosen Scenarios

WP1: Accident Data Study

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Executive Summary

The South-East Asian region shows the higher death rate of motorcyclist among their road users. Within this context, the OASIM project aims to improve the safety of motorcycle users in this region by establishing active safety test protocols representative of the accident situations. Work Package 1 is dedicated to an accident data study to provide a set of accident scenarios that can be implemented in future test procedure. The main scenarios between motorcycles and passenger cars in the ASEAN countries have been highlighted in a previous step. The main situations selected to be further analysed in detail correspond to 78% of the Killed and Seriously Injured (KSI) Malaysian cases and to 83% of the KSI Thai data. Based on this first study, the six most critical accident scenarios have been clustered according to similar situations. The corresponding 12 sub-scenarios clustered are:

- Rear-end scenario with the motorcycle hit at the rear by the frontal part of the car
- Head-on scenario (1) with the car and the motorcycle coming from opposite direction
- Head-on scenario (2) with the motorcycle changing lane and colliding with an oncoming car
- Head-on scenario (3) with the car changing lane and colliding with an oncoming motorcycle
- Angular scenario (1) with the car turning across the path of the motorcycle, opposite direction
- Angular scenario (2) with the car turning into the path of the motorcycle, right direction
- Angular scenario (3) with the car turning right/left in the path of the motorcycle, same direction
- Angular scenario with the motorcycle turning right in the path of the car
- Crossing scenario with the car and the motorcycle coming from perpendicular direction
- Side-swipe scenario (1) with the motorcycle merging toward the right within the lane of the car, same direction
- Side-swipe scenario (2) with the car entering the lane of the motorcycle from the right or the left, same direction
- Side-swipe scenario (3) with the car and the motorcycle going straight in the same direction

This report describes in detail, with the parameters defined, all these accidents. The parameters concern the accidents, the vehicles, and the collision characteristics. The six accident scenarios are described with the national Malaysian database, whereas the in-depth Thai database is used to analyse the twelve sub-scenarios.

They represent the most frequent KSI accident configurations involving a car and a motorcycle and they are considered representative of the car-to-motorcycle accidents in the ASEAN region. The sub-scenarios description done within this report should help at providing relevant data in order to set up test scenarios to evaluate the systems and therefore improve motorcycle safety in the ASEAN countries.

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Table of contents

Introduction

With 43% of fatalities among their road users, the South-East Asian countries have the highest rate of death among riders of motorized 2- and 3-wheelers (according to the Global Status report on Road Safety 2018). The Association of Southeast Asian Nations (ASEAN), an intergovernmental organization created in 1967, represents ten countries: Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, the Philippines, Singapore, Thailand, and Vietnam.

With pedestrians and cyclists, motorcyclists are considered as Vulnerable Road Users (VRU) as they respectively account for 26% (pedestrians and cyclists) and 28% (motorcycles) of all deaths in the world. Looking at the ASEAN countries situations, their proportion goes up to 59% of the fatalities on the road.

Since 2011, the ASEAN New Car Assessment Program (ASEAN NCAP) aims to elevate vehicle's safety standards. ASEAN NCAP places high importance on motorcyclist safety and claim to become the most challenging protocol of a kind. Thus, the Motorcyclist Safety Pillar was specifically created in the 2021-2025 Roadmap, to urge the automotive industry to reduce motorcyclist's road traffic deaths through new technologies. The industrial consortium Overall ASEAN market Safety Improvement for Motorcycles (OASIM) coordinated by UTAC was set off in September 2020 with the support of the ASEAN NCAP. The OASIM project aims to improve the motorcyclist safety in the ASEAN region by promoting an official rating.

The first Work Package (WP1) aims at providing a set of accident scenarios representative of the main accident situations between passenger cars and motorcycles in the ASEAN region.

At first, the most critical scenarios from both databases were identified in the D1.1 deliverable:

- Rear-end accidents with the car colliding into the motorcycle, both vehicles going in the same direction
- Head-on accidents with vehicles coming from opposite direction, frontal collision
- Angular accidents with motorcycle colliding the car with its front in an angular collision, vehicles coming from the same direction or opposite direction
- Angular accidents with motorcycle colliding the car with its lateral side in an angular collision, vehicles coming from the same direction or opposite direction
- Right angle collision with motorcycle colliding the car with its front or lateral side, vehicles coming from perpendicular direction
- Side-swipe scenario where both vehicles collide with their sides, coming from the same direction
- Angular accident with the car turning right in the path of the motorcycle, both vehicles traveling in the same direction

The first five scenarios represent around 60% of the KSI cases in the Thai and Malaysian database as described in the deliverable D1.1. In order to increase the coverage of the study, two additional scenarios have been included to cover around 80% of the accident situations.

This report aims at describing in detail the accident scenarios identified in the previous step of the OASIM project. Each of these scenarios are described first with a macro analysis given the national Malaysian database parameters available. Then, within these accident scenarios, sub-scenarios cluster are described. First, the general conditions of the accidents are analysed, then the characteristics of the road, and finally the characteristics of the vehicles. To conclude, a summary is presented for each accident sub-scenario.

1 OASIM accidents scenarios and description parameters

Within a first step in the accident data study, the accident situations happening in ASEAN region between a passenger car and a motorcycle have been identified and gathered into scenarios based on two databases from Thailand and Malaysia. The Malaysian one is a national and police-report based database owned by the Traffic Enforcement and Investigation Department of the Royal Malaysian Police and provided to the project partners by MIROS (Malaysian Institute of Road Safety Research). It allows high level information. The Thai database, managed by Honda and Yamaha, is an on-the-spot accident study that provides lots of details about the accidents. Once identifying these ASEAN accident scenarios, the main ones are selected as OASIM accident scenarios, then clustered as OASIM sub-scenario clusters to be further analysed over an in-depth study (refer to method in Annex 3).

1.1 OASIM sub-scenario clusters selection

The OASIM accident scenarios have been defined according to the databases provided by Malaysia and Thailand (Deliverable D1.1). The method applied for the analysis is to characterise the accident scenarios by crossing three common variables, the type of collision, the impact point on the motorcycle and the manoeuvre of the motorcycle (Table 1).

Table 1 : Scenario constitution and coverage

OASIM accident scenarios	Type of collision	Impact on the motorcycle	Manoeuvre of the motorcycle	% KSI Malaysian data	% KSI Thai data
Rear-end	Rear-end	MC – Rear Car - Front	▪ Same direction	5%	9%
Head-on	Head-on	Front	▪ Opposite	36%	19%
Angular with frontal impact on the motorcycle	Angular	Front	▪ Forward/other (Malaysia) ▪ Forward same direction/ opposite direction (Thailand)	15%	20%
Angular with lateral impact on the motorcycle	Angular	Lateral	▪ Forward/other (Malaysia) ▪ Forward same direction/ opposite direction (Thailand)	4%	9%
Angular with motorcycle turning	Angular	Lateral/Frontal	▪ Motorcycle turning	6%	13%
Right-angle (crossing)	Lateral 90°	Lateral/Frontal	▪ Perpendicular direction	5%	7%
Side-swipe	Lateral for both	Lateral	▪ Same direction	7%	6%
Total Coverage				78%	83%

Finally, these seven accident scenarios represent around 80% of the accidents that involved killed and seriously injured person in Malaysia and Thailand.

For each of these scenarios, the next step of the analysis was to identify the manoeuvre of both vehicles to identify the sub-scenarios of accidents. This was done through the use of the pictogram variable available in the Thai database (illustration in Annex 4).

The sub-scenario distribution for each scenario is as below:

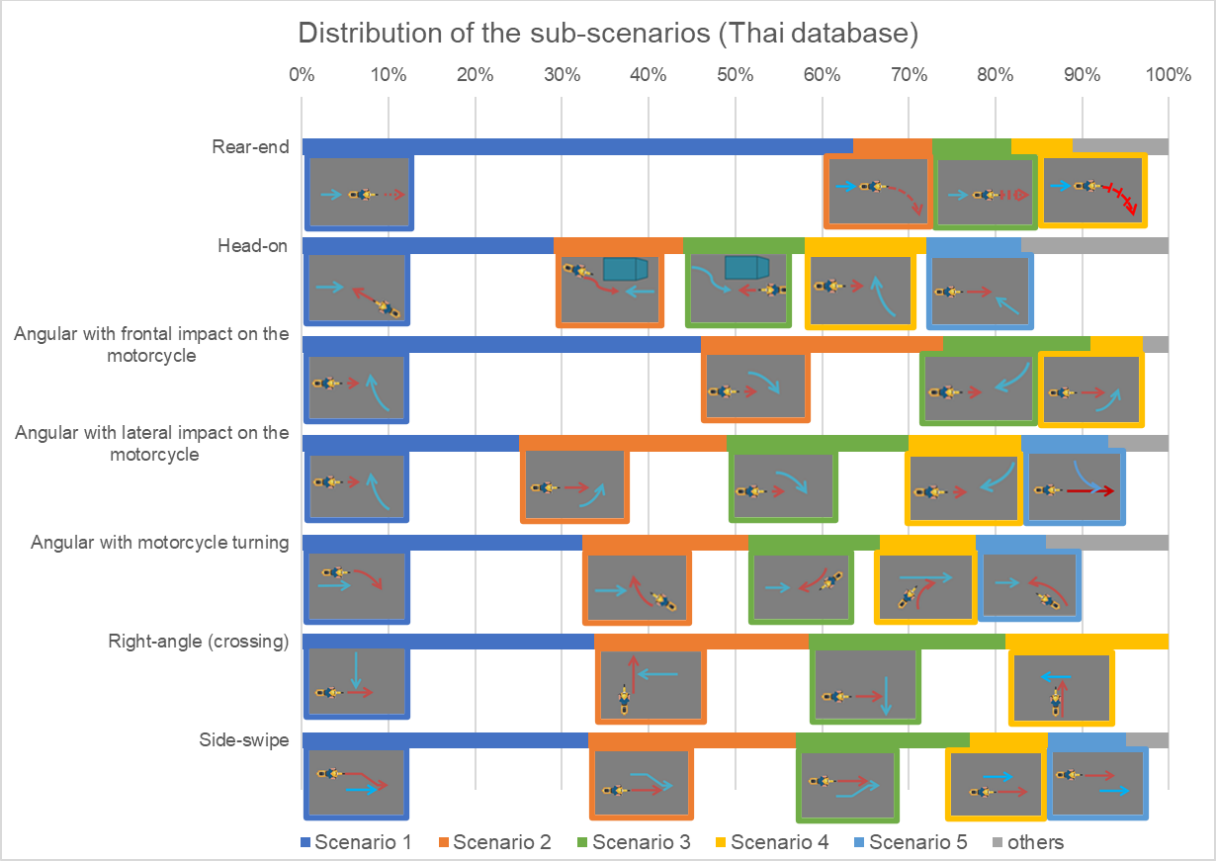
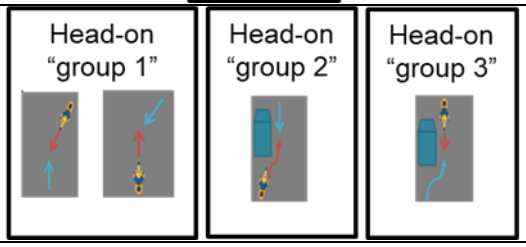
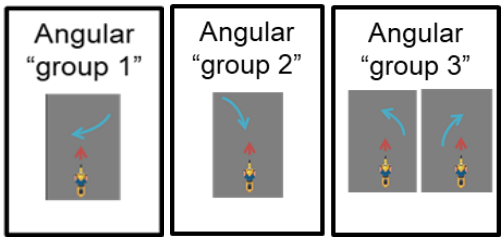
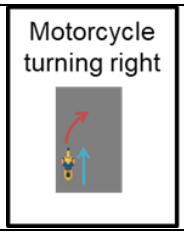
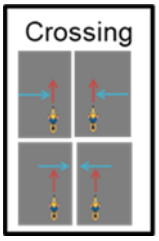
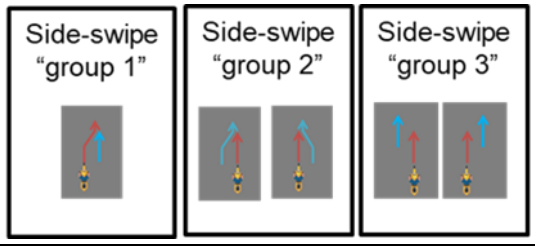


Figure 1: Distribution of sub-scenarios for each scenario

Then based on a study of manoeuvre, speeds and impact angle, the sub-scenarios were grouped to get sub-scenarios clusters, as in the Table 2. These clustered are then described in detail within this report.

Table 2: List of OASIM sub-scenario clusters

Accident Scenarios	Sub-scenario clusters
Rear-end	
Head-on	
Angular	
Angular with motorcycle turning right	
Crossing	
Side-swipe	

At the end, within the six scenarios, a list of twelve sub-scenarios clustered was established. They will be described with the parameters given bellow.

1.2 Description parameters

Based on data available in both databases, the list of the variables to be studied is described in Table 3. The parameters are presented in three main categories. General conditions describe the environmental conditions when the accident occurred. Road characteristics category describe all the conditions of the road where it happened. And finally, vehicles characteristics inform about all the details from both vehicles, from the travelling speed and initial manoeuvre to the impact characteristics.

Table 3 : List of the parameters used to describe the scenarios

Parameters	Thai data	Malaysian data
Accident characteristics – general conditions		
Weather conditions	☑	☑
Light conditions	☑	☑
Road surface conditions	☑	☑
Road characteristics		
Location (city / urban)	☑	☑
Road category	☑	☑
Configuration (junction / roundabout / single carriage way)	☑	☑
Bend	☑	☑
Slope	☑	⊘
Lane marking	⊘	☑
Speed limit	☑	☑
Number of the lane	☑	⊘
Travelled lane	☑	⊘
Accident characteristics – vehicles		
Visibility	☑	⊘
Impact angle	☑	⊘
Motorcycle impact type	☑	☑
Car impact type	☑	⊘
Initial speeds	☑	⊘
Collision speeds	☑	⊘
Delta Initial velocity	☑	⊘
Skid marks	☑	⊘
ABS fitment on the car	☑	⊘
Motorcycle manoeuvre before crash	☑	☑
Car manoeuvre before crash	☑	⊘
Action before crash (braking / avoidance)	☑	⊘

The delta Initial velocity is calculated as a proxy of the initial relative velocity, as follows:

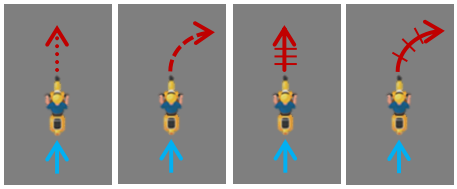
Delta Initial velocity = Car initial speed – Motorcycle initial speed

The presence of skid marks on the road is an indication of braking or skidding as the exact deceleration values are not available.

The objective of the report is to describe each OASIM sub-scenario clusters to deliver a clear overview of the characteristics and the progress of the accidents. Data from Malaysia illustrate the accident scenarios as an overview of the accident situations. Then, each of the twelve OASIM sub-scenario clusters are described with the information gathered in the Thai database.

In the conclusion, a sum-up of the key data for each of the twelve sub-scenario clusters is provided.

2 Rear-end scenario



The rear-end accident scenario is defined as accidents with a rear-end collision, with a rear impact on the motorcycle and a frontal impact on the car, both vehicles traveling in the same direction. This scenario where the car hits the rear of the motorcycle represents **5%** of the KSI accidents in the Malaysian database and **9%** in the Thai database.

2.1 Malaysian database

This paragraph is describing the distributions of the variables in the Malaysian database for the rear-end scenario. There are 52 accidents of this scenario in the Malaysian database.

2.1.1 Accident characteristics – general conditions

2.1.1.1 Weather conditions

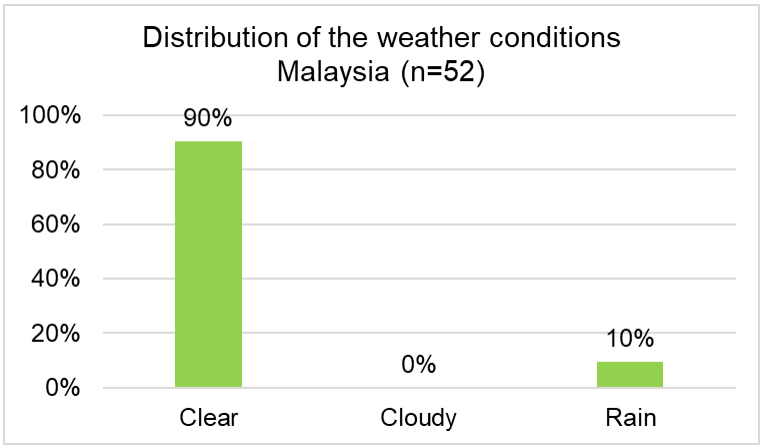


Figure 2: Weather conditions - Malaysia – REAR-END SCENARIO

2.1.1.2 Light conditions

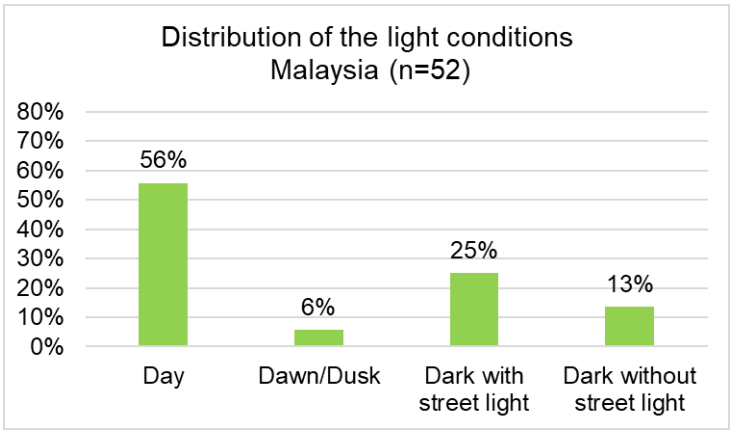


Figure 3: Light conditions - Malaysia – REAR-END SCENARIO

2.1.1.3 Road surface conditions

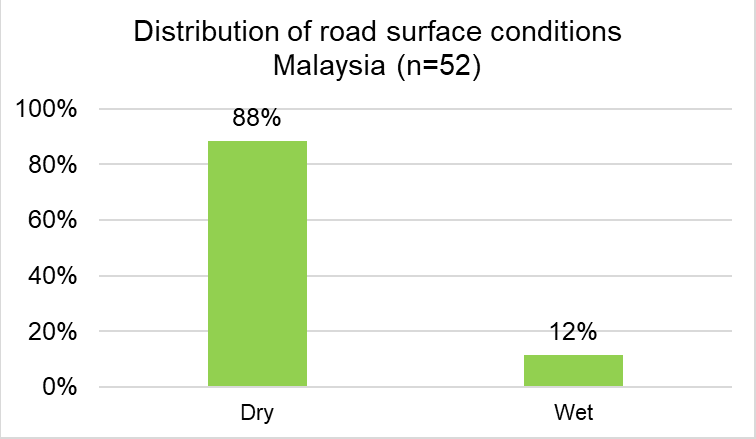


Figure 4: Road surface conditions – Malaysia – REAR-END SCENARIO

2.1.1.4 Conclusion on general accident conditions

Table 4: Conclusion on general accident conditions – Malaysia – REAR-END SCENARIO

General conditions	**REAR-END**	*Malaysian data*

- ✓ *90% of the accidents happen with clear weather.*
- ✓ *Only 56% happening during the day (13% at night without light and 25% at night with streetlights).*
- ✓ *88% on dry road surface.*

2.1.2 Road characteristics

2.1.2.1 Location (city / urban)

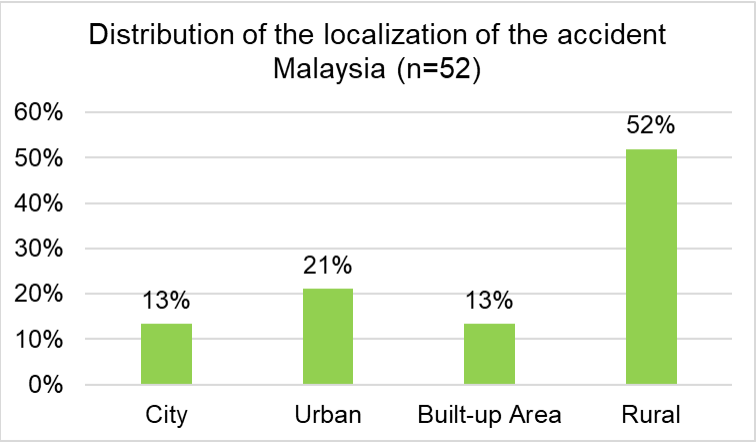


Figure 5: Localization of the accident – Malaysia –REAR-END SCENARIO

2.1.2.2 Road category

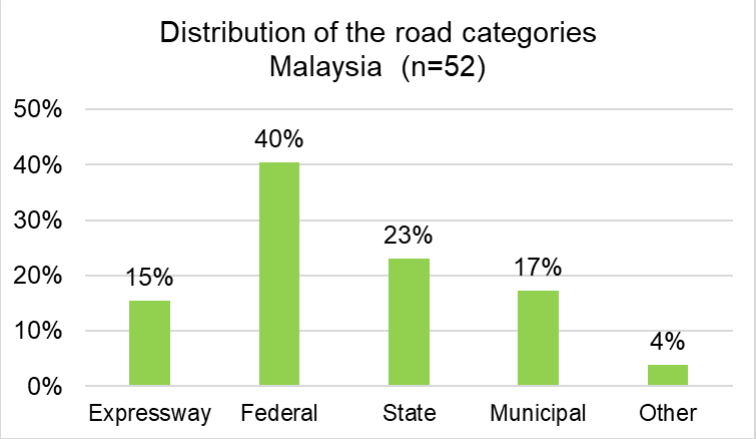


Figure 6: Road category – Malaysia – REAR-END SCENARIO

2.1.2.3 Road geometry

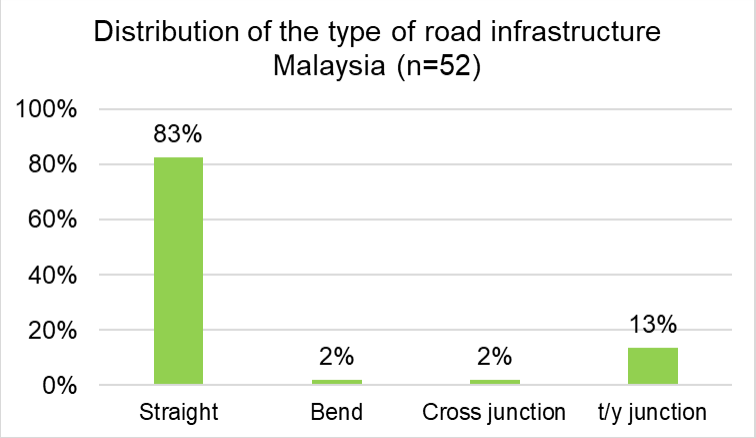


Figure 7: Road geometry – Malaysia – REAR-END SCENARIO

2.1.2.4 Lane marking

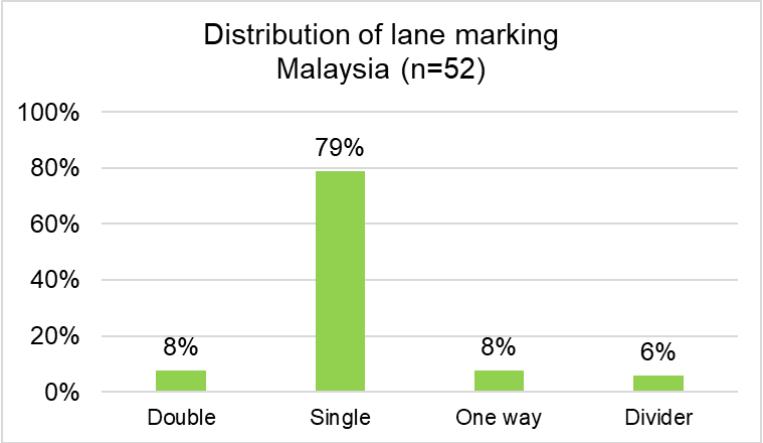


Figure 8: Lane marking – Malaysia – REAR-END SCENARIO

2.1.2.5 Speed limit

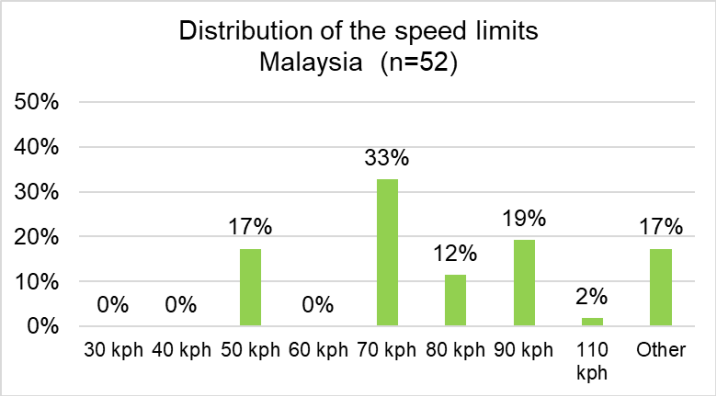


Figure 9: Speed limits – Malaysia – REAR-END SCENARIO

2.1.2.6 Conclusion on road characteristics

Table 5: Conclusion on road characteristics – Malaysia – REAR-END SCENARIO

Road characteristics	**REAR-END**	*Malaysian data*

- ✓ *52% of the accidents happen in rural area (34% in urban or city).*
- ✓ *Majority of federal or state roads.*
- ✓ *83% of the accidents happen in a straight road, 15% happen in intersection.*
- ✓ *Most of the accidents with single lane marking (79%).*
- ✓ *Speed limits: 33% at 70 kph, 17% at 50 kph and 19% at 90 kph.*

2.1.3 Accident characteristics – vehicles

2.1.3.1 Motorcycle impact type

All the motorcycles in this scenario have a rear impact.

2.1.3.2 Motorcycle action before crash

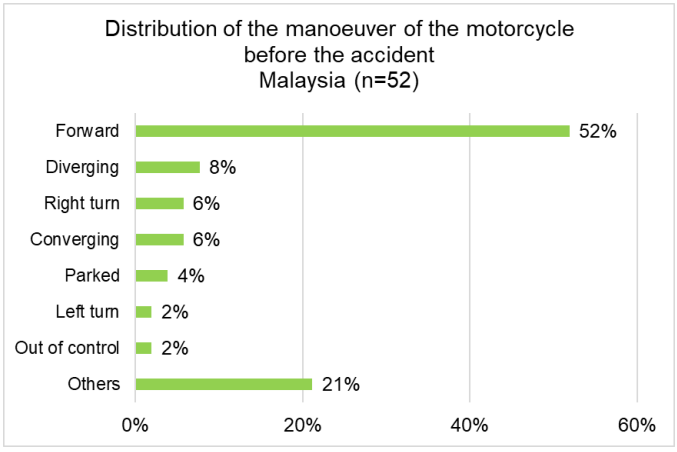


Figure 10: Motorcycle manoeuvre – Malaysia – REAR-END SCENARIO

2.1.3.3 Conclusion on vehicle characteristics

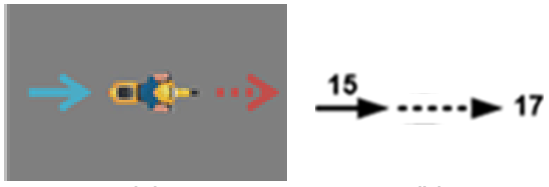
Table 6: Conclusion on vehicle characteristics – Malaysia – REAR-END SCENARIO

Vehicle characteristics	**REAR-END**	*Malaysian data*
✓ *100% of rear impact for the motorcycle.* ✓ *Motorcycle going forward in 52 % of the accidents, 8% diverging, turning right and converging (6%).*		

2.2 Thai database

This rear-end OASIM sub-scenario represents **5,3%** of all the accidents and **6,6%** of the KSI accidents in the Thai database.

In this scenario, the car is going straight and is hitting the rear part of a motorcycle. The motorcycle is going slower than the car. This configuration is illustrated by the figure below:



(a) (b)

Car=15

Motorcycle=17

Figure 11: (a) Illustration of the REAR-END scenario (b) pictogram from the Thai database.

The following graphs provide in-depth description of the scenario. There are 34 cases from this scenario in the Thai database.

2.2.1 Accident characteristics – general conditions

2.2.1.1 Weather conditions

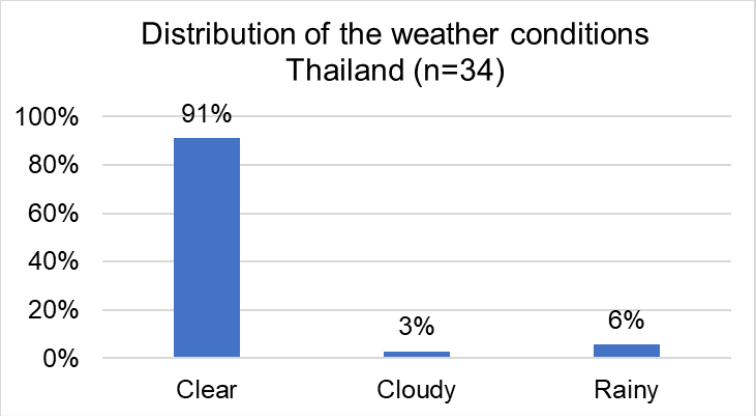


Figure 12: Weather conditions - Thailand – REAR-END SCENARIO

2.2.1.2 Light conditions

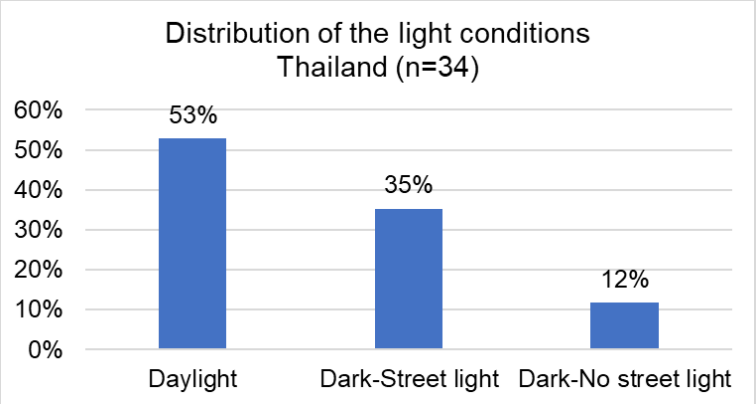


Figure 13: Light conditions - Thailand – REAR-END SCENARIO

2.2.1.3 Road surface conditions

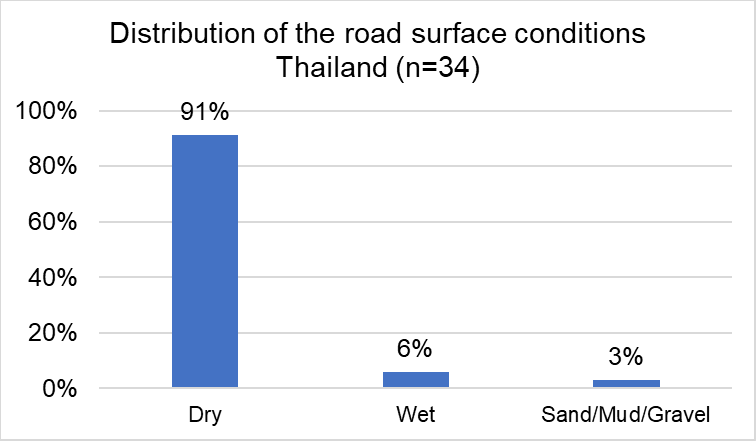


Figure 14: Road surface conditions – Thailand – REAR-END SCENARIO

2.2.1.4 Conclusion on general accident conditions

Table 7: Conclusion on general accident conditions – Thailand – REAR-END SCENARIO

General conditions	**REAR-END**	*Thai data*

- ✓ *91% of clear weather.*
- ✓ *53% of the accidents happen during the day (12% at night without streetlights).*
- ✓ *91% of the accidents happen on a dry road surface.*

The environmental conditions when rear-end accident scenarios happened are similar in Thailand and Malaysia based on the databases. A high proportion of cases in dark condition is observed with around one quarter of the accidents at night without lights.

2.2.2 Road characteristics

2.2.2.1 Location (city / urban)

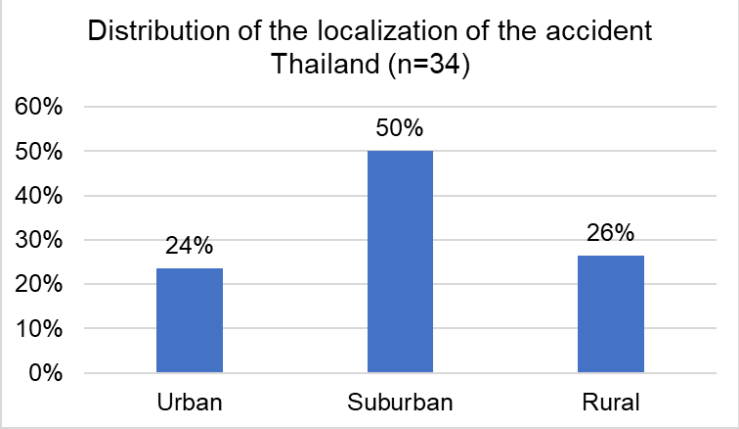


Figure 15: Localization of the accident –Thailand – REAR-END SCENARIO

2.2.2.2 Road category

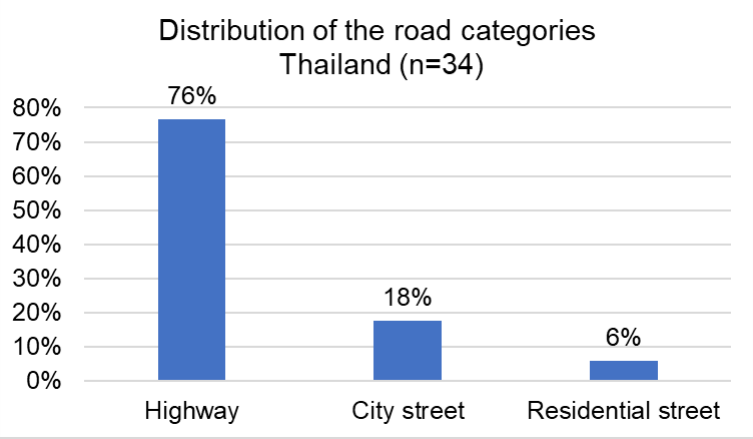
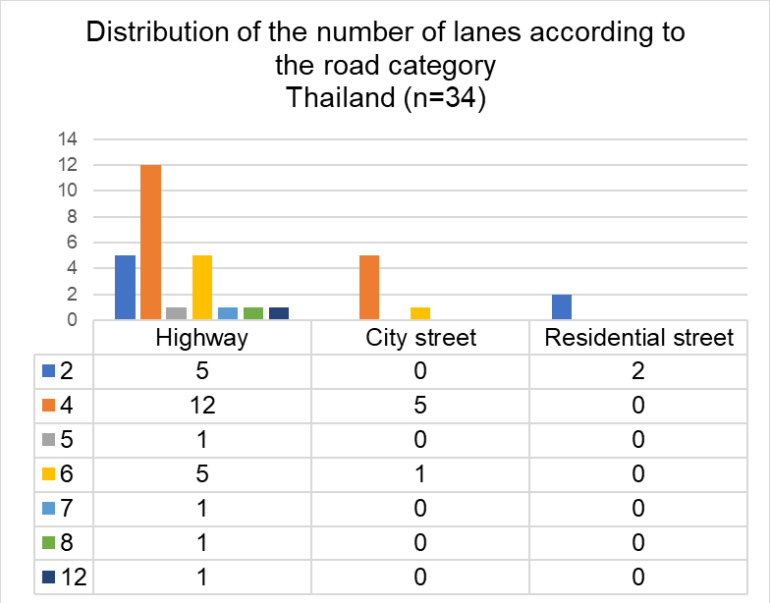


Figure 16: Road category – Thailand – REAR-END SCENARIO



	Highway	City street	Residential street
2	5	0	2
4	12	5	0
5	1	0	0
6	5	1	0
7	1	0	0
8	1	0	0
12	1	0	0

Figure 17: Road category and number of lanes – Thailand – REAR-END SCENARIO

2.2.2.3 Configuration

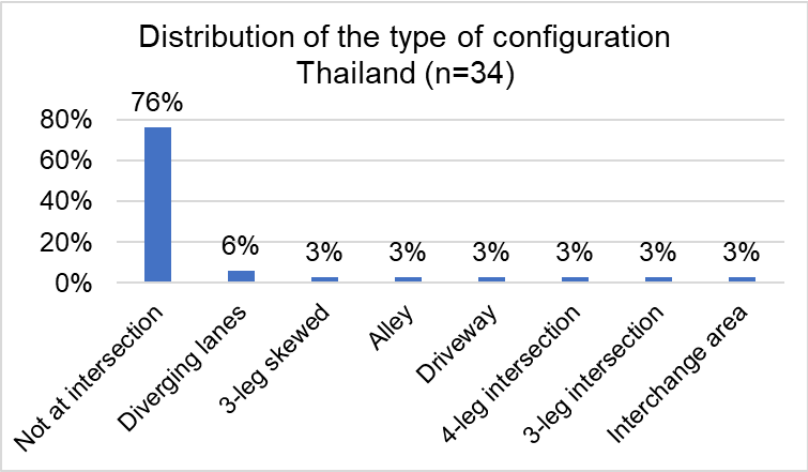


Figure 18: Configuration – Thailand – REAR-END SCENARIO

2.2.2.4 Road geometry

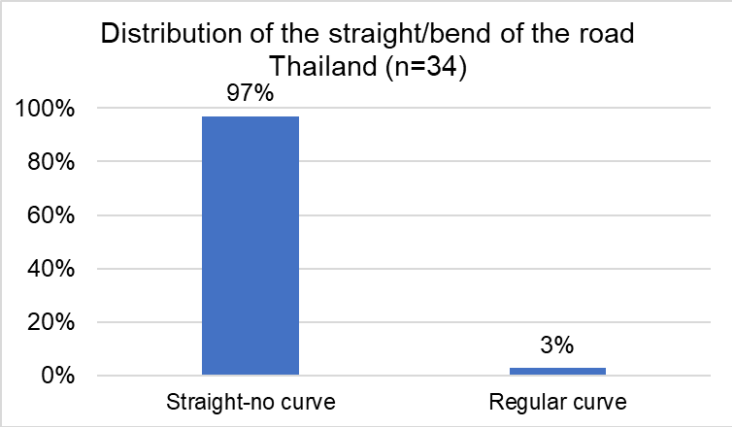


Figure 19: Road geometry – Thailand – REAR-END SCENARIO

2.2.2.5 Slope

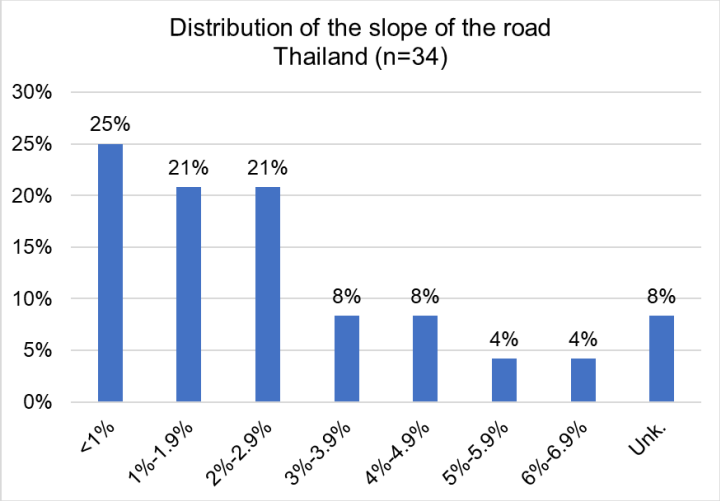


Figure 20: Slop of the road – Thailand – REAR-END SCENARIO

2.2.2.6 Speed limit

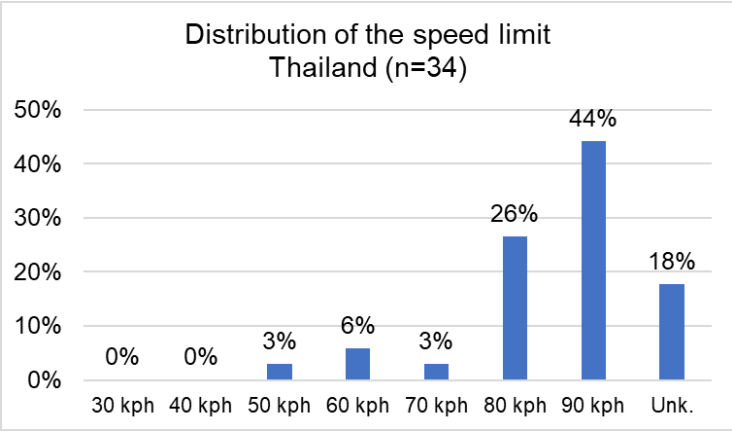


Figure 21: Speed limits – Thailand – REAR-END SCENARIO

2.2.2.7 Number of the lane

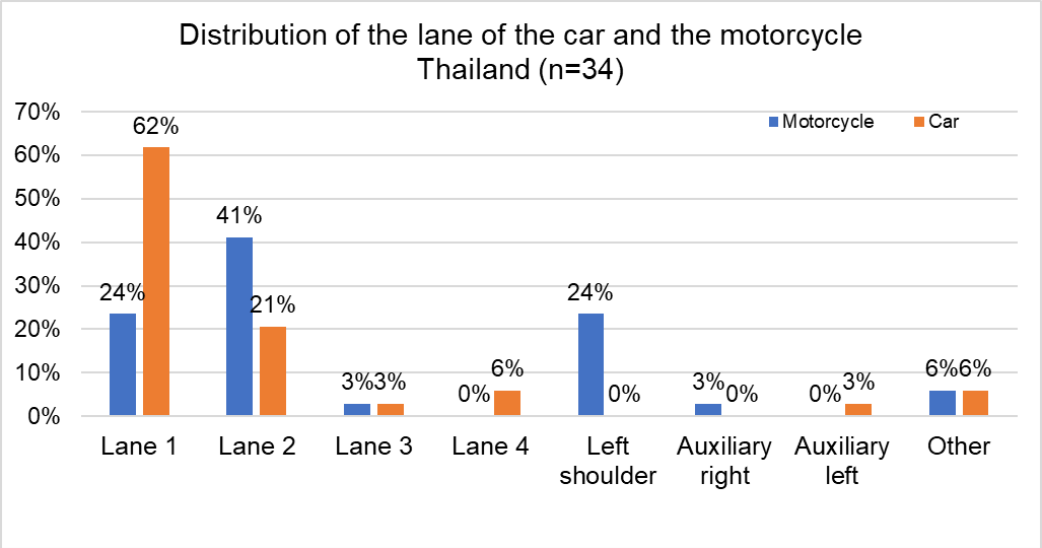
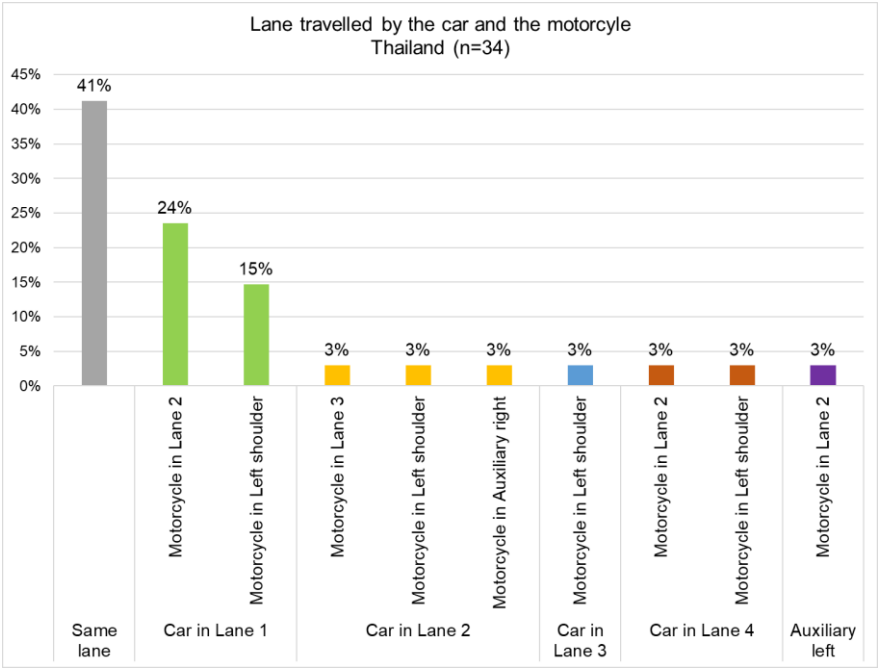


Figure 22: Lanes of the vehicles – Thailand – REAR-END SCENARIO

2.2.2.8 Travelled lane



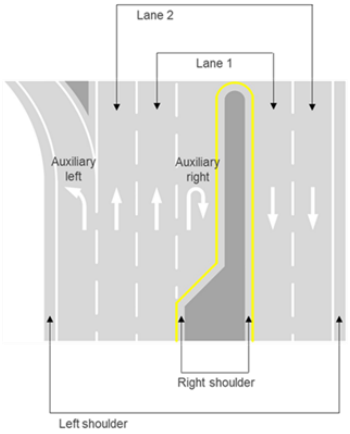


Figure 23: Vehicles on same lane – Thailand – REAR-END SCENARIO

2.2.2.9 Conclusion on road characteristics

Table 8: Conclusion on road characteristics – Thailand – REAR-END SCENARIO

Road characteristics	**REAR-END**	*Thai data*

- ✓ *Mostly suburban (50%) and rural (26%) areas.*
- ✓ *76% of the accidents occur on highway, 2-4-6 lanes but up to 12 lanes.*
- ✓ *76% of the accidents are out of intersection.*
- ✓ *Almost all the accidents happen on a straight road (97%).*
- ✓ *Speed limit at 90 kph (44%) and 80 kph (16%).*
- ✓ *In 62% of the accidents, the cars are in lane 1 and the motorcycles in lane 2 in 41%.*
- ✓ *41% of the vehicles are in the same lane, 24% the cars are in lane 1 and the motorcycles in lane 2.*

Finally, both in Malaysia and Thailand, the main configuration for this accident scenario is on a straight road, out of intersection.

2.2.3 Accident characteristics – vehicles

2.2.3.1 Visibility

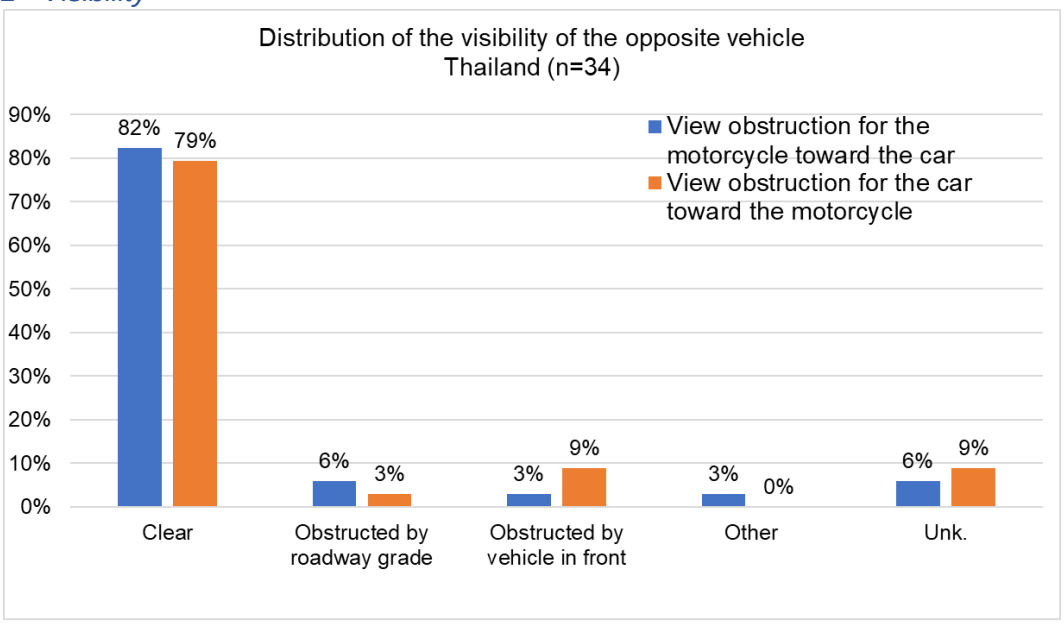
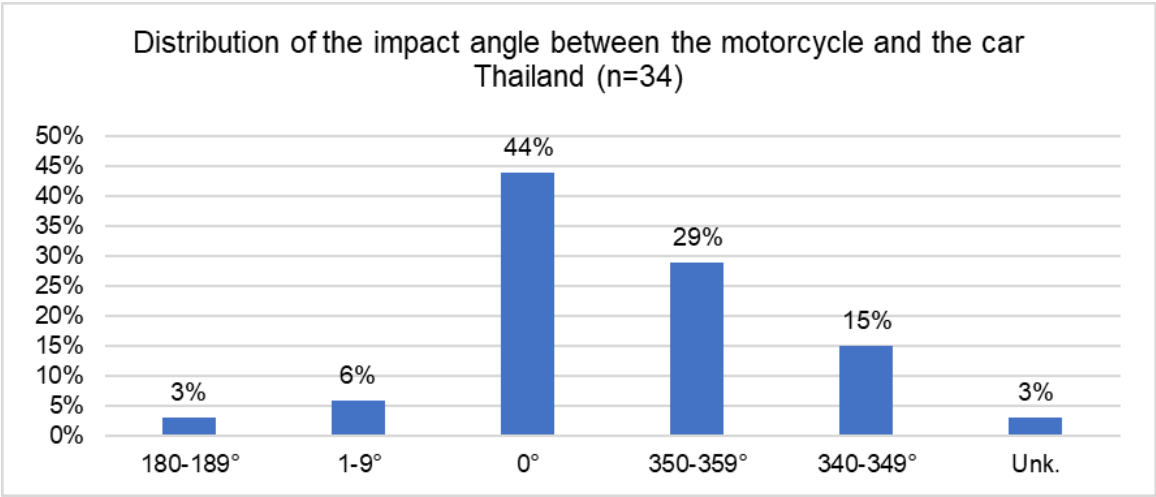


Figure 24: Visibility – Thailand – REAR-END SCENARIO

2.2.3.2 Impact angle between the motorcycle and the car



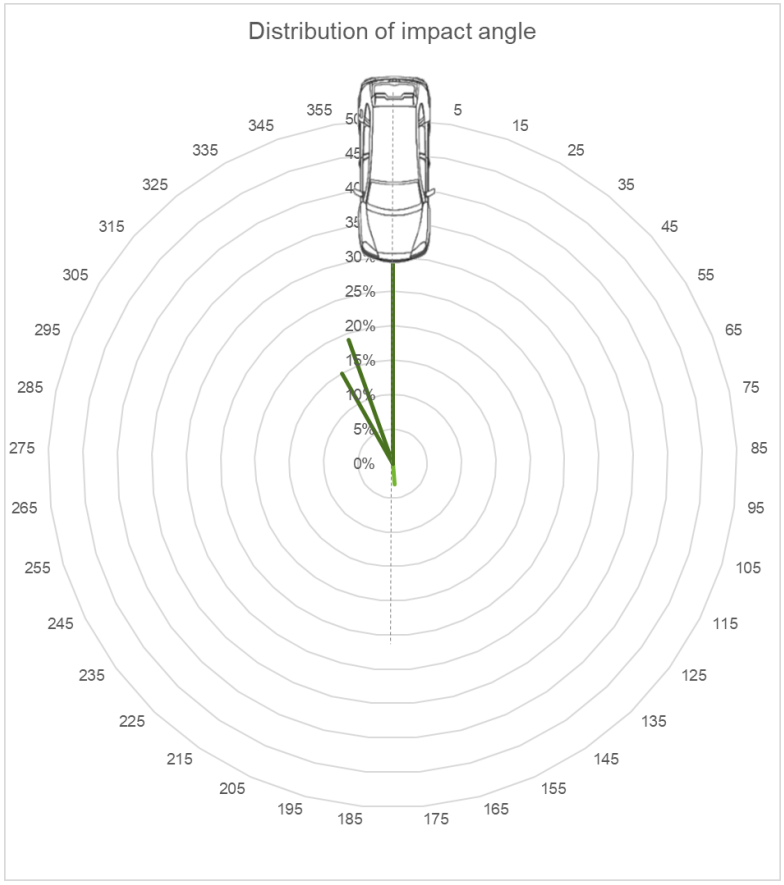


Figure 25: Impact angle – Thailand – REAR-END SCENARIO

2.2.3.3 Motorcycle impact type

All the motorcycles in the scenario had a rear impact.

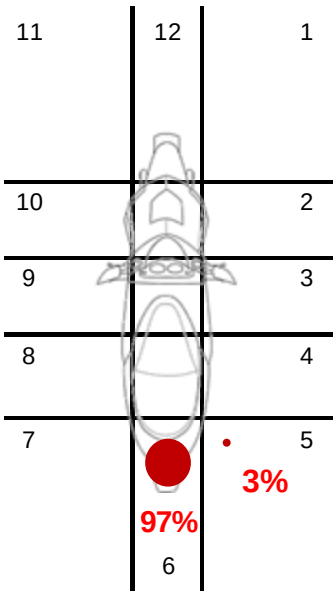


Figure 26: First collision point for the motorcycle – Thailand – REAR-END SCENARIO

2.2.3.4 Car impact type

All the cars in the scenario had a frontal impact.

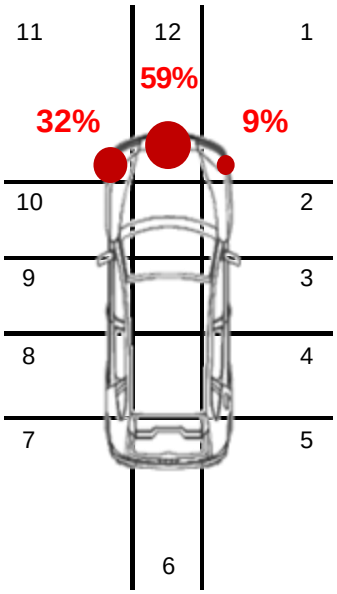


Figure 27: First collision point for the car – Thailand – REAR-END SCENARIO

2.2.3.5 Initial speeds

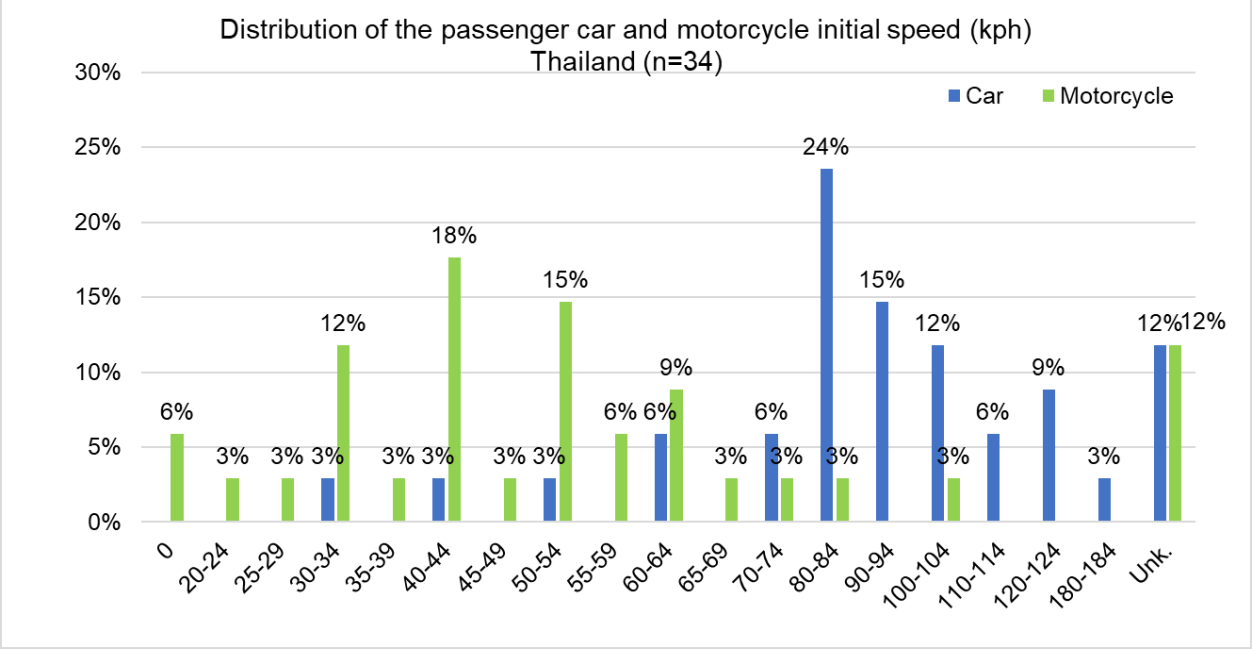


Figure 28: Initial speeds – Thailand – REAR-END SCENARIO

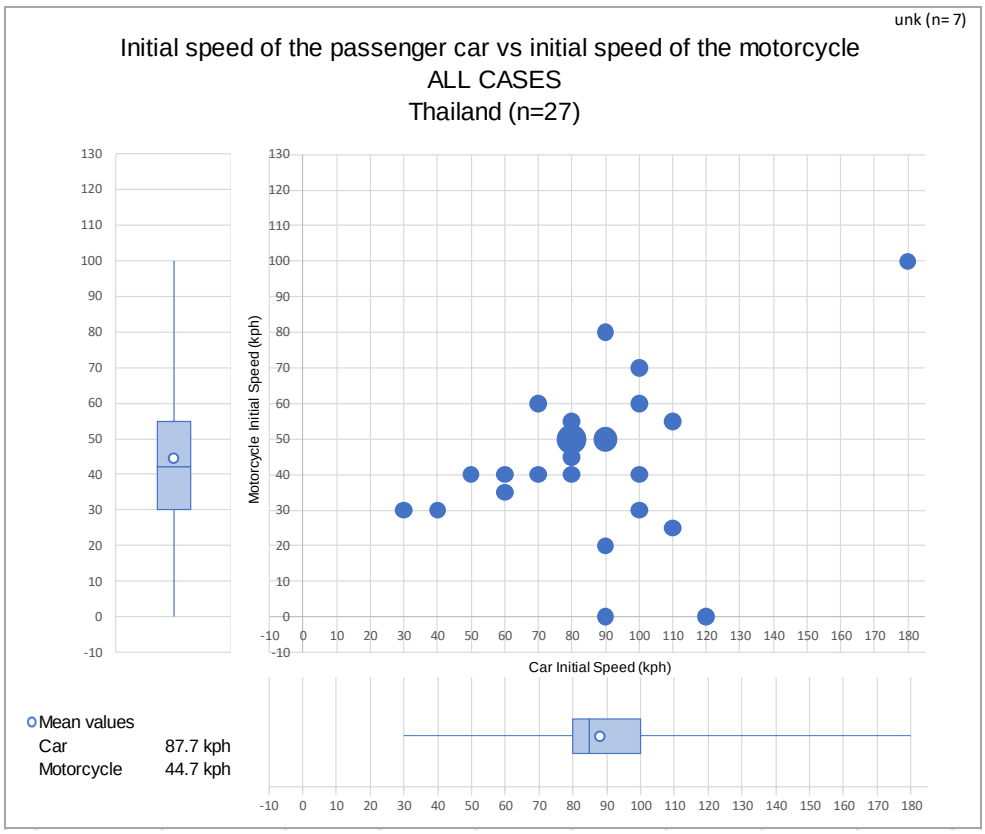


Figure 29: Initial speed of the car versus initial speed of the motorcycle, all cases – Thailand – REAR-END SCENARIO

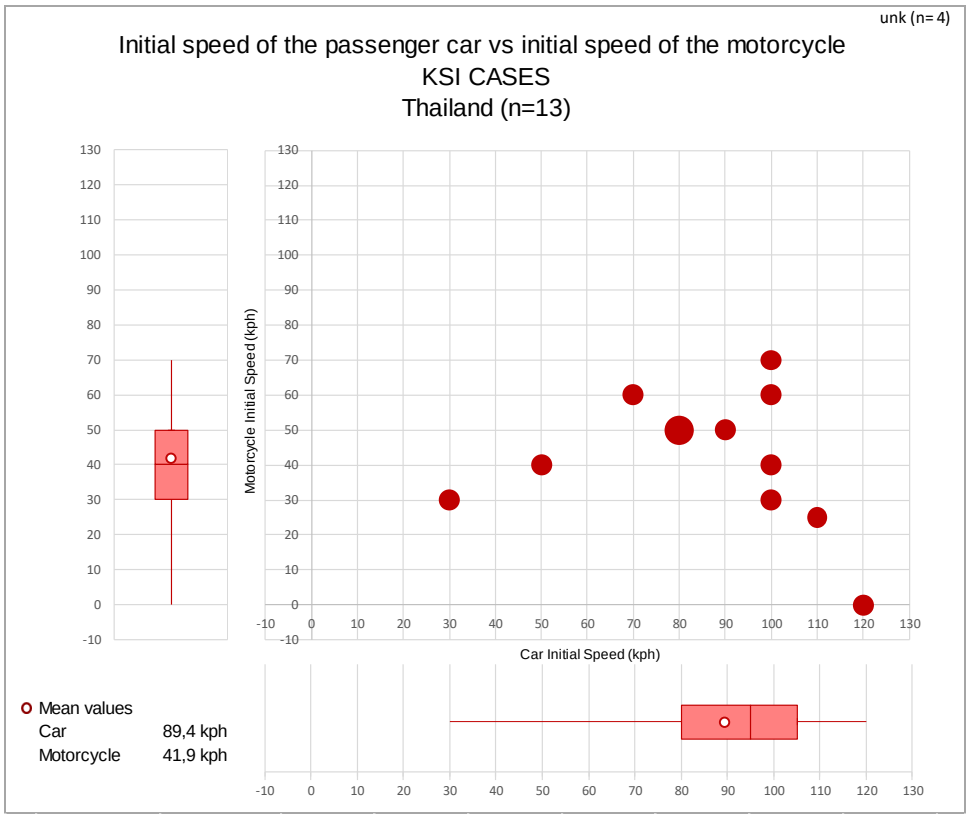


Figure 30: Initial speed of the car versus initial speed of the motorcycle, KSI cases – Thailand – REAR-END SCENARIO

Table 9: Initial speed values for the car and the motorcycle, all cases – Thailand – REAR-END SCENARIO

All Accidents																										unk:	5
Number of cases		Passenger Car Initial Speed (kph)																									
		0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Initial Speed (kph)	0																				1						1
	1																										
	5																										
	10																										
	15																										
	20																				1						
	25																								1		
	30								1		1												1				
	35														1												
	40												1		1		1		1				1				1
	45																		1								
	50																		3		2						
	55																		1						1		
	60																1						1				
	65																										
	70																						1				
	75																										
	80																				1						
	85																										
	90																										
	95																										
	100																										1
	105≤																										

Table 10: Initial speed values for the car and the motorcycle, KSI cases – Thailand – REAR-END SCENARIO

KSI Accidents																										unk:	4
Number of cases		Passenger Car Initial Speed (kph)																									
		0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Initial Speed (kph)	0																										1
	1																										
	5																										
	10																										
	15																										
	20																										
	25																								1		
	30								1														1				
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	40												1										1				1
	45																										
	50																		2		1						
	55																										
	60																1						1				
	65																										
	70																						1				
	75																										
	80																										
	85																										
	90																										
	95																										
	100																										
	105≤																										

2.2.3.6 Collision speeds

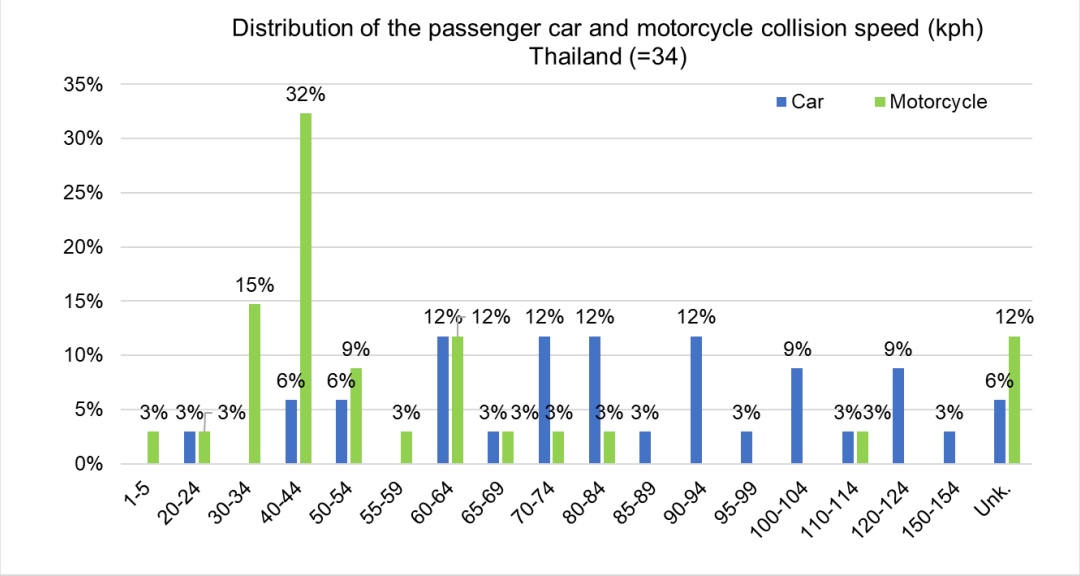

Figure 31: Collision speeds – Thailand – REAR-END SCENARIO

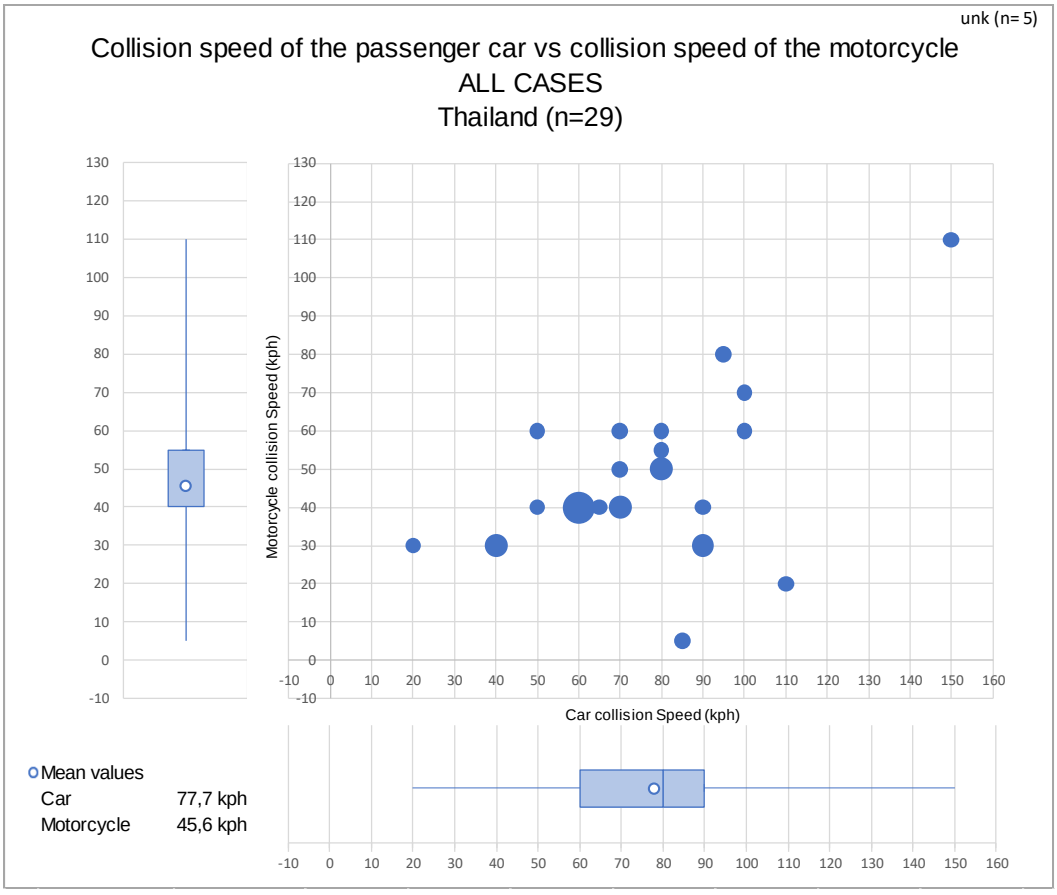

Figure 32: Collision speed of the car versus collision speed of the motorcycle, all cases – Thailand – REAR-END SCENARIO

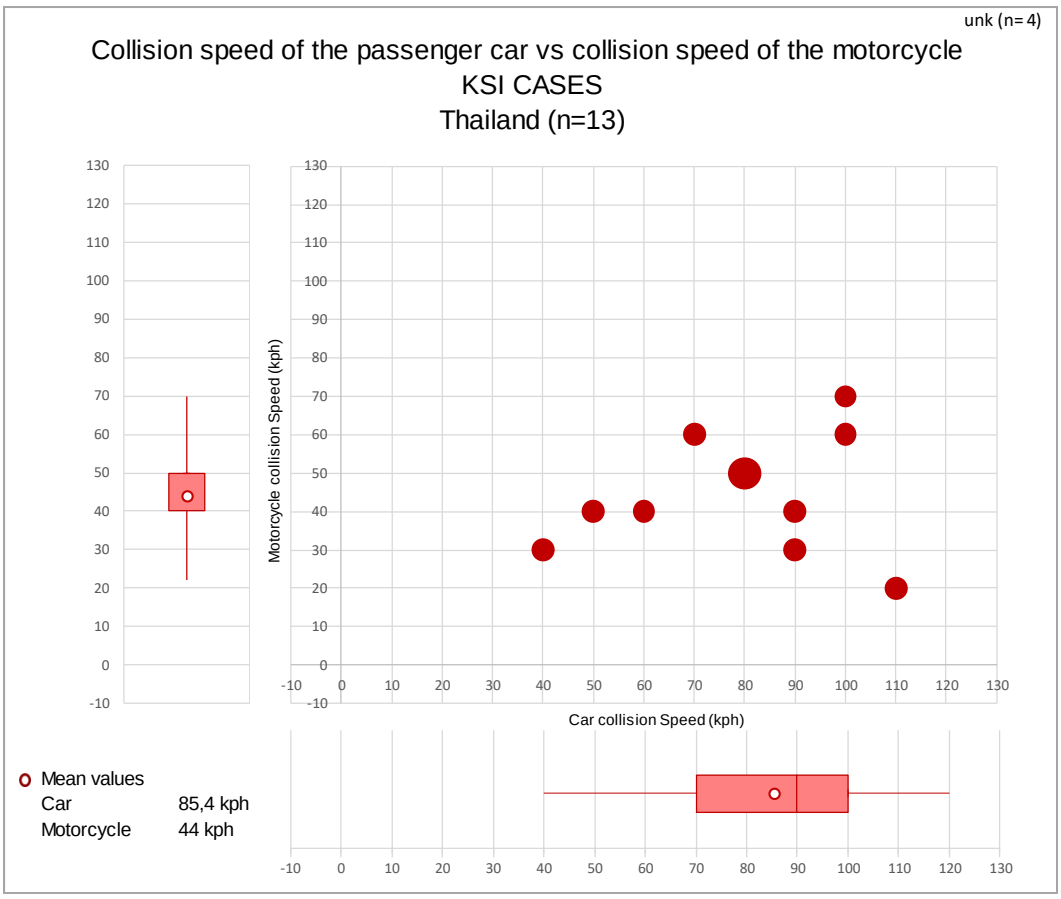

Figure 33: Collision speed of the car versus collision speed of the motorcycle, KSI cases – Thailand – REAR-END SCENARIO

Table 11: Collision speed values for the car and the motorcycle, all cases – Thailand – REAR-END SCENARIO

All Accidents																									unk:	5
Number of cases	Passenger Car Collision Speed (kph)																									
Motorcycle Collision Speed (kph)	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
0																										
1																										
5																			1							
10																										
15																										
20																								1		
25																										
30						1				2										2						
35																										
40												1		4	1	2				1						2
45																										
50																1		2								
55																		1								
60												1				1		1				1				
65																										
70																						1				
75																										
80																					1					
85																										
90																										
95																										
100																										
105≤																										1

Table 12: Collision speed values for the car and the motorcycle, KSI cases – Thailand REAR-END SCENARIO

KSI Accidents																										unk:	4
Number of cases	Passenger Car Collision Speed (kph)																										
	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Collision Speed (kph) 0																										
1																										
5																										
10																										
15																										
20																								1		
25																										
30										1										1						
35																										
40												1		1						1						2
45																										
50																		2								
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65																										
70																						1				
75																										
80																										
85																										
90																										
95																										
100																										
105≤																										

2.2.3.7 Delta Initial velocity (kph) – calculated

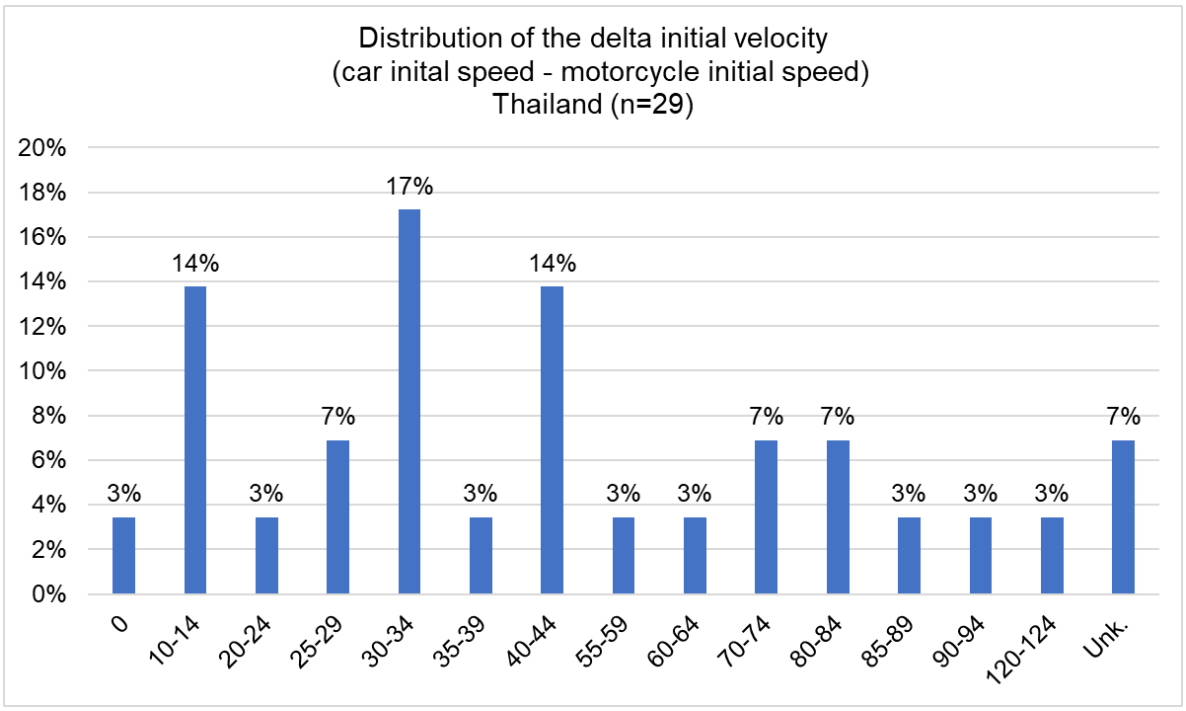


Figure 34: Delta initial velocity (kph) – Thailand – REAR-END SCENARIO

2.2.3.8 Skid marks

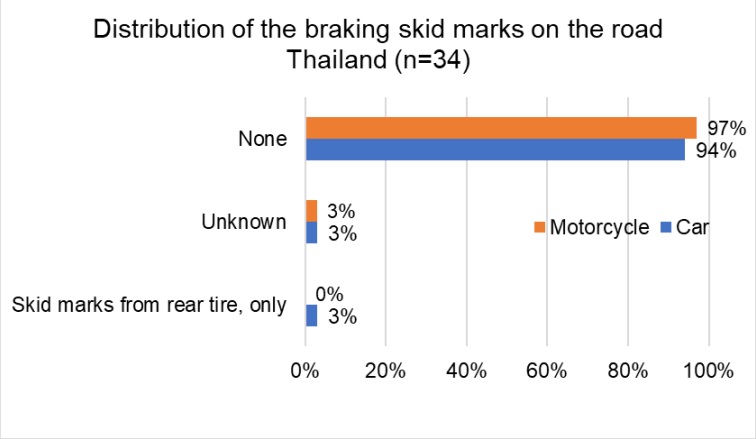


Figure 35: Skid marks – Thailand – REAR-END SCENARIO

2.2.3.9 ABS fitment on the car

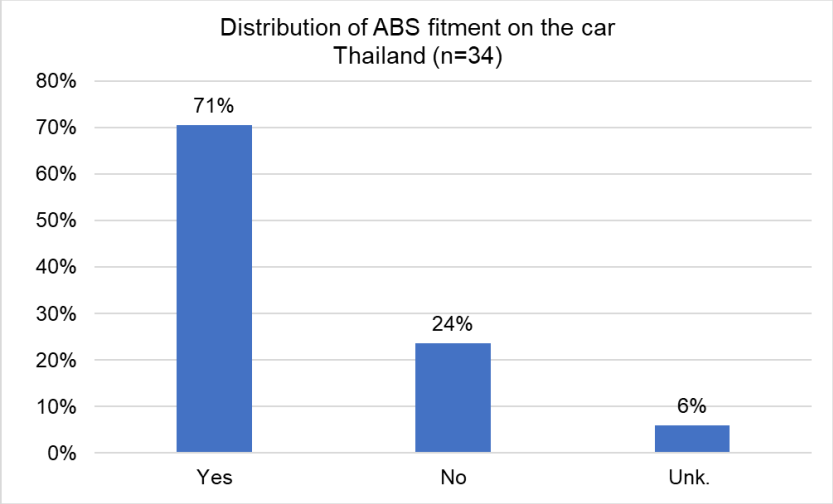


Figure 36: ABS fitment – Thailand – REAR-END SCENARIO

2.2.3.10 Motorcycle manoeuvre before crash

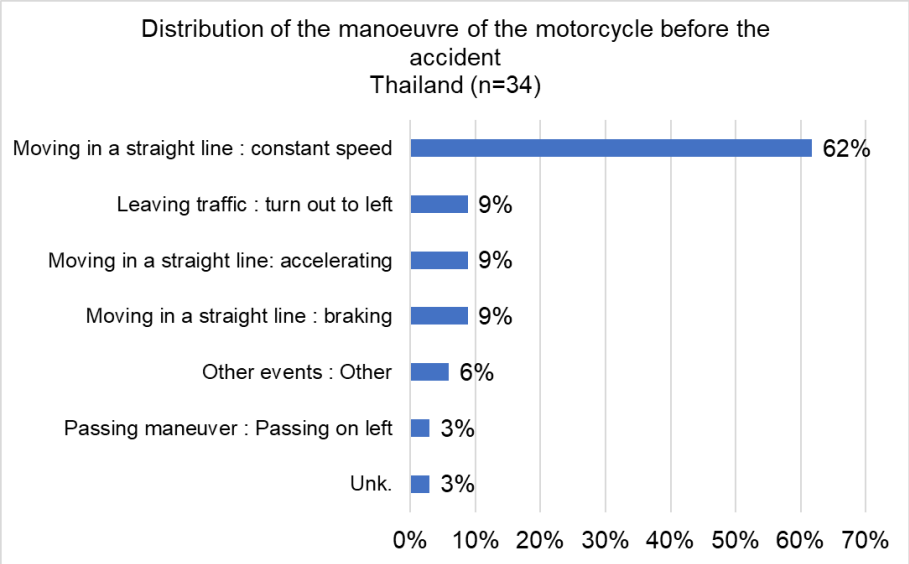


Figure 37: Motorcycle manoeuvre – Thailand – REAR-END SCENARIO

2.2.3.11 Car manoeuvre before crash

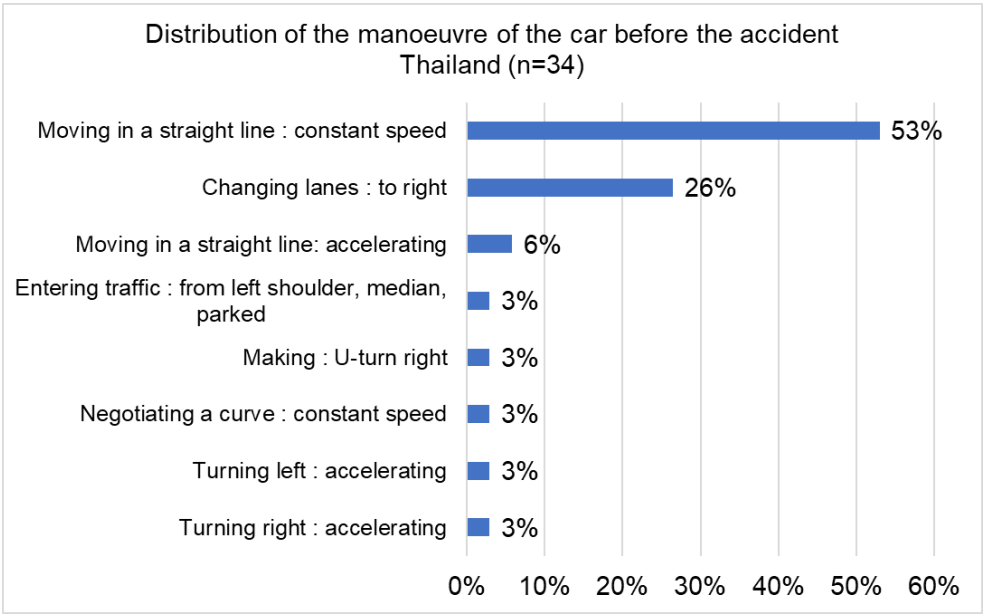


Figure 38: Car manoeuvre – Thailand – REAR-END SCENARIO

2.2.3.12 Avoidance action by vehicle

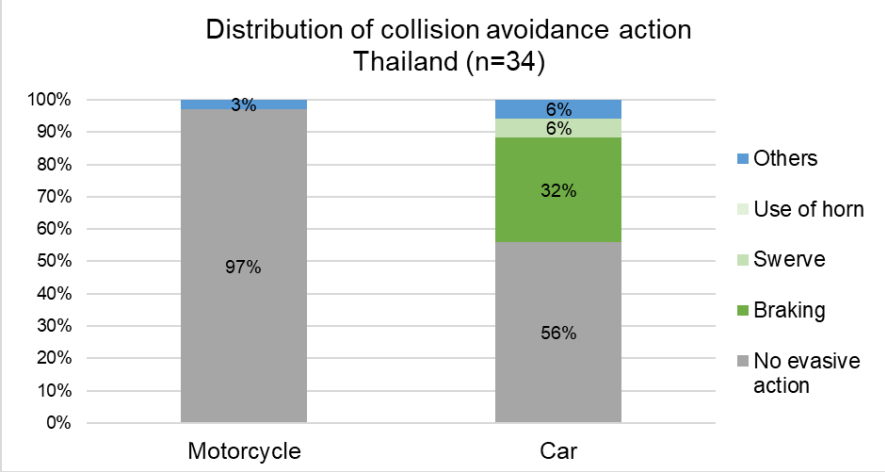


Figure 39: Avoidance action by vehicle – Thailand – REAR-END SCENARIO

2.2.3.13 Conclusion on accident characteristics

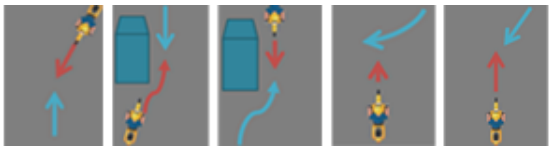
Table 13: Conclusion on accident characteristics – Thailand – REAR-END SCENARIO

Accident characteristics	**REAR-END**	*Thai data*

- ✓ *Clear visibility in the accident for 80% of the cases, 9% of vehicle obstruction for the car.*
- ✓ *100% rear impact for the motorcycle, 100% of frontal impact on the car.*
- ✓ *Mean initial speed: Car=87,7 kph and Motorcycle=44,7 kph*
- ✓ *Mean collision speed: Car=77,7 kph and Motorcycle=45,6 kph*
- ✓ *Only 3% of tire skid marks for the car.*
- ✓ *71% of the car had ABS.*
- ✓ *The motorcycle goes straight at constant speed (62%).*
- ✓ *The car goes straight at constant speed (53%) or is changing lane to the right (26%).*
- ✓ *No avoidance action from the motorcycle (97%).*
- ✓ *44% of the cars try to avoid the crash: braking (32%), swerving to the right (6%).*

3 Head-on scenarios

The head-on scenarios concern accidents where vehicles are travelling in opposite direction and collide with their frontal parts. Head-on accidents scenarios represent **36%** of the KSI accidents in the Malaysian database and **19%** in the Thai database.



The head-on accident scenarios are divided in 3 OASIM head-on sub-scenarios which will be described with the Thai data, whereas the overall head-on accident scenario is described with the Malaysian data, in the following paragraph.

3.1 Malaysian database

This paragraph is describing the distributions of the common variables in the Malaysian database for the head-on scenario. There are 326 accidents of this scenario in the Malaysian database.

3.1.1 Accident characteristics – general conditions

3.1.1.1 Weather conditions

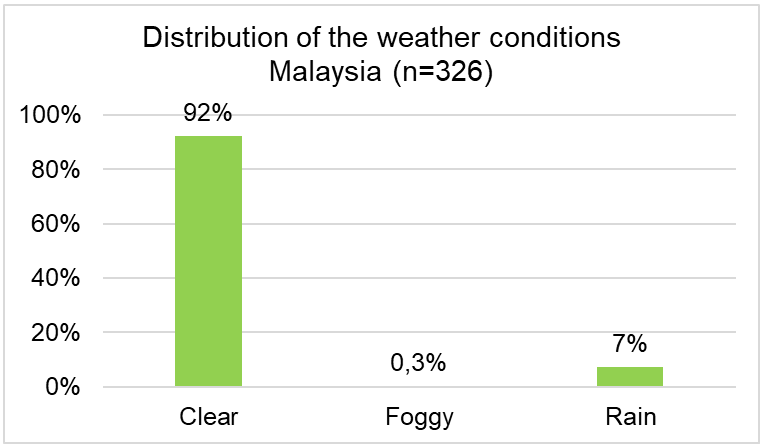


Figure 40: Weather conditions - Malaysia – HEAD-ON SCENARIO

3.1.1.2 Light conditions

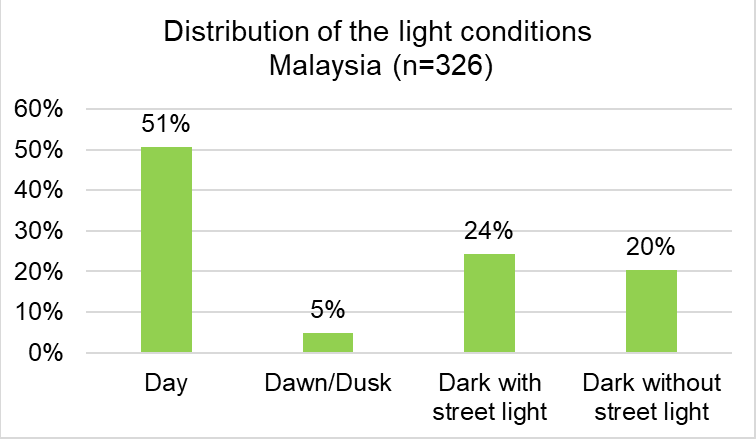


Figure 41: Light conditions - Malaysia – HEAD-ON SCENARIO

3.1.1.3 Road surface conditions

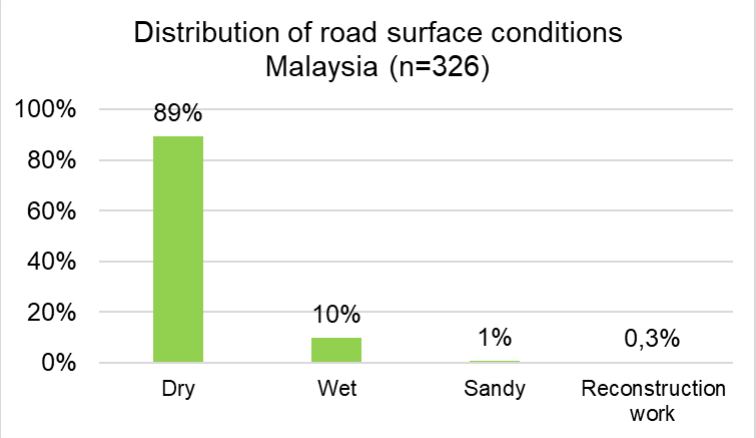


Figure 42: Road surface conditions – Malaysia – HEAD-ON SCENARIO

3.1.1.4 Conclusion on general accident conditions

Table 14: Conclusion on general accident conditions – Malaysia – HEAD-ON SCENARIO

General conditions	**HEAD-ON**	*Malaysian data*

- ✓ *92% of the accidents happen with clear weather.*
- ✓ *51% happening during the day (24% at night with streetlight, 20% at night without light).*
- ✓ *89% on dry road surface.*

3.1.2 Road characteristics

3.1.2.1 Location (city / urban)

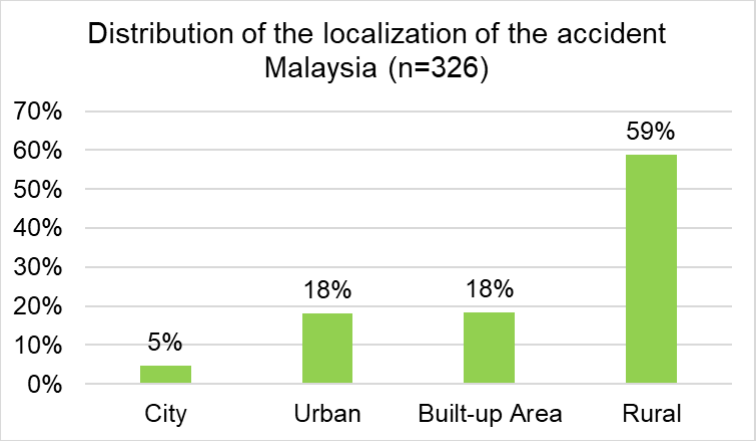


Figure 43: Localization of the accident – Malaysia – HEAD-ON SCENARIO

3.1.2.2 Road category

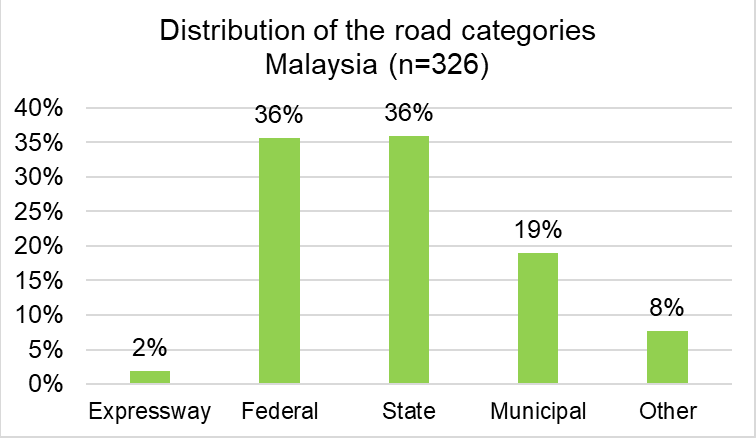


Figure 44: Road category – Malaysia – HEAD-ON SCENARIO

3.1.2.3 Road geometry

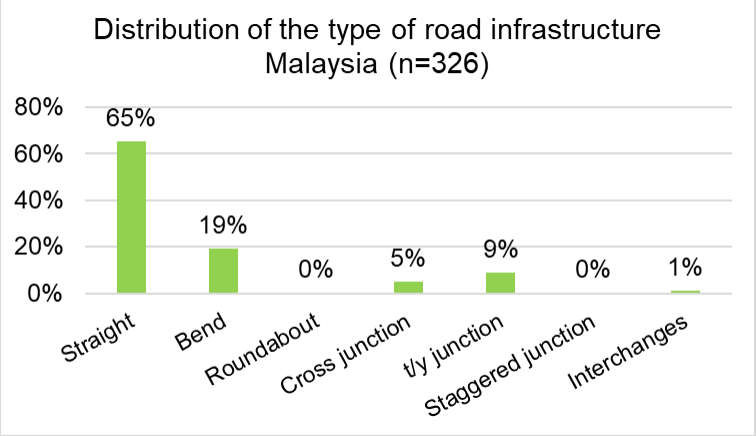


Figure 45: Road geometry – Malaysia –HEAD-ON SCENARIO

3.1.2.4 Lane marking

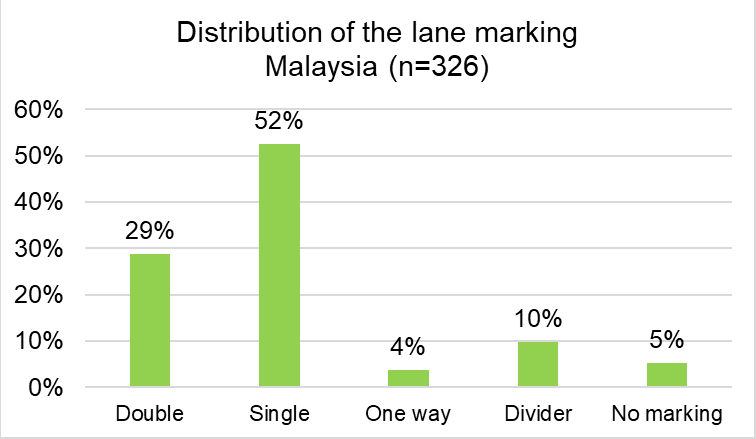


Figure 46: Lane marking – Malaysia – HEAD-ON SCENARIO

3.1.2.5 Speed limit

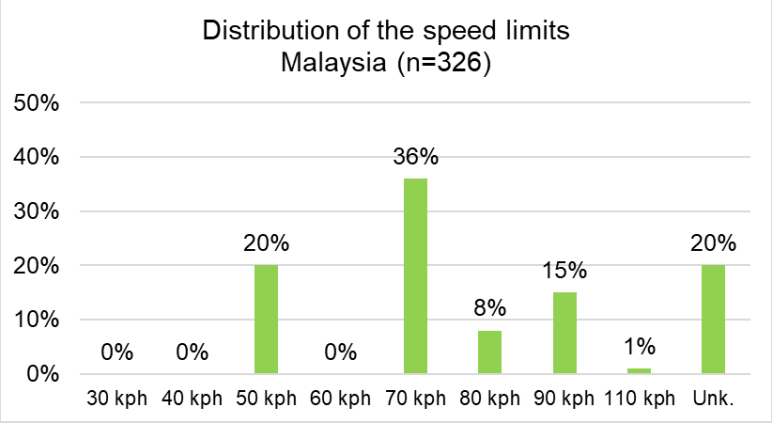


Figure 47: Speed limits – Malaysia – HEAD-ON SCENARIO

3.1.2.6 Conclusion on road characteristics

Table 15: Conclusion on road characteristics – Malaysia – HEAD-ON SCENARIO

Road characteristics	**HEAD-ON**	*Malaysian data*

- ✓ *59% of the accidents happen in rural area (23% in urban or city).*
- ✓ *Majority of federal or state roads (36%).*
- ✓ *65% of the accidents happen in a straight road, 19% happen in a curve.*
- ✓ *Most of the accidents with single lane marking (52%). 5% have no marking.*
- ✓ *Speed limits: 36% at 70 kph, 20% at 50 kph.*

3.1.3 Accident characteristics – vehicles

3.1.3.1 Motorcycle impact type

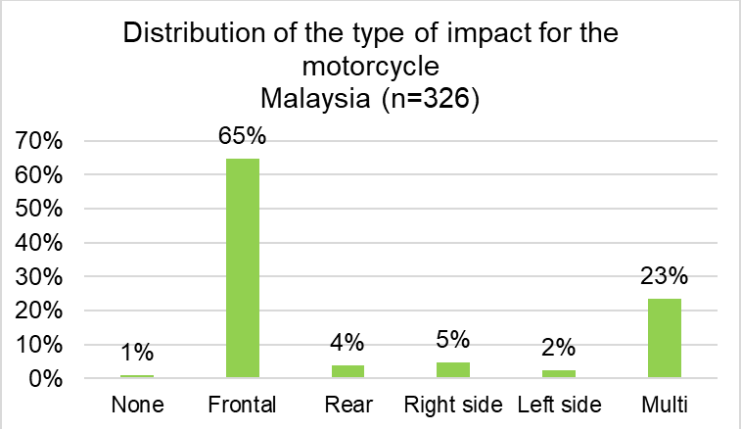


Figure 48: Motorcycle impact type – Malaysia – HEAD-ON SCENARIO

3.1.3.2 Motorcycle action before crash

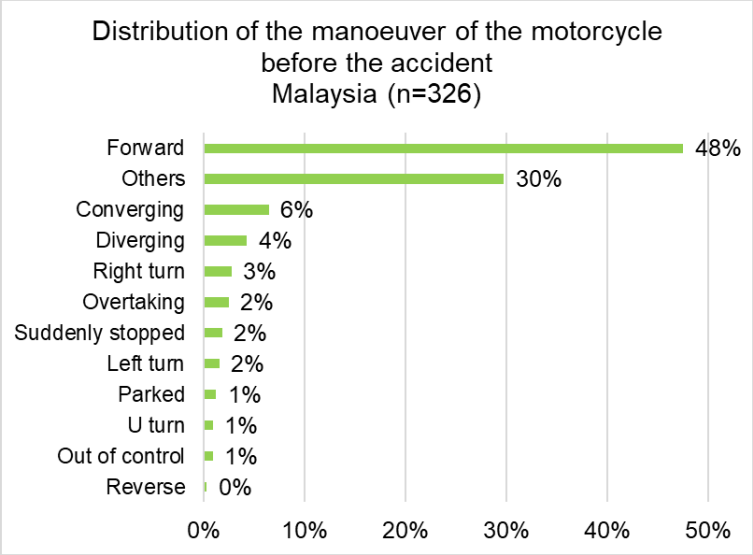


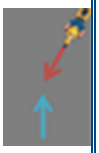
Figure 49: Motorcycle manoeuvre – Malaysia – HEAD-ON SCENARIO

3.1.3.3 Conclusion on vehicle characteristics

Table 16: Conclusion on vehicle characteristics – Malaysia – HEAD-ON SCENARIO

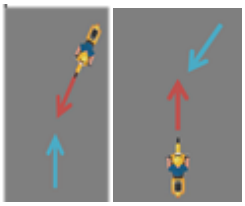
Vehicle characteristics	**HEAD-ON**	*Malaysian data*
✓ *65% of frontal impact for the motorcycle, 23% of multiple impacts.* ✓ *Motorcycle going forward in 48 % of the accidents, and 30% of others manoeuvres not specified.*		

3.2 Thai database: Car and motorcycle coming from opposite direction, frontal collision (Head-on 1)



This OASIM sub-scenario represents **4,1%** of all the accidents and **3,6%** of the KSI accidents in the Thai database.

In this sub-scenario, the car and the motorcycle are going in opposite direction, one of them moving in the lane of the opposite vehicle. This configuration is illustrated by the figure below:



(a)

(b)
Car=36 or 37
Motorcycle=36 or 37

Figure 50: (a) Illustration of the HEAD-ON 1, (b) pictogram from the Thai database.

The following graphs provide in-depth description of the sub-scenario. There are 26 cases in the Thai database.

3.2.1 Accident characteristics – general conditions

3.2.1.1 Weather conditions

All the accidents of this sub-scenario happen with clear weather conditions.

3.2.1.2 Light conditions

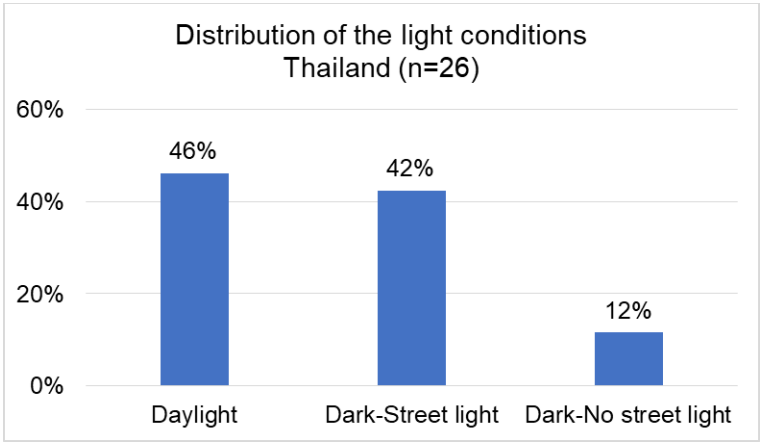
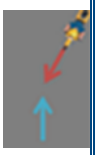


Figure 51: Light conditions - Thailand – HEAD-ON 1 SCENARIO

3.2.1.3 Road surface conditions

All the accidents of this sub-scenario happen on a dry road.



3.2.1.4 Conclusion on general accident conditions

Table 17: Conclusion on general accident conditions – Thailand – HEAD-ON 1 SCENARIO

General conditions	**HEAD-ON 1**	*Thai data*

- ✓ *Clear weather for all the cases.*
- ✓ *46% of the accidents happen during the day (42% at night with streetlights).*
- ✓ *Dry road surface for all the cases*

The environmental conditions are similar in Thailand and Malaysia based on the databases, with good weather conditions and half of the head-on accidents happening at night.

3.2.2 Road characteristics

3.2.2.1 Location (city/urban)

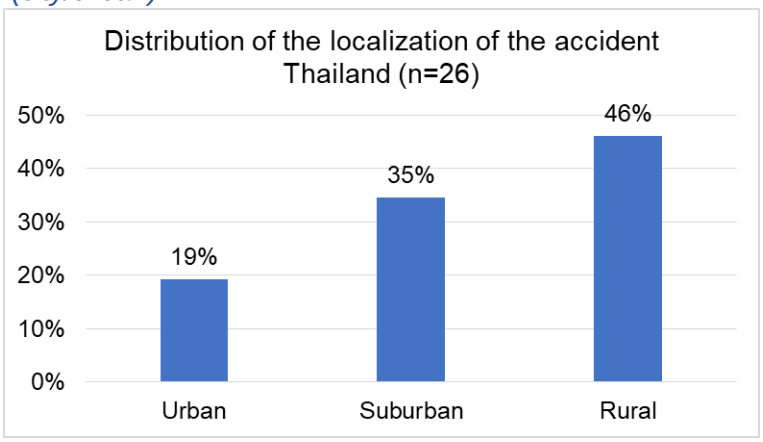


Figure 52: Localization of the accident –Thailand – HEAD-ON 1 SCENARIO

3.2.2.2 Road category

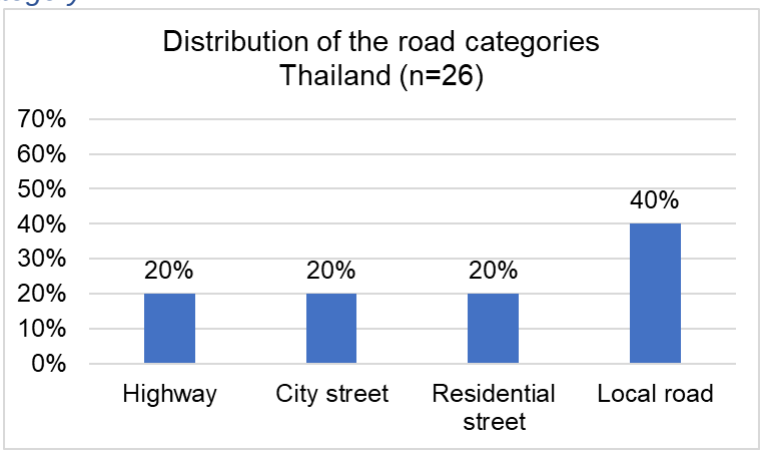
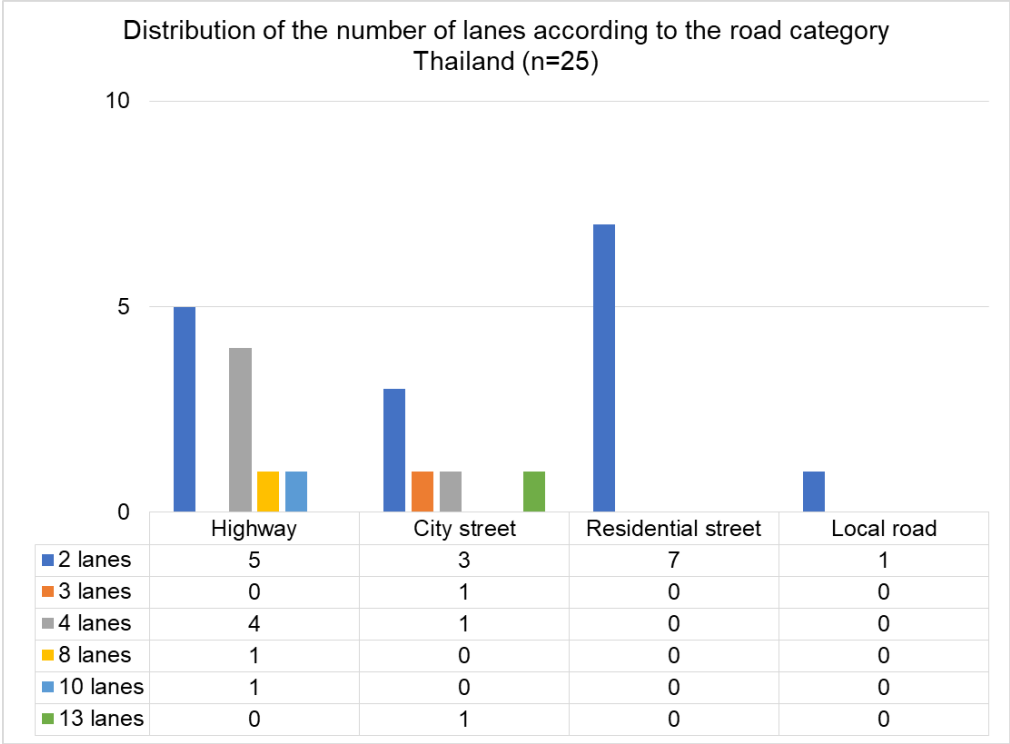


Figure 53: Road category – Thailand – HEAD-ON 1 SCENARIO



	Highway	City street	Residential street	Local road
2 lanes	5	3	7	1
3 lanes	0	1	0	0
4 lanes	4	1	0	0
8 lanes	1	0	0	0
10 lanes	1	0	0	0
13 lanes	0	1	0	0

Figure 54: Road category and number of lanes – Thailand – HEAD-ON 1 SCENARIO

3.2.2.3 Configuration

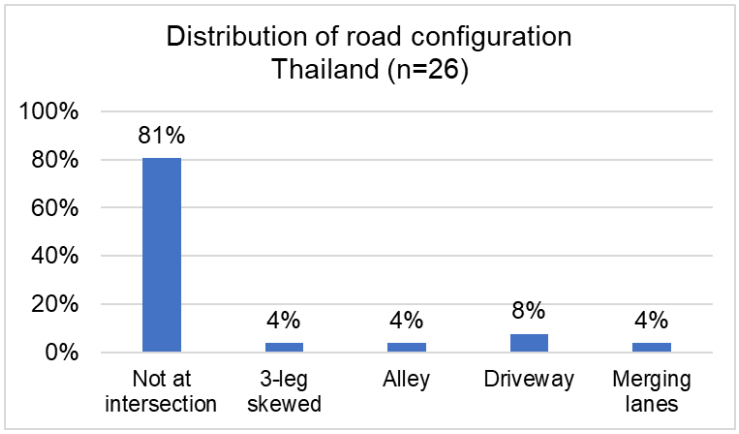


Figure 55: Configuration – Thailand – HEAD-ON 1 SCENARIO

3.2.2.4 Road geometry

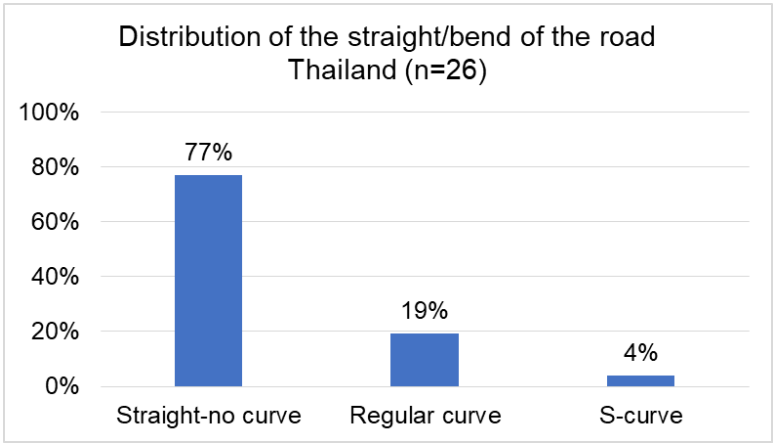


Figure 56: Road geometry – Thailand – HEAD-ON 1 SCENARIO

3.2.2.5 Slope

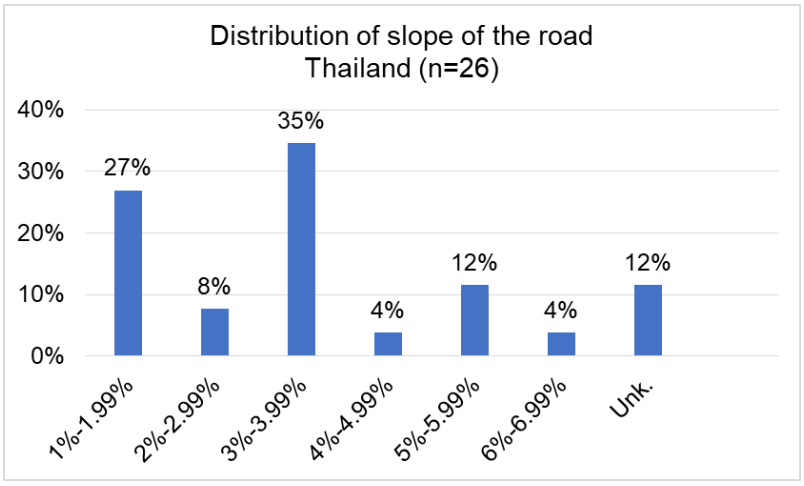


Figure 57: Slop of the road – Thailand – HEAD-ON 1 SCENARIO

3.2.2.6 Speed limit

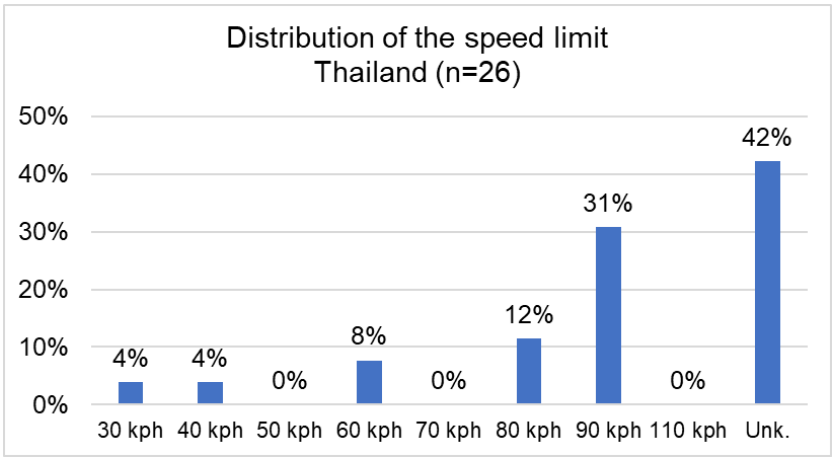


Figure 58: Speed limits – Thailand – HEAD-ON 1 SCENARIO

3.2.2.7 Number of lanes

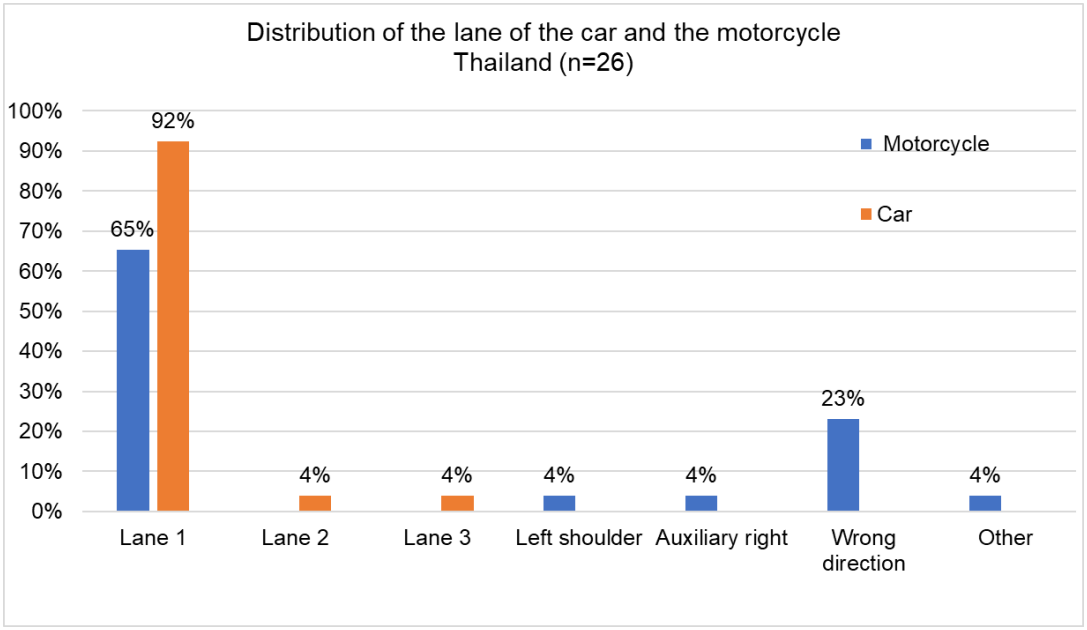
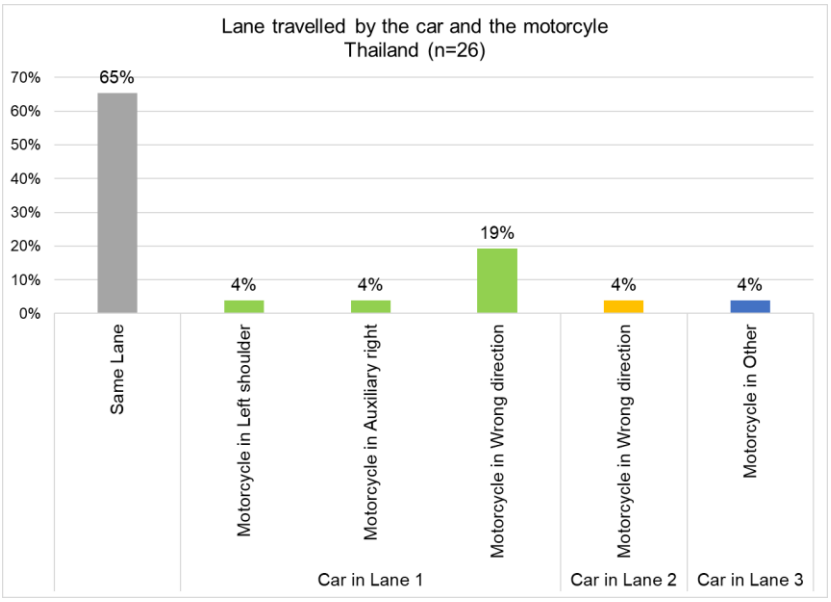


Figure 59: Lanes of the vehicles – Thailand – HEAD-ON 1 SCENARIO

3.2.2.8 Travelled lane



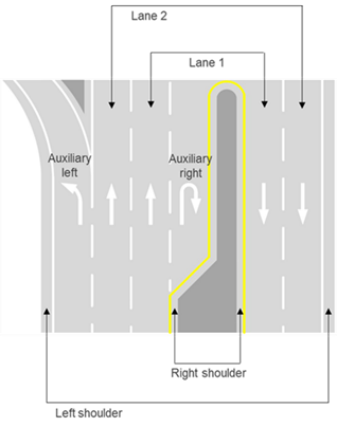


Figure 60: Vehicles on same lane – Thailand – HEAD-ON 1 SCENARIO

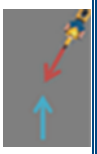
3.2.2.9 Conclusion on road characteristics

Table 18: Conclusion on road characteristics – Thailand – HEAD-ON 1 SCENARIO

Road characteristics	**HEAD-ON 1**	*Thai data*

- ✓ *Mostly rural (46%) and suburban (35%) area.*
- ✓ *40% of the accidents occur on local roads.*
- ✓ *2-4 lanes roads.*
- ✓ *81% of the accidents are out of intersection.*
- ✓ *77% of the accidents happen in a straight road.*
- ✓ *Speed limit at 90 kph (31%) and 80 kph (12%), 42% of unknown values.*
- ✓ *92% of the cars are in lane 1, and 23% of the motorcycles are travelling in the wrong way.*

The conclusion on this scenario is relevant with the Malaysian data. The accidents seem to happen mostly on rural areas, on straight roads, out of intersections.



3.2.3 Accident characteristics – vehicles

3.2.3.1 Visibility

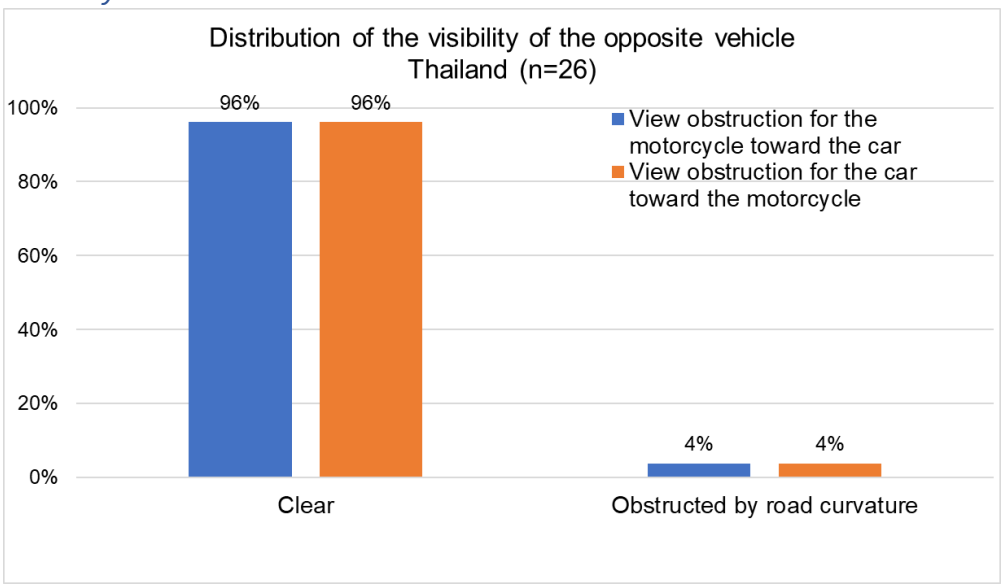
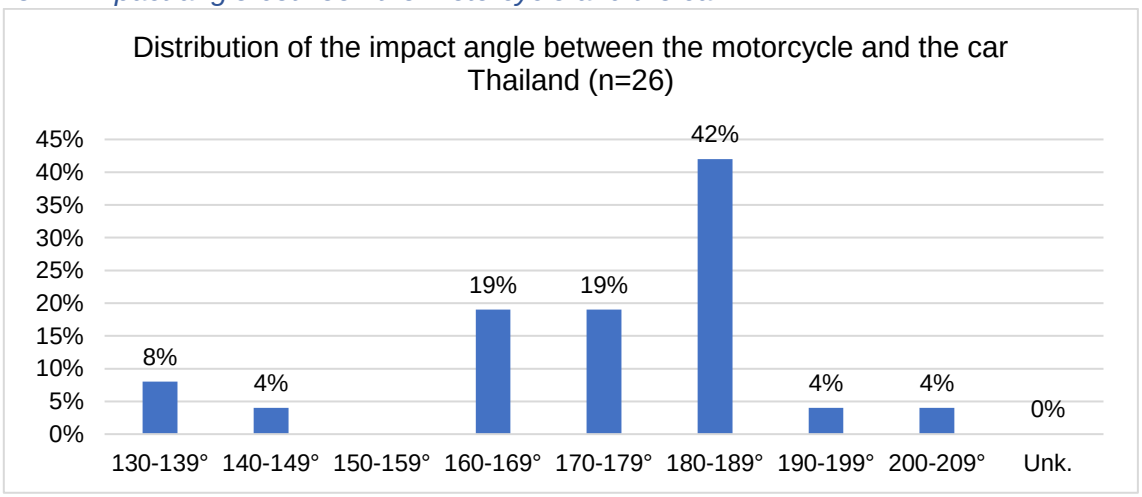


Figure 61: Visibility – Thailand – HEAD-ON 1 SCENARIO

3.2.3.2 Impact angle between the motorcycle and the car



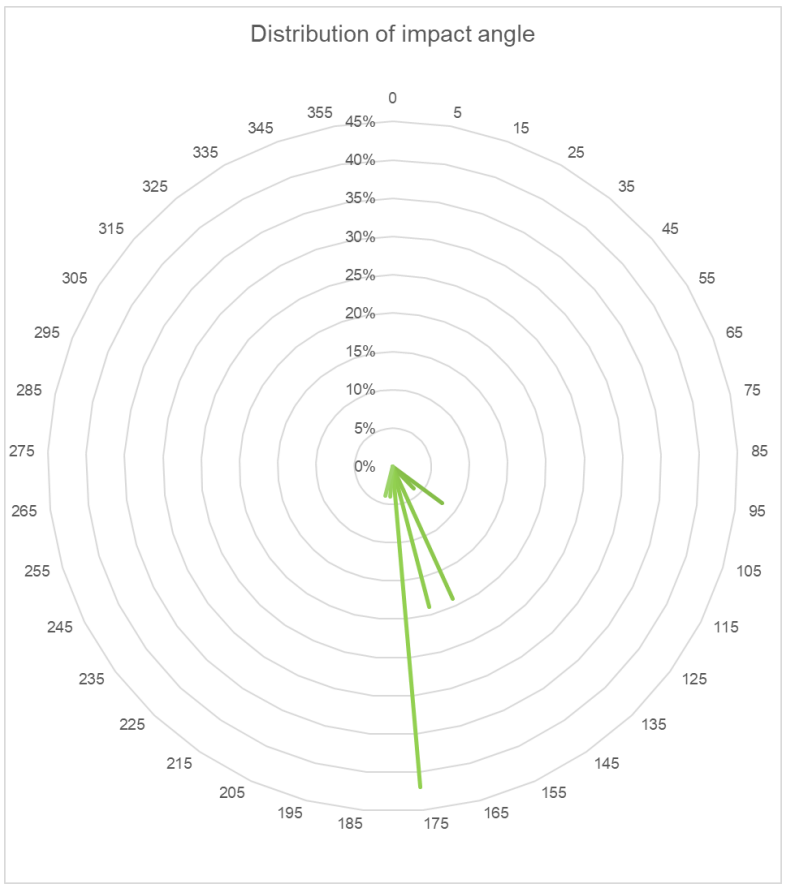


Figure 62: Impact angle – Thailand – HEAD-ON 1 SCENARIO

3.2.3.3 Motorcycle impact type

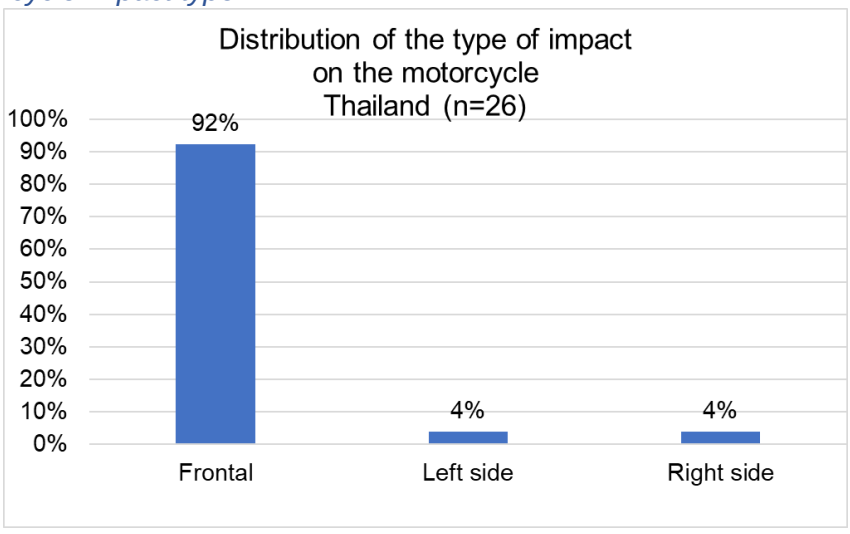


Figure 63: Type of impact for the motorcycle – Thailand – HEAD-ON 1 SCENARIO

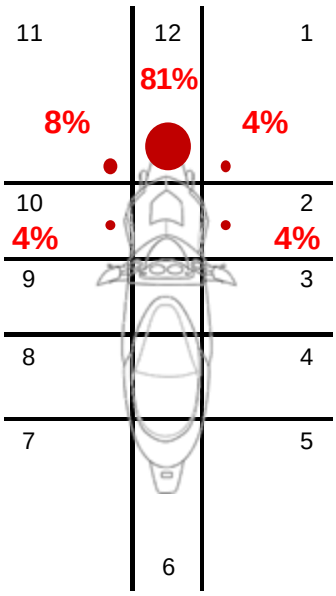


Figure 64: First collision point for the motorcycle – Thailand – HEAD-ON 1 SCENARIO

3.2.3.4 Car impact type

All the cars of this sub-scenario have a frontal impact.

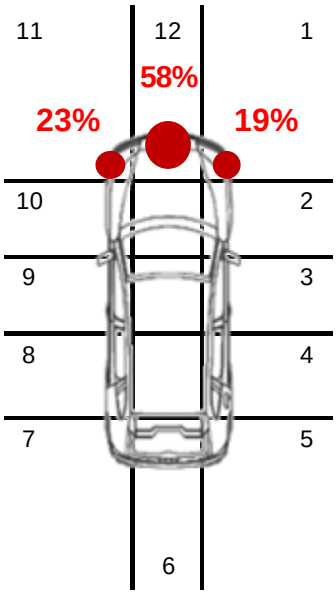


Figure 65: First collision point for the car – Thailand – HEAD-ON 1 SCENARIO

3.2.3.5 Initial speeds

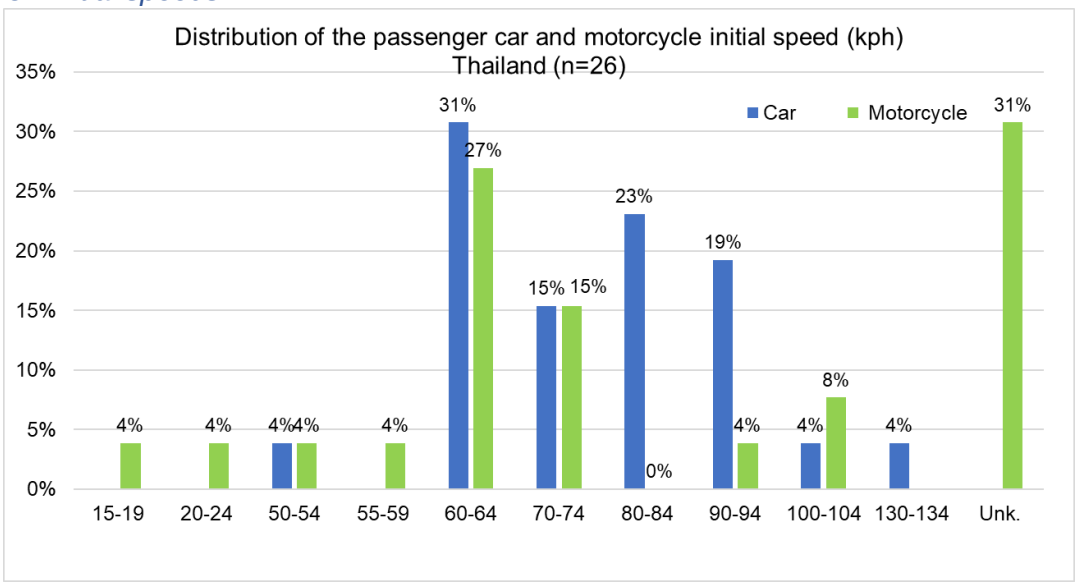


Figure 66: Initial speeds – Thailand – HEAD-ON 1 SCENARIO

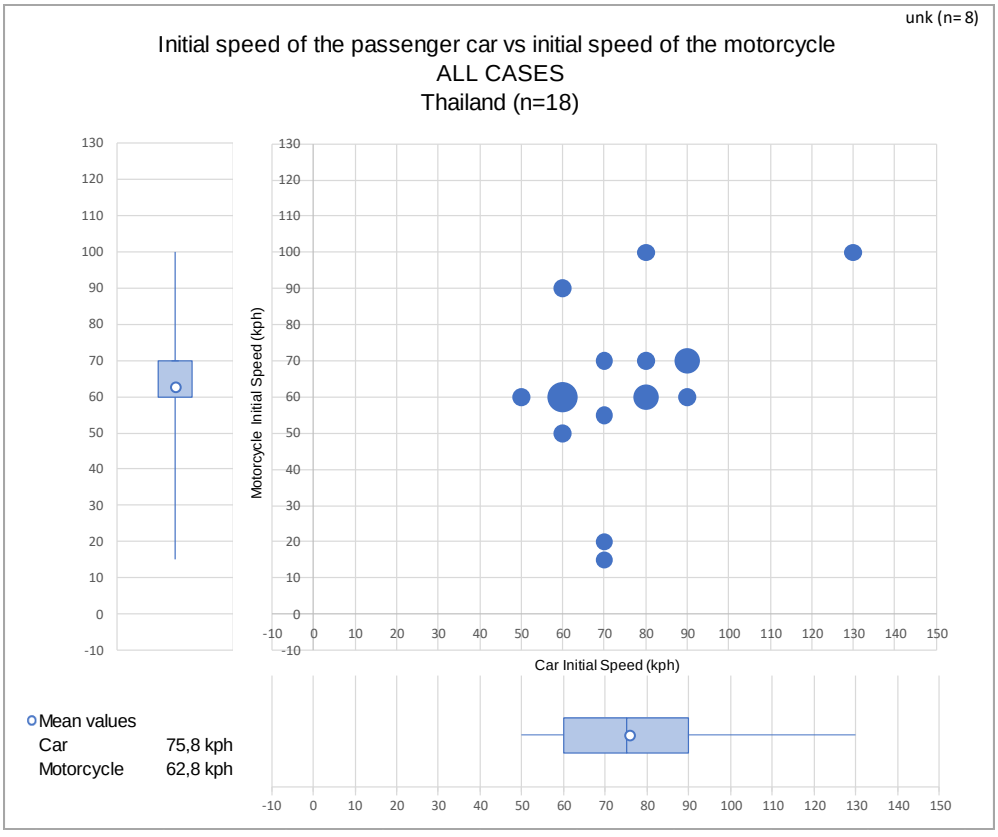


Figure 67: Initial speed of the car versus initial speed of the motorcycle, all cases – Thailand – HEAD-ON 1 SCENARIO

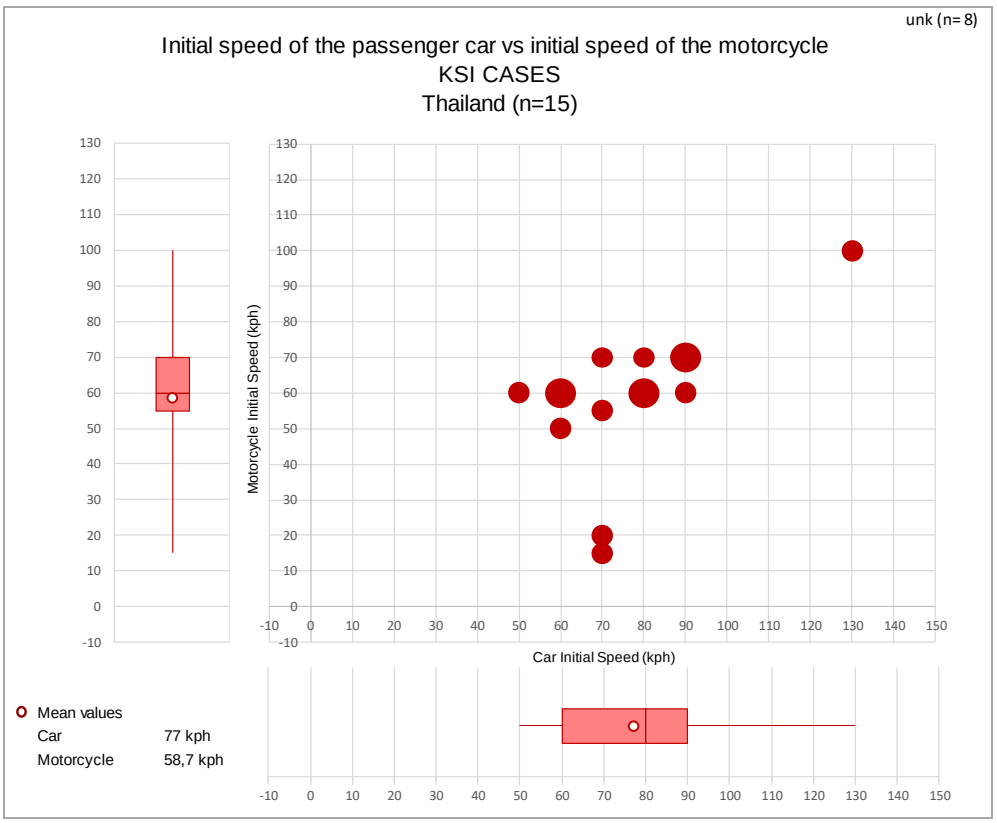


Figure 68: Initial speed of the car versus initial speed of the motorcycle, KSI cases – Thailand HEAD-ON 1 SCENARIO

Table 19: Initial speed values for the car and the motorcycle, all cases – Thailand – HEAD-ON 1 SCENARIO

All Accidents																										unk: 8
Number of cases	Passenger Car Initial Speed (kph)																									
	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Initial Speed (kph) 0																										
1																										
5																										
10																										
15																1										
20																1										
25																										
30																										
35																										
40																										
45																										
50														1												
55																1										
60												1		3				2		1						
65																										
70																1		1		2						
75																										
80																										
85																										
90														1												
95																										
100																		1								1
105≤																										

Table 20: Initial speed values for the car and the motorcycle, KSI cases – Thailand – HEAD-ON 1 SCENARIO

KSI Accidents																										unk:	8
Number of cases	Passenger Car Initial Speed (kph)																										
Motorcycle Initial Speed (kph)	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
0																										
1																										
5																										
10																										
15																1										
20																1										
25																										
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45																										
50														1												
55																1										
60												1		2				2		1						
65																										
70																1		1		2						
75																										
80																										
85																										
90																										
95																										
100																										1
105≤																										

3.2.3.6 Collision speeds

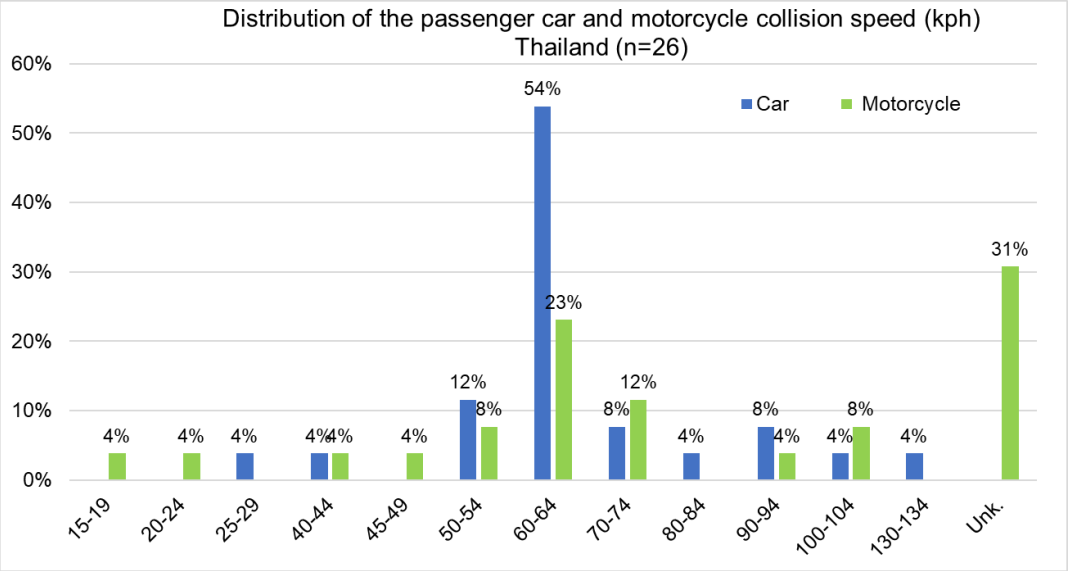
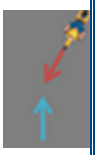


Figure 69: Collision speeds – Thailand – HEAD-ON 1 SCENARIO



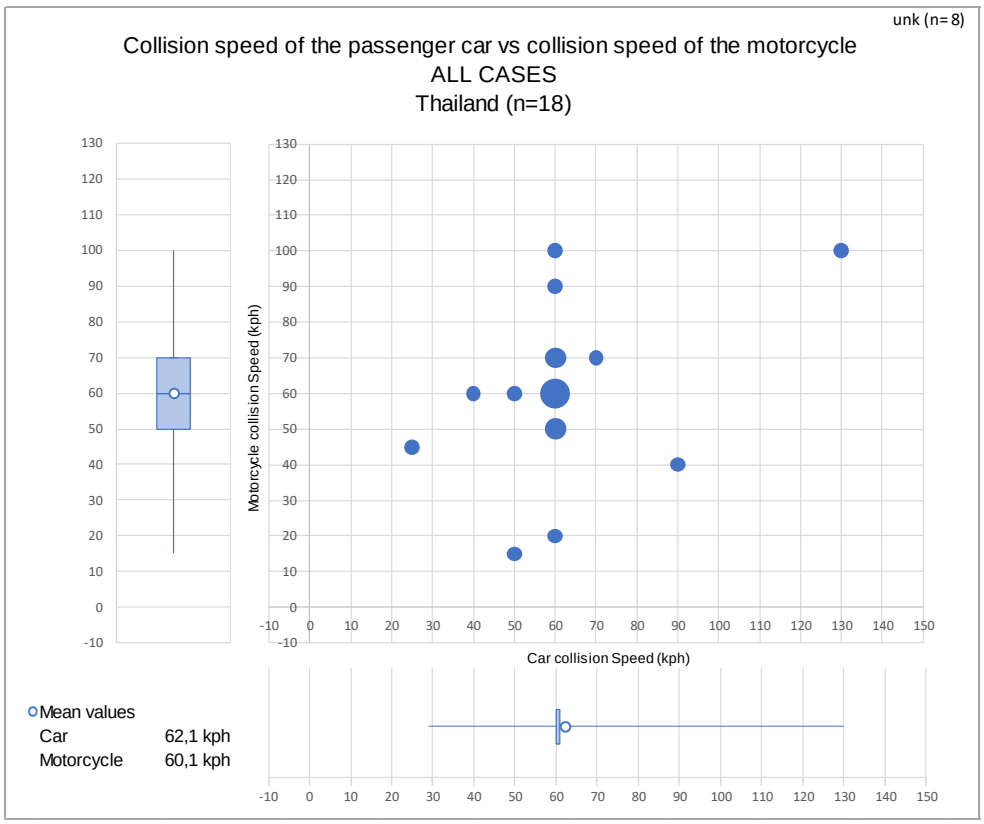


Figure 70: Collision speed of the car versus collision speed of the motorcycle, all cases – Thailand – HEAD-ON 1 SCENARIO

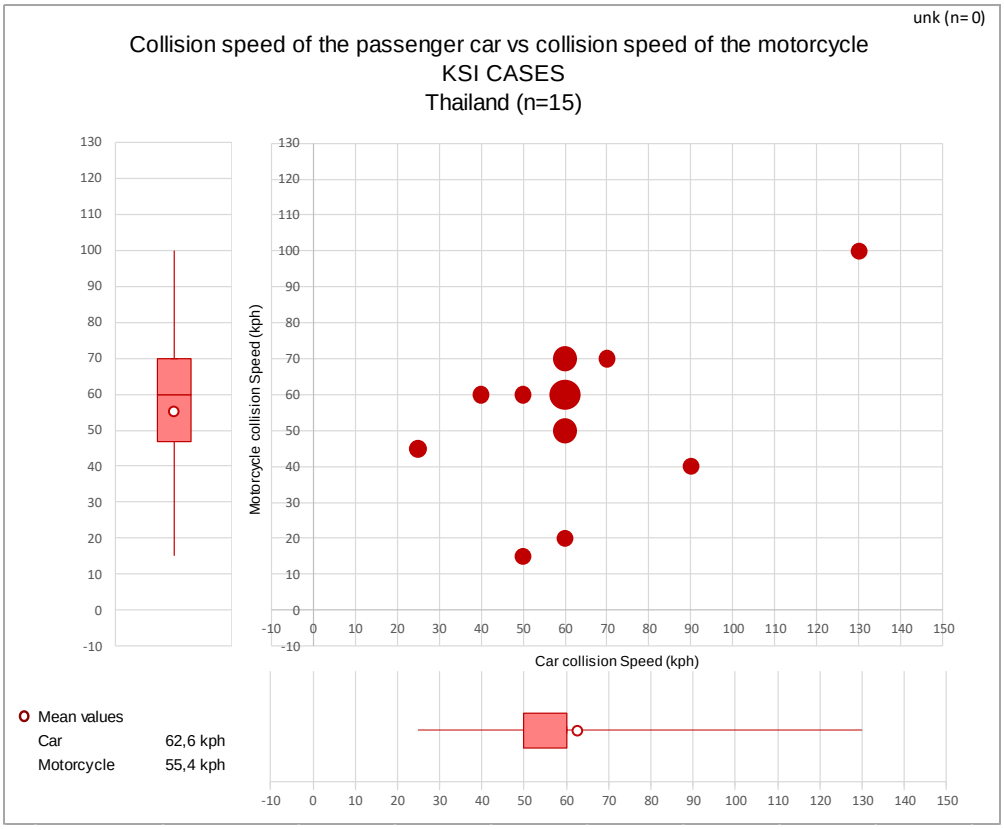


Figure 71: Collision speed of the car versus collision speed of the motorcycle, KSI cases – Thailand – HEAD-ON 1 SCENARIO

Table 21: Collision speed values for the car and the motorcycle, all cases – Thailand – HEAD-ON 1 SCENARIO

All Accidents																										unk:	8
Number of cases	Passenger Car Collision Speed (kph)																										
	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Collision Speed (kph) 0																										
1																										
5																										
10																										
15												1														
20														1												
25																										
30																										
35																										
40																				1						
45							1																			
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60										1		1		4												
65																										
70														2		1										
75																										
80																										
85																										
90														1												
95																										
100														1												1
105≤																										

Table 22: Collision speed values for the car and the motorcycle, KSI cases – Thailand – HEAD-ON 1 SCENARIO

KSI Accidents																										unk:	8
Number of cases	Passenger Car Collision Speed (kph)																										
	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Collision Speed (kph) 0																										
1																										
5																										
10																										
15												1														
20														1												
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45							1																			
50														2												
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65																										
70														2		1										
75																										
80																										
85																										
90																										
95																										
100																										1
105≤																										

3.2.3.7 Delta initial velocity (kph) – calculated

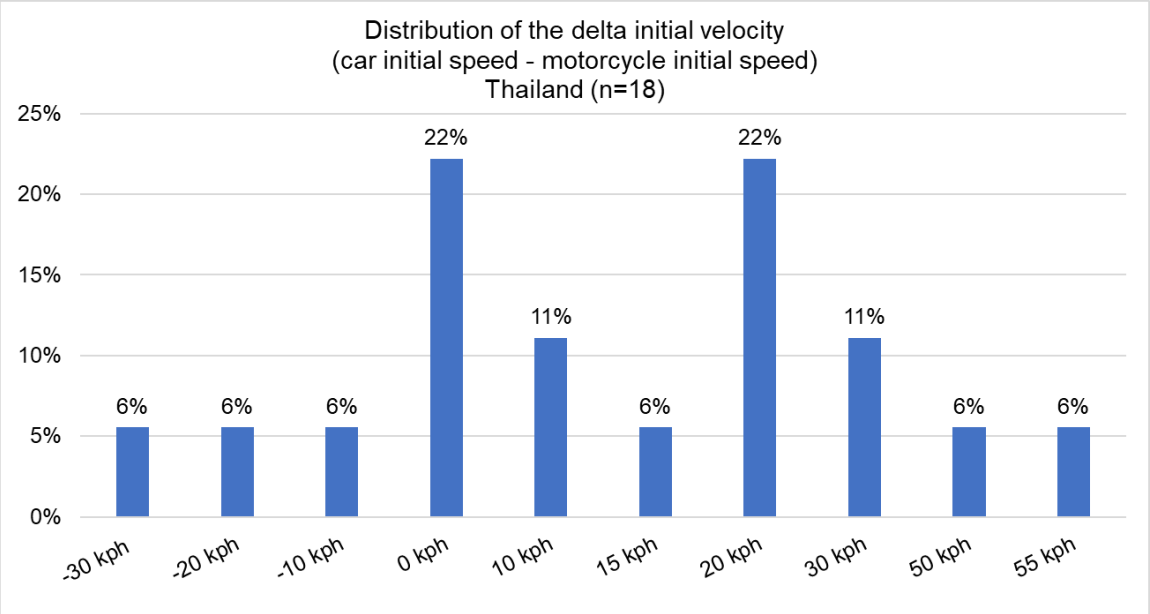


Figure 72: Delta initial velocity (kph) – Thailand – HEAD-ON 1 SCENARIO

3.2.3.8 Skid marks

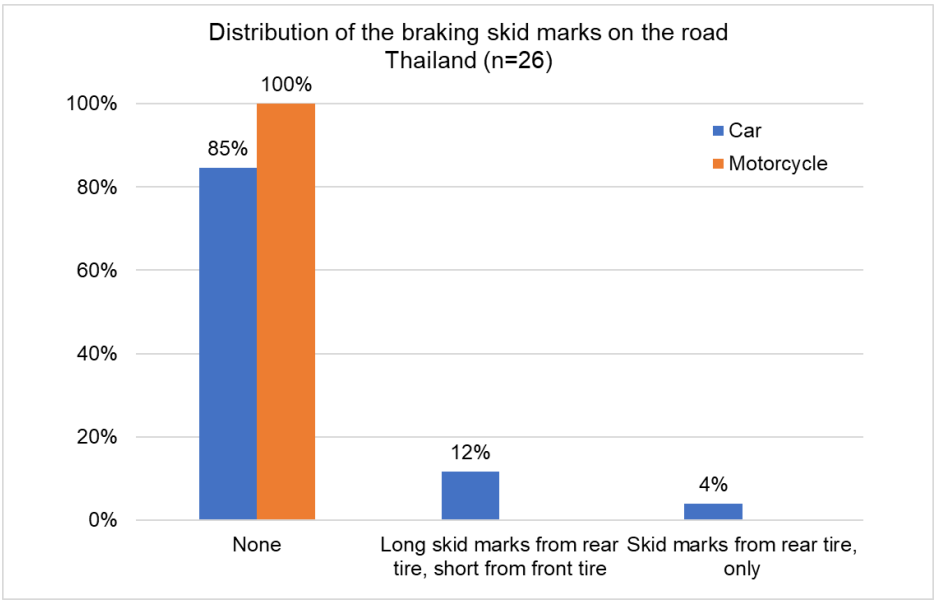


Figure 73: Skid marks – Thailand – HEAD-ON 1 SCENARIO

3.2.3.9 ABS fitment on the car

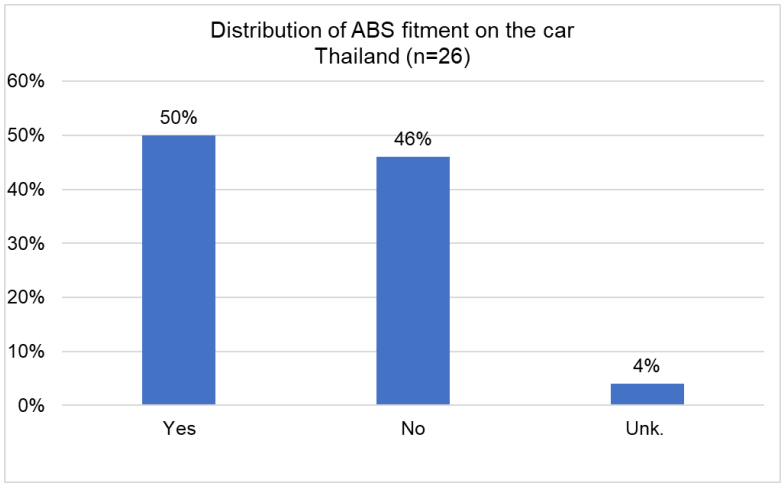


Figure 74: ABS fitment – Thailand – HEAD-ON 1 SCENARIO

3.2.3.10 Motorcycle manoeuvre before crash

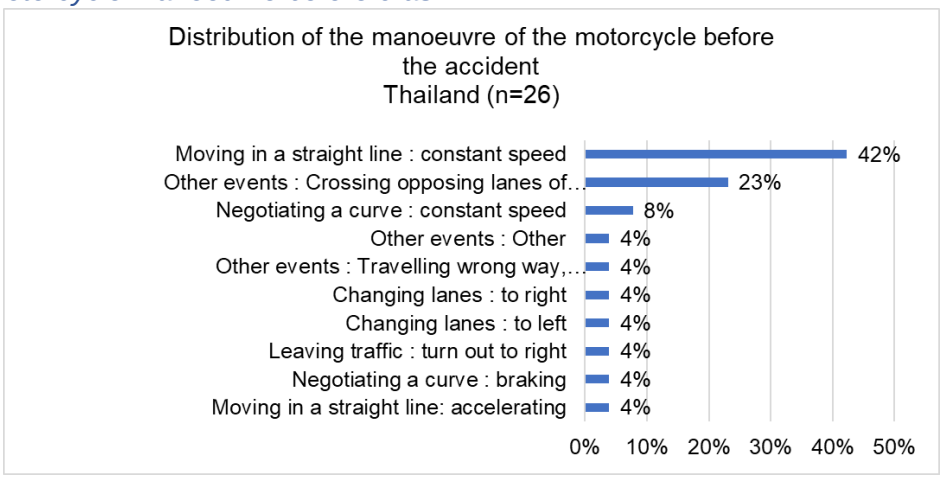


Figure 75: Motorcycle manoeuvre – Thailand – HEAD-ON 1 SCENARIO

3.2.3.11 Car manoeuvre before crash

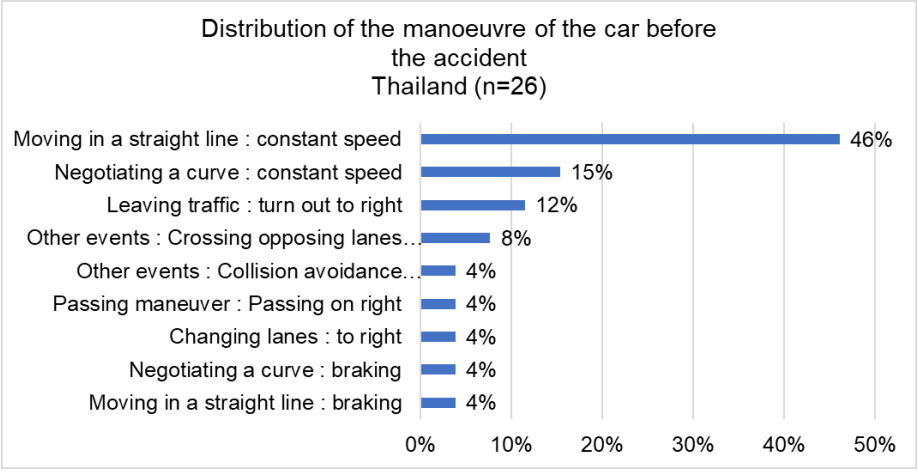


Figure 76: Car manoeuvre – Thailand – HEAD-ON 1 SCENARIO

3.2.3.12 Avoidance action by vehicle

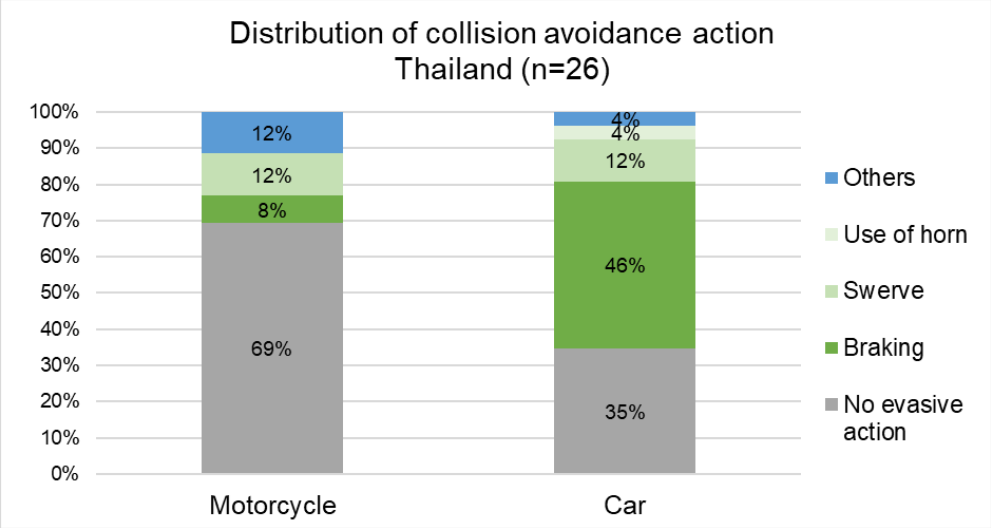


Figure 77: Avoidance action by vehicle – Thailand – HEAD-ON 1 SCENARIO

3.2.3.13 Conclusion on accident characteristics

Table 23: Conclusion on accident characteristics – Thailand – HEAD-ON 1 SCENARIO

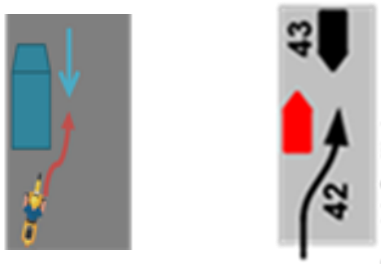
Accident characteristics	**HEAD-ON 1**	*Thai data*

- ✓ *Clear visibility for 96% of the accidents, one case of obstruction due to road curvature.*
- ✓ *92% frontal impact for the motorcycle.*
- ✓ *100% frontal impact for the car.*
- ✓ *Mean initial speed: Car=75,8 kph and Motorcycle=62,8 kph*
- ✓ *Mean collision speed: Car=62,1 kph and Motorcycle=60,1 kph*
- ✓ *50% of the car had ABS.*
- ✓ *The motorcycle goes straight at constant speed (42%) or is crossing the opposite lane of traffic (23%).*
- ✓ *The car goes straight at constant speed (46%) or is negotiating a curve (15%).*
- ✓ *Avoidance action for 62% of the cars and 20% of the motorcycles. The cars mostly brake and the motorcycles swerve.*

3.3 Thai database: Motorcycle changing lane and colliding with oncoming car (Head-on 2)

This head-on sub-scenario represents **1,6%** of all the accidents and **3,1%** of the KSI accidents in the Thai database.

In this sub-scenario, the motorcycle changes lane (passing manoeuvre) and hits the oncoming car. This configuration is illustrated by the figure below:



(a) (b)
Car=43
Motorcycle=42

Figure 78: (a) Illustration of the HEAD-ON 2 scenario, (b) pictogram from the Thai database.

The following graphs provide in-depth description of the sub-scenario. There are 11 cases in the Thai database.

3.3.1 Accident characteristics – general conditions

3.3.1.1 Weather conditions

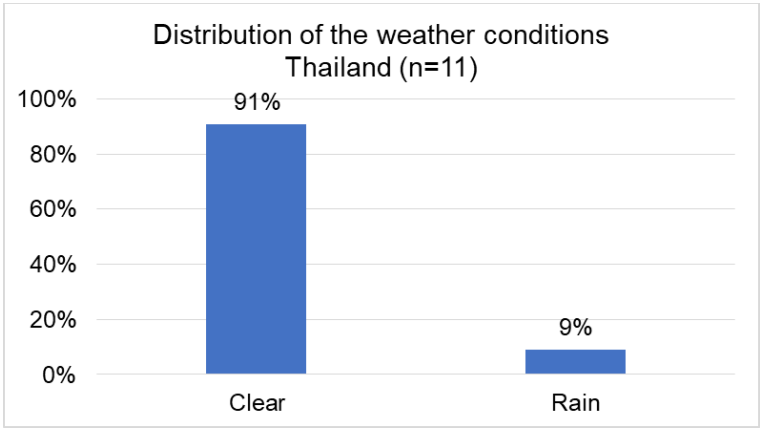
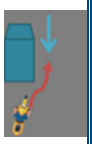


Figure 79: Weather conditions - Thailand – HEAD-ON 2 SCENARIO



3.3.1.2 Light conditions

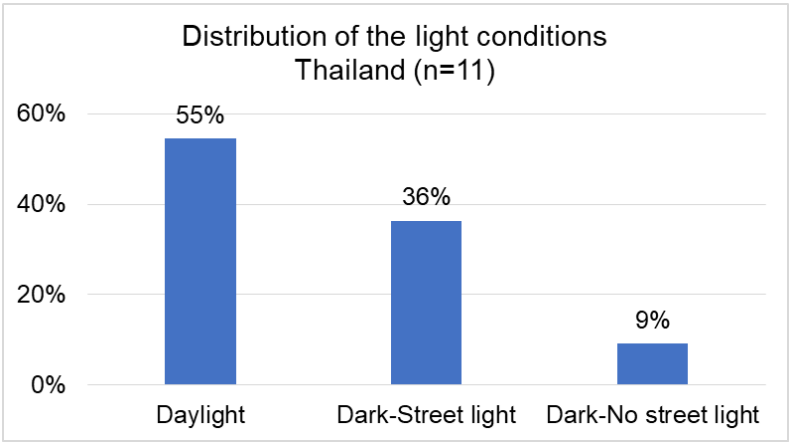


Figure 80: Light conditions - Thailand – HEAD-ON 2 SCENARIO

3.3.1.3 Road surface conditions

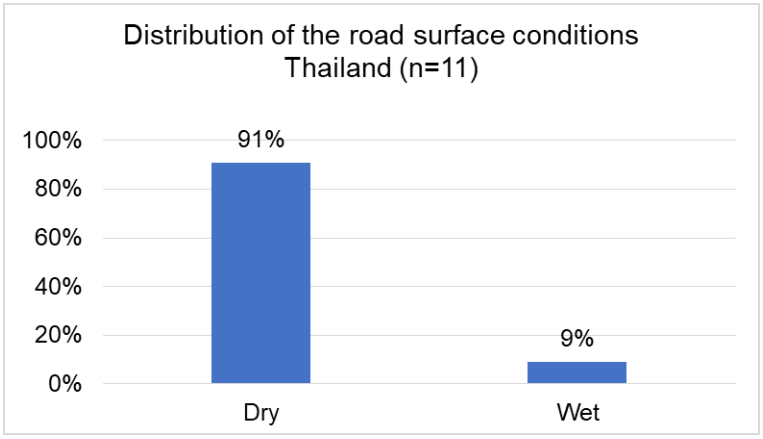


Figure 81: Road surface conditions – Thailand – HEAD-ON 2 SCENARIO

3.3.1.4 Conclusion on general accident conditions

Table 24: Conclusion on general accident conditions – Thailand – HEAD-ON 2 SCENARIO

General conditions	**HEAD-ON 2**	*Thai data*
✓ *Clear weather for 91% of the cases.* ✓ *55% of the accidents happen during the day (36% at night with streetlights).* ✓ *Dry road surface for 91% of the cases.*		

The environmental conditions are similar in Thailand and Malaysia based on the databases, with good weather conditions and half of the head-on accidents happening at night.

3.3.2 Road characteristics

3.3.2.1 Location (city/urban)

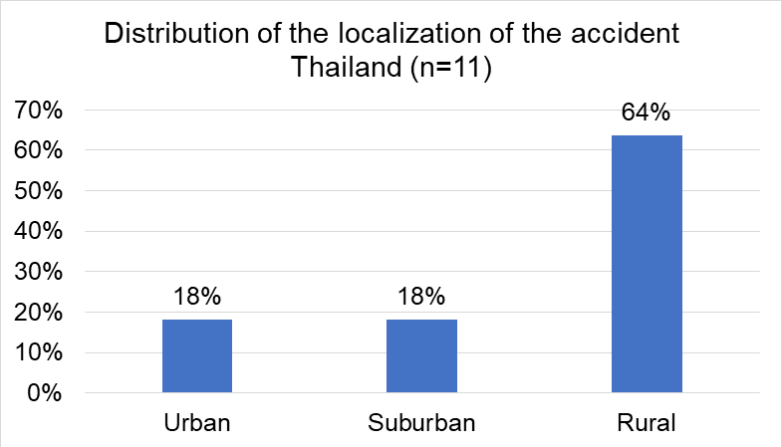


Figure 82: Localization of the accident –Thailand – HEAD-ON 2 SCENARIO

3.3.2.2 Road category

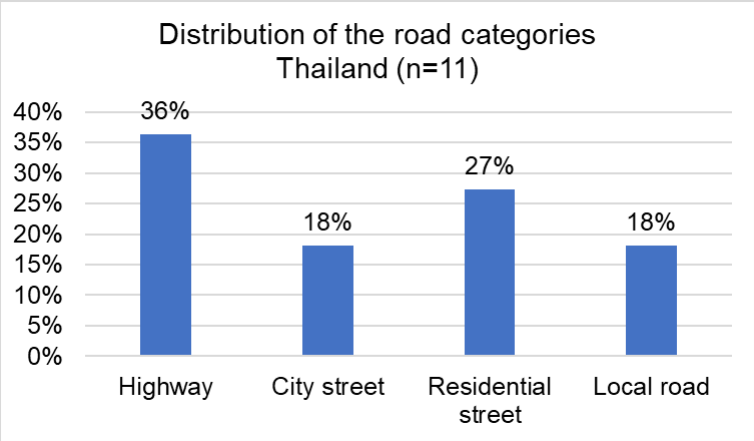


Figure 83: Road category – Thailand – HEAD-ON 2 SCENARIO

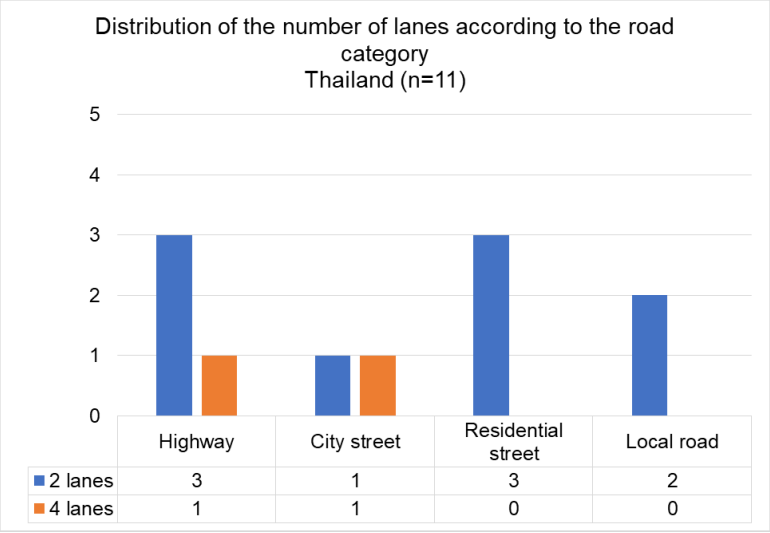
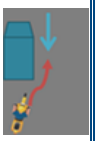


Figure 84: Road category and number of lanes – Thailand – HEAD-ON 2 SCENARIO



3.3.2.3 Configuration

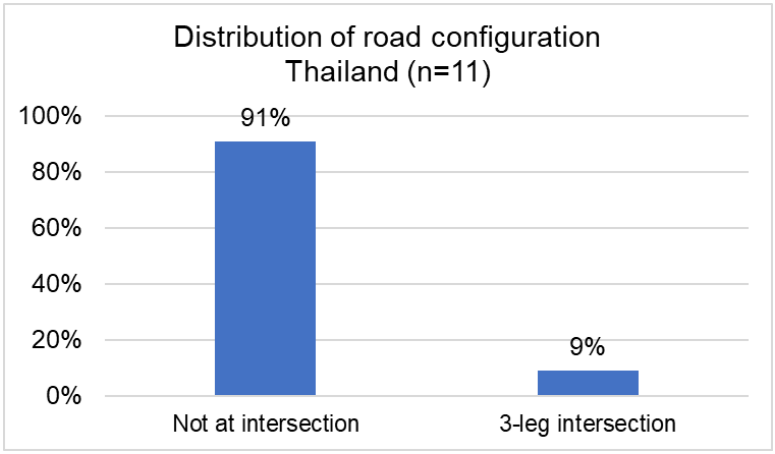


Figure 85: Configuration – Thailand – HEAD-ON 2 SCENARIO

3.3.2.4 Road geometry

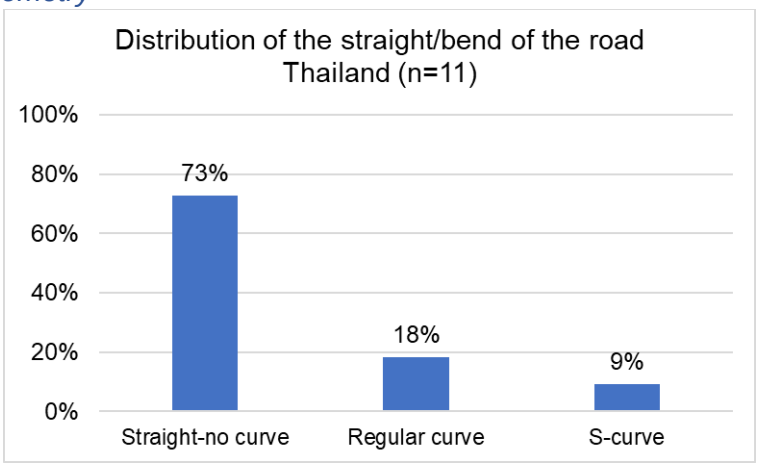


Figure 86: Road geometry – Thailand – HEAD-ON 2 SCENARIO

3.3.2.5 Slope

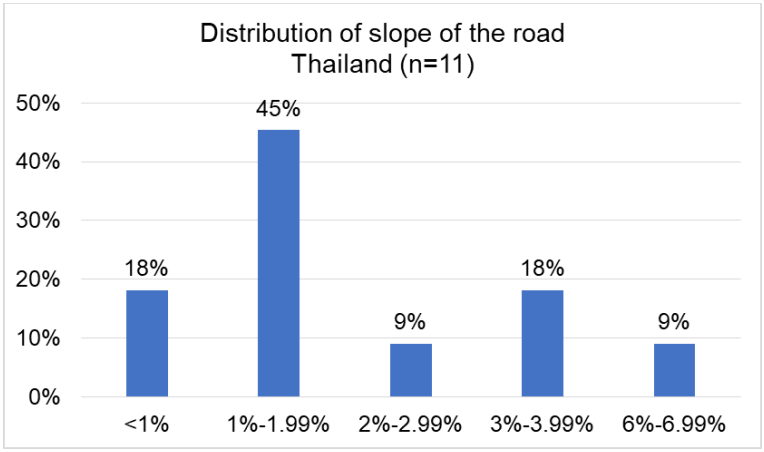
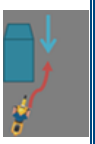


Figure 87: Slop of the road – Thailand – HEAD-ON 2 SCENARIO



3.3.2.6 Speed limit

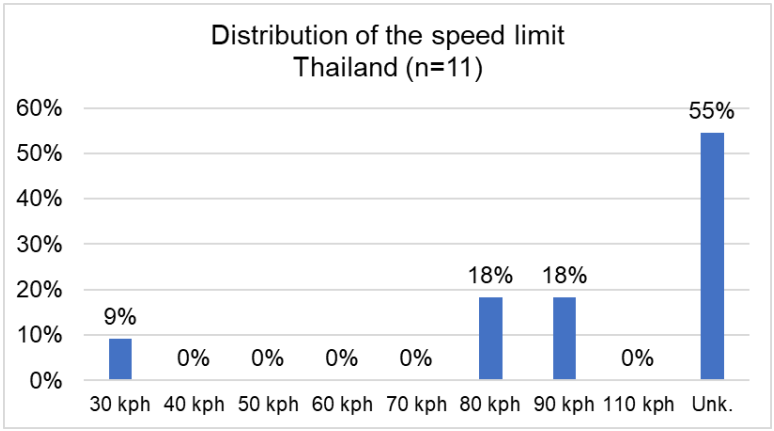


Figure 88: Speed limits – Thailand – HEAD-ON 2 SCENARIO

3.3.2.7 Number of lanes

All vehicles of this sub-scenario are traveling in the Lane 1.

3.3.2.8 Travelled lane

All vehicles of this sub-scenario are traveling in the same lane.

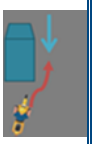
3.3.2.9 Conclusion on road characteristics

Table 25: Conclusion on road characteristics – Thailand – HEAD-ON 2 SCENARIO

Road characteristics	**HEAD-ON 2**	*Thai data*

- ✓ *Mostly rural (64%) area.*
- ✓ *36% of the accidents occur on highways and 27% on residential streets.*
- ✓ *2 lanes roads.*
- ✓ *91% of the accidents are out of intersection.*
- ✓ *63% of the accidents happen in a straight road, 27% in a curve.*
- ✓ *Speed limit mostly unknown (55%), 18% at 80 kph and 90 kph.*
- ✓ *All the vehicles are in the same lane.*

The conclusion on this scenario is relevant with the Malaysian data. The accidents seem to happen mostly on rural areas, on straight roads, out of intersections.



3.3.3 Accident characteristics – vehicles

3.3.3.1 Visibility

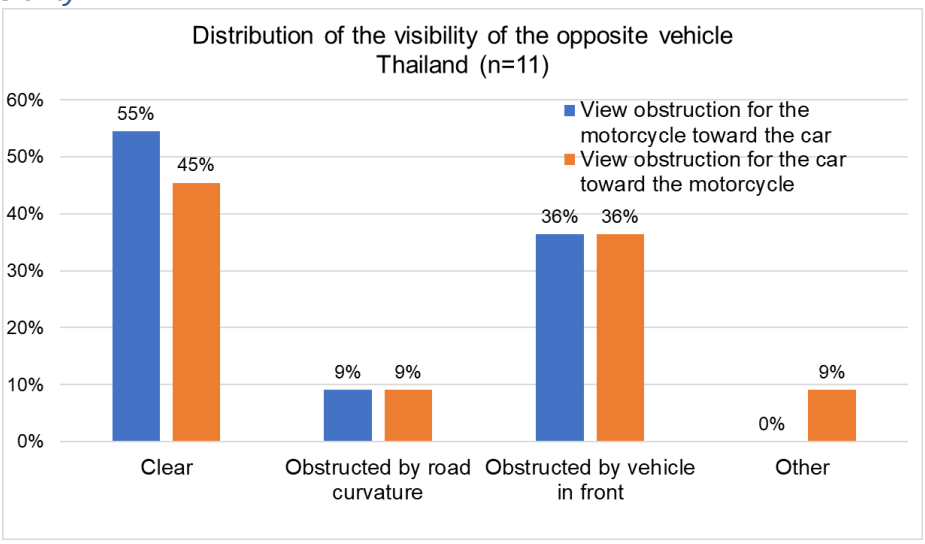
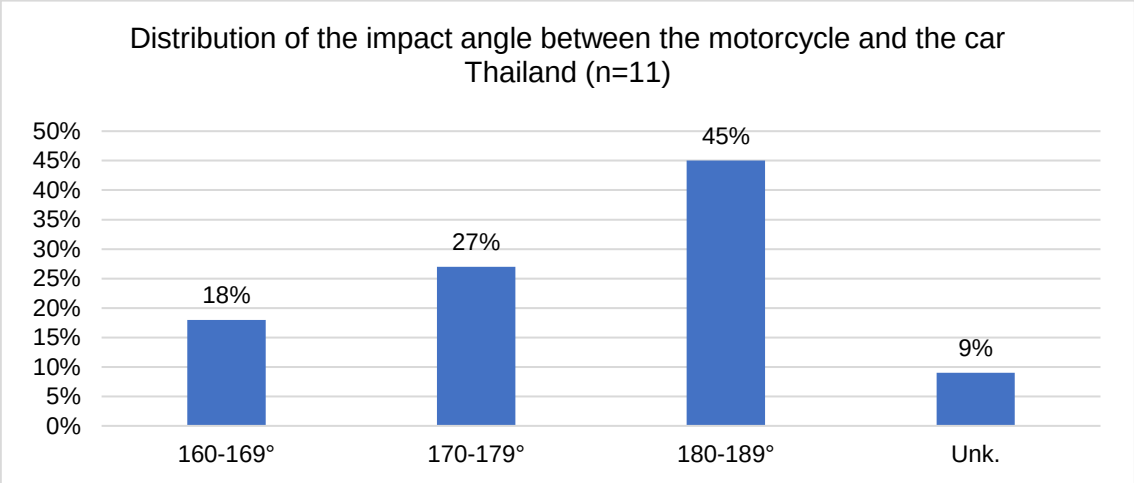


Figure 89: Visibility – Thailand – HEAD-ON 2 SCENARIO

3.3.3.2 Impact angle



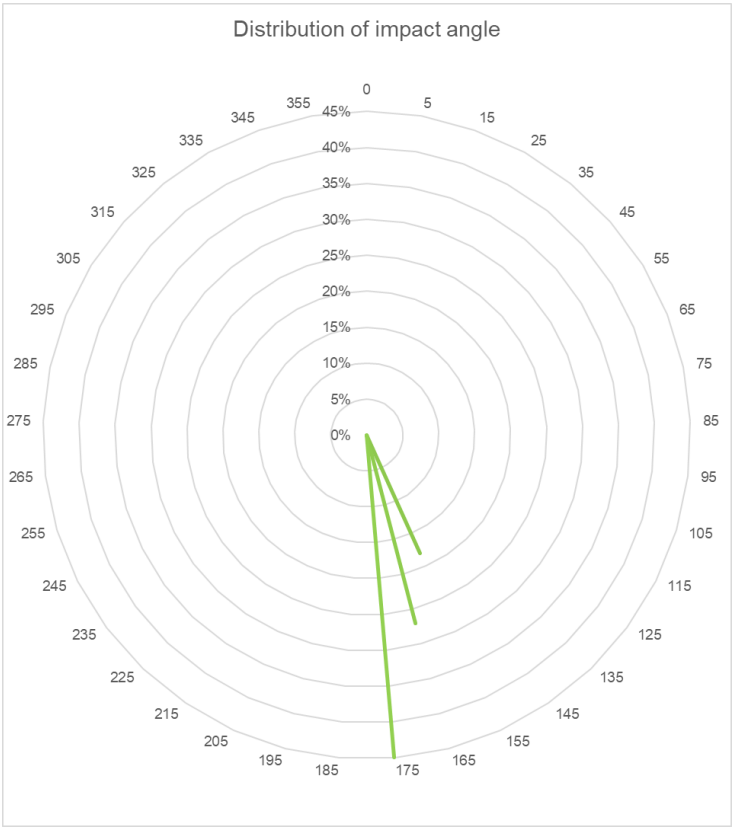


Figure 90: Impact angle – Thailand – HEAD-ON 2 SCENARIO

3.3.3.3 Motorcycle impact type

All the motorcycles within this sub-scenario have a frontal impact.

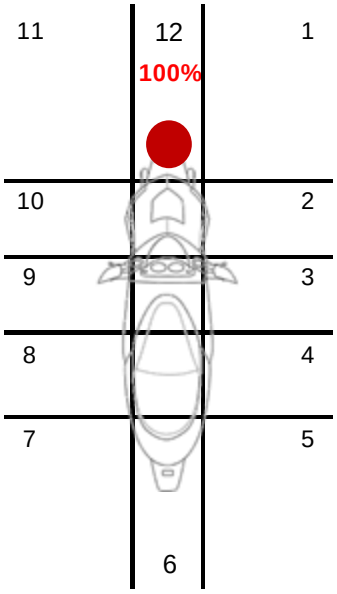


Figure 91: First collision point for the motorcycle – Thailand – HEAD-ON 2 SCENARIO

3.3.3.4 Car impact type

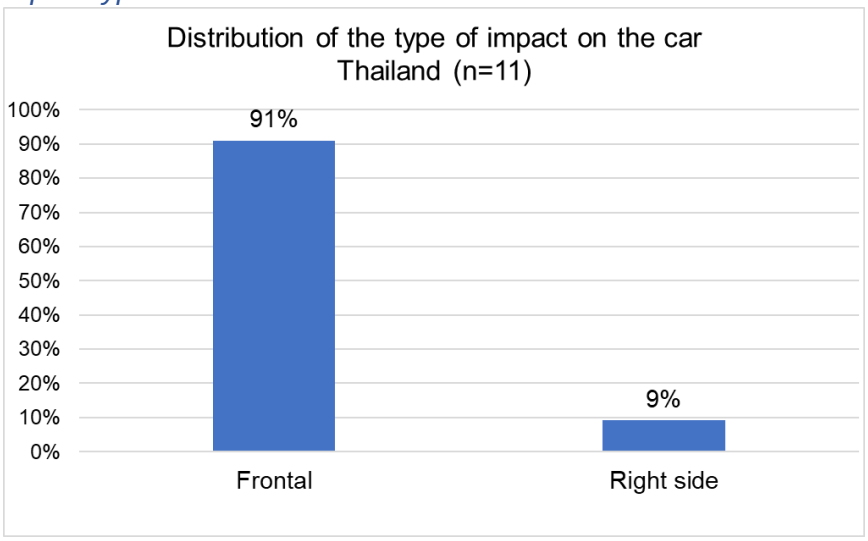


Figure 92: Type of impact for the car– Thailand – HEAD-ON 2 SCENARIO

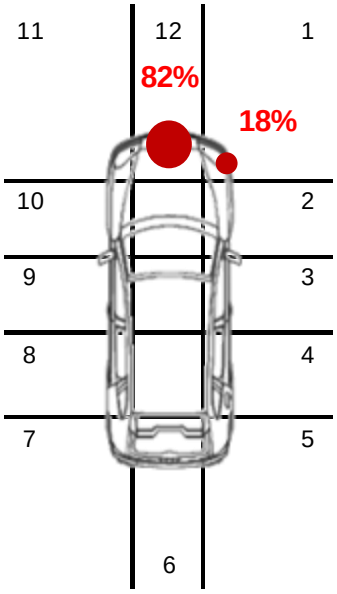


Figure 93: First collision point for the car – Thailand – HEAD-ON 2 SCENARIO

3.3.3.5 Initial speeds

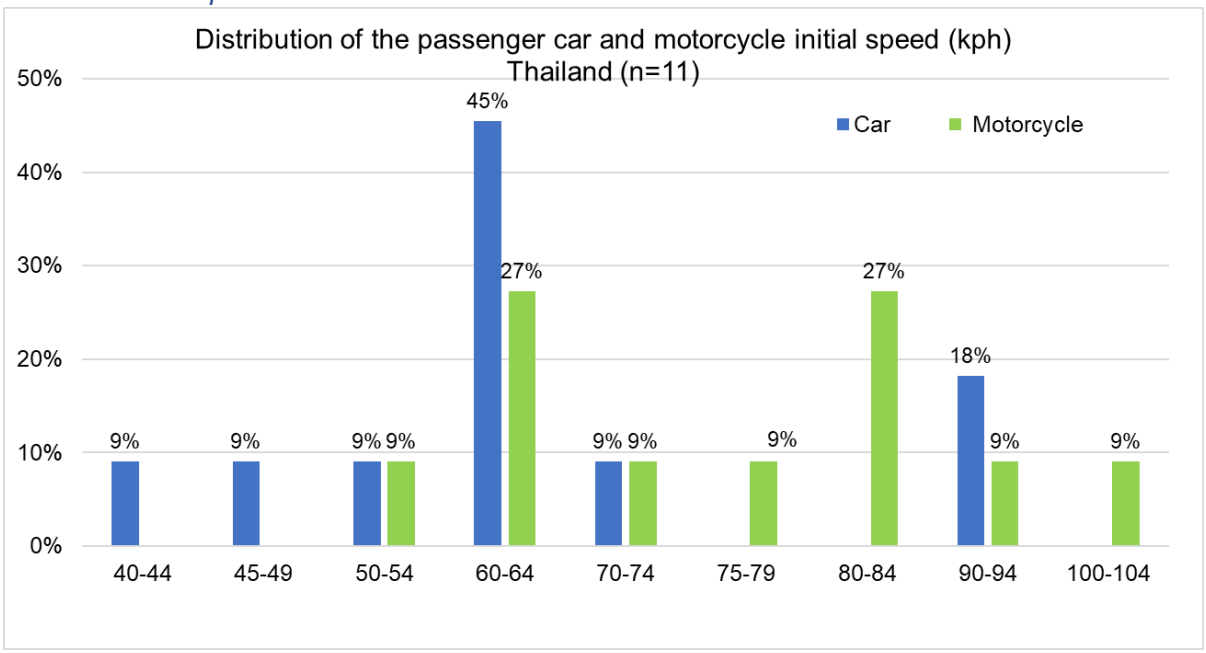


Figure 94: Initial speeds – Thailand – HEAD-ON 2 SCENARIO

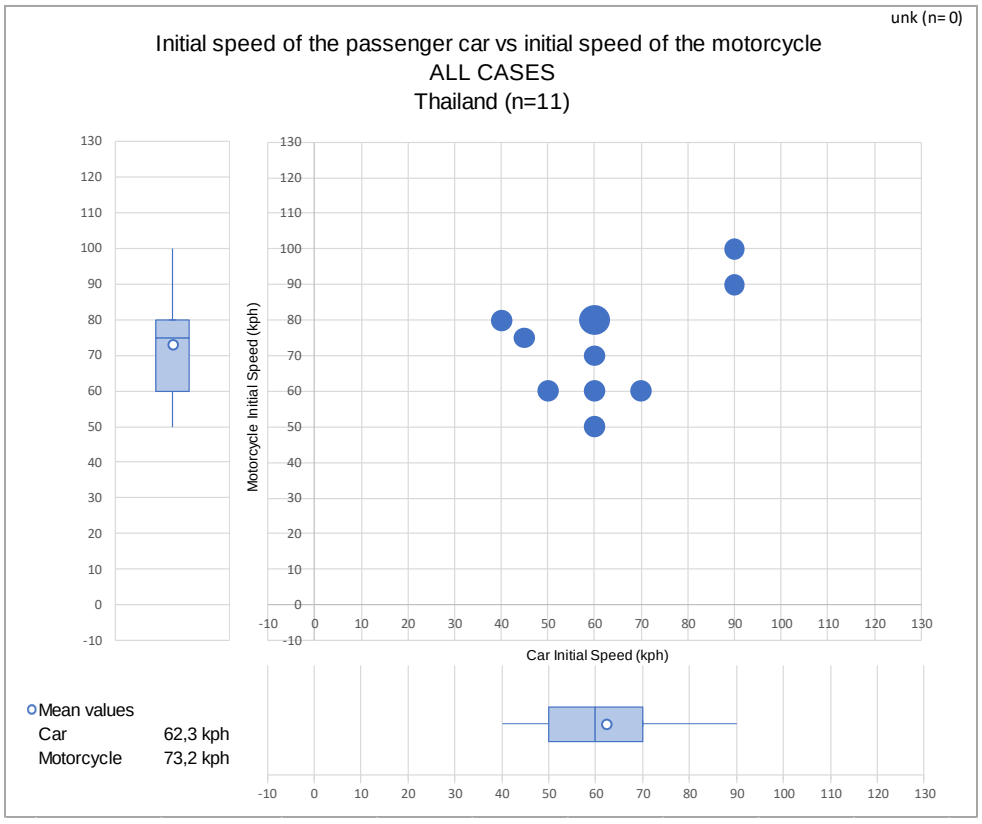


Figure 95: Initial speed of the car versus initial speed of the motorcycle, all cases – Thailand – HEAD-ON 2 SCENARIO

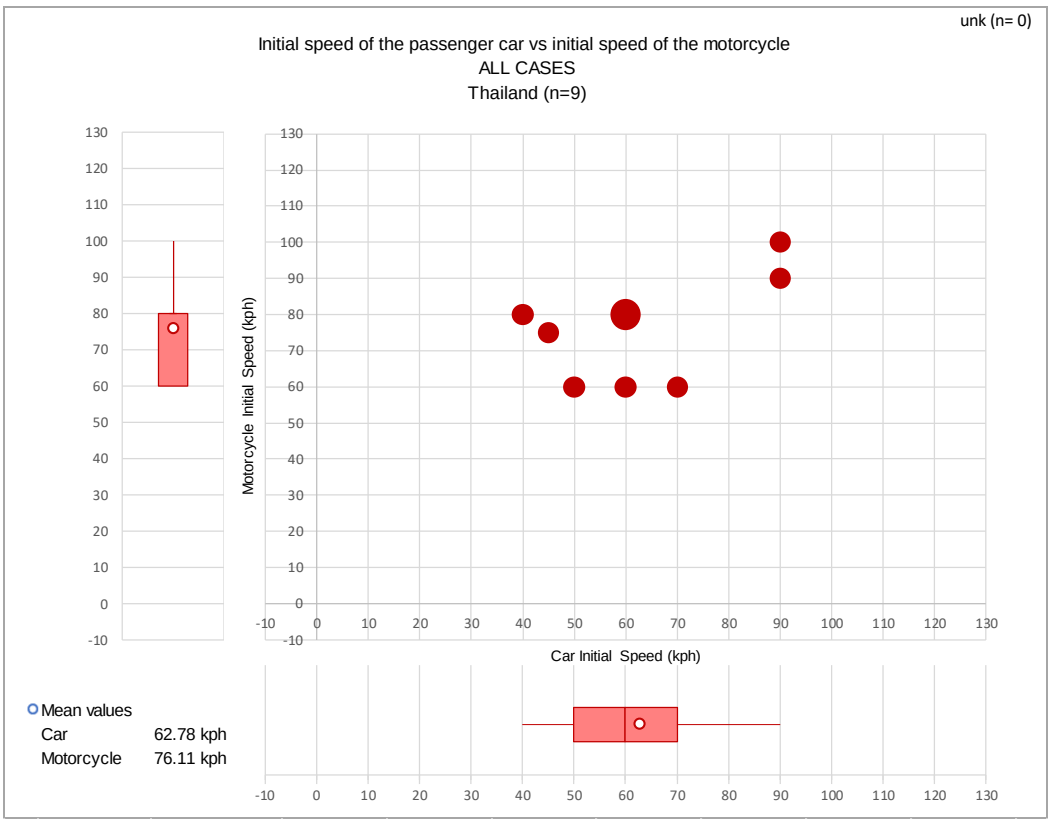


Figure 96: Initial speed of the car versus initial speed of the motorcycle, KSI cases – Thailand HEAD-ON 2 SCENARIO

Table 26: Initial speed values for the car and the motorcycle, all cases – Thailand – HEAD-ON 2 SCENARIO

All Accidents																										unk: 0
Number of cases	Passenger Car Initial Speed (kph)																									
Motorcycle Initial Speed (kph)	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
0																										
1																										
5																										
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65																										
70														1												
75											1															
80										1				2												
85																										
90																				1						
95																										
100																				1						
105≤																										

Table 27: Initial speed values for the car and the motorcycle, KSI cases – Thailand – HEAD-ON 2 SCENARIO

KSI Accidents																										unk:	0
Number of cases	Passenger Car Initial Speed (kph)																										
Motorcycle Initial Speed (kph)	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
0																										
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75											1															
80										1				2												
85																										
90																				1						
95																										
100																				1						
105≤																										

3.3.3.6 Collision speeds

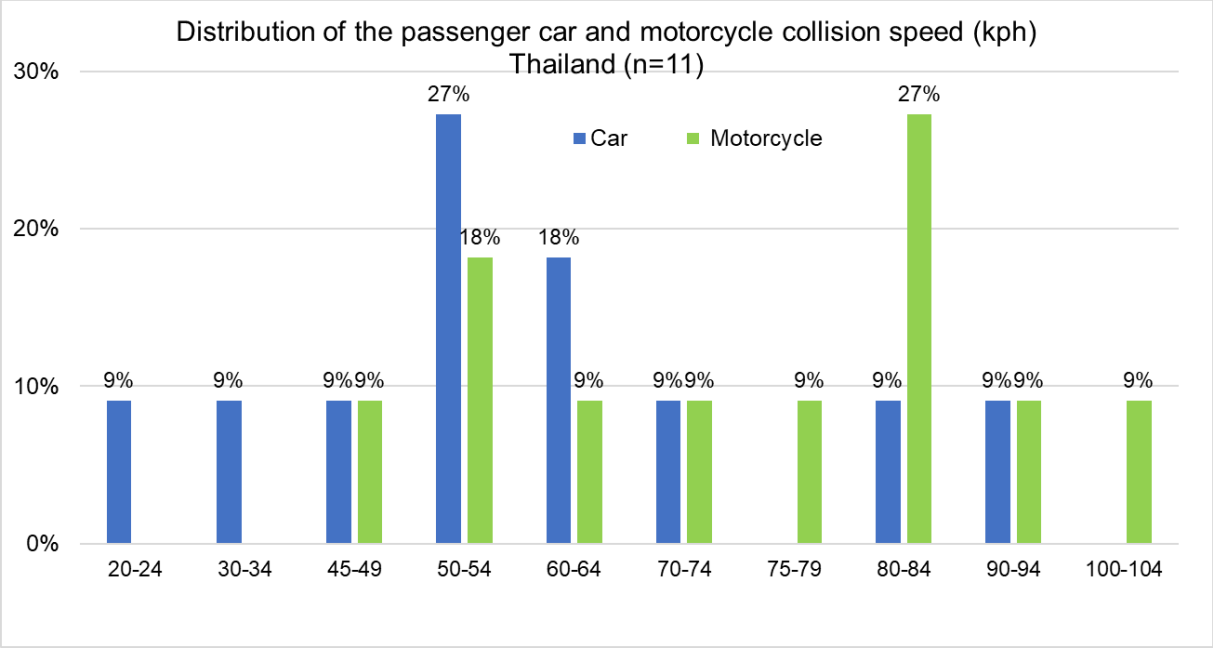

Figure 97: Collision speeds – Thailand – HEAD-ON 2 SCENARIO

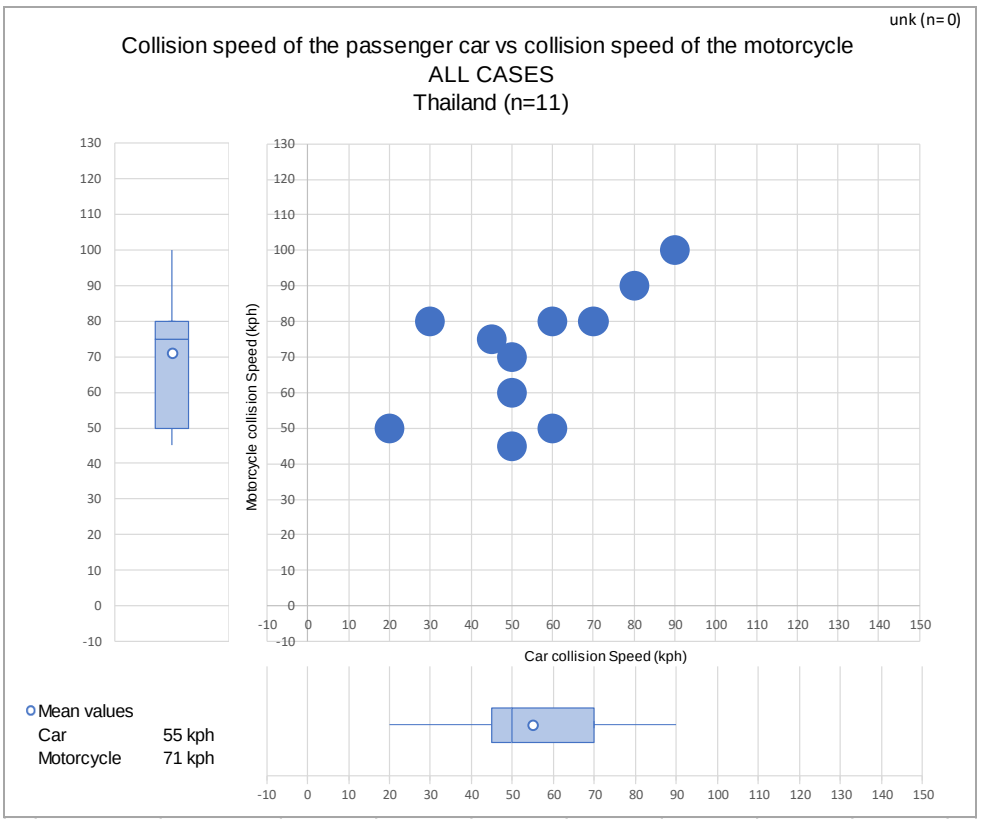

Figure 98: Collision speed of the car versus collision speed of the motorcycle, all cases – Thailand – HEAD-ON 2 SCENARIO

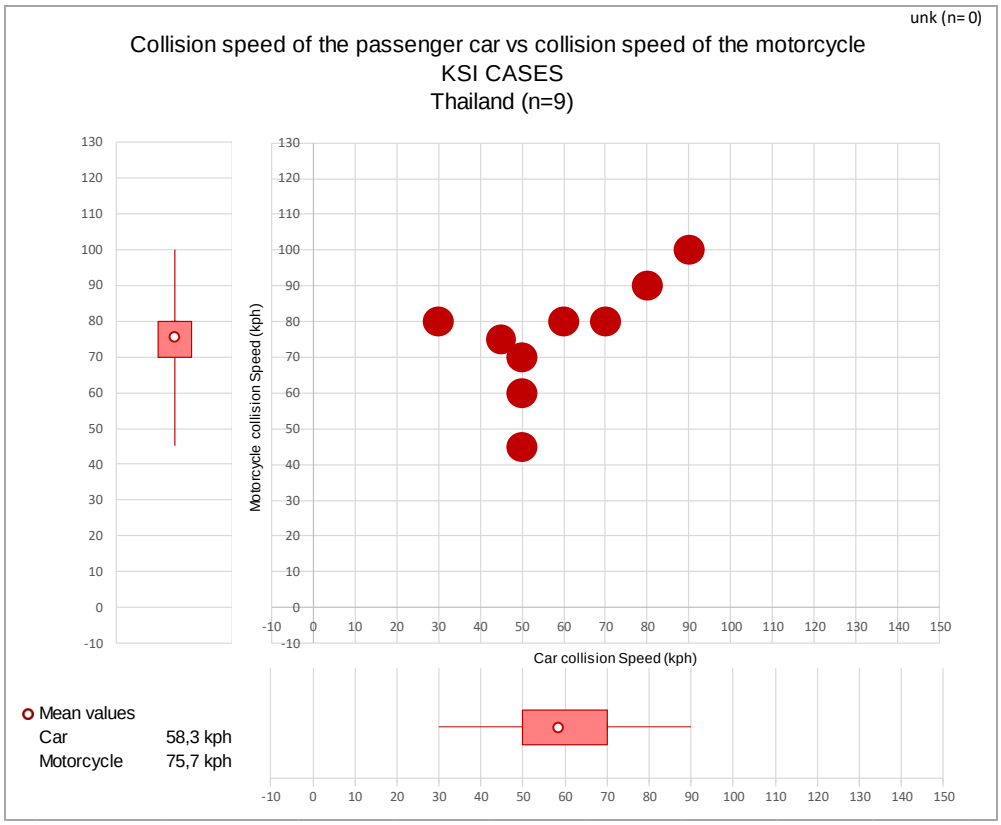

Figure 99: Collision speed of the car versus collision speed of the motorcycle, KSI cases – Thailand – HEAD-ON 2 SCENARIO

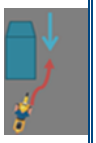

Table 28: Collision speed values for the car and the motorcycle, all cases – Thailand – HEAD-ON 2 SCENARIO

All Accidents																										unk:	0
Number of cases		Passenger Car Collision Speed (kph)																									
		0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Collision Speed (kph)	0																										
	1																										
	5																										
	10																										
	15																										
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	80								1						1		1										
	85																										
	90																		1								
	95																										
	100																				1						
	105≤																										

Table 29: Collision speed values for the car and the motorcycle, KSI cases – Thailand – HEAD-ON 2 SCENARIO

KSI Accidents																										unk:	0
Number of cases		Passenger Car Collision Speed (kph)																									
		0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Collision Speed (kph)	0																										
	1																										
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	70												1														
	75											1															
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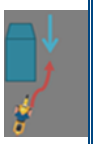
	85																										
	90																		1								
	95																										
	100																				1						
	105≤																										



3.3.3.7 Delta initial velocity – calculated

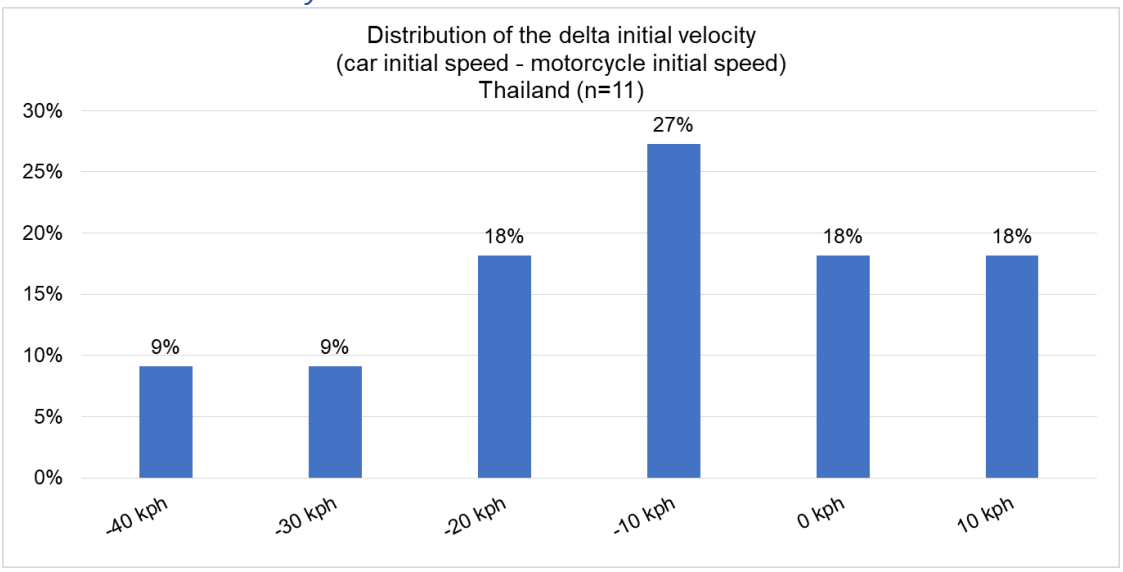


Figure 100: Delta initial velocity – Thailand – HEAD-ON 2 SCENARIO

3.3.3.8 Skid marks

In this scenario braking skids marks were not observed either for the car nor for the motorcycle.

3.3.3.9 ABS fitment on the car

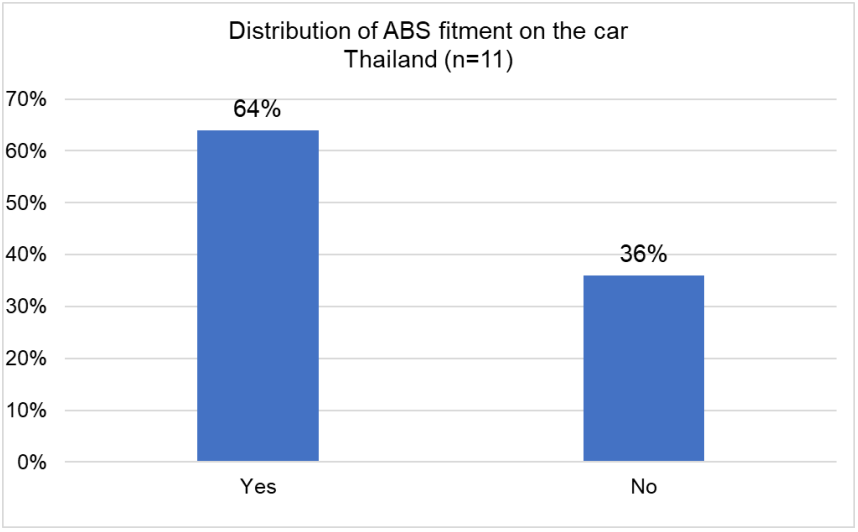


Figure 101: ABS fitment – Thailand – HEAD-ON 2 SCENARIO

3.3.3.10 Motorcycle manoeuvre before crash

All the motorcycles within this sub-scenario are doing a passing on the right manoeuvre.

3.3.3.11 Car manoeuvre before crash

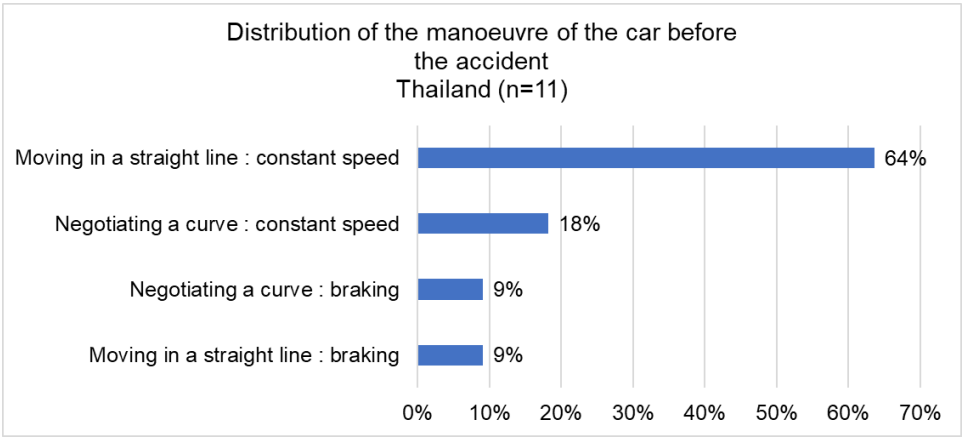


Figure 102: Car manoeuvre – Thailand – HEAD-ON 2 SCENARIO

3.3.3.12 Avoidance action by vehicle

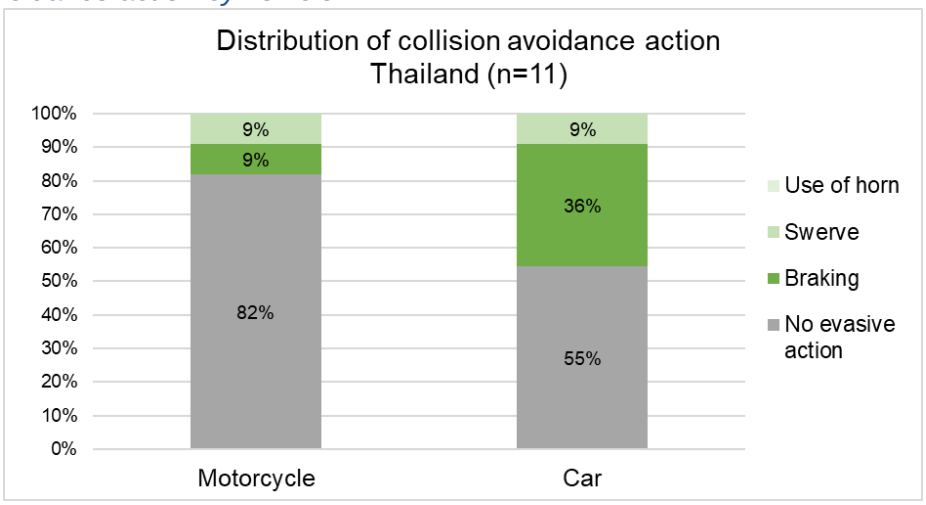


Figure 103: Avoidance action by vehicle – Thailand – HEAD-ON 2 SCENARIO

3.3.3.13 Conclusion on accident characteristics

Table 30: Conclusion on accident characteristics – Thailand – HEAD-ON 2 SCENARIO

Accident characteristics	**HEAD-ON 2**	*Thai data*

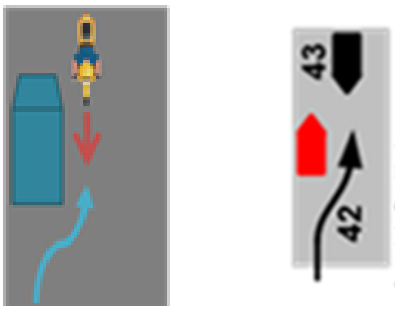
- ✓ *36% of the accidents with visibility obstruction due to vehicles in front, 9% due to road curvature.*
- ✓ *100% frontal impact for the motorcycle.*
- ✓ *91% frontal impact for the car.*
- ✓ *Mean initial speed: Car=62,3 kph and Motorcycle=73,2 kph*
- ✓ *Mean collision speed: Car=55 kph and Motorcycle=71,1 kph*
- ✓ *64% of the car had ABS.*

- ✓ *All motorcycles pass on the right.*
- ✓ *The car goes straight at constant speed (64%) or is negotiating a curve (18%).*
- ✓ *Avoidance action for 45% of the cars and 18% of the motorcycles. The cars mostly brake.*

3.4 Thai database: Car changing lane and colliding with oncoming motorcycle (Head-on 3)

This third head-on sub-scenario represents **1,4%** of all the accidents and **3,5%** of the KSI accidents in the Thai database.

In this sub-scenario, the car changes lane (passing right) and hit the oncoming motorcycle. This configuration is illustrated by the figure below:



(a) (b)
Car=52
Motorcycle=43

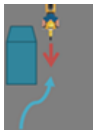
Figure 104: (a) Illustration of the HEAD-ON 3 scenario, (b) pictogram from the Thai database.

The following graphs provide in-depth description of the sub-scenario. There are 10 cases in the Thai database.

3.4.1 Accident characteristics – general conditions

3.4.1.1 Weather conditions

All the accidents within this sub-scenario occur with clear weather conditions.



3.4.1.2 Light conditions

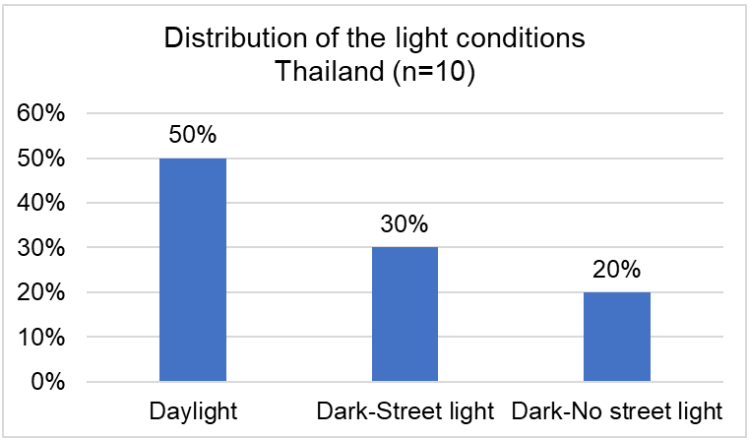


Figure 105: Light conditions - Thailand – HEAD-ON 3 SCENARIO

3.4.1.3 Road surface conditions

All the accidents within this sub-scenario occur on a dry road.

3.4.1.4 Conclusion on general accident conditions

Table 31: Conclusion on general accident conditions – Thailand – HEAD-ON 3 SCENARIO

General conditions	**HEAD-ON 3**	*Thai data*
✓ *Clear weather for all the cases.* ✓ *50% of the accidents happen during the day (30% at night with streetlights).* ✓ *Dry road surface for all the cases.*		

The environmental conditions are similar in Thailand and Malaysia based on the databases, with good weather conditions and half of the head-on accidents happening at night.

3.4.2 Road characteristics

3.4.2.1 Location (city/urban)

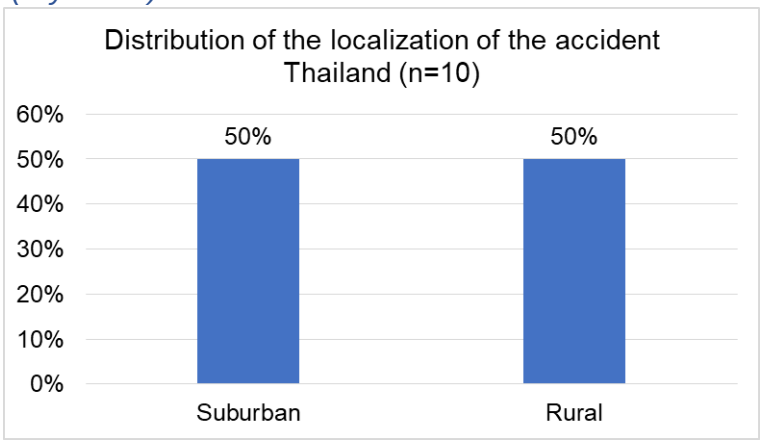
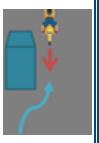


Figure 106: Localization of the accident –Thailand – HEAD-ON 3 SCENARIO



3.4.2.2 Road category

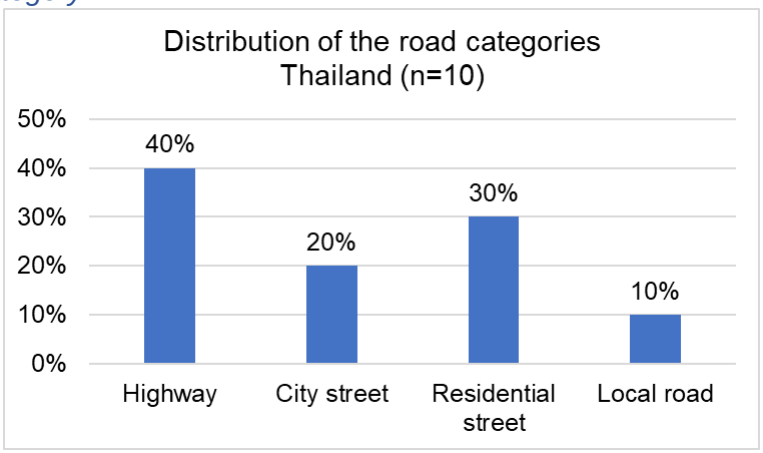


Figure 107: Road category – Thailand – HEAD-ON 3 SCENARIO

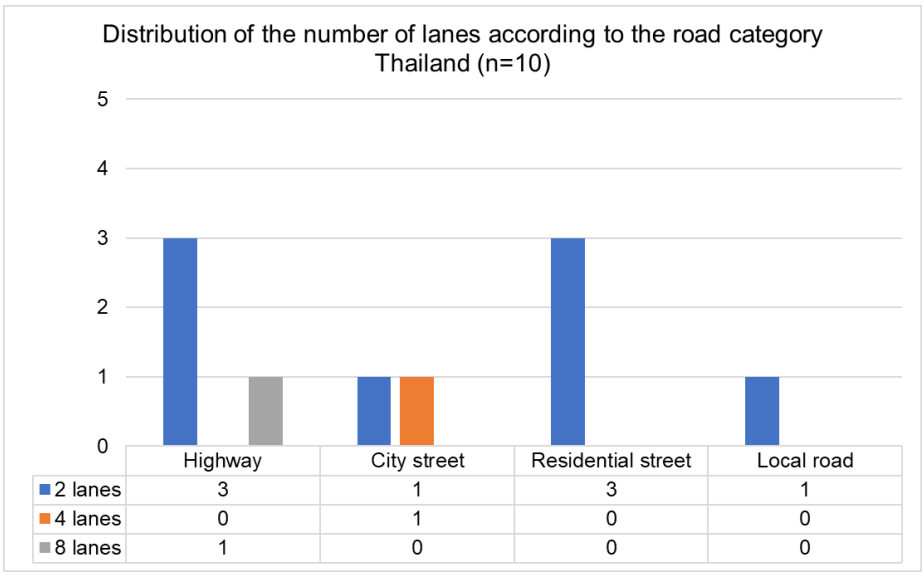


Figure 108: Road category and number of lanes – Thailand – HEAD-ON 3 SCENARIO

3.4.2.3 Configuration

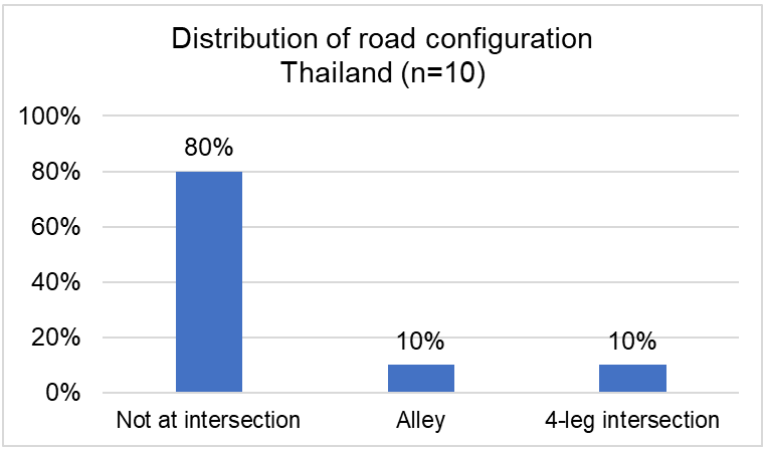
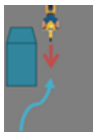


Figure 109: Configuration – Thailand – HEAD-ON 3 SCENARIO



3.4.2.4 Road geometry

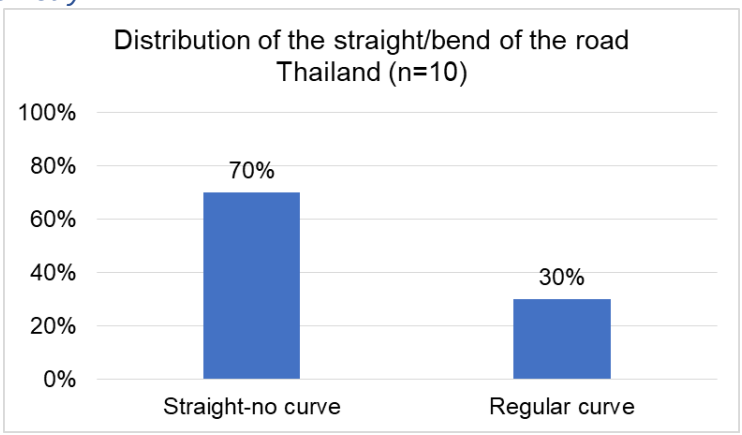


Figure 110: Road geometry – Thailand – HEAD-ON 3 SCENARIO

3.4.2.5 Slope

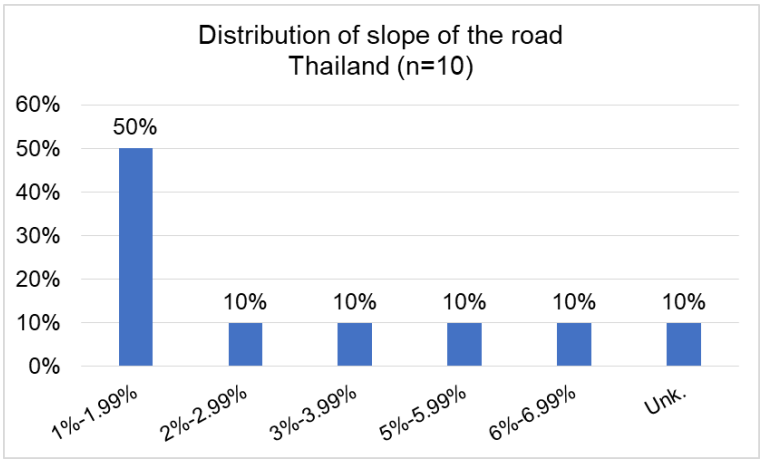


Figure 111: Slop of the road – Thailand – HEAD-ON 3 SCENARIO

3.4.2.6 Speed limit

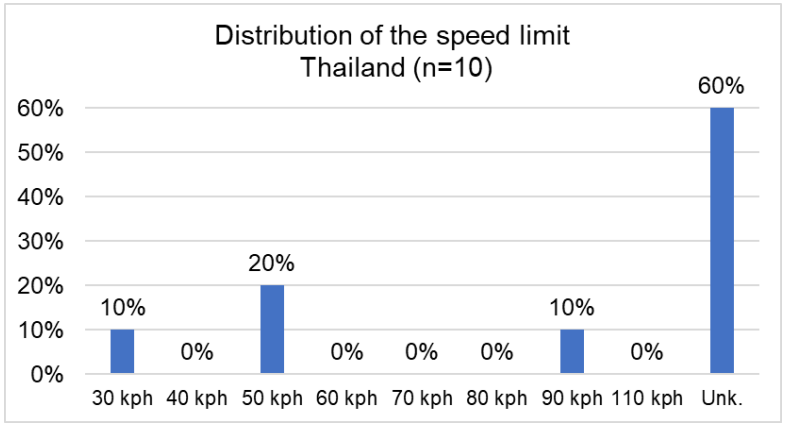
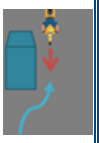


Figure 112: Speed limits – Thailand – HEAD-ON 3 SCENARIO

3.4.2.7 Number of lanes



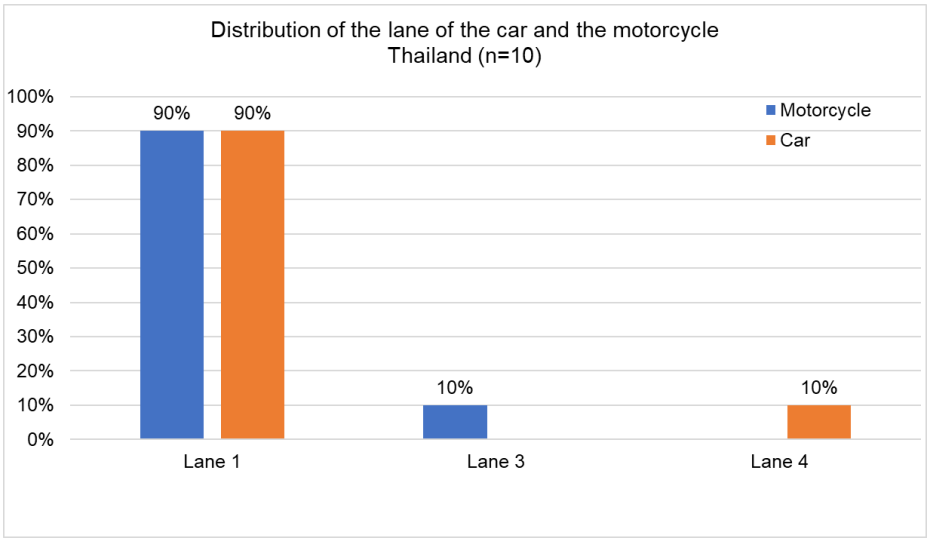
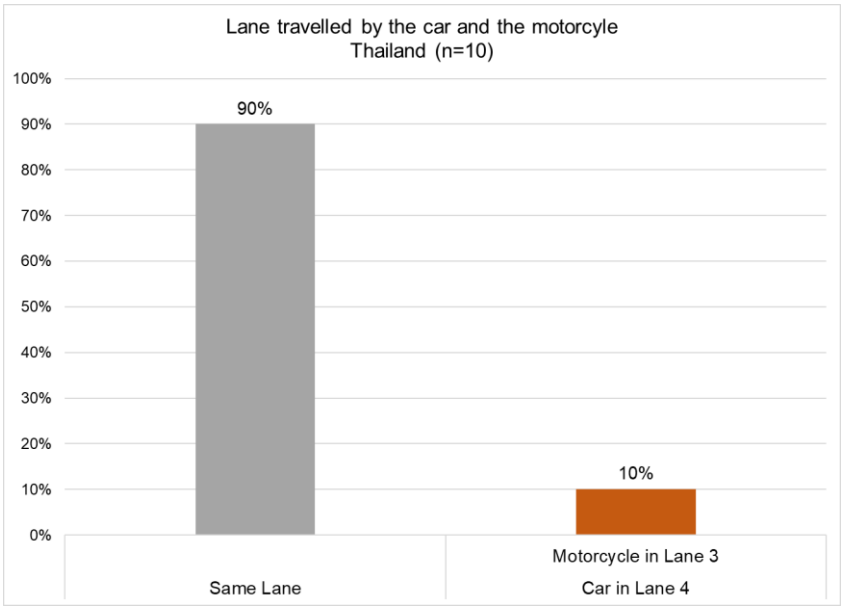


Figure 113: Lanes of the vehicles – Thailand – HEAD-ON 3 SCENARIO

3.4.2.8 Travelled lane



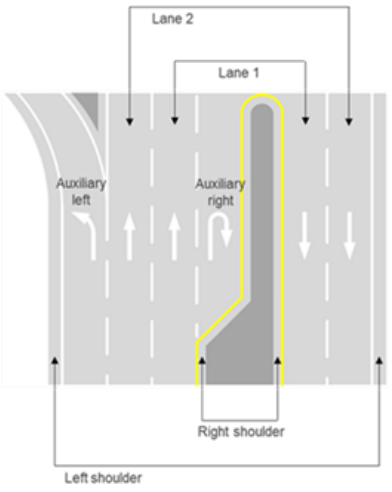
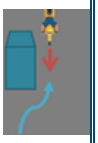


Figure 114: Vehicles on same lane – Thailand – HEAD-ON 3 SCENARIO



3.4.2.9 Conclusion on road characteristics

Table 32: Conclusion on road characteristics – Thailand – HEAD-ON 3 SCENARIO

Road characteristics	**HEAD-ON 3**	*Thai data*

- ✓ *50% in rural area and 50% in suburban area.*
- ✓ *40% of the accidents occur on highways and 30% on residential streets.*
- ✓ *2 lanes roads.*
- ✓ *80% of the accidents are out of intersection.*
- ✓ *70% of the accidents happen in a straight road.*
- ✓ *Speed limit is mainly unknow (60%), 20% at 50 kph.*
- ✓ *90% of the vehicles were in lane1, both in the same lane.*

The conclusion on this scenario is relevant with the Malaysian data. The accidents seem to happen mostly on straight roads, out of intersections.

3.4.3 Accident characteristics – vehicles

3.4.3.1 Visibility

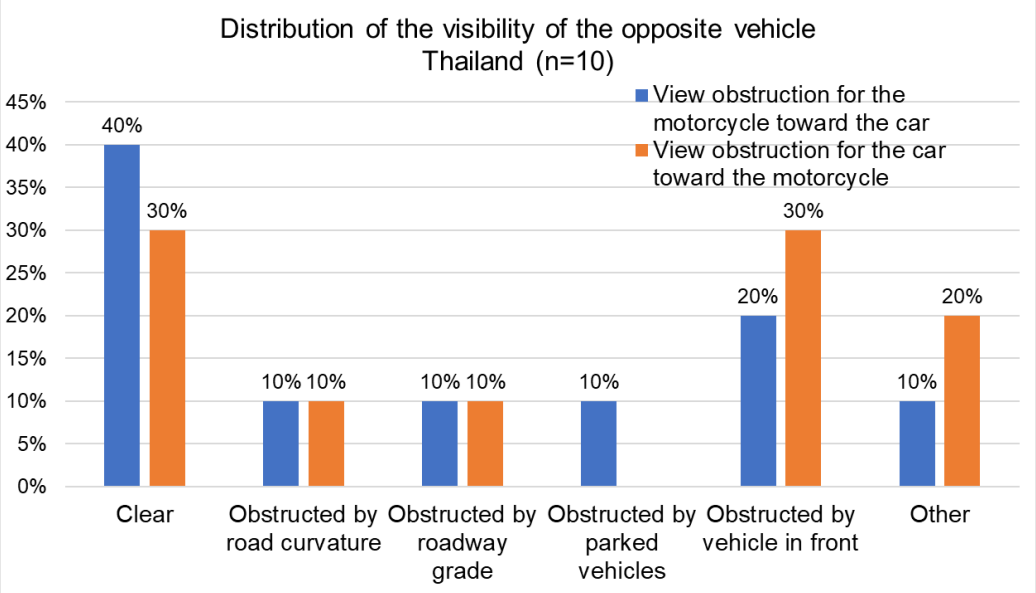
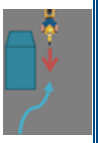
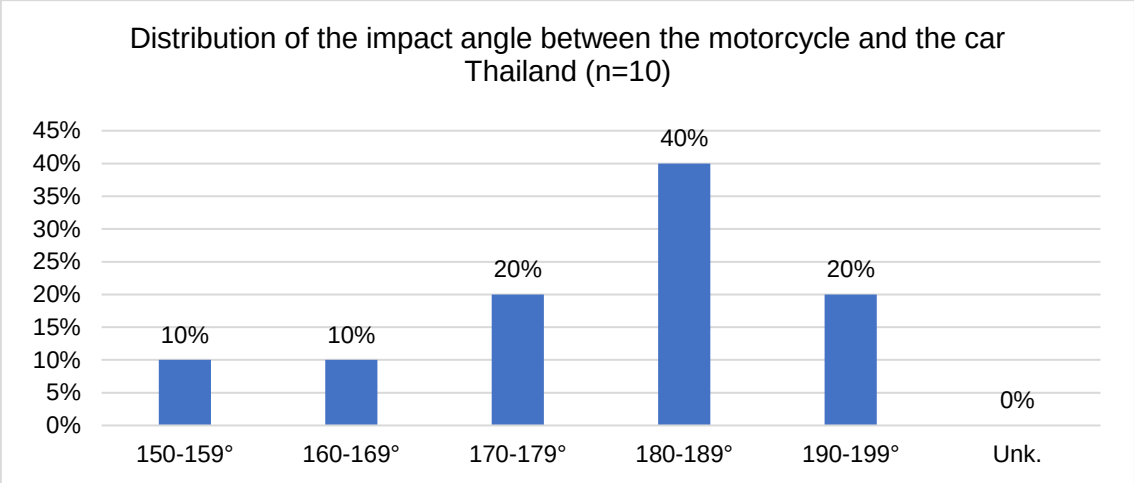


Figure 115: Visibility – Thailand – HEAD-ON 3 SCENARIO

3.4.3.2 Impact angle





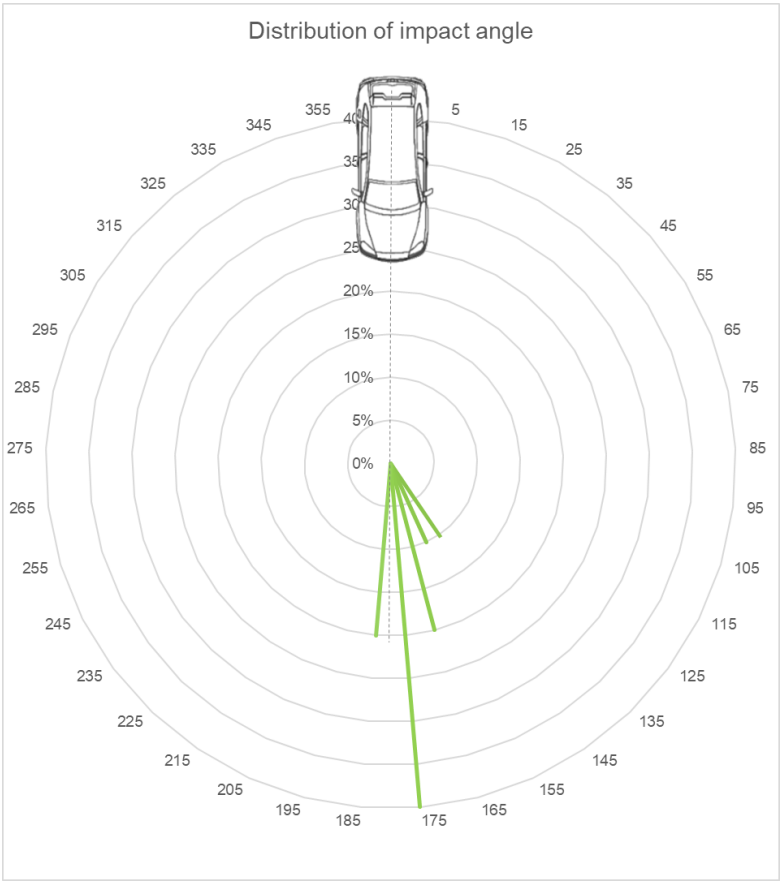


Figure 116: Impact angle – Thailand – HEAD-ON 3 SCENARIO

3.4.3.3 Motorcycle impact type

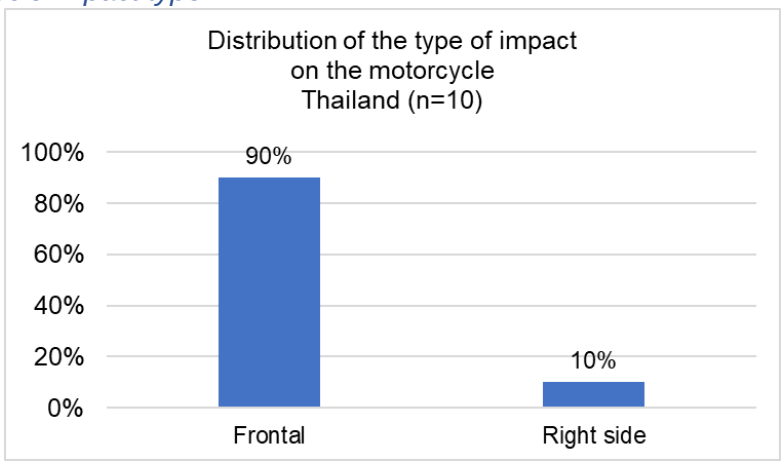


Figure 117: Type of impact for the motorcycle – Thailand – HEAD-ON 3 SCENARIO

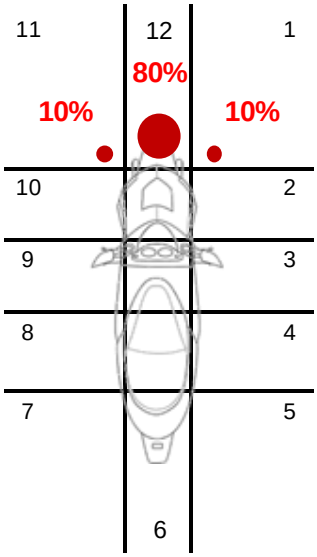


Figure 118: First collision point for the motorcycle – Thailand – HEAD-ON 3 SCENARIO

3.4.3.4 Car impact type

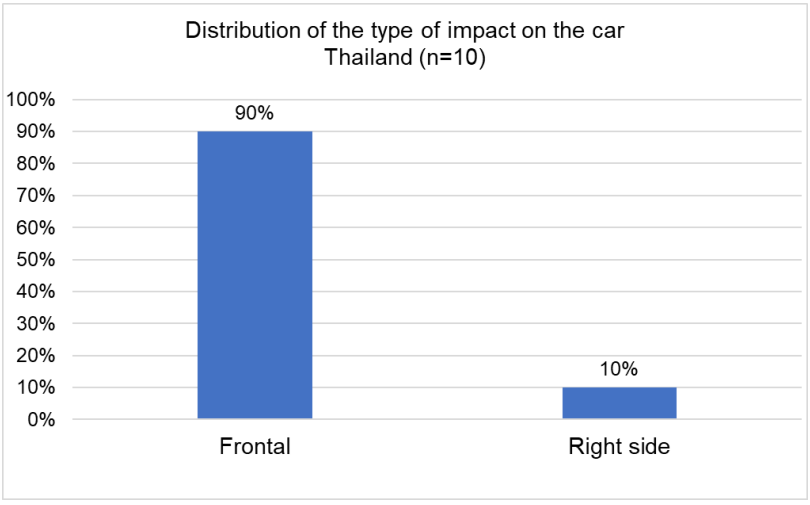
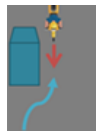


Figure 119: Type of impact for the car– Thailand – HEAD-ON 3 SCENARIO



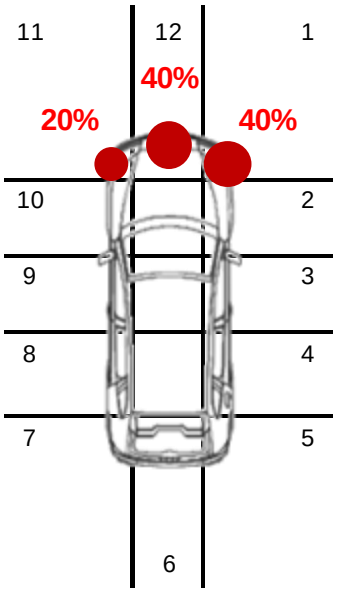


Figure 120: First collision point for the car – Thailand – HEAD-ON 3 SCENARIO

3.4.3.5 Initial speeds

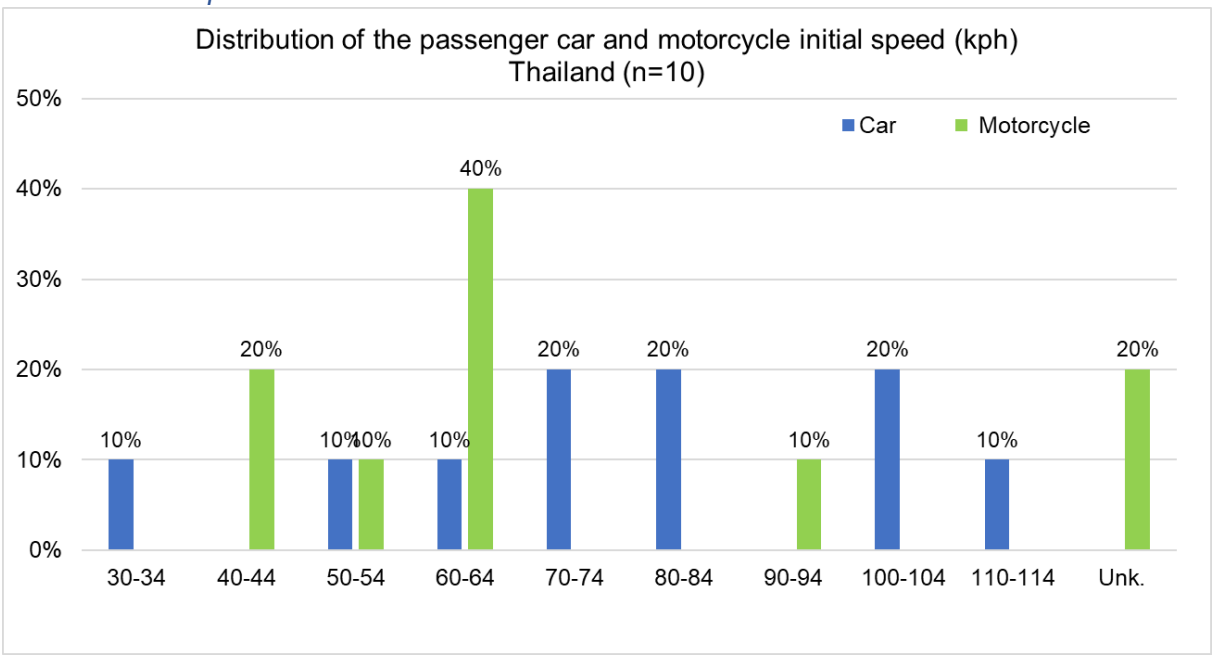
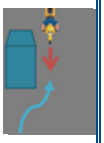


Figure 121: Initial speeds – Thailand – HEAD-ON 3 SCENARIO



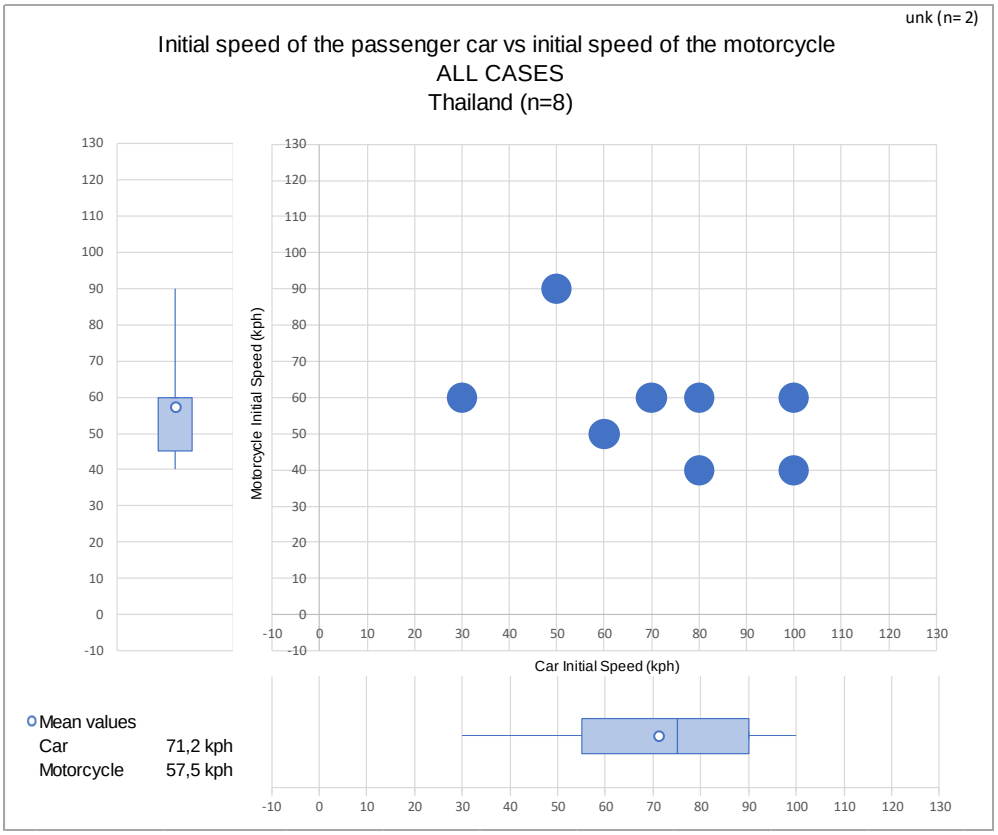


Figure 122: Initial speed of the car versus initial speed of the motorcycle, all cases – Thailand – HEAD-ON 3 SCENARIO

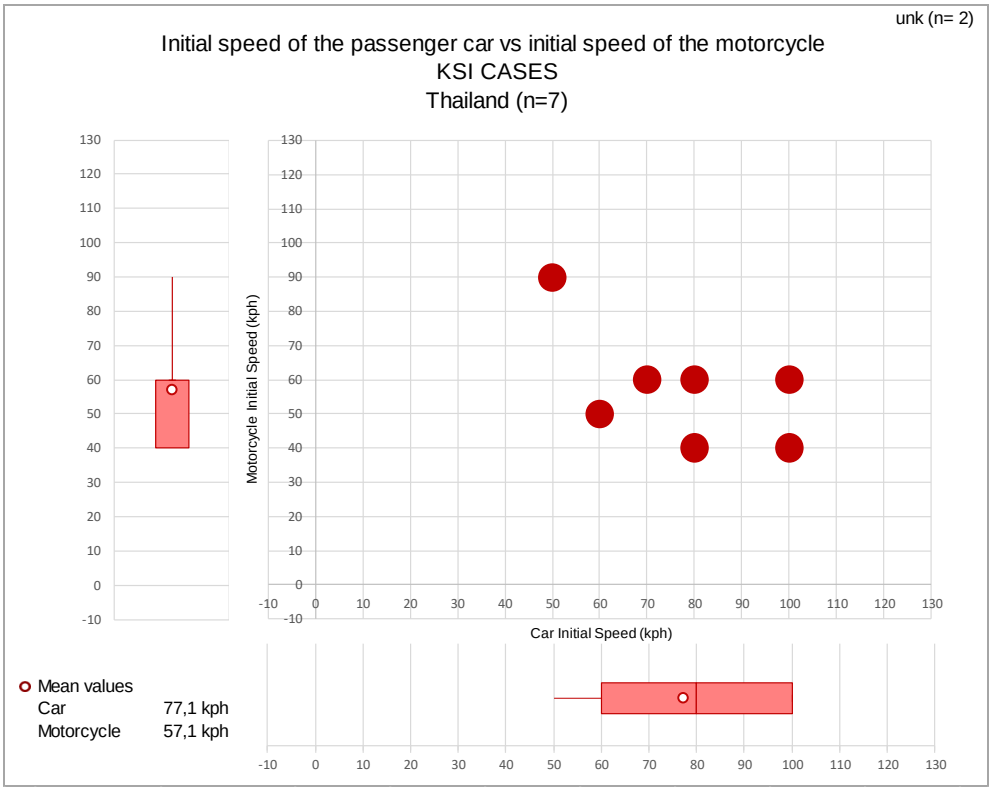


Figure 123: Initial speed of the car versus initial speed of the motorcycle, KSI cases – Thailand HEAD-ON 3 SCENARIO

Table 33: Initial speed values for the car and the motorcycle, all cases – Thailand – HEAD-ON 3 SCENARIO

All Accidents																										unk:	2
Number of cases	Passenger Car Initial Speed (kph)																										
	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Initial Speed (kph) 0																										
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105≤																										

Table 34: Initial speed values for the car and the motorcycle, KSI cases – Thailand – HEAD-ON 3 SCENARIO

All Accidents																										unk:	2
Number of cases	Passenger Car Initial Speed (kph)																										
	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Initial Speed (kph) 0																										
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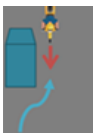
105≤																										

3.4.3.6 Collision speeds



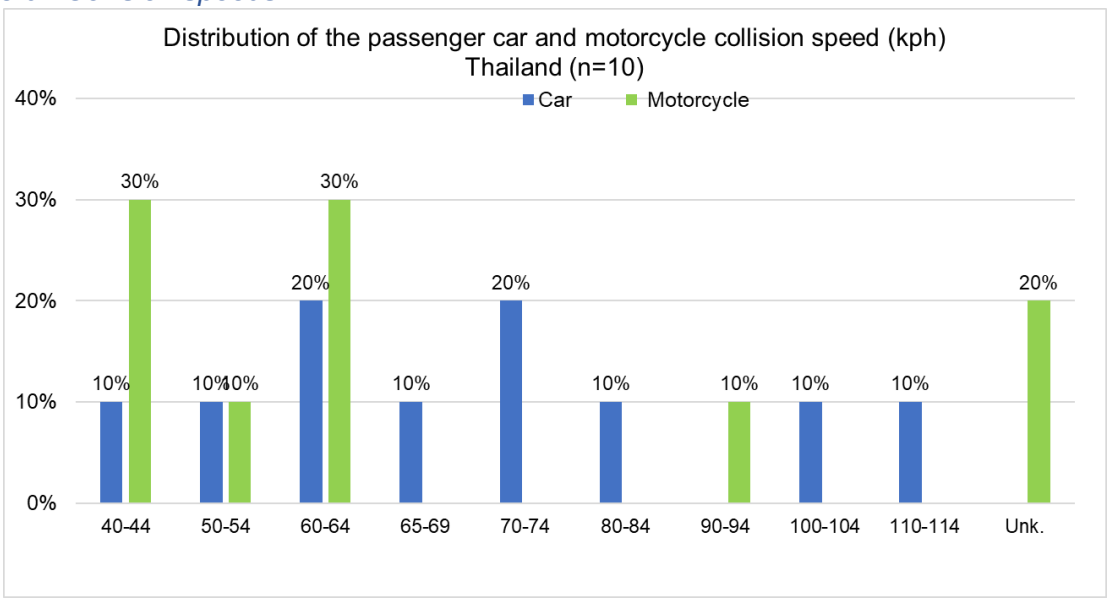


Figure 124: Collision speeds – Thailand – HEAD-ON 3 SCENARIO

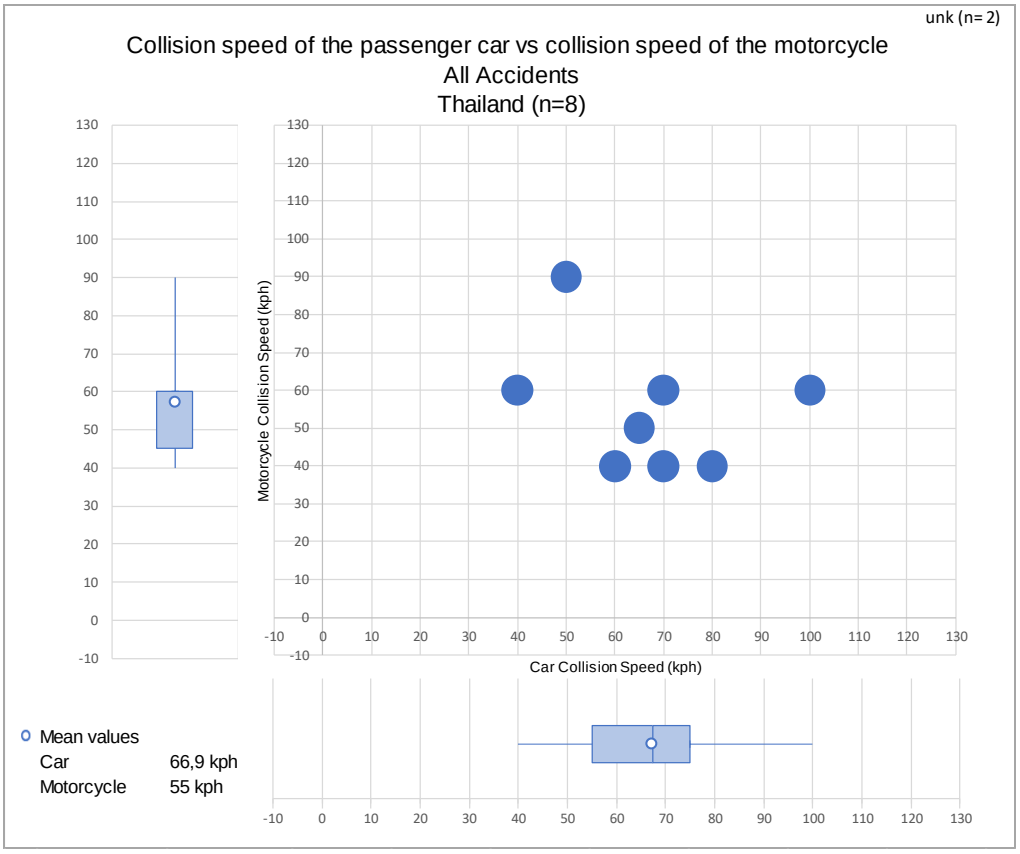


Figure 125: Collision speed of the car versus collision speed of the motorcycle, all cases – Thailand – HEAD-ON 3 SCENARIO

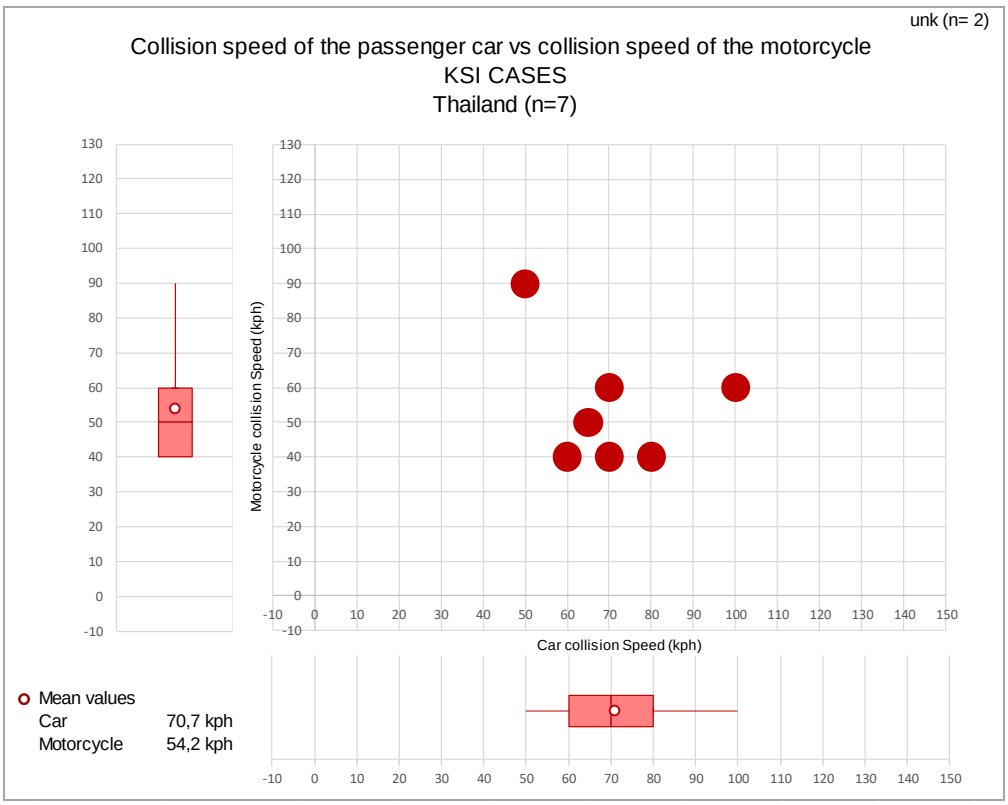


Figure 126: Collision speed of the car versus collision speed of the motorcycle, KSI cases – Thailand – HEAD-ON 3 SCENARIO

Table 35: Collision speed values for the car and the motorcycle, all cases – Thailand – HEAD-ON 3 SCENARIO

All Accidents																										unk:	2
Number of cases	Passenger Car Collision Speed (kph)																										
Motorcycle Collision Speed (kph)	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
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Table 36: Collision speed values for the car and the motorcycle, KSI cases – Thailand – HEAD-ON 3 SCENARIO

KSI Accidents																										unk:	2
Number of cases	Passenger Car Collision Speed (kph)																										
Motorcycle Collision Speed (kph)	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
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105≤																										

3.4.3.7 *Delta initial velocity (kph) – calculated*

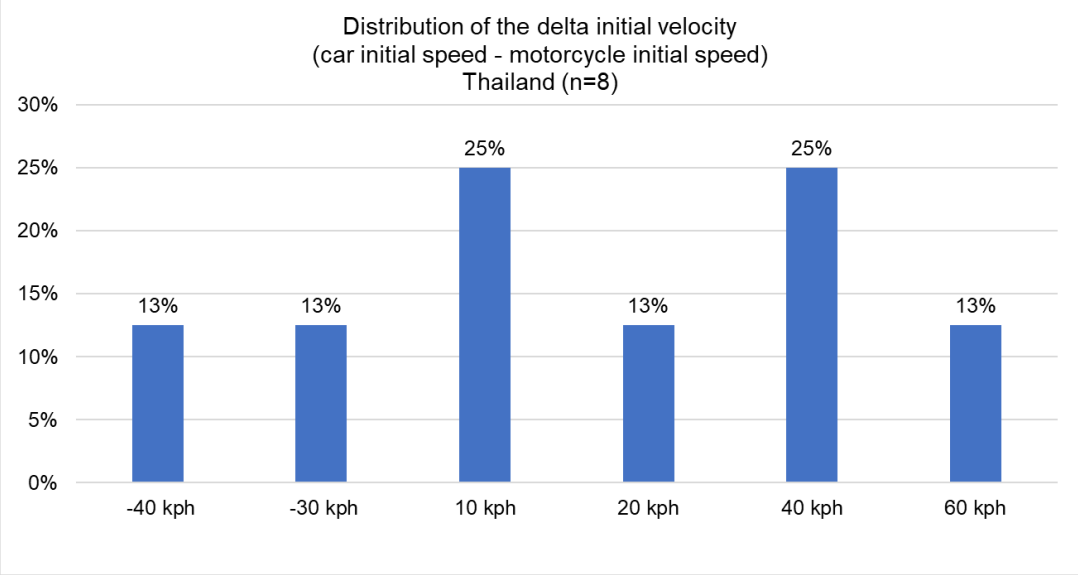
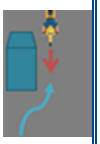


Figure 127: Delta initial velocity (kph) – Thailand – HEAD-ON 3 SCENARIO



3.4.3.8 Skid marks

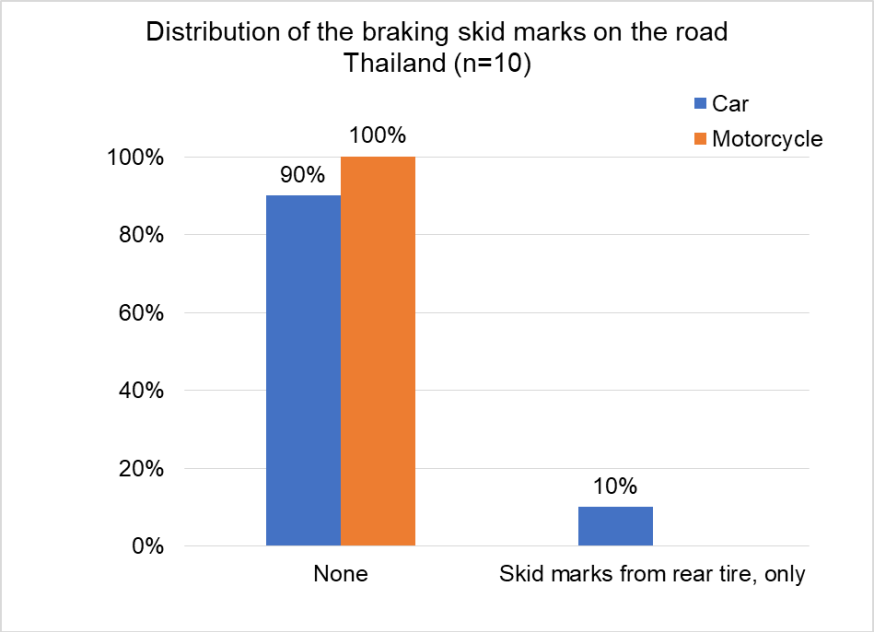


Figure 128: Skid marks – Thailand – HEAD-ON 3 SCENARIO

3.4.3.9 ABS fitment on the car

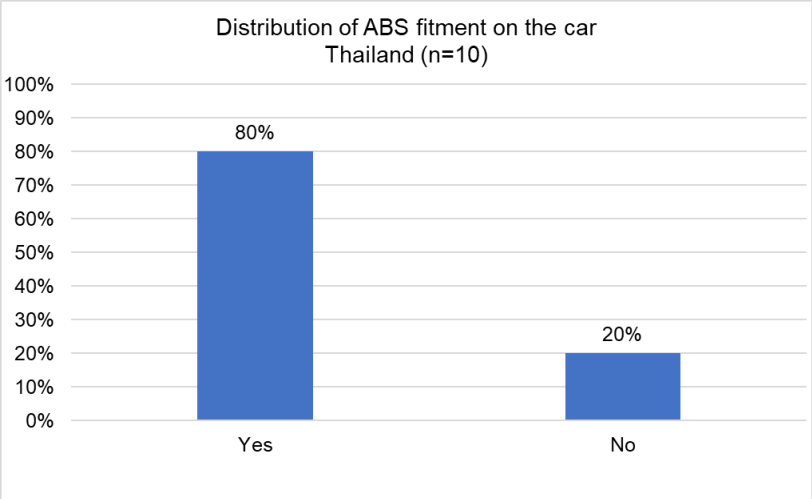
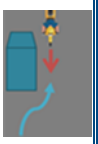


Figure 129: ABS fitment – Thailand – HEAD-ON 3 SCENARIO



3.4.3.10 Motorcycle manoeuvre before crash

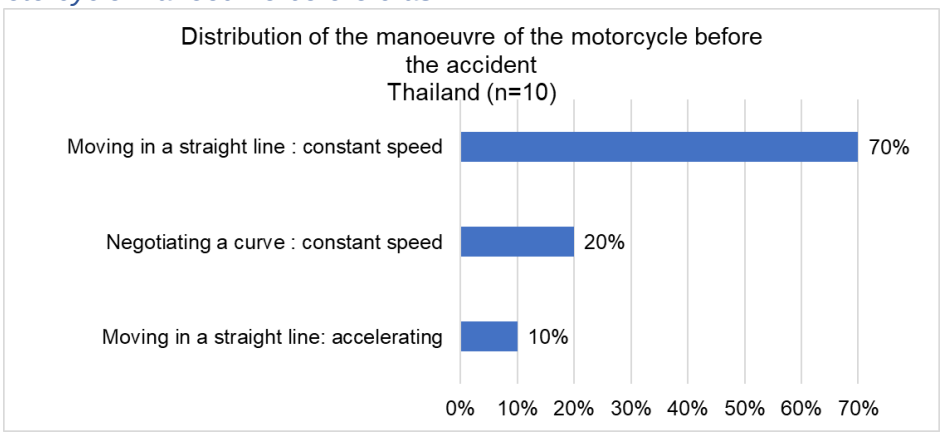


Figure 130: Motorcycle manoeuvre – Thailand – HEAD-ON 3 SCENARIO

3.4.3.11 Car manoeuvre before crash

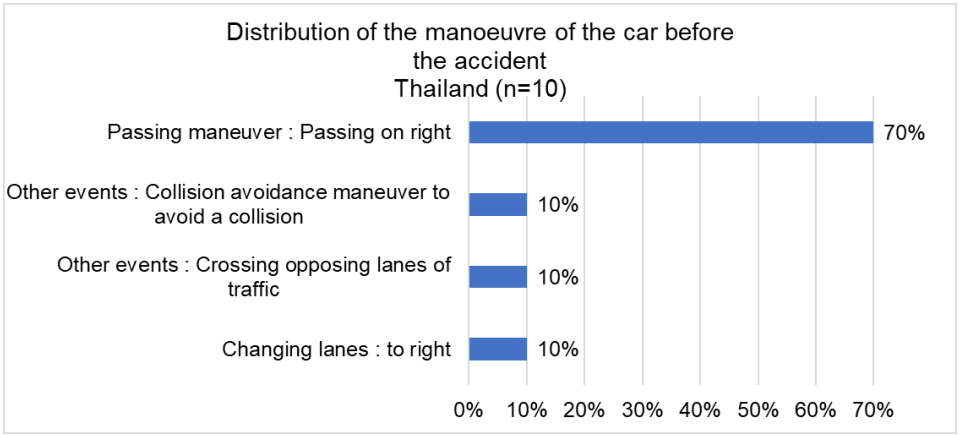


Figure 131: Car manoeuvre – Thailand – HEAD-ON 3 SCENARIO

3.4.3.12 Avoidance action by vehicle

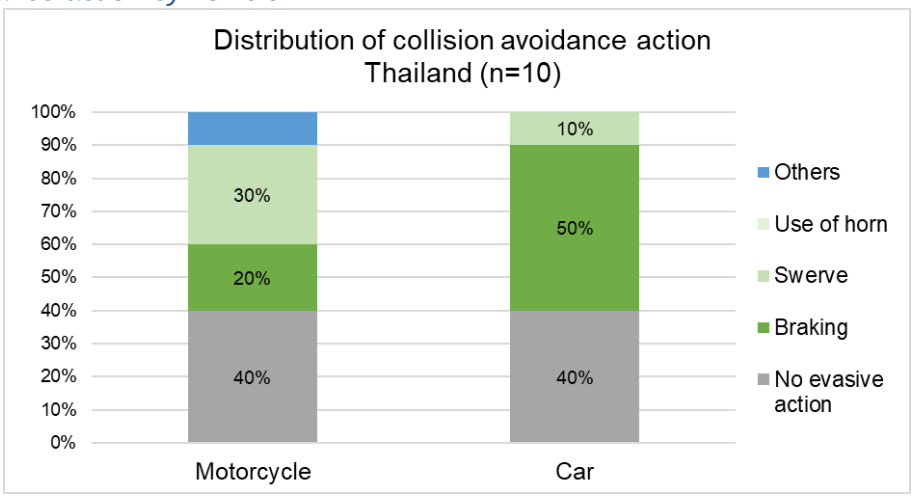


Figure 132: Avoidance action by vehicle – Thailand – HEAD-ON 3 SCENARIO

3.4.3.13 Conclusion on accident characteristics

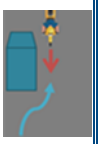


Table 37: Conclusion on accident characteristics – Thailand – HEAD-ON 3 SCENARIO

Accident characteristics	**HEAD-ON 3**	*Thai data*

- ✓ *Clear visibility for 40% of the motorcycles and 30% of the cars. Visibility obstructed by a vehicle in front for 30% of the cars and 20% of the motorcycles.*
- ✓ *90% frontal impact for the motorcycle.*
- ✓ *90% frontal impact for the car.*
- ✓ *Mean initial speed: Car=71,2 kph and Motorcycle=57,5 kph*
- ✓ *Mean collision speed: Car=66,9 kph and Motorcycle=55 kph*
- ✓ *80% of the car had ABS.*
- ✓ *The motorcycle goes straight at constant speed (70%) or is negotiating a curve at constant speed (20%).*
- ✓ *The car is passing on right in 70% of the cases.*
- ✓ *Avoidance action for 60% of the cars and the motorcycles. The cars mostly brake and the motorcycles swerve and brake.*

4 Angular scenarios with motorcycle going straight

The angular scenarios with the motorcycle going straight are defined as accidents with an angular collision, a frontal or a lateral impact on the motorcycle, no turning manoeuvre from the motorcycle and vehicles traveling in the same or opposite direction. These accident scenarios represent **19%** of the KSI accidents in the Malaysian database and **29%** in the Thai database.

The angular accident scenario is divided in 3 OASIM angular sub-scenario clusters which will be described with the Thai data, whereas the overall angular accident scenario is described with the Malaysian data, in the following paragraph.

4.1 Malaysian database

This part is describing the distributions of the variables in the Malaysian database for the angular with frontal or lateral impact on the motorcycle scenario. There are 293 accidents of this scenario in the Malaysian database.

4.1.1 Accident characteristics – general conditions

4.1.1.1 Weather conditions

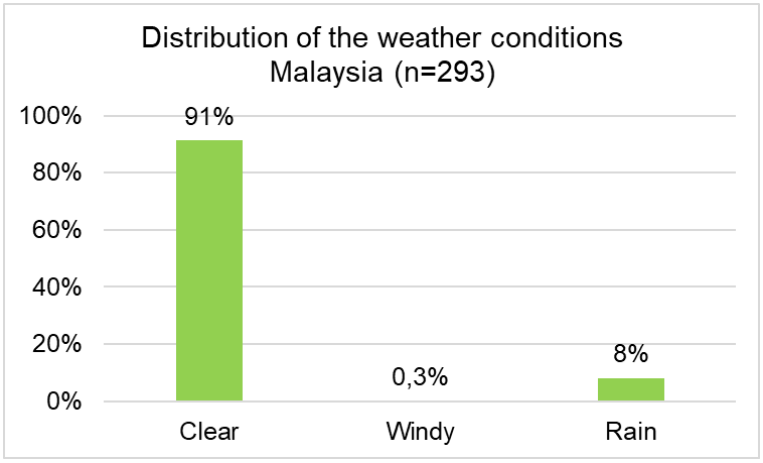


Figure 133: Weather conditions - Malaysia - ANGULAR MOTORCYCLE GOING STRAIGHT SCENARIO

4.1.1.2 Light conditions

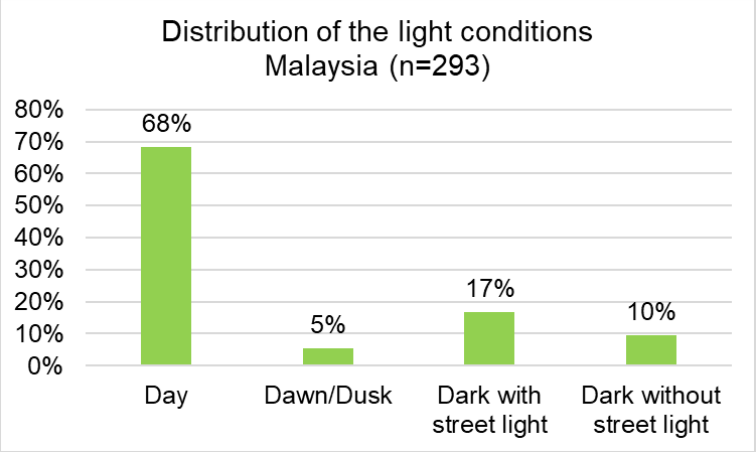


Figure 134: Light conditions - Malaysia - ANGULAR MOTORCYCLE GOING STRAIGHT SCENARIO

4.1.1.3 Road surface conditions

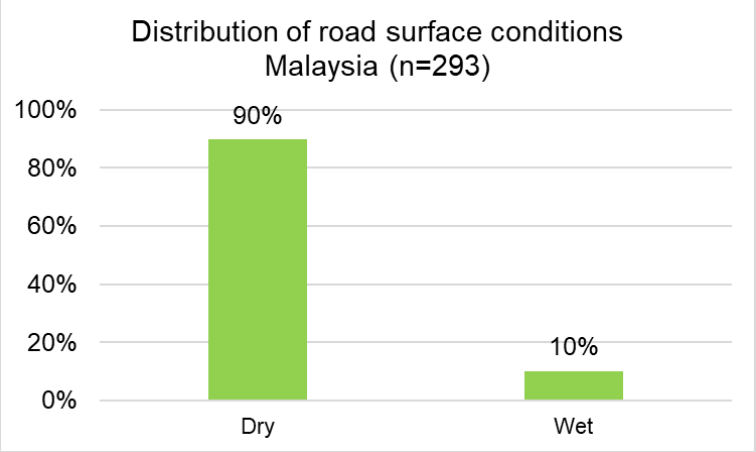


Figure 135: Road surface conditions – Malaysia – ANGULAR MOTORCYCLE GOING STRAIGHT SCENARIO

4.1.1.4 Conclusion on general accident conditions

Figure 136 : Conclusion on general accident conditions – Malaysia – ANGULAR SCENARIO

General conditions	**ANGULAR MOTORCYCLE GOING STRAIGHT**	*Malaysian data*

- ✓ *More than 90% of the accidents happen with clear weather.*
- ✓ *68% happening during the day (10% at night without light).*
- ✓ *90% on dry road surface.*

4.1.2 Road characteristics

4.1.2.1 Location (city / urban)

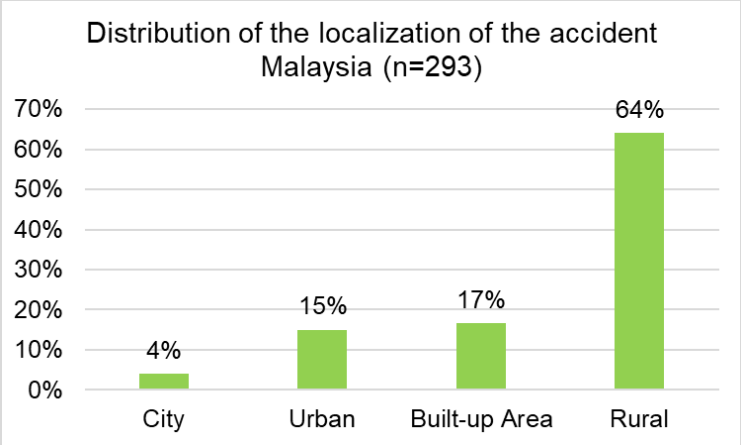


Figure 137: Localization of the accident – Malaysia – ANGULAR MOTORCYCLE GOING STRAIGHT SCENARIO

4.1.2.2 Road category

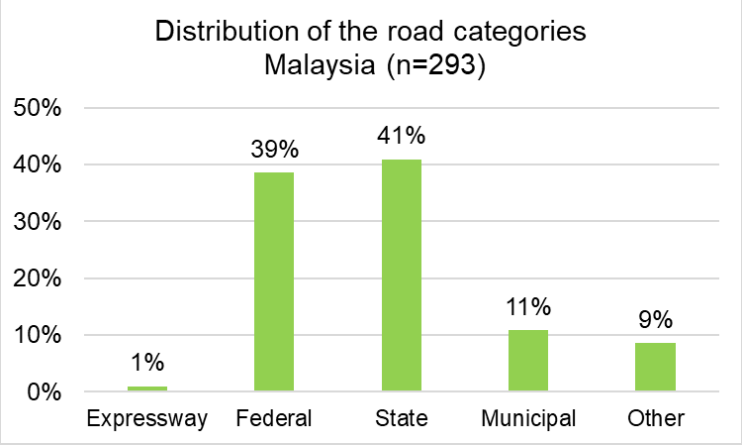


Figure 138: Road category – Malaysia – ANGULAR MOTORCYCLE GOING STRAIGHT SCENARIO

4.1.2.3 Road geometry

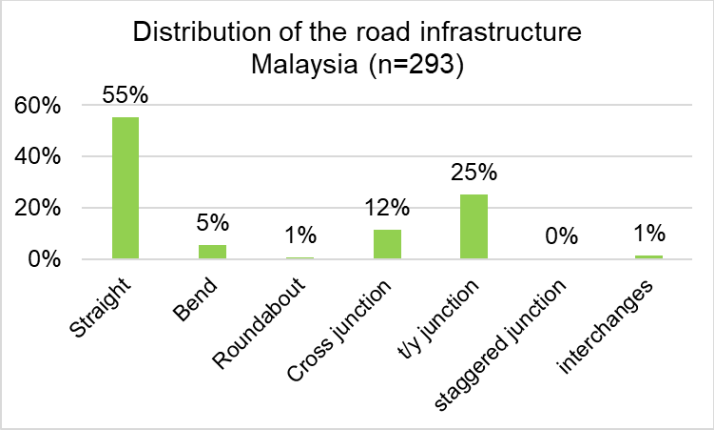


Figure 139: Road geometry – Malaysia – ANGULAR MOTORCYCLE GOING STRAIGHT SCENARIO

4.1.2.4 Lane marking

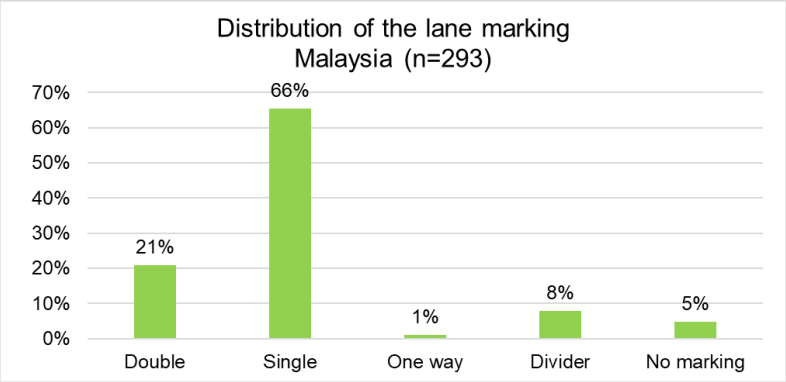


Figure 140: Lane marking – Malaysia – ANGULAR MOTORCYCLE GOING STRAIGHT SCENARIO

4.1.2.5 Speed limit

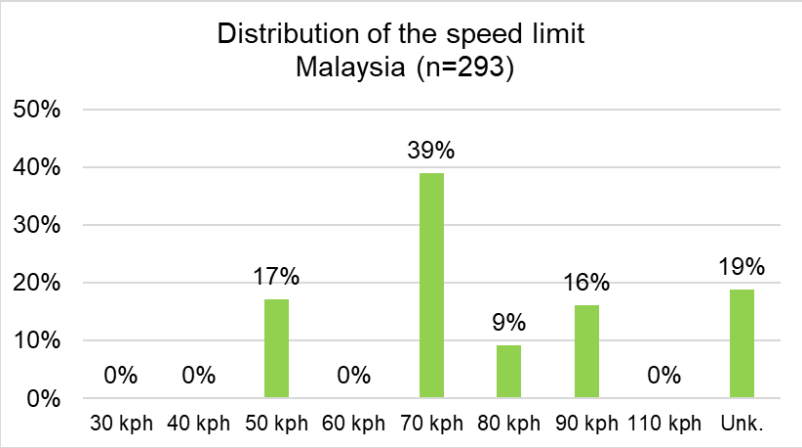


Figure 141: Speed limits – Malaysia – ANGULAR MOTORCYCLE GOING STRAIGHT SCENARIO

4.1.2.6 Conclusion on road characteristics

Table 38: Conclusion on road characteristics – Malaysia – ANGULAR MOTORCYCLE GOING STRAIGHT SCENARIO

Road characteristics	**ANGULAR MOTORCYCLE GOING STRAIGHT**	*Malaysian data*

- ✓ *64% of the accidents happen in rural area (19% in urban area or city).*
- ✓ *Majority of federal or state roads.*
- ✓ *55% of the accidents happen in a straight road, 37% happen in intersection.*
- ✓ *Most of the accidents with single lane marking (66%) and double lane marking (21%).*
- ✓ *Speed limits: 39% at 70 kph, 17% at 50 kph and only 16% at 90 kph.*

4.1.3 Accident characteristics – vehicles

4.1.3.1 Motorcycle impact type

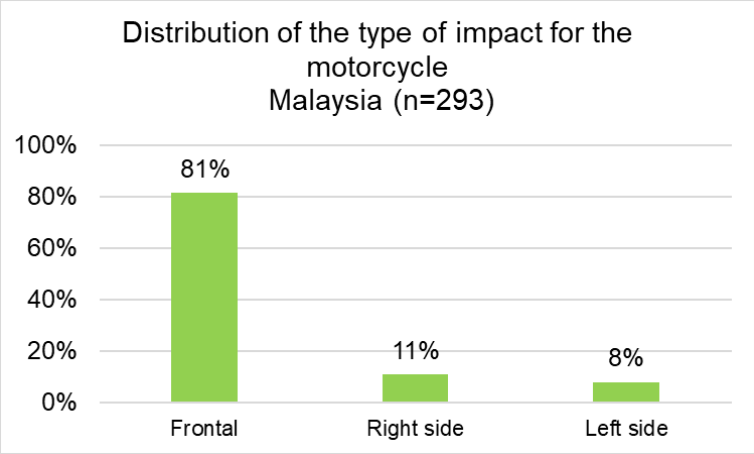


Figure 142: Motorcycle impact type – Malaysia – ANGULAR MOTORCYCLE GOING STRAIGHT SCENARIO

4.1.3.2 Motorcycle action before crash

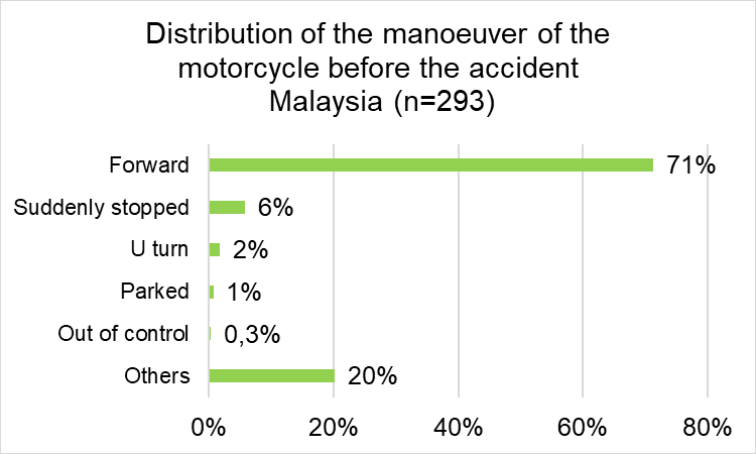


Figure 143: Motorcycle manoeuvre – Malaysia – ANGULAR MOTORCYCLE GOING STRAIGHT SCENARIO

4.1.3.3 Conclusion on vehicle characteristics

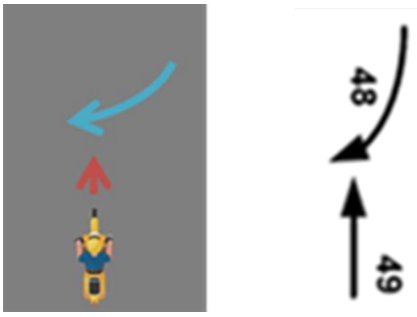
Table 39: Conclusion on vehicle characteristics – Malaysia – ANGULAR SCENARIO

Vehicle characteristics	**ANGULAR MOTORCYCLE GOING STRAIGHT**	*Malaysian data*
✓ *81% of frontal impact for the motorcycle, 19% lateral.* ✓ *Motorcycle going forward for the majority of the cases (71%).*		

4.2 Thai database: Car turning across the path of the motorcycle, opposite direction (Angular 1)

This angular sub-scenario represents **14,6%** of all the accidents and **14,8%** of the KSI accidents in the Thai database.

In this OASIM angular sub-scenario, the car is turning right across the path of the oncoming motorcycle. This configuration is illustrated by the figure below:



(a) (b)

Car=48

Motorcycle=49

Figure 144: (a) Illustration of the ANGULAR 1 scenario, (b) pictogram from the Thai database.

The following graphs provide in-depth description of the sub-scenario. There are 93 cases from this scenario in the Thai database.

4.2.1 Accident characteristics – general conditions

4.2.1.1 Weather conditions

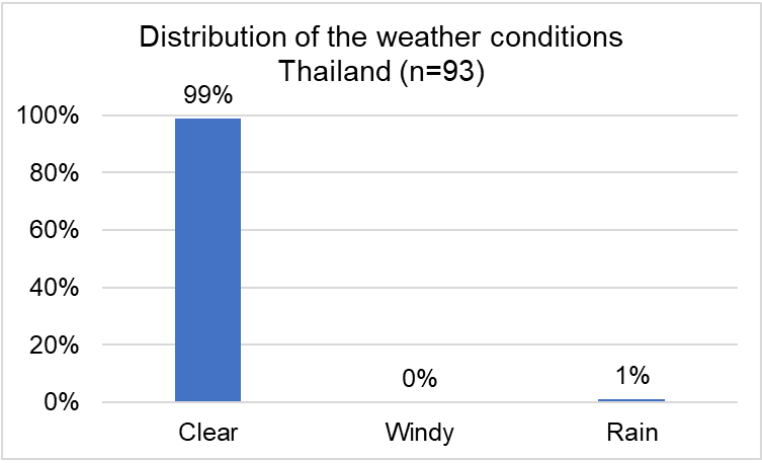


Figure 145: Weather conditions - Thailand – ANGULAR 1 SCENARIO

4.2.1.2 Light conditions

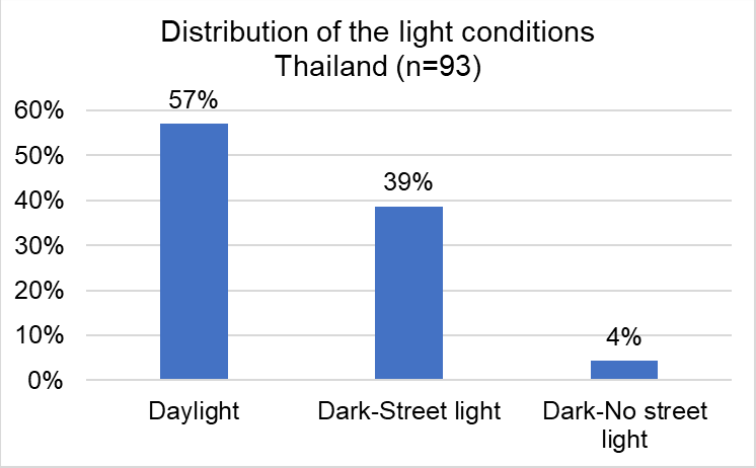


Figure 146: Light conditions - Thailand – ANGULAR 1 SCENARIO

4.2.1.3 Road surface conditions

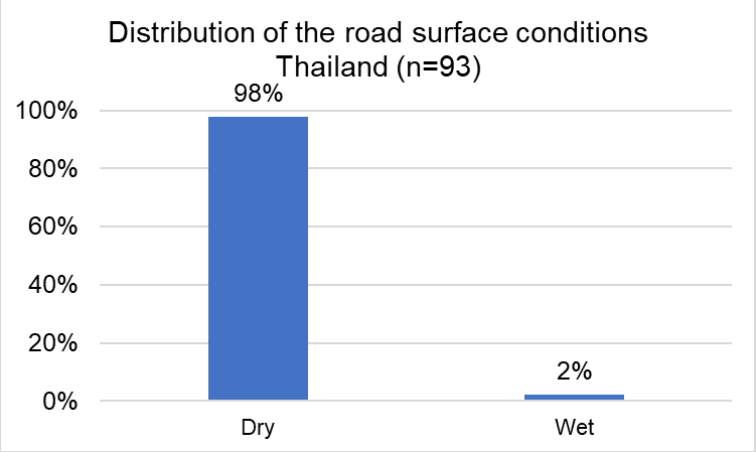


Figure 147: Road surface conditions – Thailand – ANGULAR 1 SCENARIO

4.2.1.4 Conclusion on general accident conditions

Table 40: Conclusion on general accident conditions – Thailand – ANGULAR 1 SCENARIO

General conditions	**ANGULAR 1**	*Thai data*
✓ *Clear weather for 99% of the accidents.* ✓ *57% happen during the day (4% at night with streetlights).* ✓ *Dry road surface conditions for 98% of the accidents.*		

The environmental conditions are similar in Thailand and Malaysia with good weather conditions and a small proportion of accidents at night without lights.

4.2.2 Road characteristics

4.2.2.1 Location (city / urban)

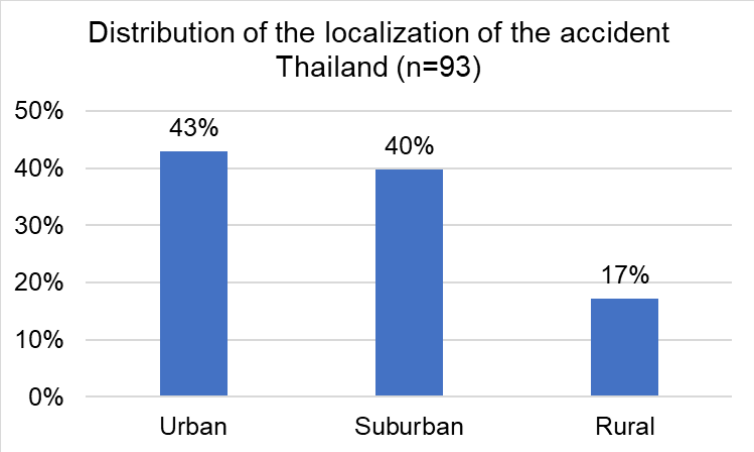


Figure 148: Localization of the accident –Thailand – ANGULAR 1 SCENARIO

4.2.2.2 Road category

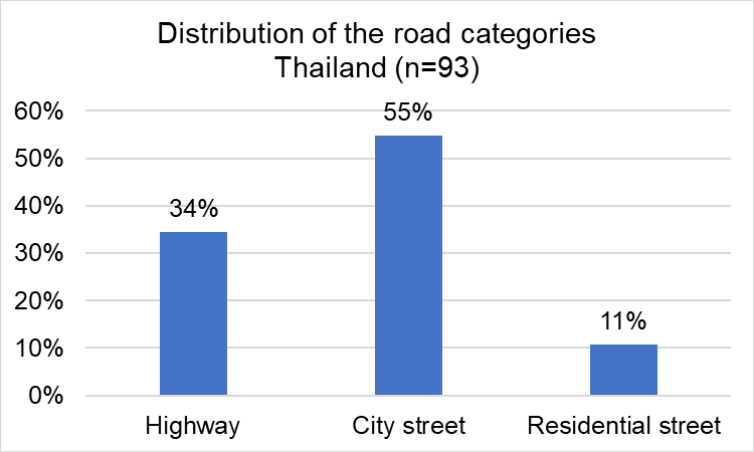
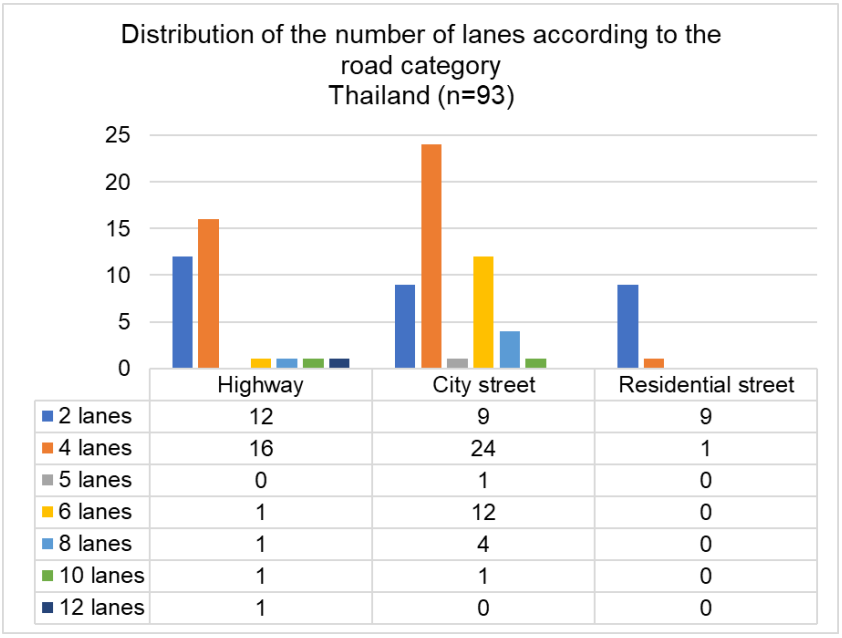


Figure 149: Road category – Thailand – ANGULAR 1 SCENARIO



	Highway	City street	Residential street
2 lanes	12	9	9
4 lanes	16	24	1
5 lanes	0	1	0
6 lanes	1	12	0
8 lanes	1	4	0
10 lanes	1	1	0
12 lanes	1	0	0

Figure 150: Road category and number of lanes – Thailand – ANGULAR 1 SCENARIO

4.2.2.3 Configuration

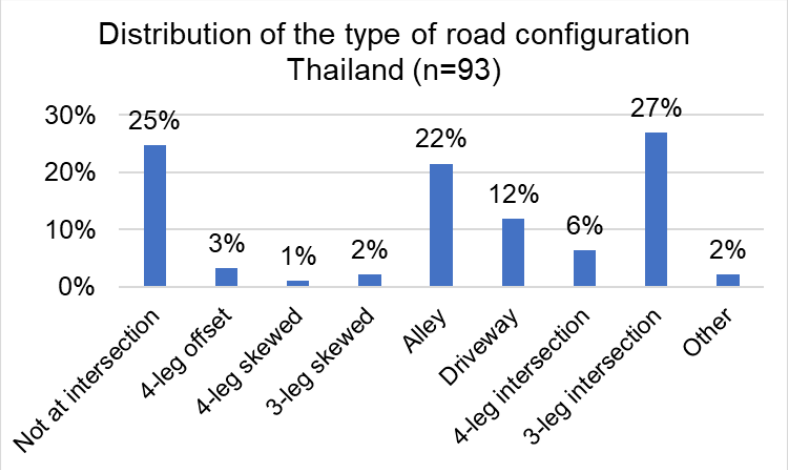


Figure 151: Configuration – Thailand – ANGULAR 1 SCENARIO

4.2.2.4 Road geometry

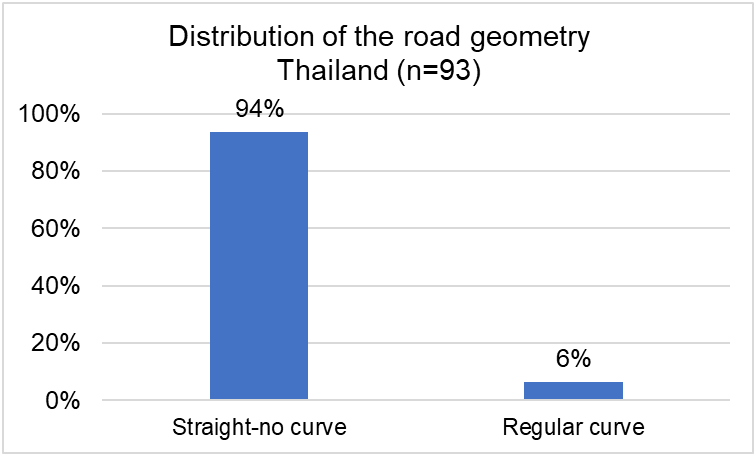


Figure 152: Road geometry – Thailand – ANGULAR 1 SCENARIO

4.2.2.5 Slope

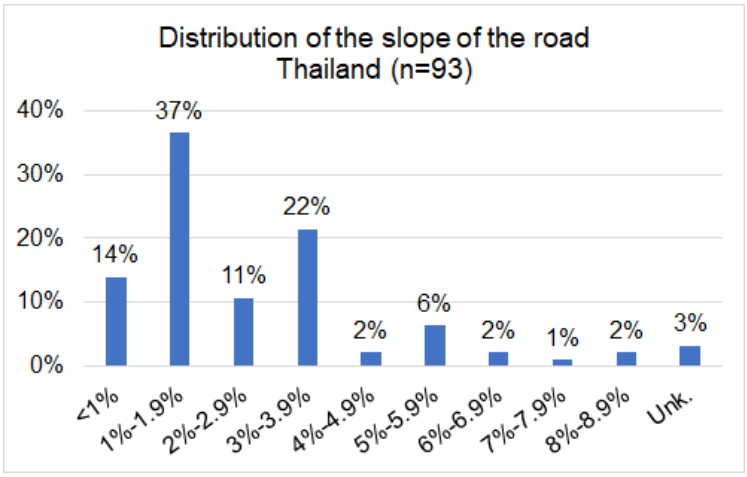


Figure 153: Slop of the road – Thailand – ANGULAR 1 SCENARIO

4.2.2.6 Speed limit

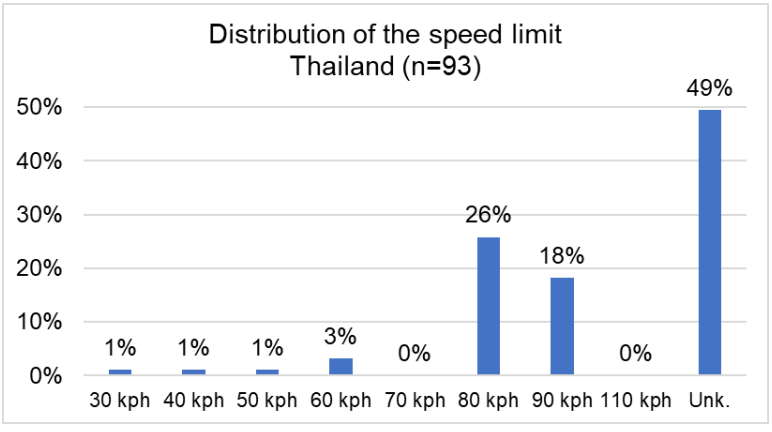


Figure 154: Speed limits – Thailand – ANGULAR 1 SCENARIO

4.2.2.7 Number of the lane

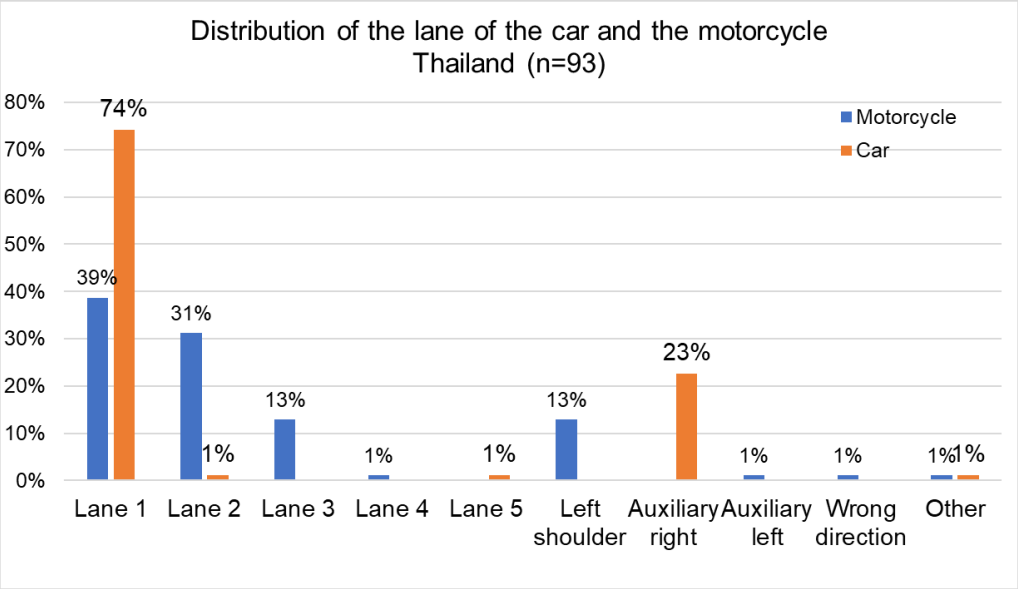


Figure 155: Lanes of the vehicles – Thailand – ANGULAR 1 SCENARIO

4.2.2.8 Travelled lane

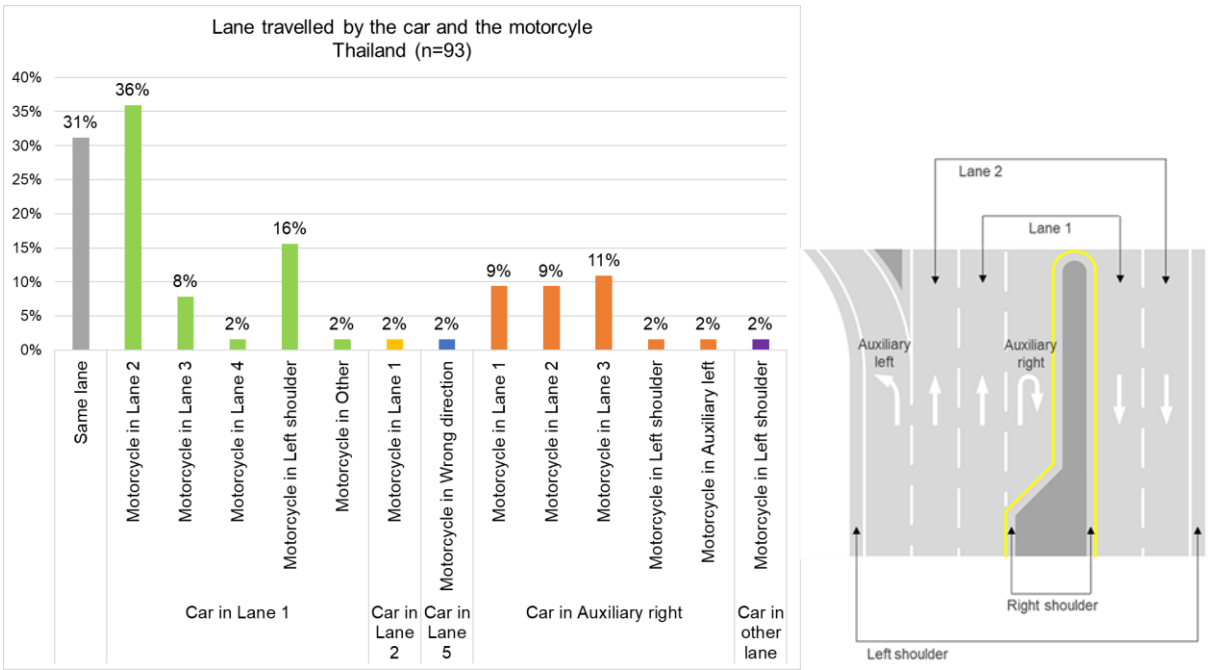


Figure 156: Vehicles on same lane – Thailand – ANGULAR 1 SCENARIO

4.2.2.9 Conclusion on road characteristics

Table 41: Conclusion on road characteristics – Thailand – ANGULAR 1 SCENARIO

Road characteristics	**ANGULAR 1**	*Thai data*

- ✓ *Mostly urban (43%) and suburban (40%) areas.*
- ✓ *City streets for 55% of the accidents and 34% on highway.*
- ✓ *4-6 lanes in city streets and 2-4 lanes on highway.*
- ✓ *25% of the accidents are out of intersection, 39% in 3-leg/4-leg intersection.*
- ✓ *94% of the accidents happen in a straight road.*
- ✓ *Speed limit at 80 kph (26%) and 90 kph (18%), lot of unknown values.*
- ✓ *In 36% of the accidents, the car is in lane 1 and the motorcycle in lane 2. 31% of the vehicles are in the same lane, 36% in adjacent lanes.*

From the high-level analysis for the angular scenarios with Malaysian data, the accidents happen mostly in rural area whereas, from Thai data, they happen mostly in urban and suburban areas. However, there is a similar proportion of accident that occurred in intersection.

4.2.3 Accident characteristics – vehicles

4.2.3.1 Visibility

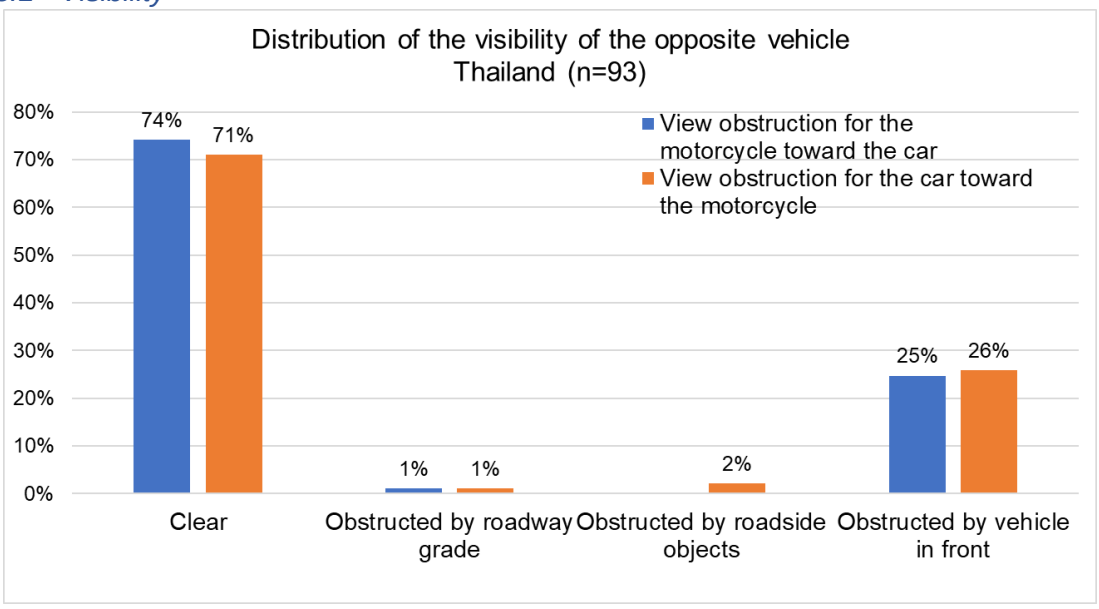
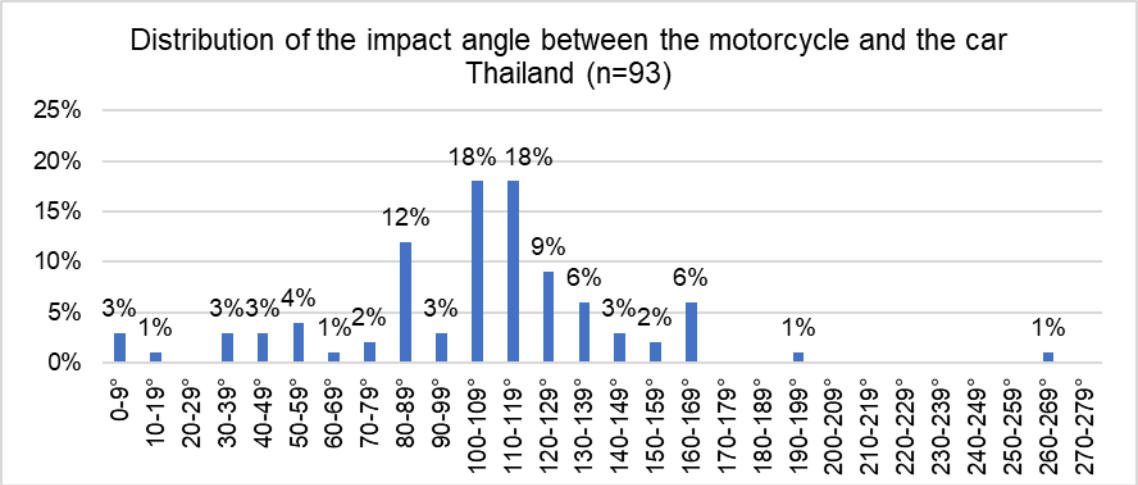


Figure 157: Visibility – Thailand – ANGULAR 1 SCENARIO

4.2.3.2 Impact angle between the motorcycle and the car



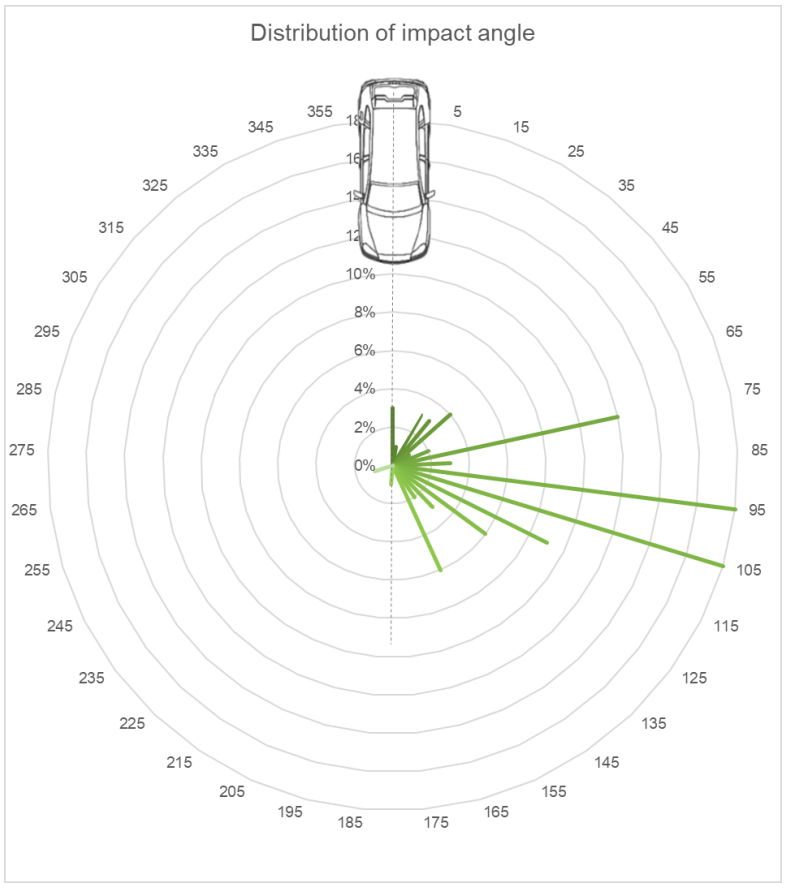


Figure 158: Impact angle – Thailand – ANGULAR 1 SCENARIO

4.2.3.3 Motorcycle impact type

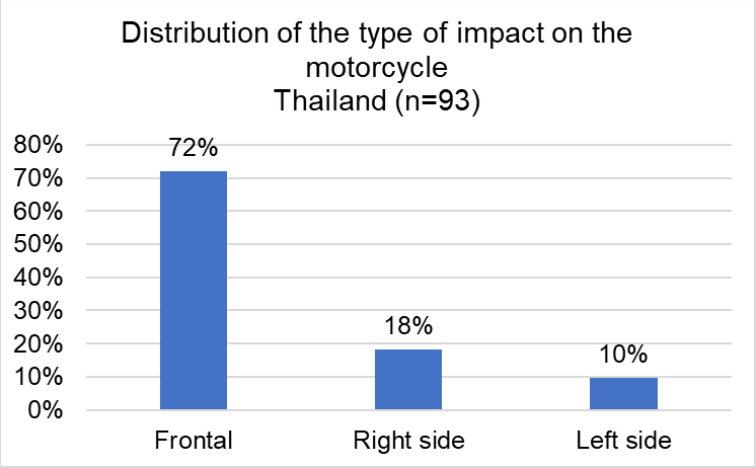


Figure 159: Type of impact for the motorcycle – Thailand – ANGULAR 1 SCENARIO

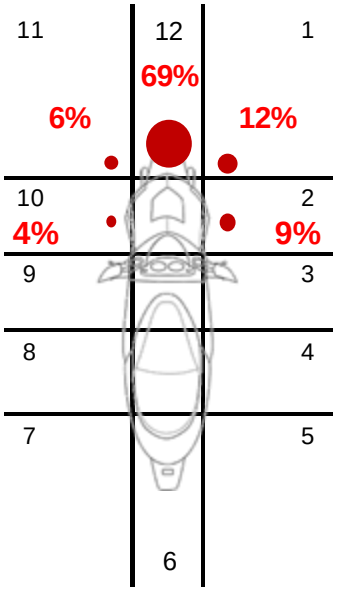


Figure 160: First collision point for the motorcycle – Thailand – ANGULAR 1 SCENARIO

4.2.3.4 Car impact type

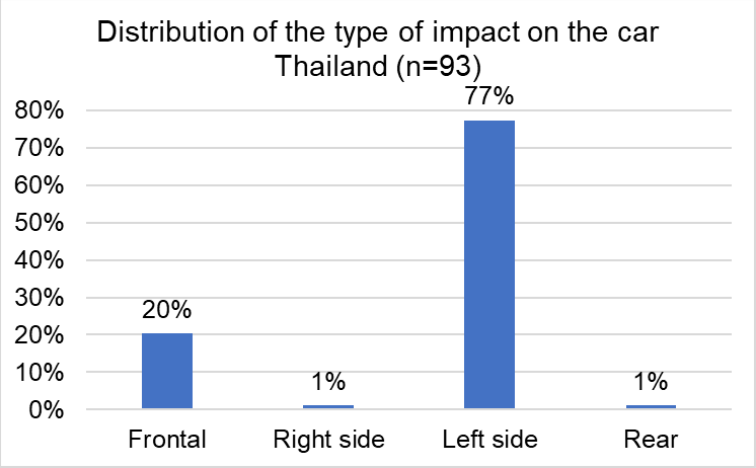


Figure 161: Type of impact for the car– Thailand – ANGULAR 1 SCENARIO

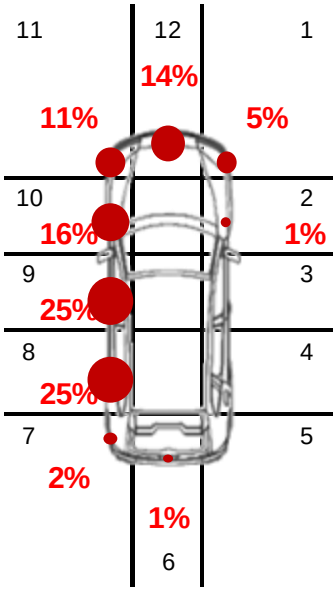


Figure 162: First collision point for the car – Thailand – ANGULAR 1 SCENARIO

4.2.3.5 Initial speeds

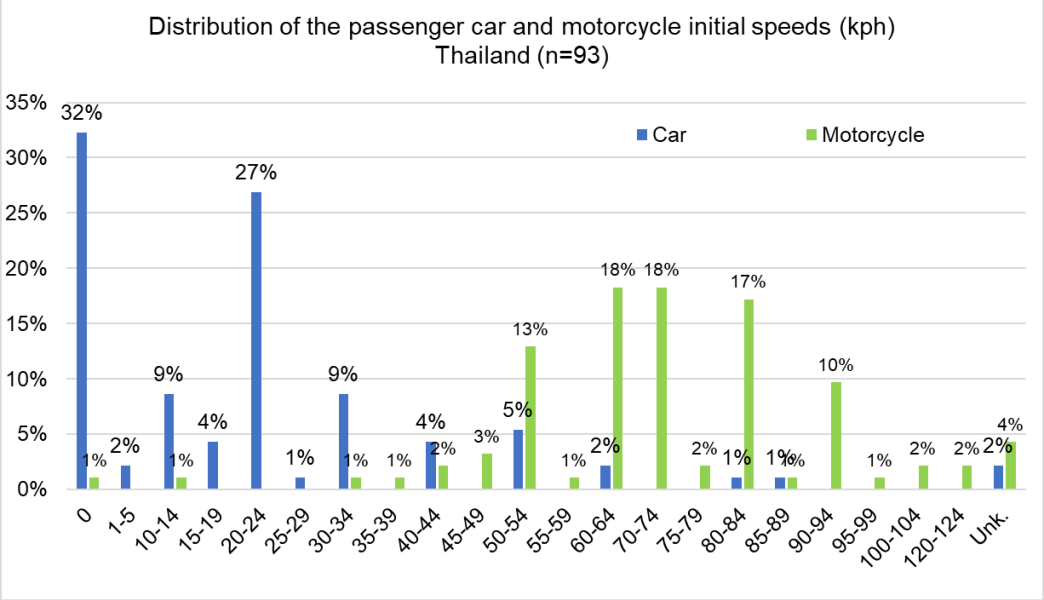


Figure 163: Initial speeds – Thailand – ANGULAR 1 SCENARIO

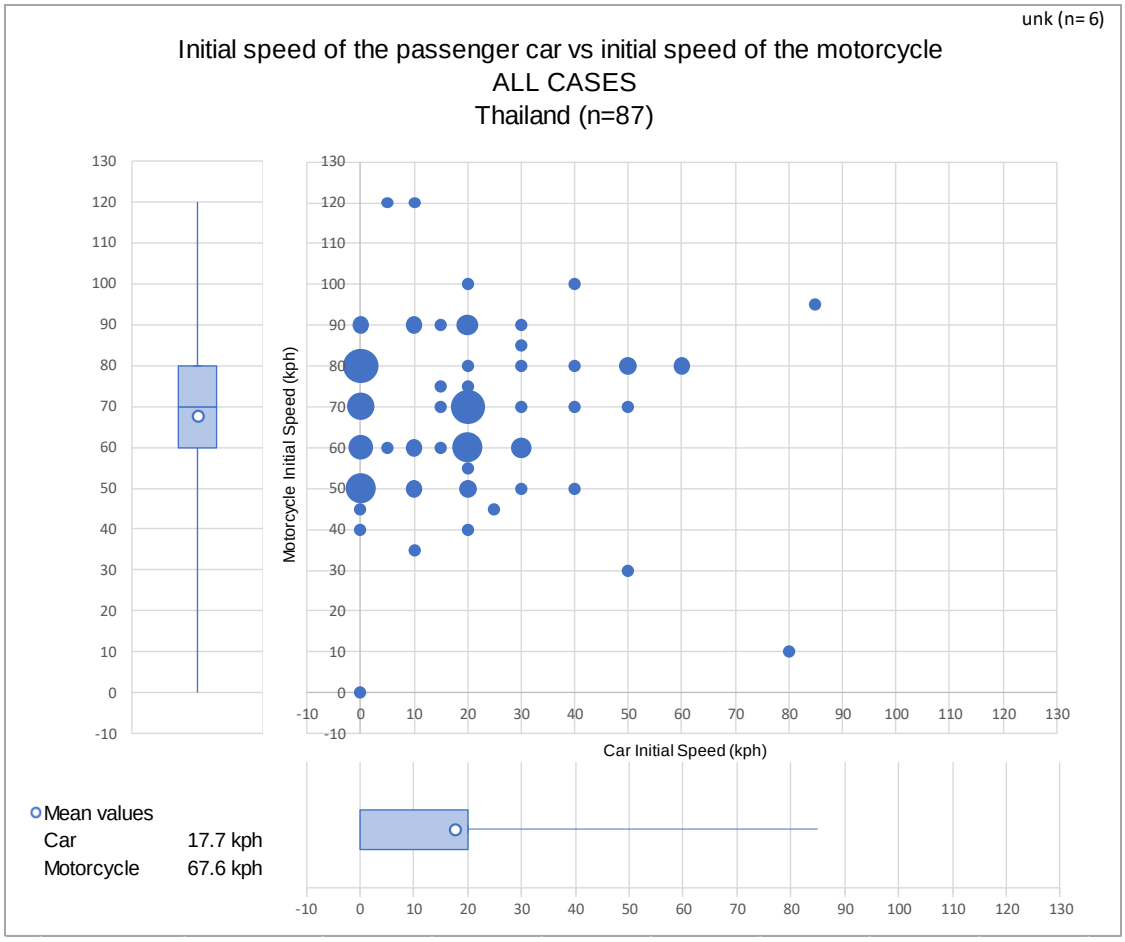


Figure 164: Initial speed of the car versus initial speed of the motorcycle, all cases – Thailand – ANGULAR 1 SCENARIO

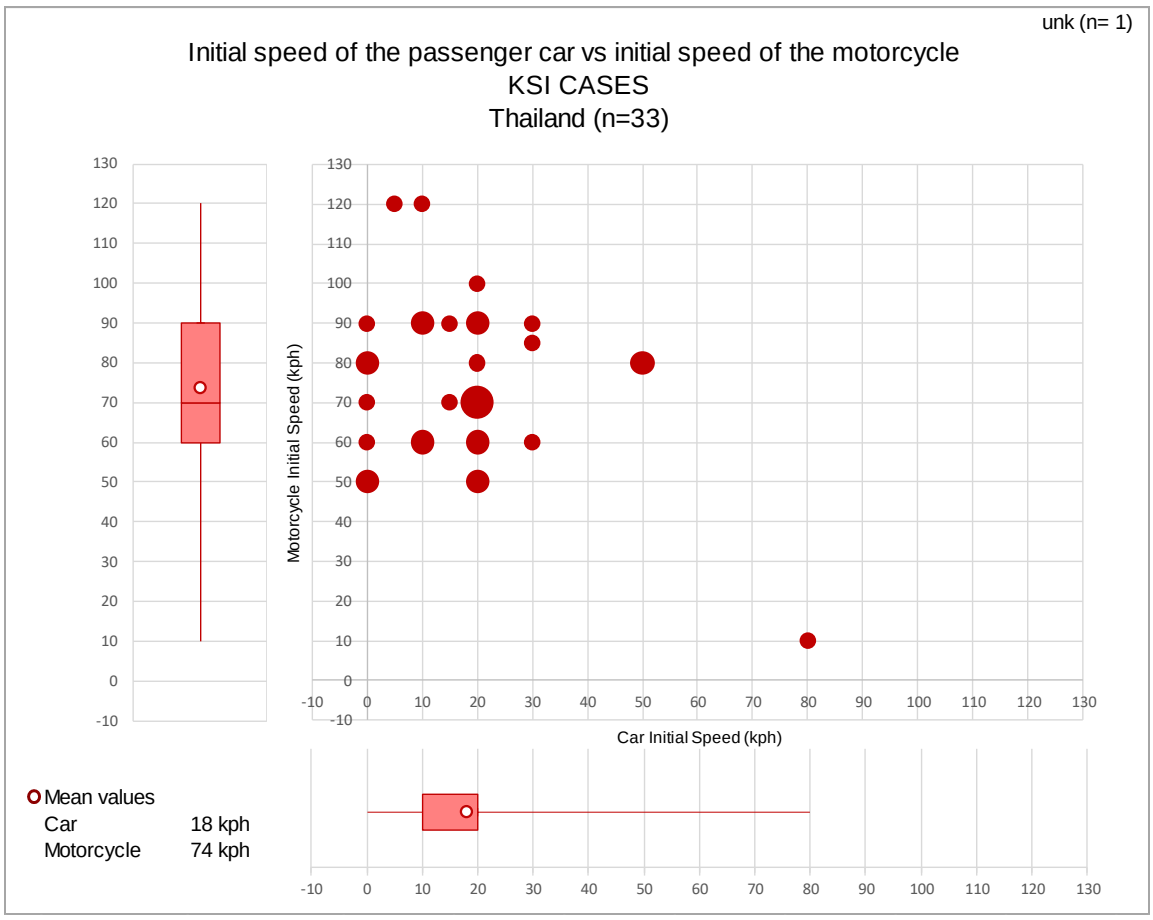


Figure 165: Initial speed of the car versus initial speed of the motorcycle, KSI cases – Thailand – ANGULAR 1 SCENARIO

Table 42: Initial speed values for the car and the motorcycle, all cases – Thailand – ANGULAR 1 SCENARIO

All Accidents																											unk: 6
Number of cases	Passenger Car Initial Speed (kph)																										
Motorcycle Initial Speed (kph)	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
0	1																									
1																										
5																										
10																		1								
15																										
20																										
25																										
30												1														
35				1																						
40	1					1																				
45	1						1																			
50	6			2		2		1		1																
55						1																				
60	4		1	2	1	6		3																		
65																										
70	5				1	8		1		1		1														
75					1	1																				
80	8					1		1		1		2		2												
85								1																		
90	2			2	1	3		1																		
95																			1							
100						1				1																
105≤			1	1																						

Table 43: Initial speed values for the car and the motorcycle, KSI cases – Thailand – ANGULAR 1 SCENARIO

KSI Accidents																										unk:	1
Number of cases		Passenger Car Initial Speed (kph)																									
		0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Initial Speed (kph)	0																										
	1																										
	5																										
	10																		1								
	15																										
	20																										
	25																										
	30																										
	35																										
	40																										
	45																										
	50	2					2																				
	55																										
	60	1			2		2		1																		
	65																										
	70	1				1	4																				
	75																										
	80	2					1						2														
	85								1																		
	90	1			2	1	2		1																		
	95																										
	100						1																				
	105≤			1	1																						

4.2.3.6 Collision speeds

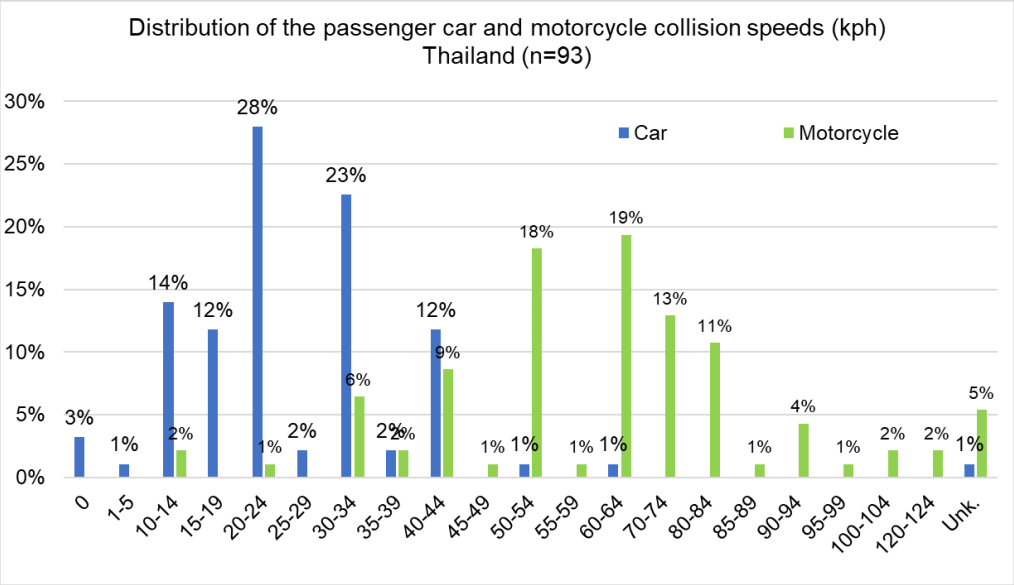


Figure 166: Collision speeds – Thailand – ANGULAR 1 SCENARIO

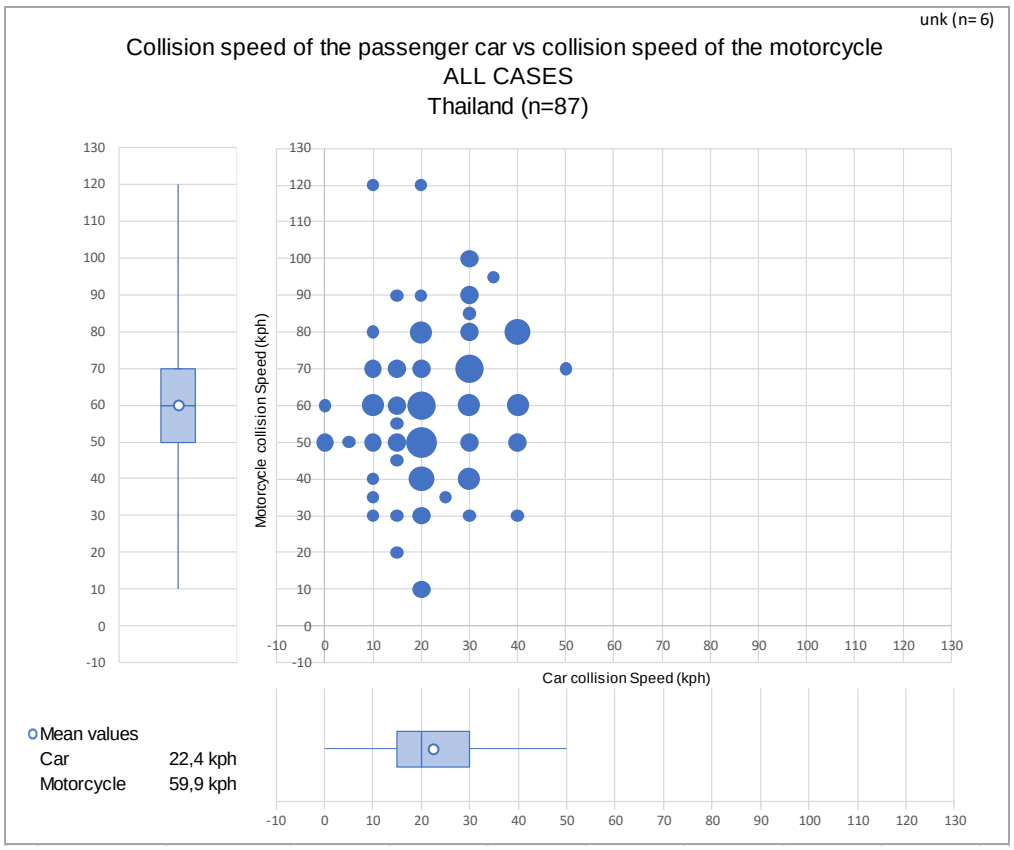


Figure 167: Collision speed of the car versus collision speed of the motorcycle, all cases – Thailand - ANGULAR 1 SCENARIO

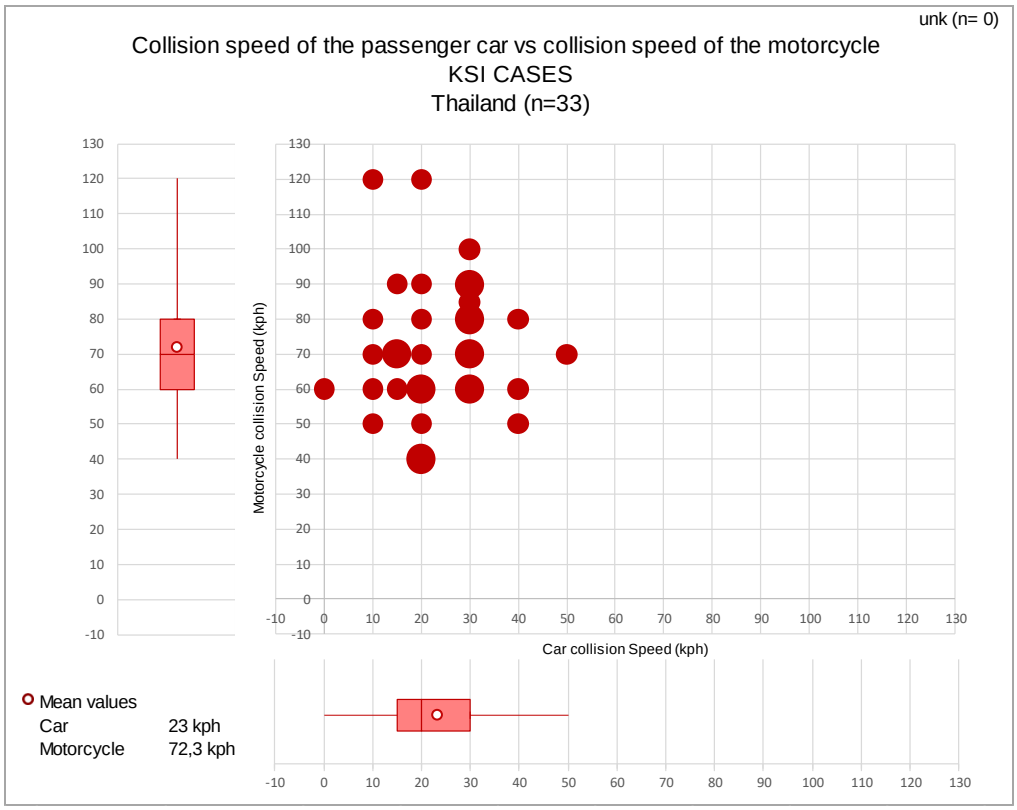


Figure 168: Collision speed of the car versus collision speed of the motorcycle, KSI cases – Thailand – ANGULAR 1 SCENARIO

Table 44: Collision speed values for the car and the motorcycle, all cases – Thailand – ANGULAR 1 SCENARIO

All Accidents																												unk:	1
Number of cases	Passenger Car Collision Speed (kph)																												
Motorcycle Collision Speed (kph)	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
0																										
1																										
5																										
10						2																				
15																										
20					1																					
25																										
30				1	1	2		1		1																
35				1			1																			
40				1		4		3																		
45					1																					
50	2		1	2	2	6		2		2																
55					1																					
60	1			3	2	5		3		3																
65																										
70				2	2	2		5				1														
75																										
80				1		3		2		4																
85								1																		
90					1	1		2																		
95									1																	
100								2																		
105≤				1		1																				

Table 45: Collision speed values for the car and the motorcycle, KSI cases – Thailand - ANGULAR 1 SCENARIO

KSI Accidents																												unk:	0
Number of cases	Passenger Car Collision Speed (kph)																												
Motorcycle Collision Speed (kph)	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
0																										
1																										
5																										
10																										
15																										
20																										
25																										
30																										
35																										
40						2																				
45																										
50				1		1				1																
55																										
60	1			1	1	2		2		1																
65																										
70				1	2	1		2				1														
75																										
80				1		1		2		1																
85								1																		
90					1	1		2																		
95																										
100								1																		
105≤				1		1																				

4.2.3.7 Delta Initial velocity (kph) – calculated

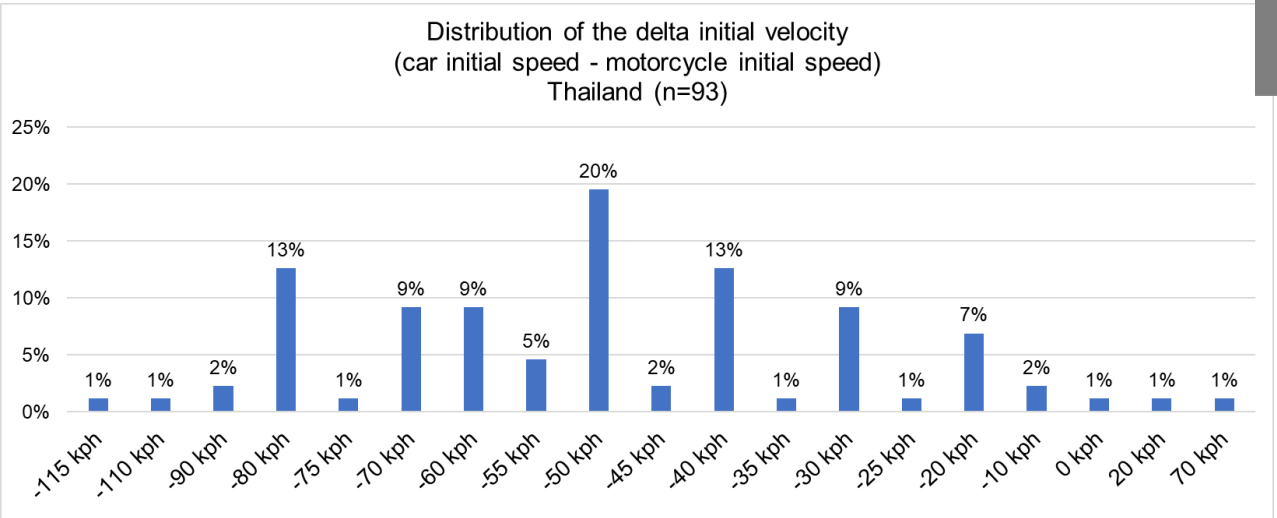


Figure 169: Delta initial velocity (kph) – Thailand – ANGULAR 1 SCENARIO

4.2.3.8 Skid marks

In this scenario, braking skids marks were not observed either for the car nor for the motorcycle.

4.2.3.9 ABS fitment on the car

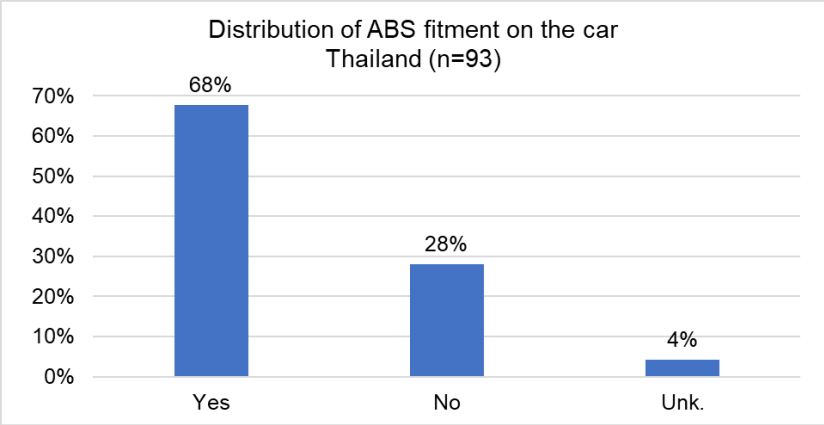


Figure 170: ABS fitment – Thailand – ANGULAR 1 SCENARIO

4.2.3.10 Motorcycle manoeuvre before crash

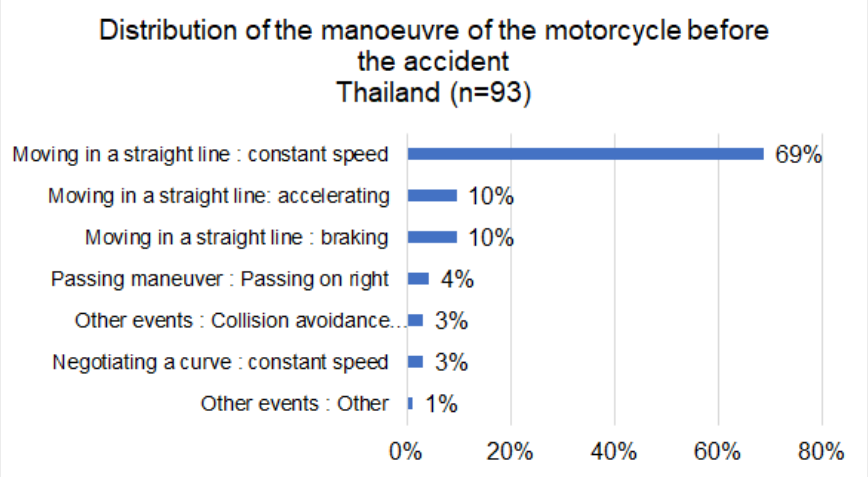


Figure 171: Motorcycle manoeuvre – Thailand – ANGULAR 1 SCENARIO

4.2.3.11 Car manoeuvre before crash

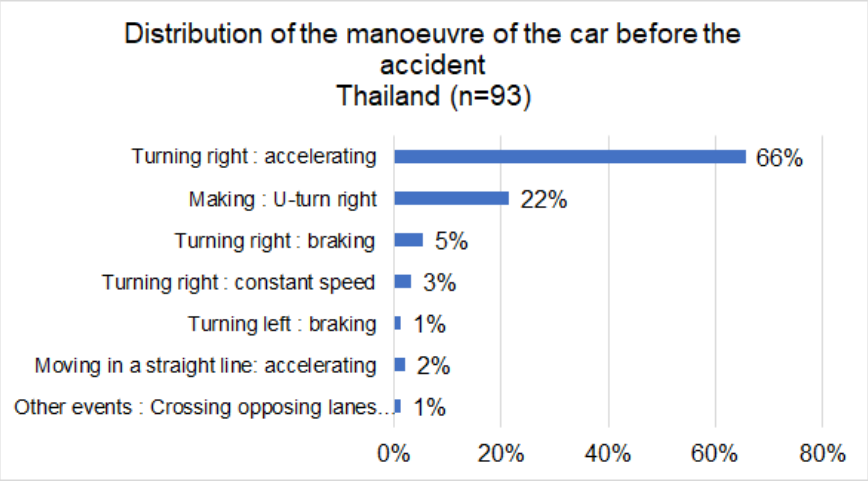


Figure 172: Car manoeuvre – Thailand – ANGULAR 1 SCENARIO

4.2.3.12 Avoidance action by vehicle

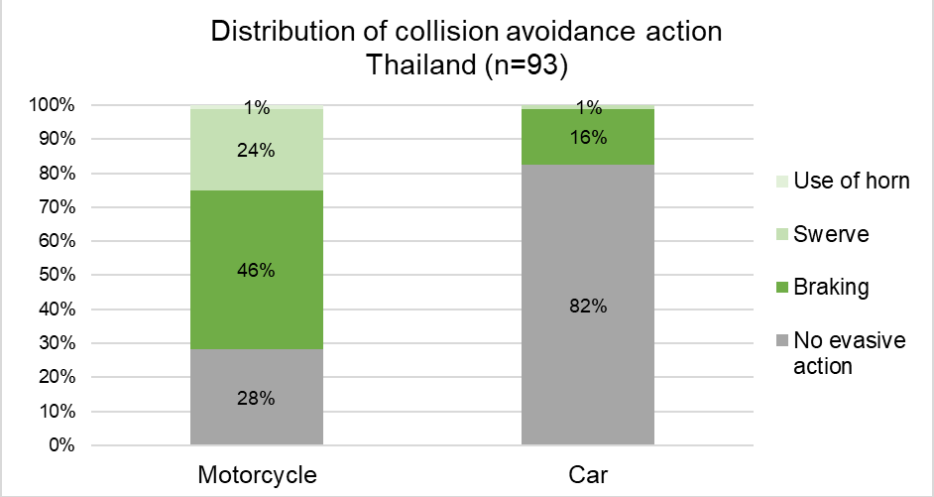


Figure 173: Avoidance action by vehicle – Thailand – ANGULAR 1 SCENARIO

4.2.3.13 Conclusion on accident characteristics

Table 46: Conclusion on accident characteristics – Thailand – ANGULAR 1 SCENARIO

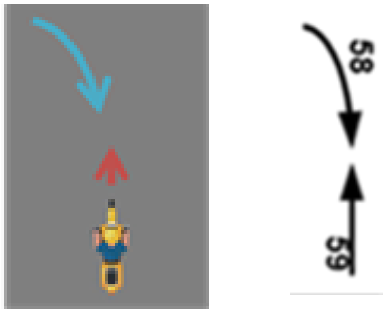
Accident characteristics	**ANGULAR 1**	*Thai data*

- ✓ *25% of cars and motorcycles have obstruction visibility due to vehicle in front.*
- ✓ *70% frontal impact for the motorcycle.*
- ✓ *77% of left side impact for the car.*
- ✓ *Mean initial speed: Car=17,7 kph and Motorcycle=67,6 kph*
- ✓ *Mean collision speed: Car=22,4 kph and Motorcycle=59,9 kph*
- ✓ *68% of the car had ABS.*
- ✓ *The motorcycle goes straight at constant speed (69%), straight accelerating (10%), straight braking (10%).*
- ✓ *The car is turning right and accelerating (66%) or making a U-turn (22%).*
- ✓ *No avoidance action from the car (82%) and action from the motorcycle (71%). The motorcycle tries to avoid the collision by braking (65%) or swerving (33%).*

4.3 Thai database: Car turning right into the path of the motorcycle, right direction (Angular 2)

The second angular sub-scenario cluster represents **6,3%** of all the accidents and **1,9%** of the KSI accidents in the Thai database.

In this OASIM angular sub-scenario, the car is turning right into the path of the oncoming motorcycle. This configuration is illustrated by the figure below:



(a) (b)
Car=58
Motorcycle=59

Figure 174: (a) Illustration of ANGULAR 2 scenario, (b) pictogram from the Thai database.

The following graphs provide in-depth description of the scenario. There are 40 cases from this scenario in the Thai database.

4.3.1 Accident characteristics – general conditions

4.3.1.1 Weather conditions

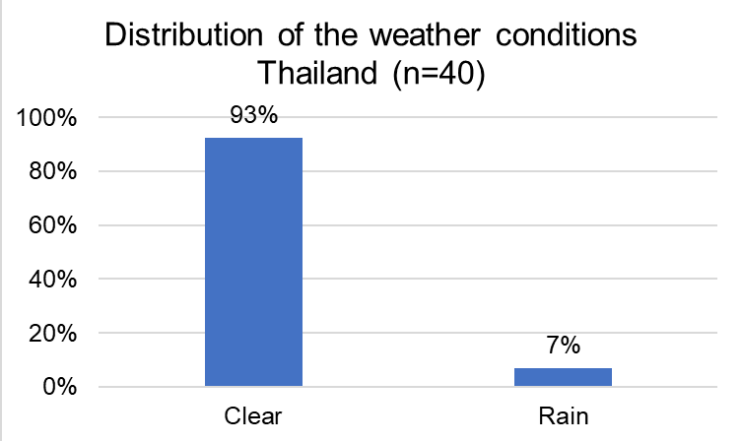


Figure 175: Weather conditions - Thailand – ANGULAR 2 SCENARIO

4.3.1.2 Light conditions

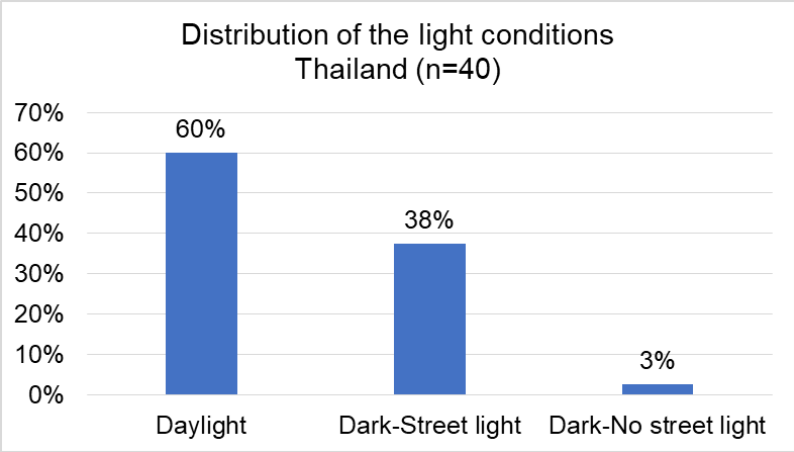


Figure 176: Light conditions - Thailand – ANGULAR 2 SCENARIO

4.3.1.3 Road surface conditions

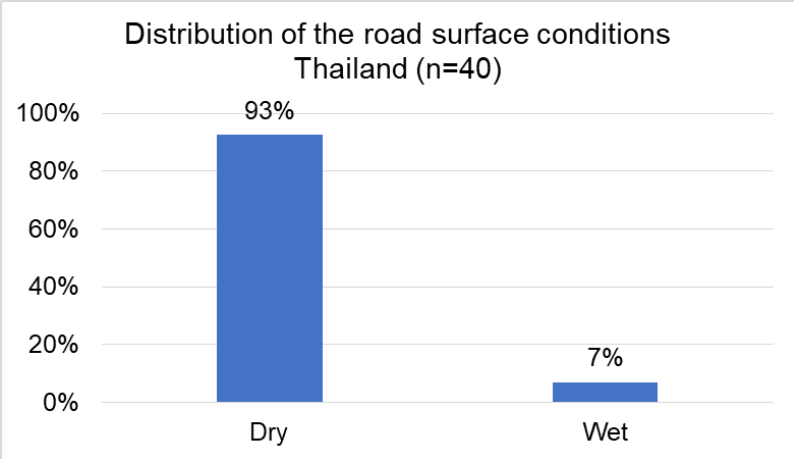


Figure 177: Road surface conditions – Thailand – ANGULAR 2 SCENARIO

4.3.1.4 Conclusion on general accident conditions

Table 47: Conclusion on general accident conditions – Thailand – ANGULAR 2 SCENARIO

General conditions	**ANGULAR 2**	*Thai data*
✓ *Clear weather in 93% of the accidents* ✓ *60% happen during the day (3% at night with streetlights).* ✓ *7% of wet road surface.*		

The environmental conditions are similar in Thailand and Malaysia based on the databases with good weather conditions and a small proportion of accidents at night without lights.

4.3.2 Road characteristics

4.3.2.1 Location (city/urban)

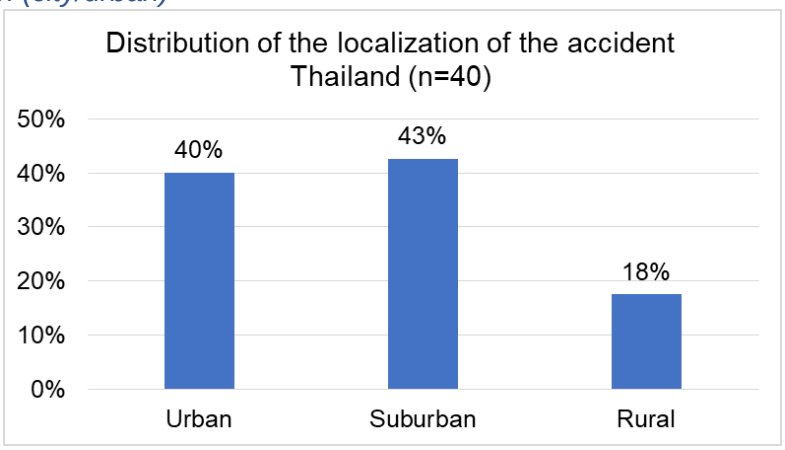


Figure 178: Localization of the accident –Thailand – ANGULAR 2 SCENARIO

4.3.2.2 Road category

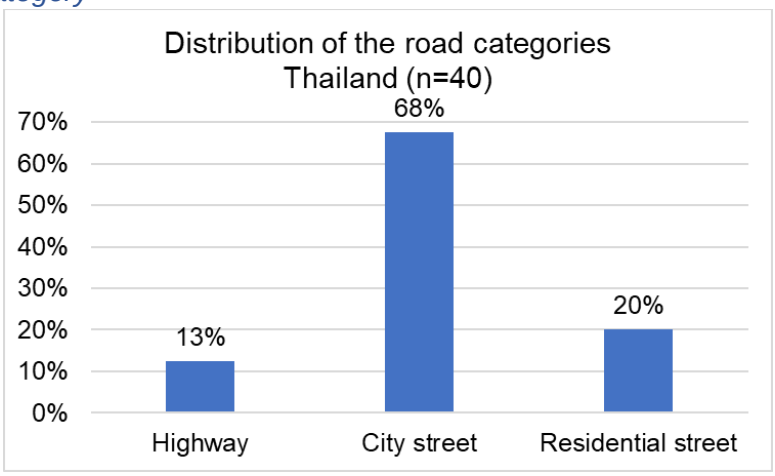


Figure 179: Road category – Thailand – ANGULAR 2 SCENARIO

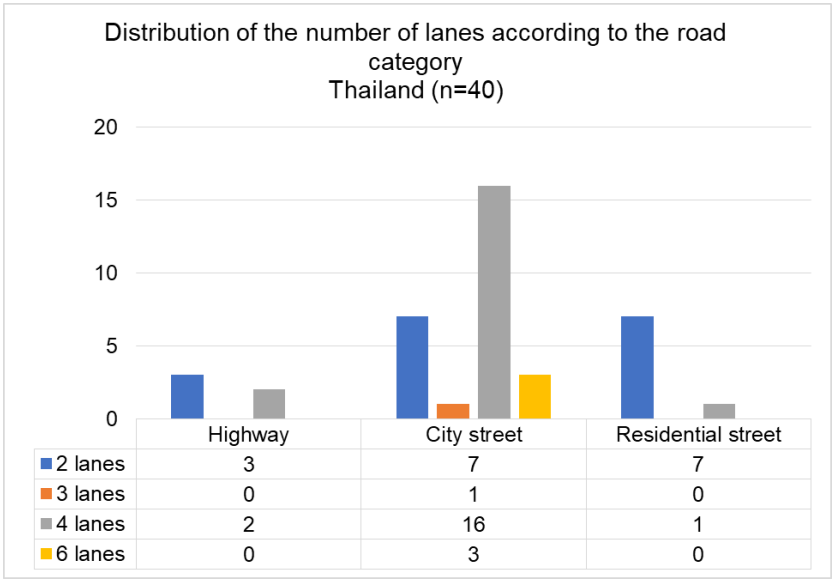


Figure 180: Road category and number of lanes – Thailand – ANGULAR 2 SCENARIO

4.3.2.3 Configuration

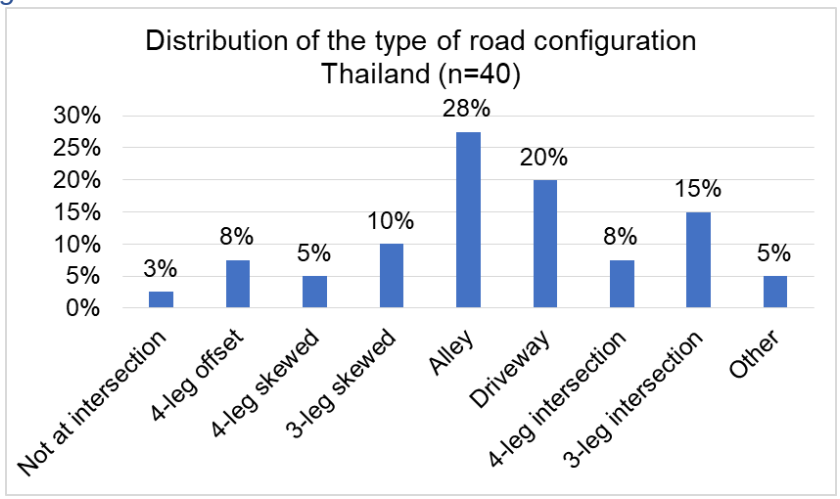


Figure 181: Configuration – Thailand – ANGULAR 2 SCENARIO

4.3.2.4 Road geometry

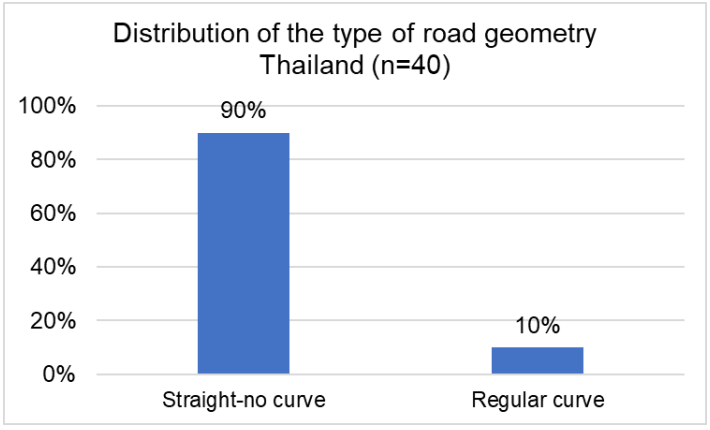


Figure 182: Road geometry – Thailand – ANGULAR 2 SCENARIO

4.3.2.5 Slope

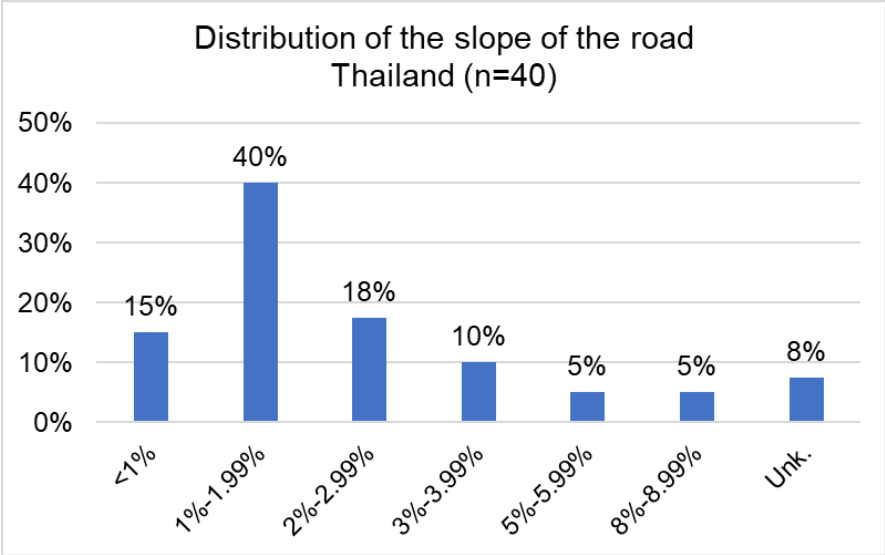


Figure 183: Slop of the road – Thailand – ANGULAR 2 SCENARIO

4.3.2.6 Speed limit

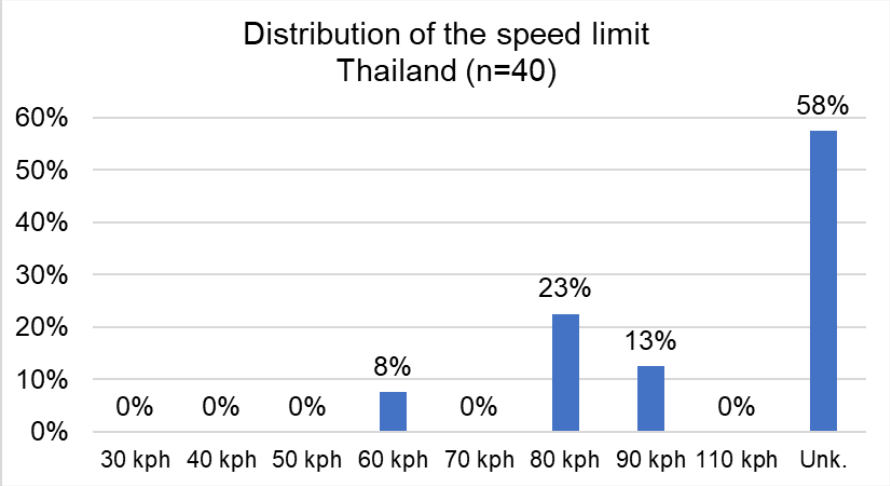


Figure 184: Speed limits – Thailand – ANGULAR 2 SCENARIO

4.3.2.7 Number of lanes

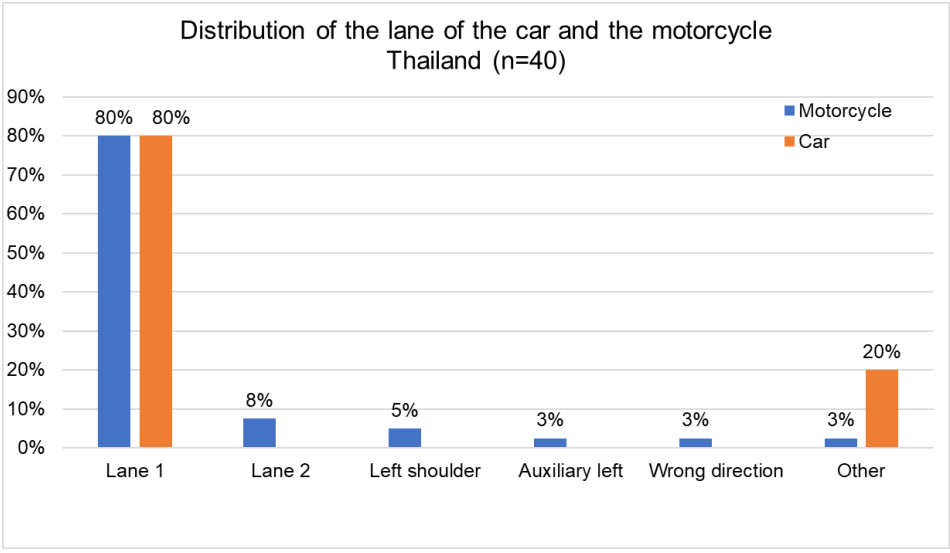


Figure 185: Lanes of the vehicles – Thailand – ANGULAR 2 SCENARIO

4.3.2.8 Travelled lane

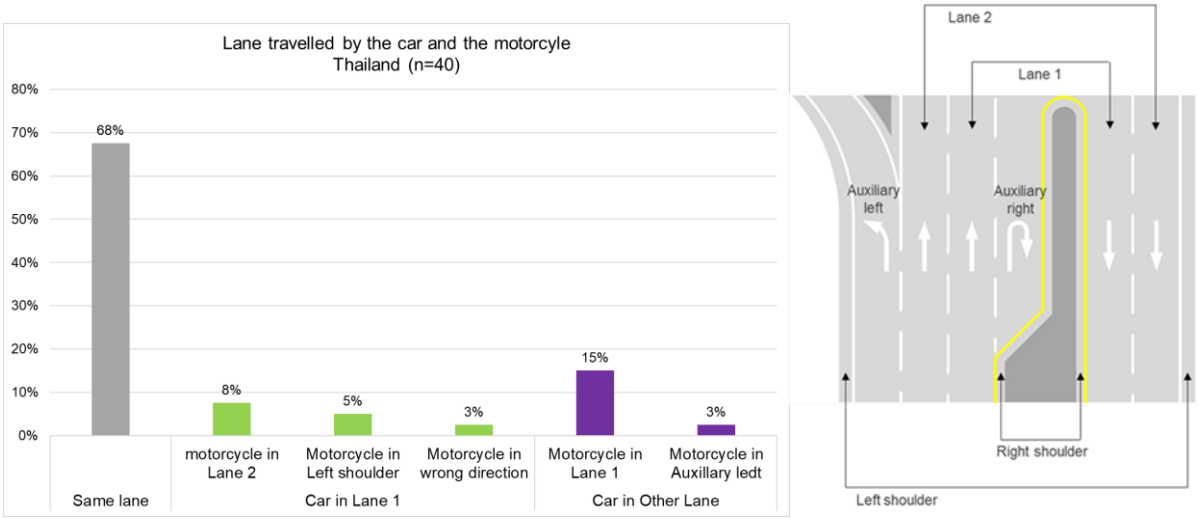


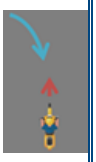
Figure 186: Vehicles on same lane – Thailand – ANGULAR 2 SCENARIO

4.3.2.9 Conclusion on road characteristics

Table 48: Conclusion on road characteristics – Thailand – ANGULAR 2 SCENARIO

Road characteristics	**ANGULAR 2**	*Thai data*
✓ *Mostly urban (40%) and suburban (43%) areas.* ✓ *City streets for 68% of the accidents, only 13% on highway.* ✓ *2-4 lanes roads.* ✓ *Mostly in intersection (46%), or alley (28%) and driveway (20%).*		

- ✓ *90% of the accidents happen in a straight road.*
- ✓ *Speed limit at 80 kph (23%) and 90 kph (13%), lot of unknown values.*
- ✓ *Vehicles in the same lane in 68% of the cases.*



From the observed data, there is a difference in the type of roads. In Malaysian data, the accidents happened mostly in rural area whereas, from Thai data, they happen mostly in urban and suburban area.

4.3.3 Accident characteristics – vehicles

4.3.3.1 Visibility

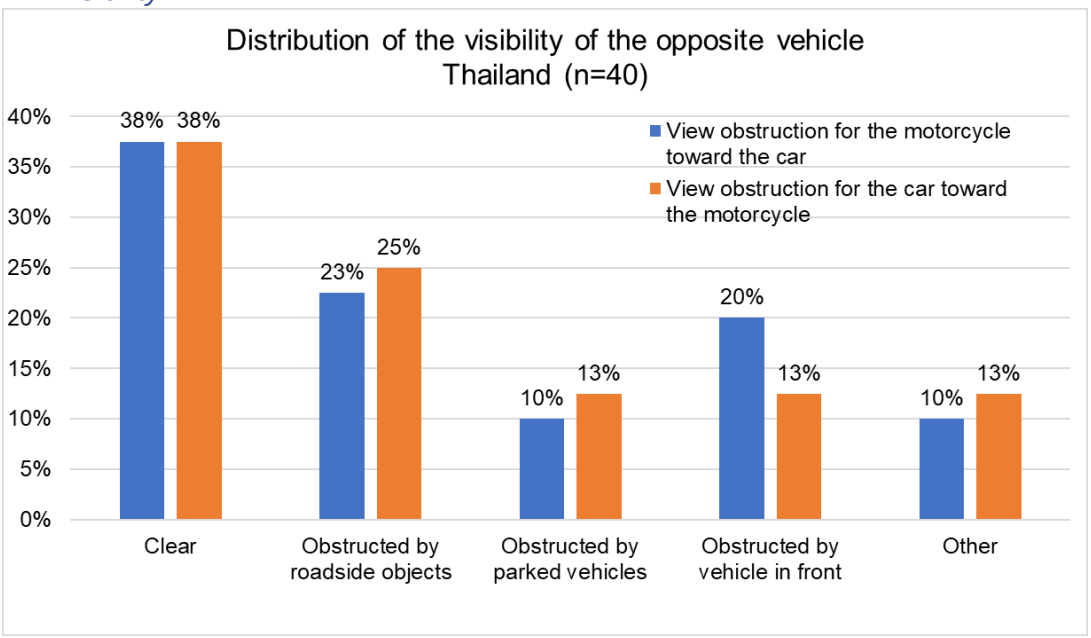
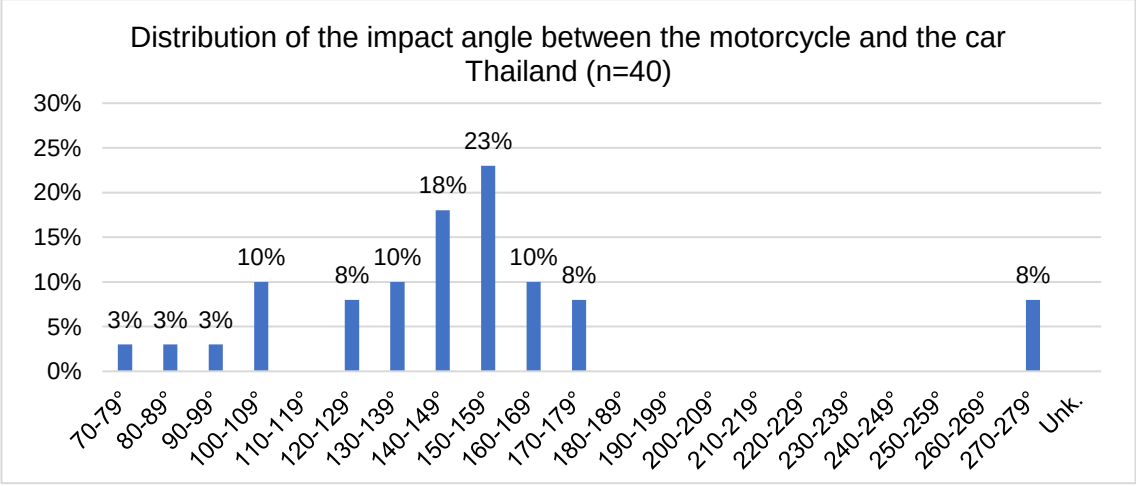


Figure 187: Visibility – Thailand – ANGULAR 2 SCENARIO

4.3.3.2 Impact angle between the motorcycle and the car



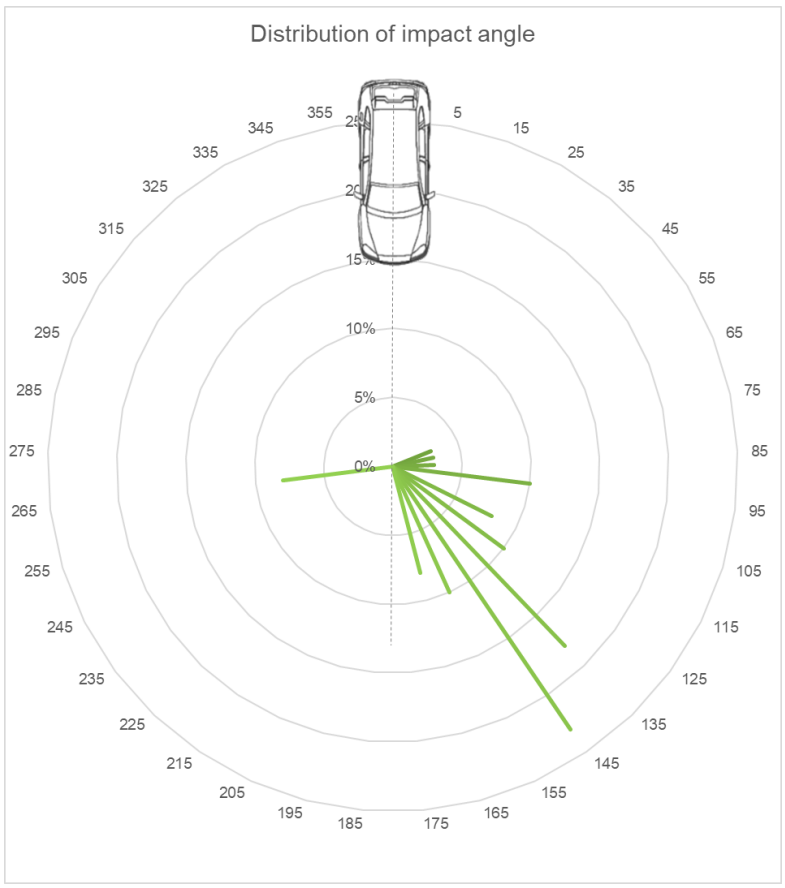


Figure 188: Impact angle – Thailand – ANGULAR 2 SCENARIO

4.3.3.3 Motorcycle impact type

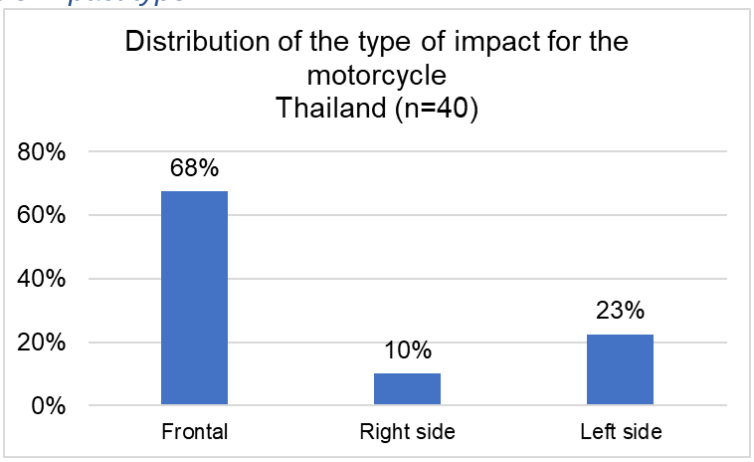
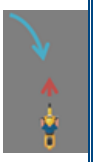


Figure 189: Type of impact for the motorcycle – Thailand – ANGULAR 2 SCENARIO



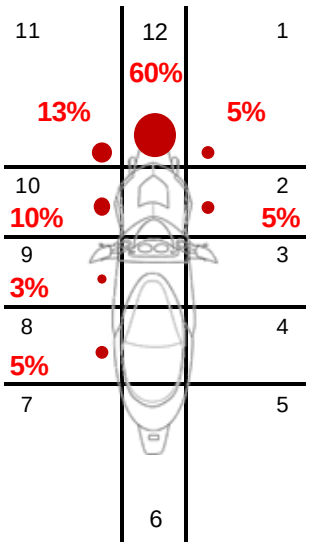


Figure 190: First collision point for the motorcycle – Thailand – ANGULAR 2 SCENARIO

4.3.3.4 Car impact type

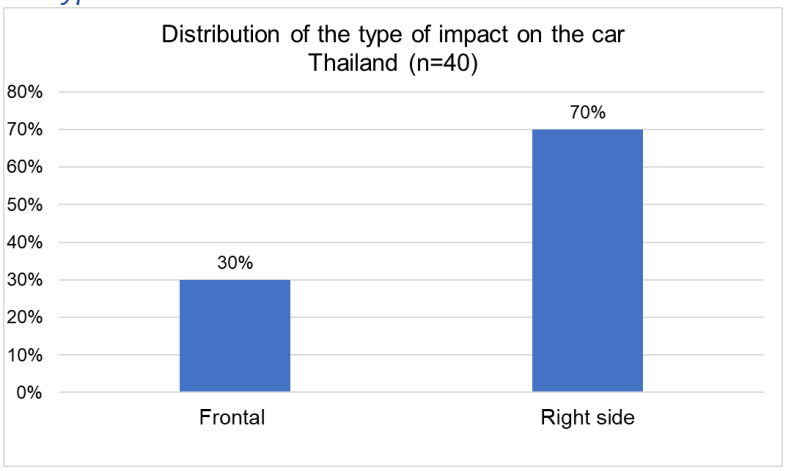


Figure 191: Type of impact for the car– Thailand – ANGULAR 2 SCENARIO

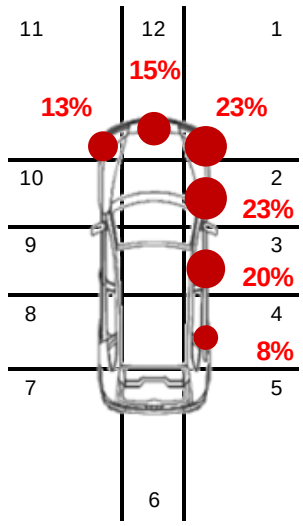


Figure 192: First collision point for the car – Thailand – ANGULAR 2 SCENARIO

4.3.3.5 Initial speeds

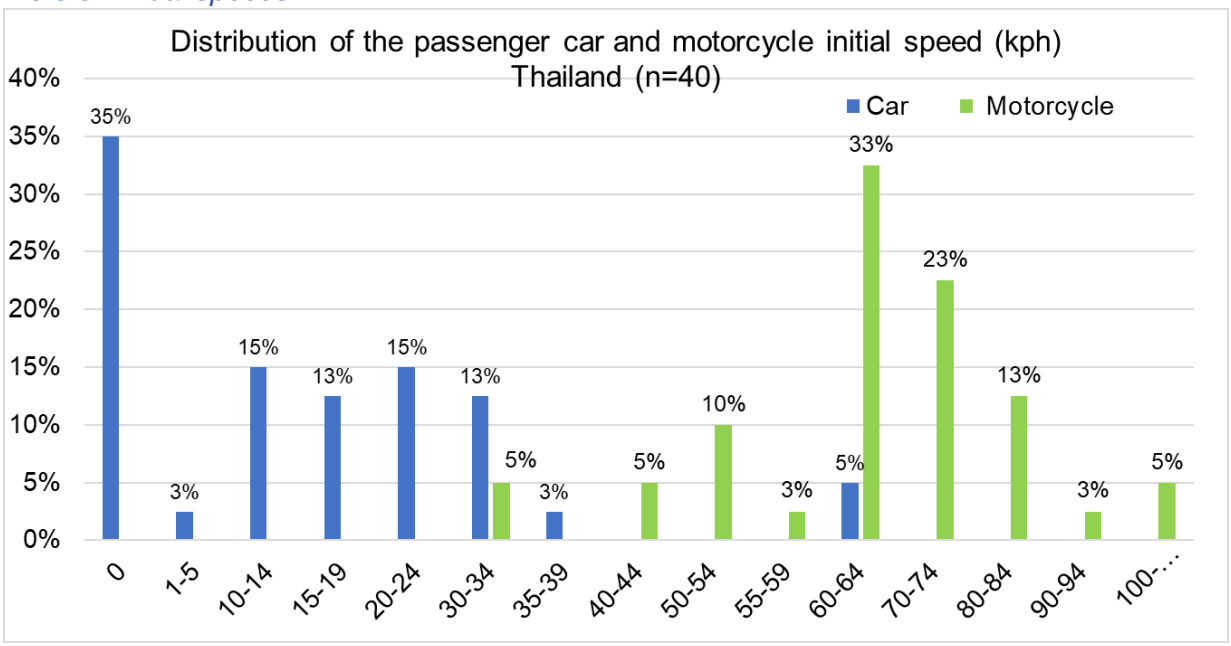


Figure 193: Initial speeds – Thailand – ANGULAR 2 SCENARIO

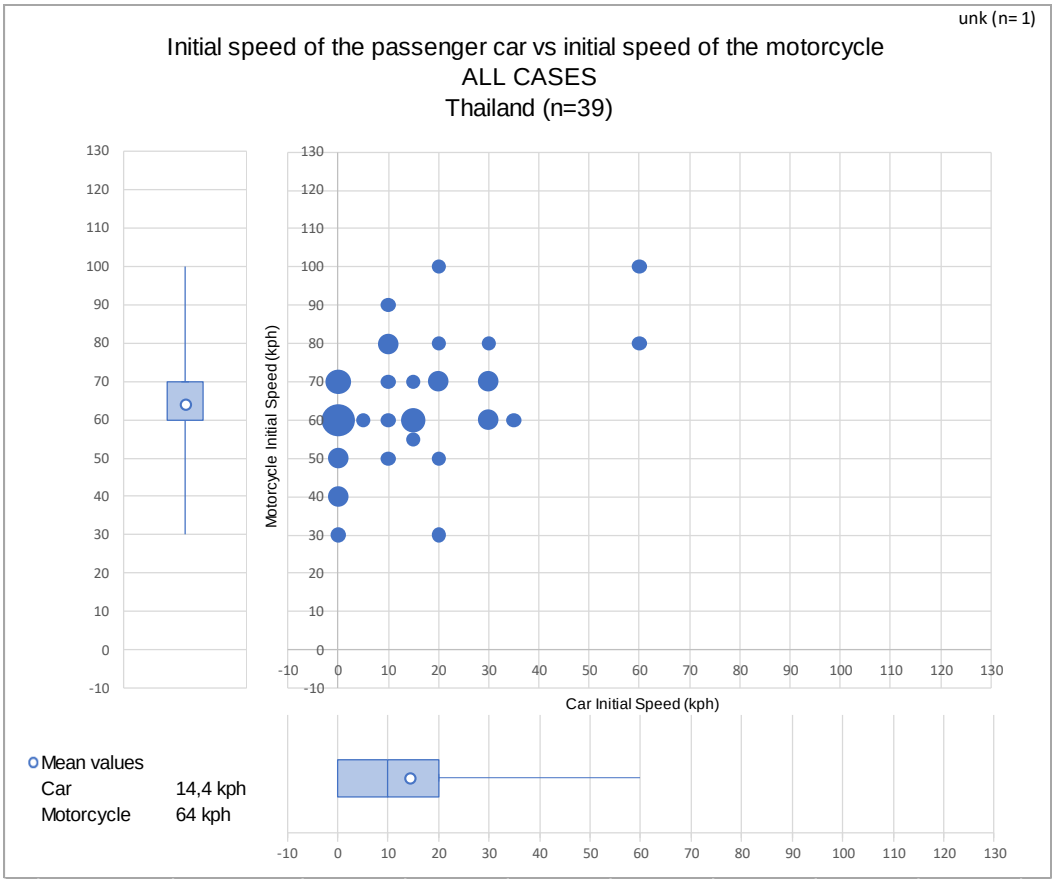


Figure 194: Initial speed of the car versus initial speed of the motorcycle, all cases – Thailand – ANGULAR 2 SCENARIO

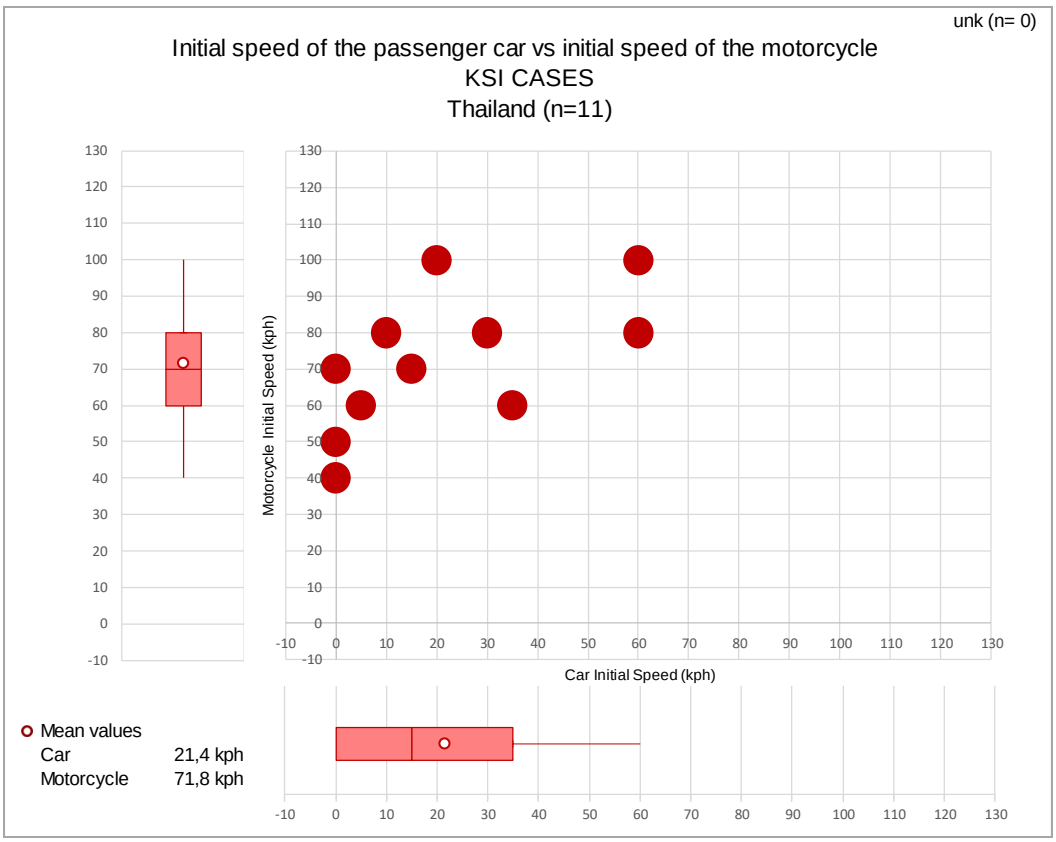


Figure 195: Initial speed of the car versus initial speed of the motorcycle, KSI cases – Thailand – ANGULAR 2 SCENARIO

Table 49: Initial speed values for the car and the motorcycle, all cases – Thailand – ANGULAR 2 SCENARIO

All Accidents																											unk: 0
Number of cases	Passenger Car Initial Speed (kph)																										
Motorcycle Initial Speed (kph)	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
0																										
1																										
5																										
10																										
15																										
20																										
25																										
30	1					1																				
35																										
40	2																									
45																										
50	2			1		1																				
55					1																					
60	5		1	1	3			2	1																	
65																										
70	3			1	1	2		2																		
75																										
80				2		1		1						1												
85																										
90				1																						
95																										
100						1								1												
105≤																										

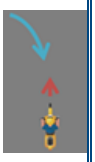


Table 50: Initial speed values for the car and the motorcycle, KSI cases – Thailand – ANGULAR 2 SCENARIO

KSI Accidents																										unk:	0
Number of cases		Passenger Car Initial Speed (kph)																									
		0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Initial Speed (kph)	0																										
	1																										
	5																										
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	35																										
	40	1																									
	45																										
	50	1																									
	55																										
	60			1						1																	
	65																										
	70	1				1																					
	75																										
	80				1				1						1												
	85																										
	90																										
	95																										
	100						1								1												
	105≤																										

4.3.3.6 Collision speeds

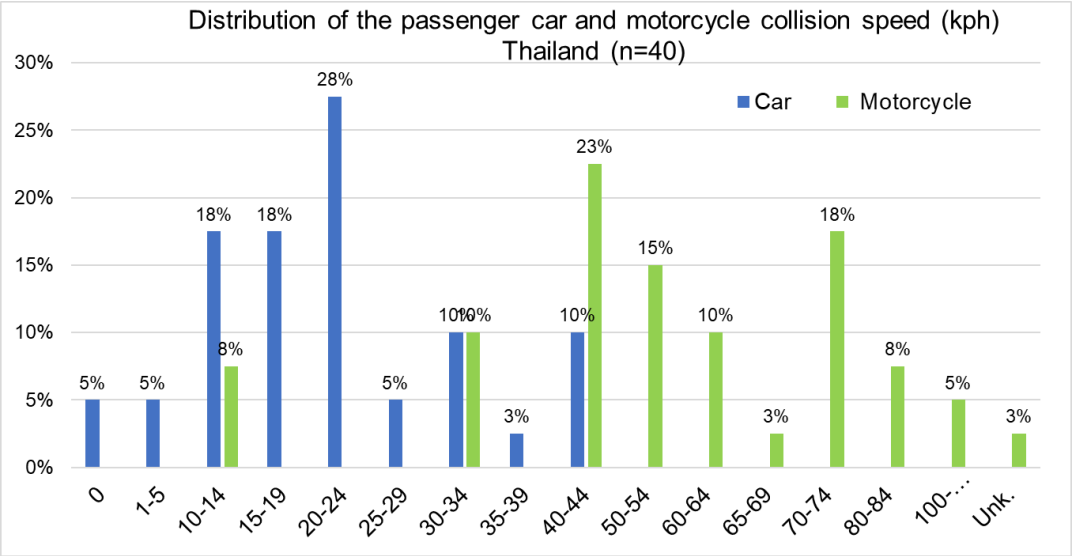

Figure 196: Collision speeds – Thailand – ANGULAR 2 SCENARIO

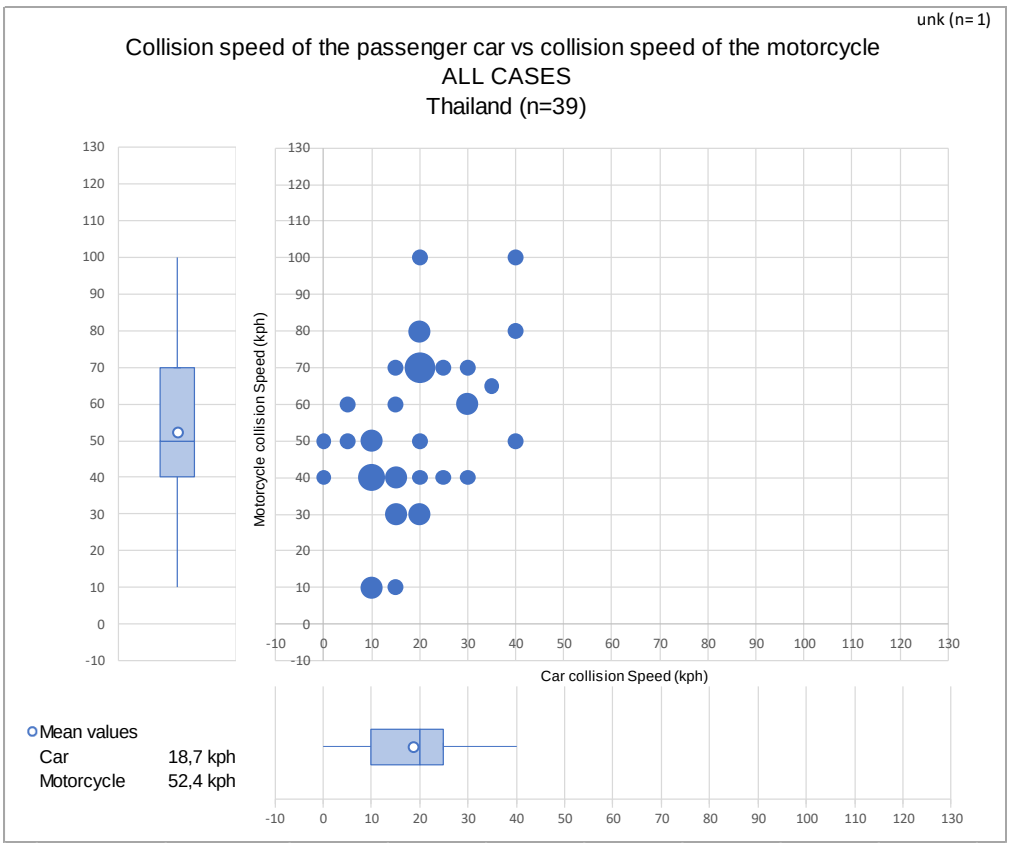

Figure 197: Collision speed of the car versus collision speed of the motorcycle, all cases – Thailand - ANGULAR 2 SCENARIO

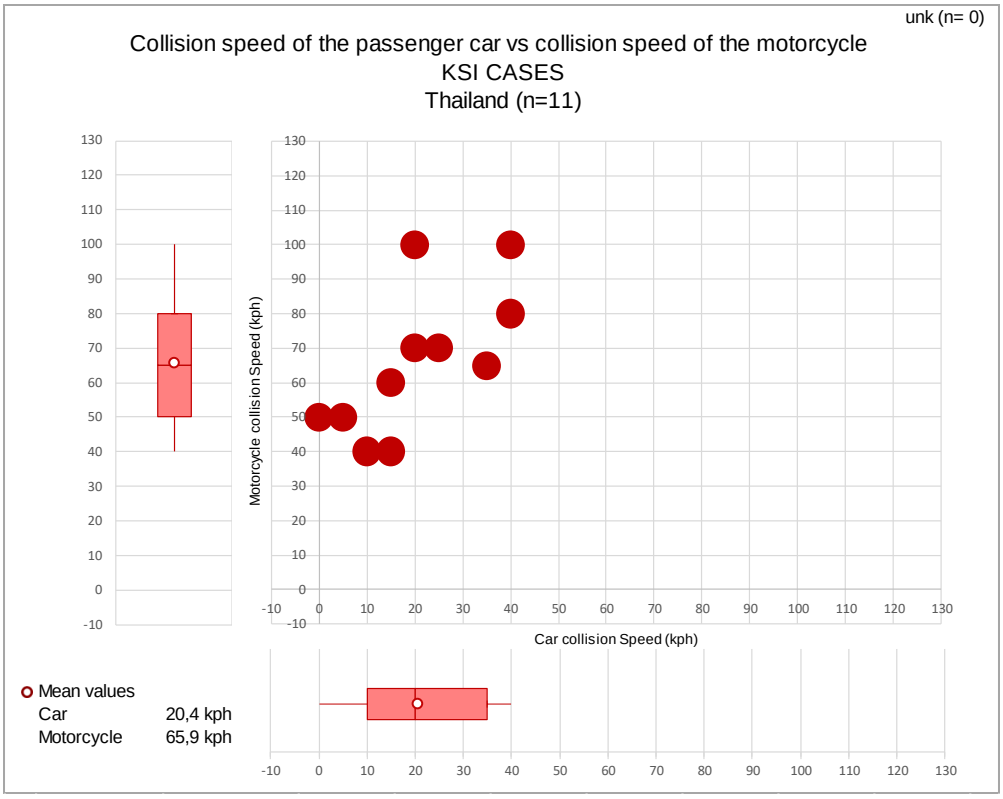

Figure 198: Collision speed of the car versus collision speed of the motorcycle, KSI cases – Thailand – ANGULAR 2 SCENARIO

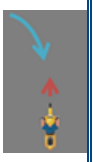

Table 51: Collision speed values for the car and the motorcycle, all cases – Thailand – ANGULAR 2 SCENARIO

All Accidents																												unk:	0
Number of cases		Passenger Car Collision Speed (kph)																											
		0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Collision Speed (kph)	0																										
	1																										
	5																										
	10				2	1																					
	15																										
	20																										
	25																										
	30					2	2																				
	35																										
	40	1			3	2	1	1	1																		
	45																										
	50	1		1	2		1				1																
	55																										
	60			1		1			2																		
	65									1																	
	70					1	4	1	1																		
	75																										
	80						2				1																
	85																										
	90																										
	95																										
	100						1				1																
	105≤																										

Table 52: Collision speed values for the car and the motorcycle, KSI cases – Thailand ANGULAR 2 SCENARIO

KSI Accidents																												unk:	0
Number of cases		Passenger Car Collision Speed (kph)																											
		0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Collision Speed (kph)	0																										
	1																										
	5																										
	10																										
	15																										
	20																										
	25																										
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	35																										
	40				1	1																					
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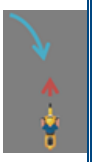
	55																										
	60					1																					
	65									1																	
	70						1	1																			
	75																										
	80										1																
	85																										
	90																										
	95																										
	100						1				1																
	105≤																										



4.3.3.7 Delta initial velocity (kph) – calculated

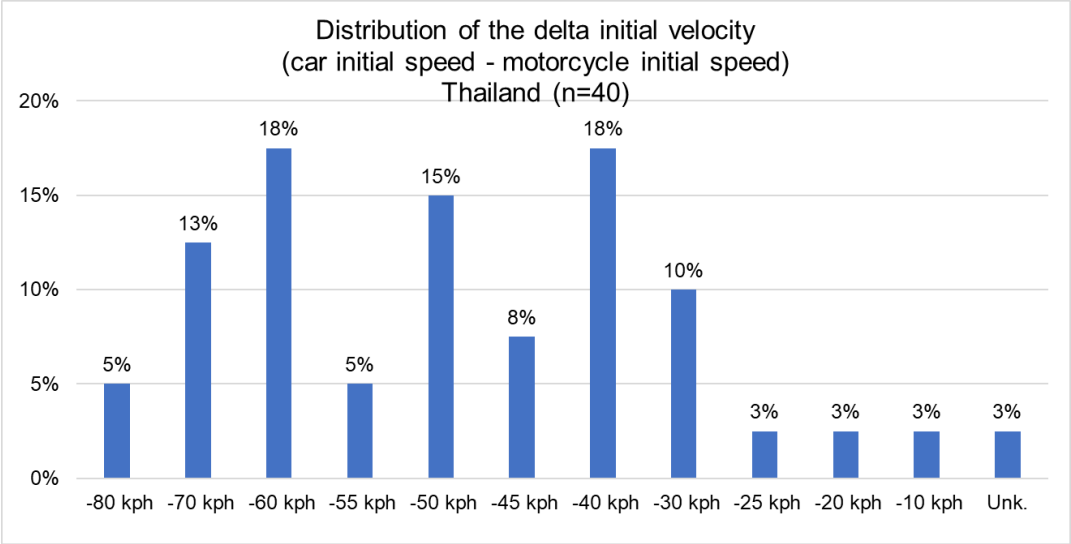


Figure 199: Delta initial velocity (kph) – Thailand – ANGULAR 2 SCENARIO

4.3.3.8 Skid marks

In this scenario, braking skid marks were not observed either for the car or for the motorcycle.

4.3.3.9 ABS fitment on the car

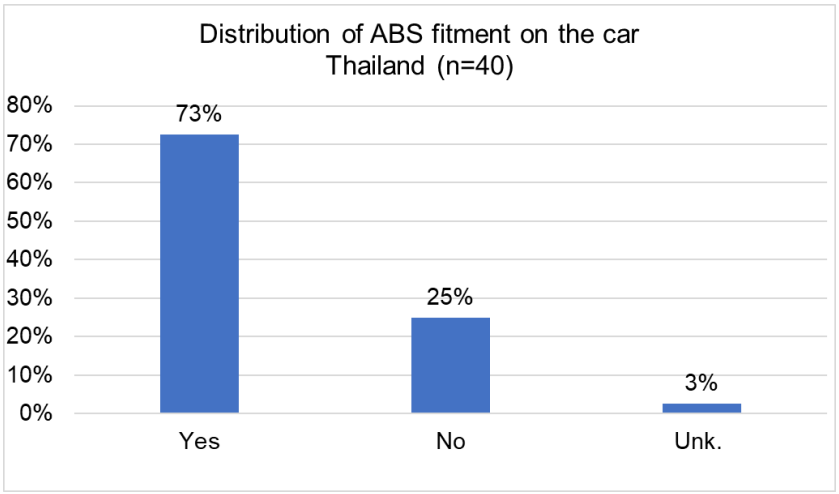


Figure 200: ABS fitment – Thailand – ANGULAR 2 SCENARIO

4.3.3.10 Motorcycle manoeuvre before crash

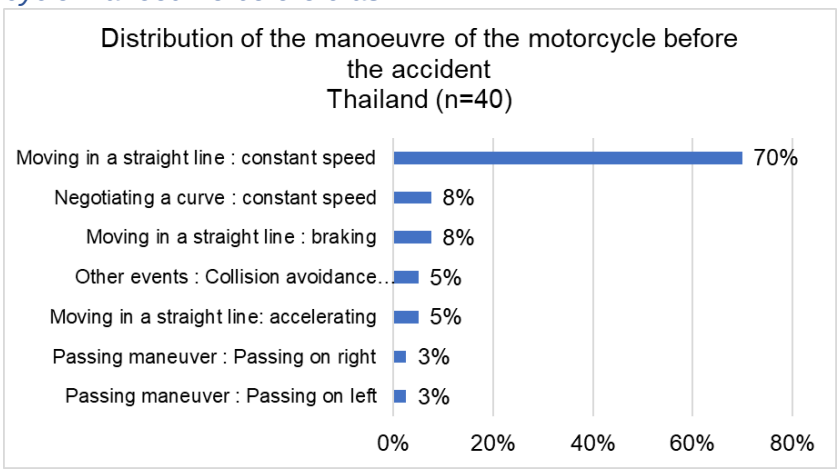


Figure 201: Motorcycle manoeuvre – Thailand – ANGULAR 2 SCENARIO

4.3.3.11 Car manoeuvre before crash

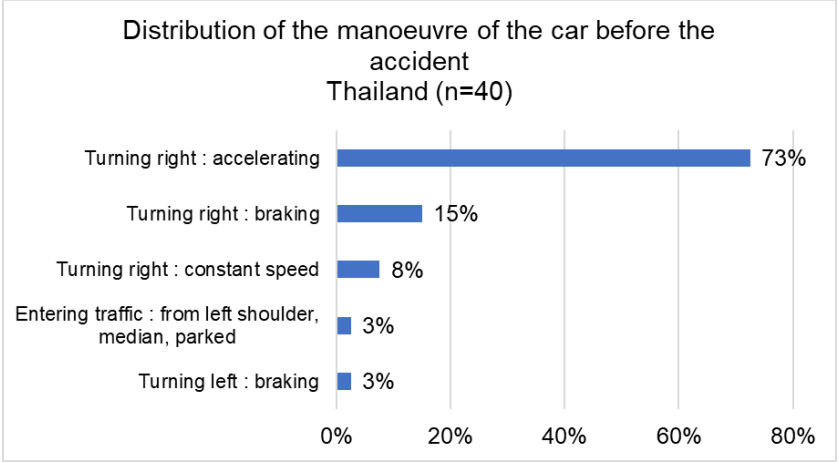


Figure 202: Car manoeuvre – Thailand – ANGULAR 2 SCENARIO

4.3.3.12 Avoidance action by vehicle

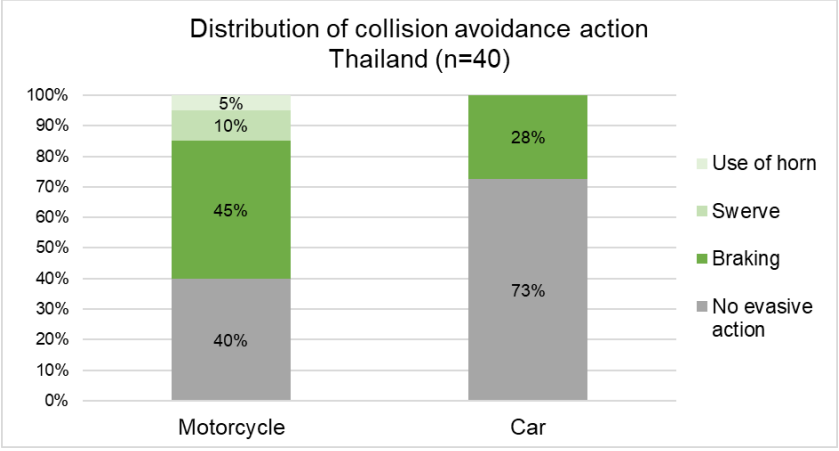


Figure 203: Avoidance action by vehicle – Thailand – ANGULAR 2 SCENARIO

4.3.3.13 Conclusion on accident characteristics

Table 53: Conclusion on accident characteristics – Thailand – ANGULAR 2 SCENARIO

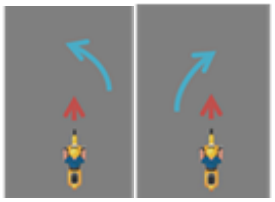
Accident characteristics	**ANGULAR 2**	*Thai data*

- ✓ *38% of cars and motorcycles have clear visibility, around 25% have roadside object obstruction, then visibility obstructed by vehicle in front or parked vehicles.*
- ✓ *68% frontal impact for the motorcycle.*
- ✓ *70% right side impact for the car.*
- ✓ *Mean initial speed: Car=14,4 kph and Motorcycle=64 kph*
- ✓ *Mean collision speed: Car=18,7 kph and Motorcycle=52,4 kph*
- ✓ *73% of the car had ABS.*
- ✓ *The motorcycle moves at constant speed, straight (70%) or in a curve (8%) or braking (8%).*
- ✓ *The car is turning right and accelerating in 73% of the accidents or turning right and braking in 15% of the cases.*
- ✓ *No avoidance action from the car (73%) and action from the motorcycle (60%). The motorcycle and the car try to avoid the collision mostly by braking.*

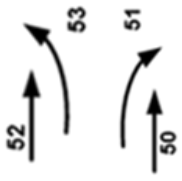
4.4 Thai database: Car turning right or left in the path of the motorcycle, vehicles in same direction (Angular 3)

This OASIM angular sub-scenario represents **13,8%** of all the accidents and **3,4%** of the KSI accidents in the Thai database.

In this sub-scenario, the car is turning right or left in the path of the motorcycle, both vehicles travelling in the same direction. This configuration is illustrated by the figure below:



(a)



(b)
Car=51 or 53
Motorcycle=50 or 52

Figure 204: (a) Illustration of the ANGULAR 3 scenario, (b) pictogram from the Thai database.

The following graphs provide in-depth description of the sub-scenario. There are 88 cases from this sub-scenario in the Thai database.

4.4.1 Accident characteristics – general conditions

4.4.1.1 Weather conditions

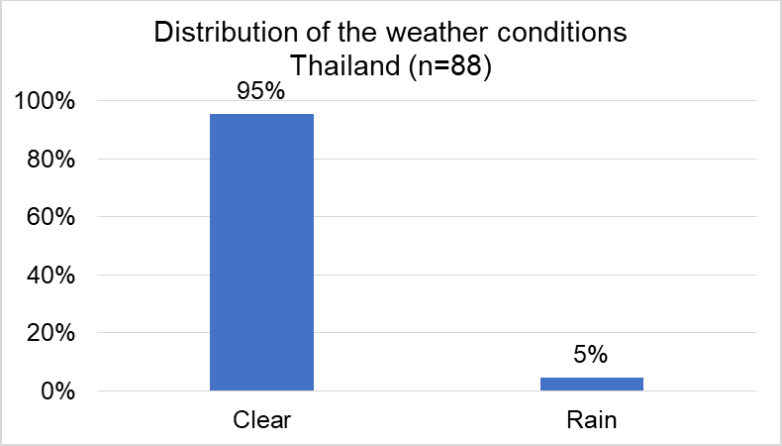


Figure 205: Weather conditions - Thailand – ANGULAR 3 SCENARIO

4.4.1.2 Light conditions

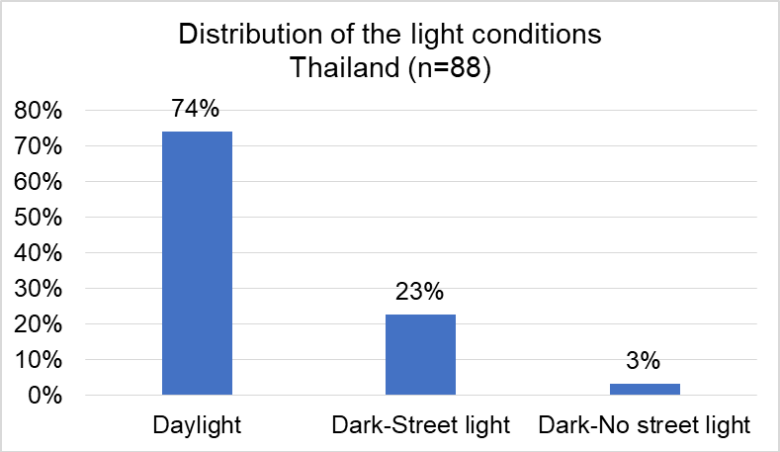


Figure 206: Light conditions - Thailand – ANGULAR 3 SCENARIO

4.4.1.3 Road surface conditions

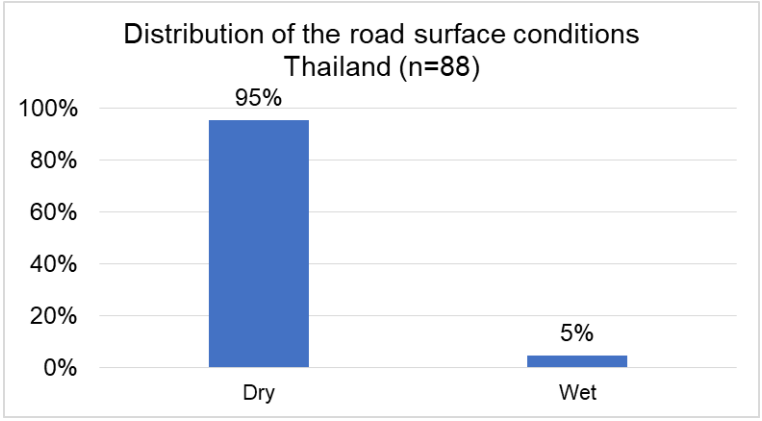


Figure 207: Road surface conditions – Thailand – ANGULAR 3 SCENARIO

4.4.1.4 Conclusion on general accident conditions

Table 54: Conclusion on general accident conditions – Thailand – ANGULAR 3 SCENARIO

General conditions	**ANGULAR 3**	*Thai data*

- ✓ *Clear weather for 95% of the accidents.*
- ✓ *74% of the accidents happen during the day (3% at night with streetlights).*
- ✓ *95% of the accidents happen on dry road surface.*

4.4.2 Road characteristics

4.4.2.1 Location (city/urban)

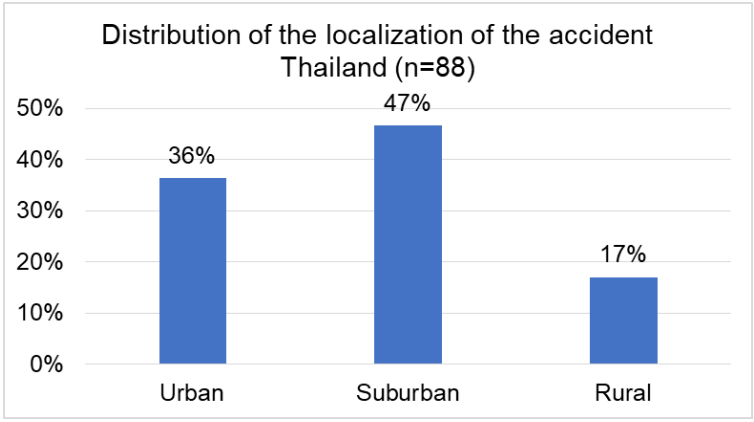


Figure 208: Localization of the accident –Thailand – ANGULAR 3 SCENARIO

4.4.2.2 Road category

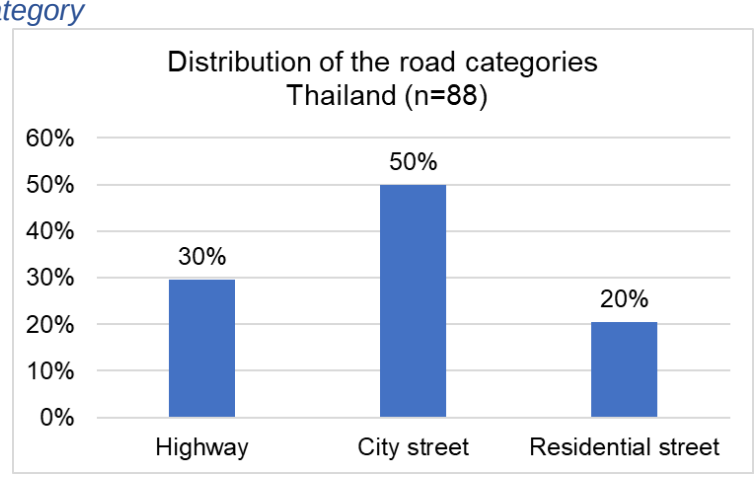
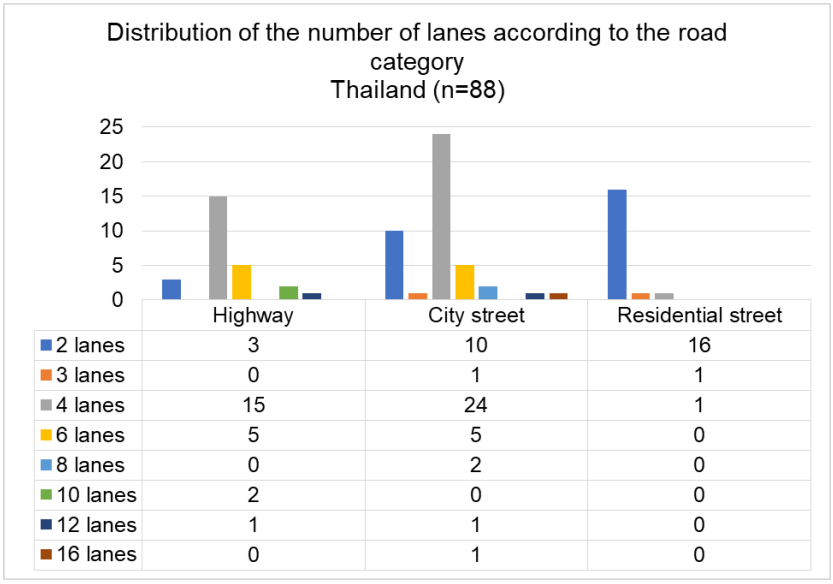


Figure 209: Road category – Thailand – ANGULAR 3 SCENARIO



	Highway	City street	Residential street
2 lanes	3	10	16
3 lanes	0	1	1
4 lanes	15	24	1
6 lanes	5	5	0
8 lanes	0	2	0
10 lanes	2	0	0
12 lanes	1	1	0
16 lanes	0	1	0

Figure 210: Road category and number of lanes – Thailand – ANGULAR 3 SCENARIO

4.4.2.3 Configuration

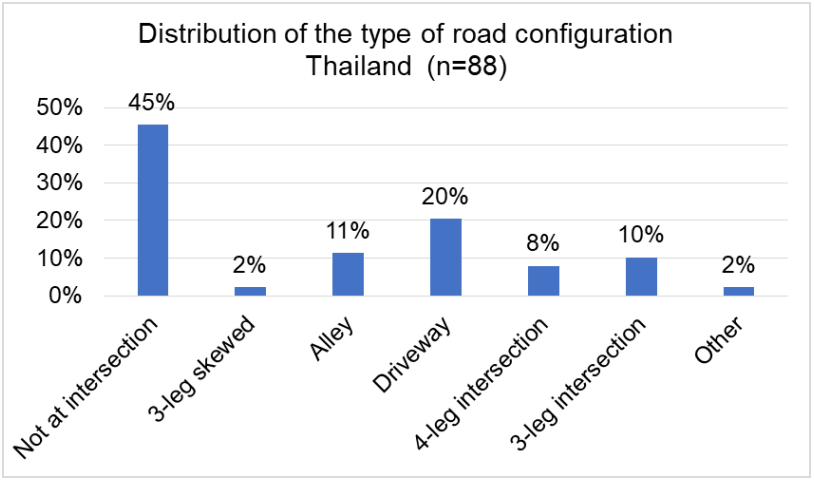


Figure 211: Configuration – Thailand – ANGULAR 3 SCENARIO

4.4.2.4 Road geometry

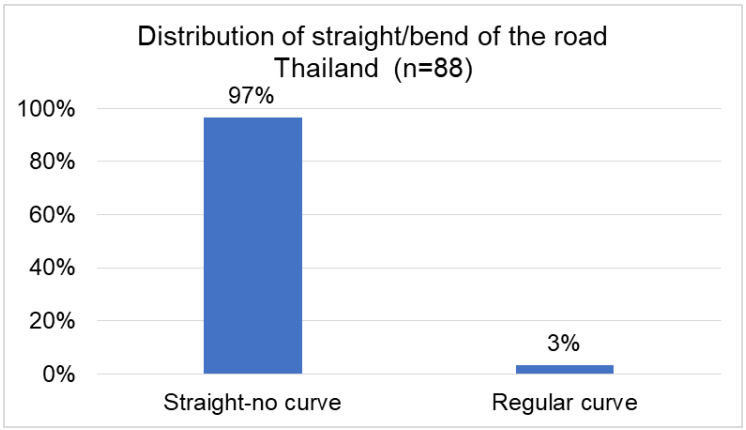


Figure 212: Road geometry – Thailand – ANGULAR 3 SCENARIO

4.4.2.5 Slope

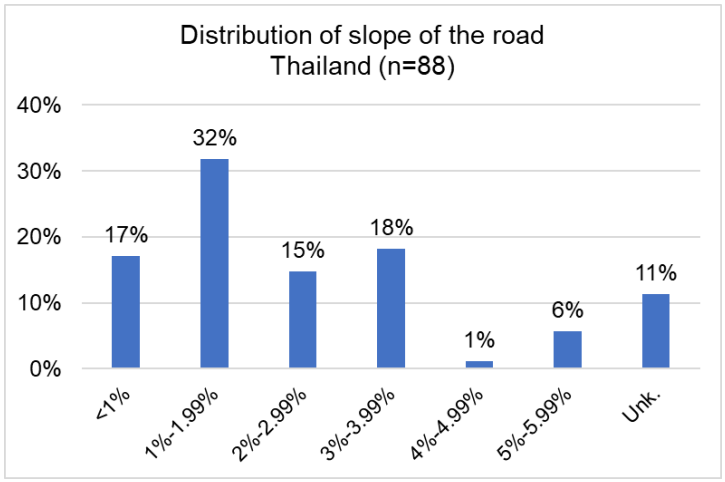


Figure 213: Slop of the road – Thailand – ANGULAR 3 SCENARIO

4.4.2.6 Speed limit

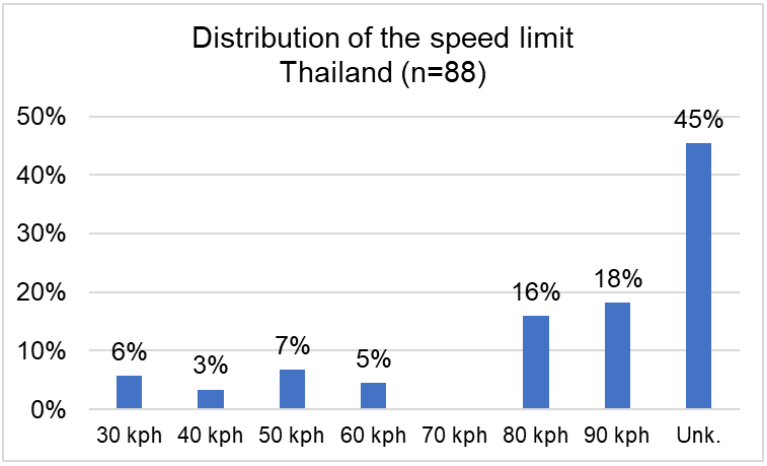


Figure 214: Speed limits – Thailand – ANGULAR 3 SCENARIO

4.4.2.7 Number of lanes

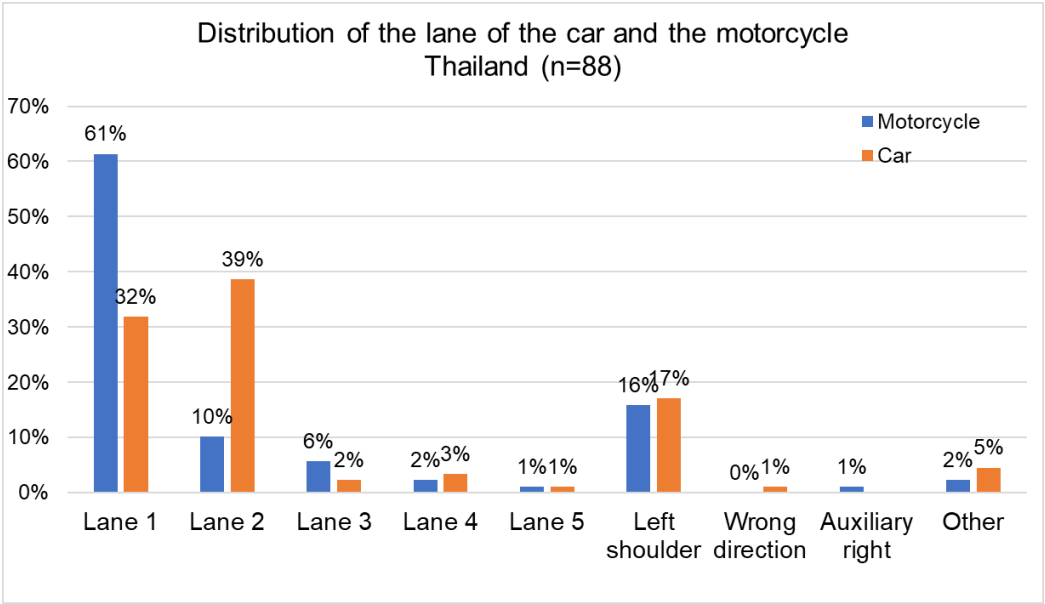
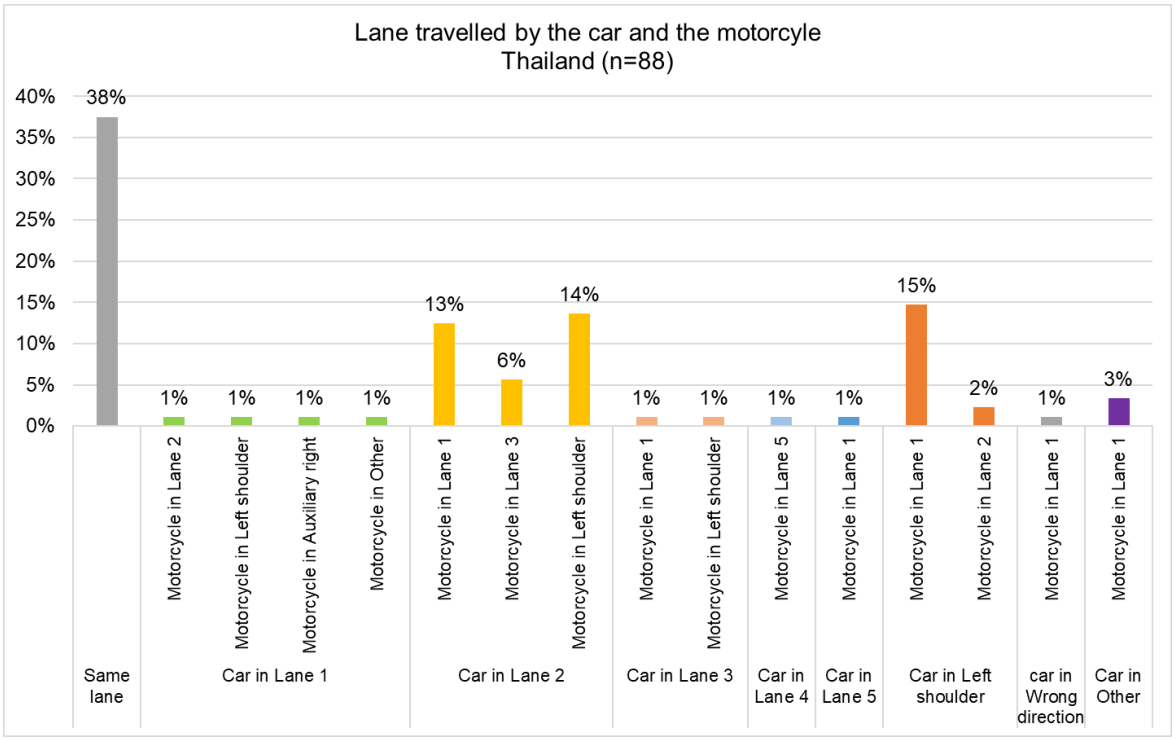


Figure 215: Lanes of the vehicles – Thailand – ANGULAR 3 SCENARIO

4.4.2.8 Travelled lane



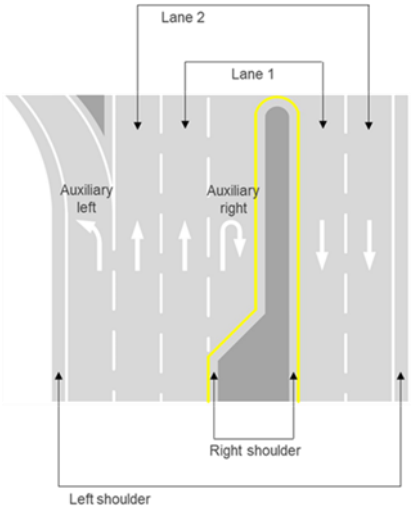


Figure 216: Vehicles on same lane – Thailand – ANGULAR 3 SCENARIO

4.4.2.9 Conclusion on road characteristics

Table 55: Conclusion on road characteristics – Thailand – ANGULAR 3 SCENARIO

Road characteristics	**ANGULAR 3**	*Thai data*

- ✓ *Mostly suburban (47%) and urban (36%) areas.*
- ✓ *Half of the accidents occurs in city street, then highway (30%).*
- ✓ *Mainly 2 or 4 lanes roads.*
- ✓ *45% of the accidents are out of intersection, 20% in driveways and 18% in 3-leg/4-leg intersection.*
- ✓ *97% of the accidents happen in a straight road.*
- ✓ *Speed limit mainly unknown (45%) otherwise 18% at 90 kph and 16% at 80 kph.*
- ✓ *In 38% of the accidents the vehicles are in the same lane, 28% in adjacent lanes.*

From the high-level analysis for the angular scenarios with Malaysian data, the accidents happen mostly in rural area whereas, from Thai data, they happen mostly in urban and suburban areas.

4.4.3 Accident characteristics – vehicles

4.4.3.1 Visibility

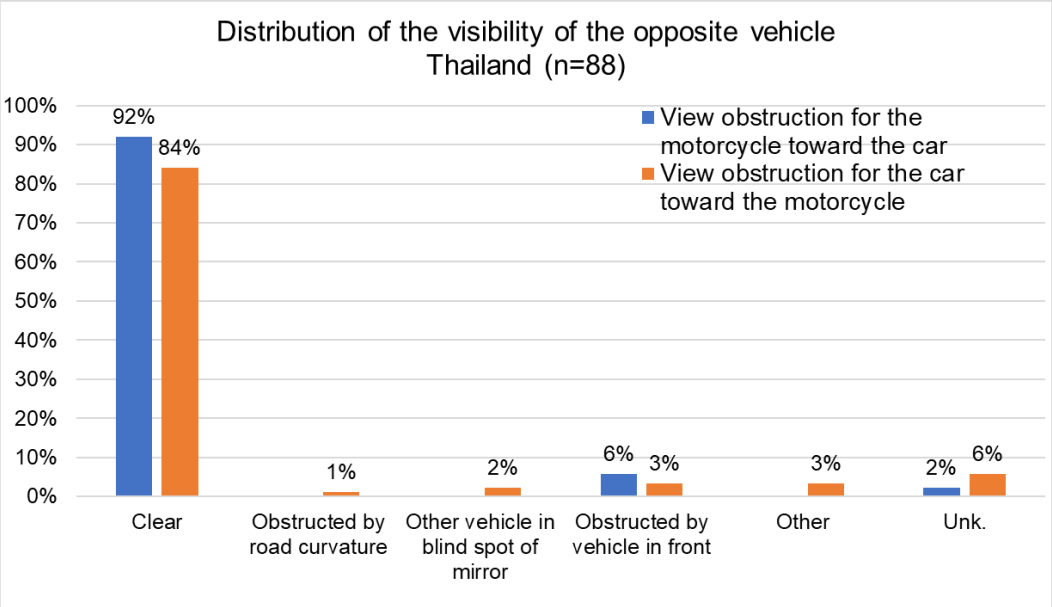
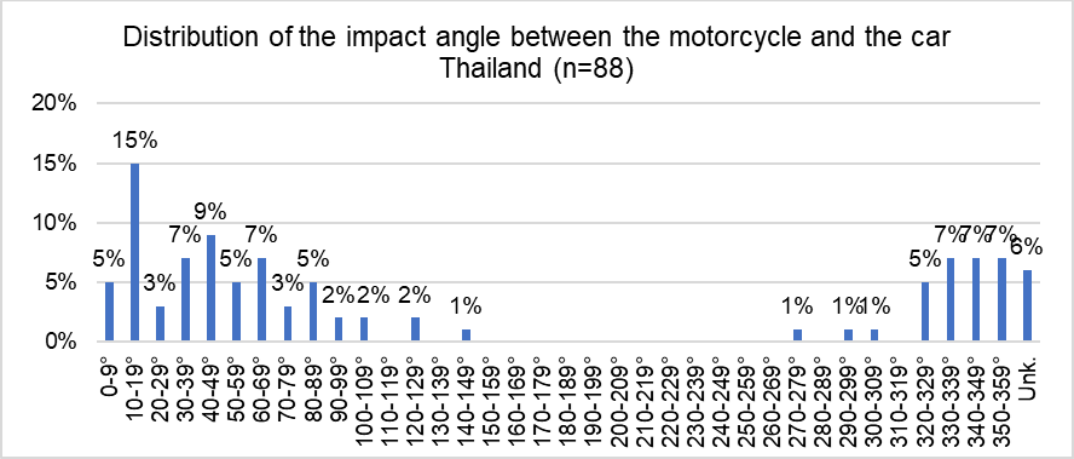


Figure 217: Visibility – Thailand – ANGULAR 3 SCENARIO

4.4.3.2 Impact angle



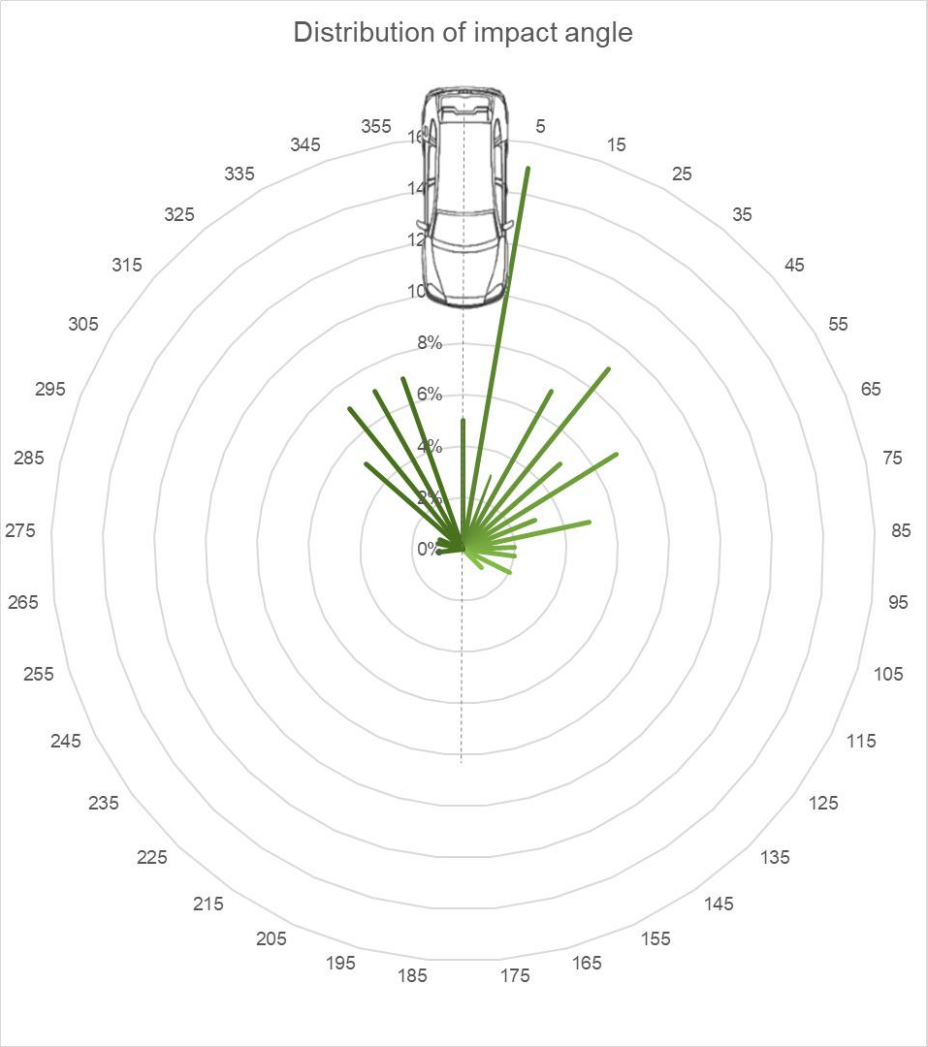


Figure 218: Impact angle – Thailand – ANGULAR 3 SCENARIO

4.4.3.3 Motorcycle impact type

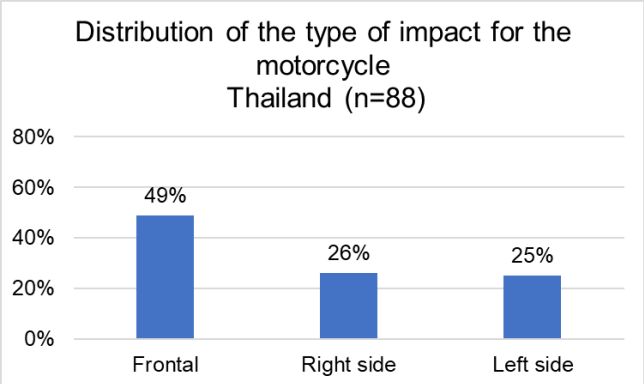


Figure 219: Type of impact for the motorcycle – Thailand – ANGULAR 3 SCENARIO

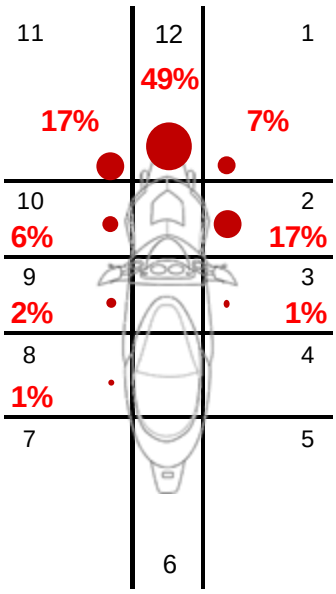


Figure 220: First collision point for the motorcycle – Thailand – ANGULAR 3 SCENARIO

4.4.3.4 Car impact type

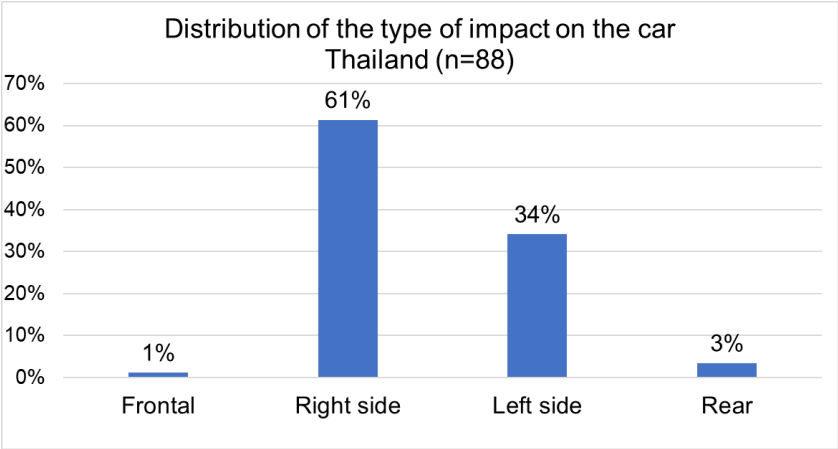


Figure 221: Type of impact for the car– Thailand – ANGULAR 3 SCENARIO

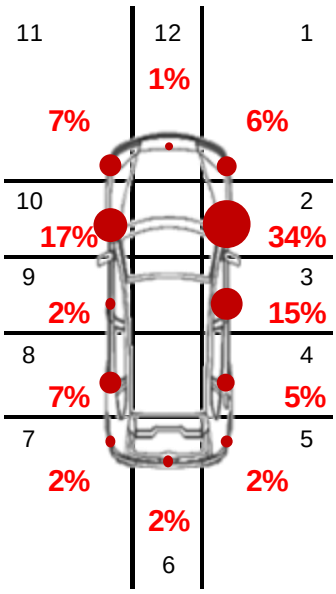


Figure 222: First collision point for the car – Thailand – ANGULAR 3 SCENARIO

4.4.3.5 Initial speeds

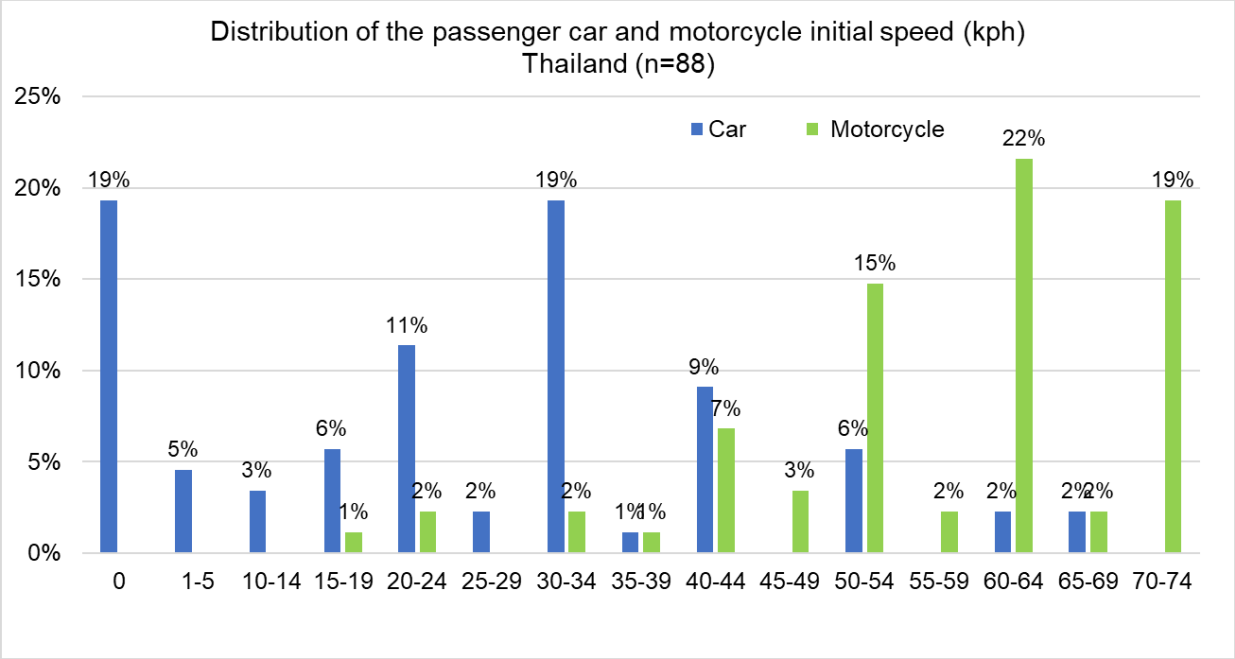


Figure 223: Initial speeds – Thailand – ANGULAR 3 SCENARIO

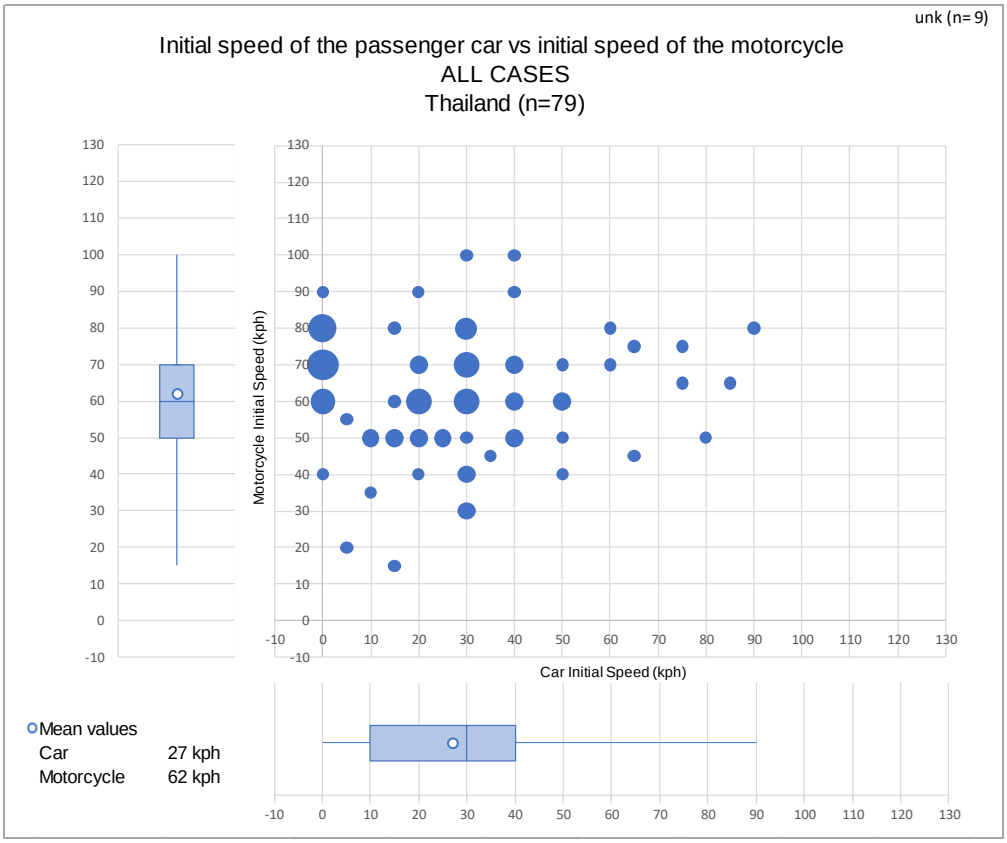


Figure 224: Initial speed of the car versus initial speed of the motorcycle, all cases – Thailand – ANGULAR 3 SCENARIO

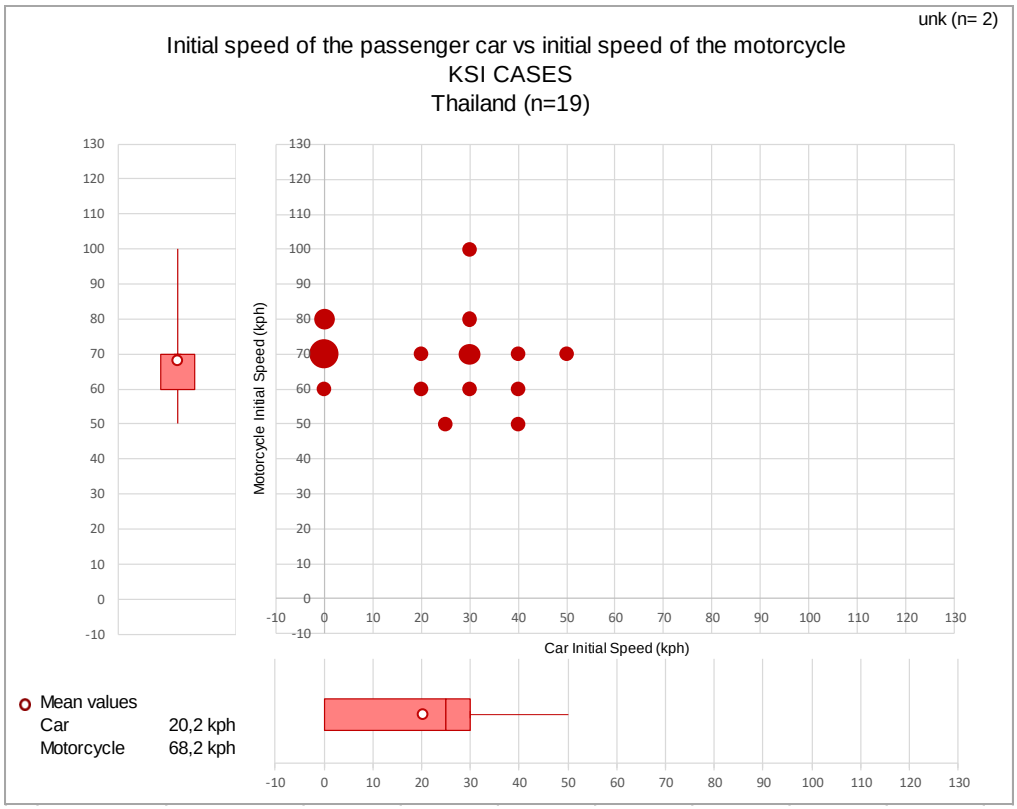


Figure 225: Initial speed of the car versus initial speed of the motorcycle, KSI cases – Thailand – ANGULAR 3 SCENARIO

Table 56: Initial speed values for the car and the motorcycle, all cases – Thailand – ANGULAR 3 SCENARIO

All Accidents																										unk:	9
Number of cases	Passenger Car Initial Speed (kph)																										
	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Initial Speed (kph) 0																										
1																										
5																										
10																										
15					1																					
20			1																							
25																										
30								2																		
35				1																						
40	1					1		2				1														
45									1						1											
50				2	2	2	2	1		2		1						1								
55			1																							
60	4				1	4		4		2		2														
65																	1		1							
70	6					2		4		2		1		1												
75															1		1									
80	5				1			3						1						1						
85																										
90	1					1				1																
95																										
100								1		1																
105≤																										

Table 57: Initial speed values for the car and the motorcycle, KSI cases – Thailand – ANGULAR 3 SCENARIO

KSI Accidents																										unk:	2
Number of cases	Passenger Car Initial Speed (kph)																										
	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Initial Speed (kph) 0																										
1																										
5																										
10																										
15																										
20																										
25																										
30																										
35																										
40																										
45																										
50							1			1																
55																										
60	1					1		1		1																
65																										
70	4					1		2		1		1														
75																										
80	2							1																		
85																										
90																										
95																										
100								1																		
105≤																										

4.4.3.6 Collision speeds

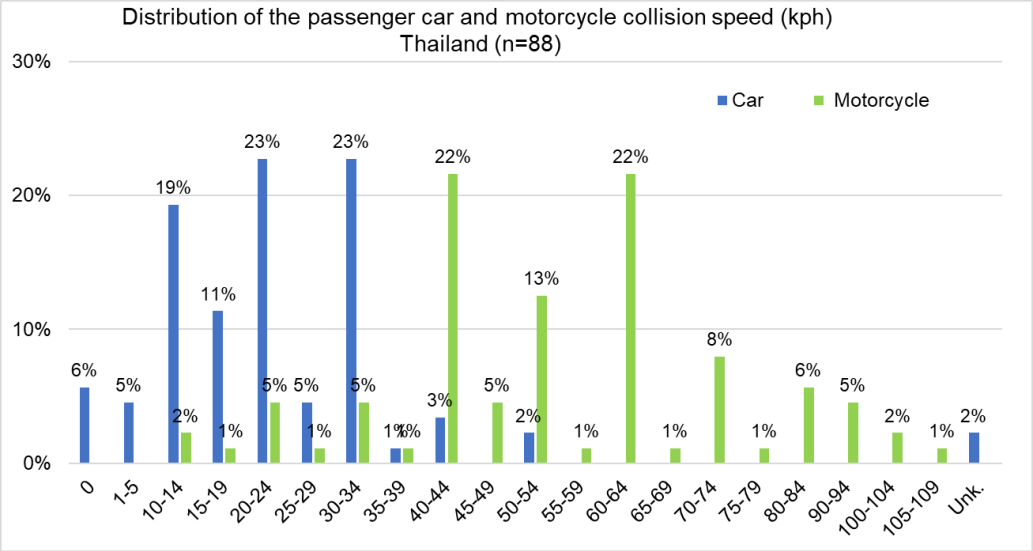


Figure 226: Collision speeds – Thailand – ANGULAR 3 SCENARIO

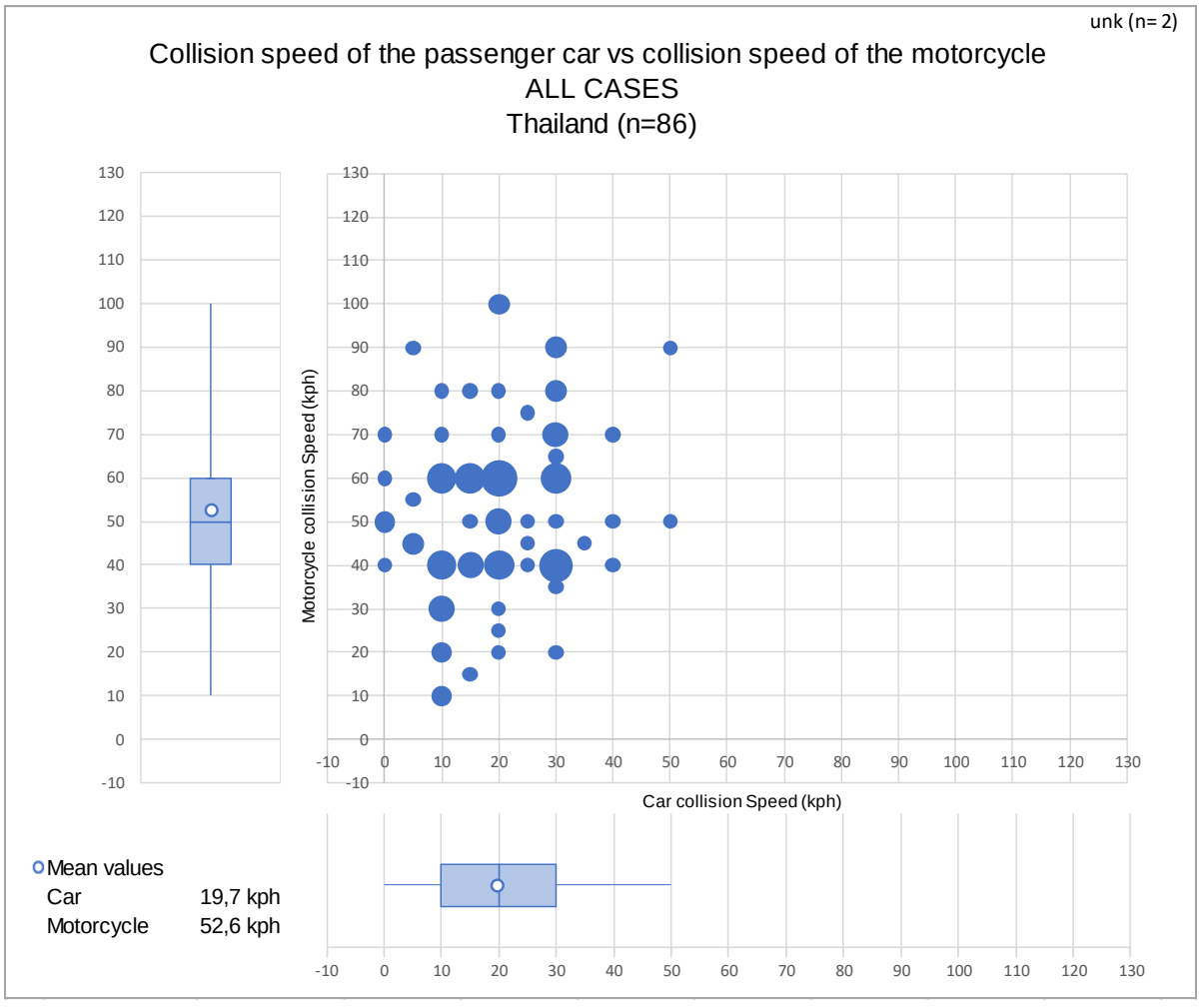


Figure 227: Collision speed of the car versus collision speed of the motorcycle, all cases – Thailand - ANGULAR 3 SCENARIO

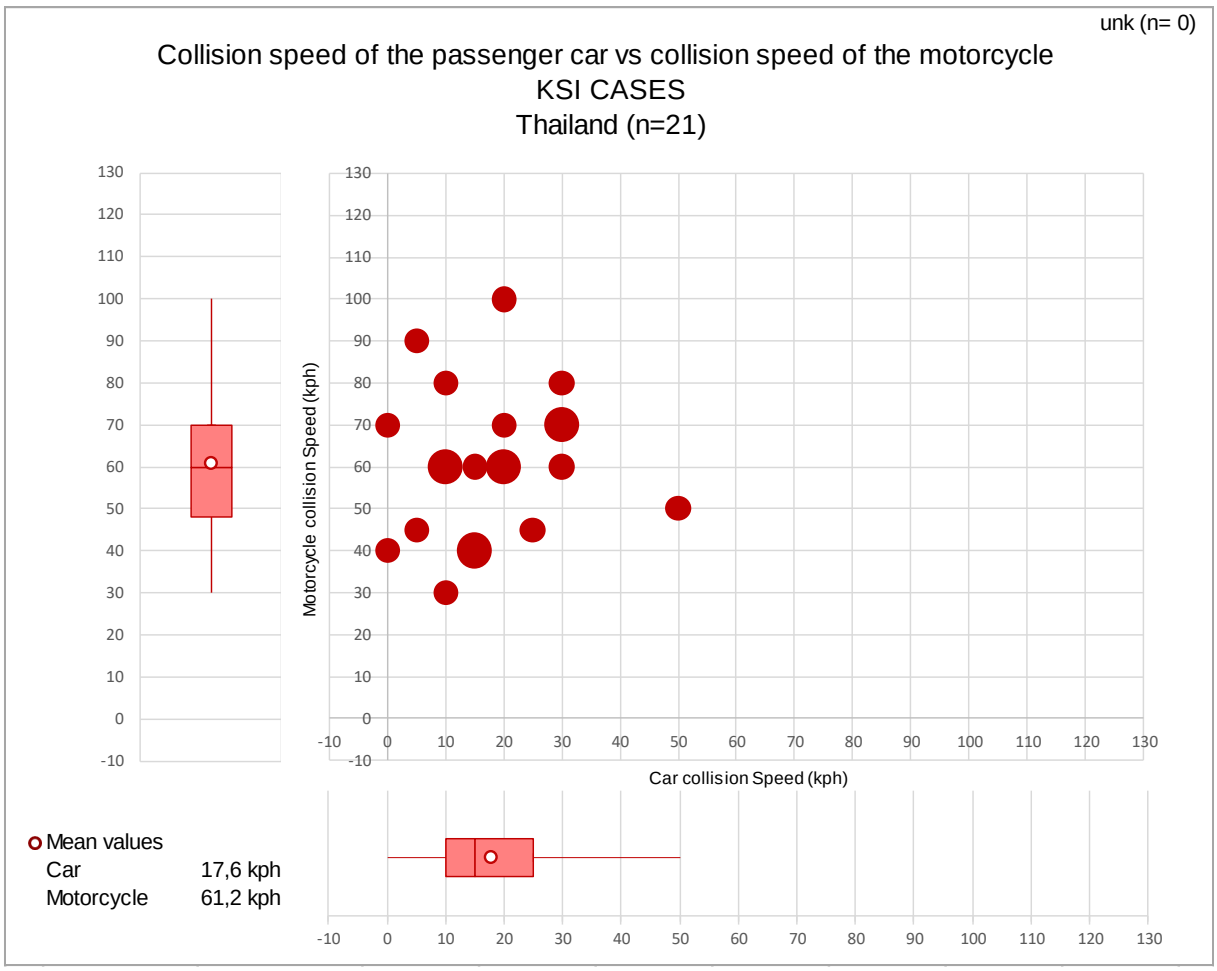


Figure 228: Collision speed of the car versus collision speed of the motorcycle, KSI cases – Thailand – ANGULAR 3 SCENARIO

Table 58: Collision speed values for the car and the motorcycle, all cases – Thailand – ANGULAR 3 SCENARIO

All Accidents																											unk:	2
Number of cases	Passenger Car Collision Speed (kph)																											
Motorcycle Collision Speed (kph)	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
0																										
1																										
5																										
10				2																						
15					1																					
20				2		1		1																		
25						1																				
30				3		1																				
35								1																		
40	1			4	3	4	1	5		1																
45			2				1		1																	
50	2				1	3	1	1		1		1														
55			1																							
60	1			4	4	6		4																		
65								1																		
70	1			1		1		3		1																
75							1																			
80				1	1	1		2																		
85																										
90			1					2				1														
95																										
100						2																				
105≤																										

Table 59: Collision speed values for the car and the motorcycle, KSI cases – Thailand ANGULAR 3 SCENARIO

KSI Accidents																										unk:	0
Number of cases		Passenger Car Collision Speed (kph)																									
		0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Collision Speed (kph)	0																										
	1																										
	5																										
	10																										
	15																										
	20																										
	25																										
	30				1																						
	35																										
	40	1				2																					
	45			1				1																			
	50												1														
	55																										
	60				2	1	2		1																		
	65																										
	70	1					1		2																		
	75																										
	80				1				1																		
	85																										
	90			1																							
	95																										
	100						1																				
	105≤																										

4.4.3.7 Delta initial velocity (kph) – calculated

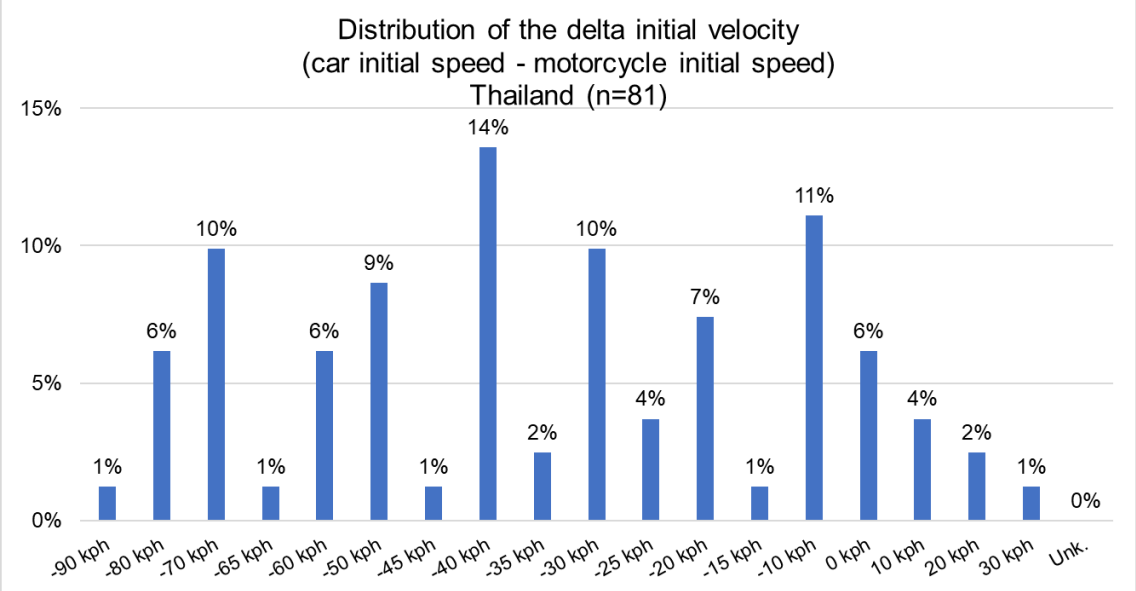


Figure 229: Delta initial velocity (kph)– Thailand – ANGULAR 3 SCENARIO

4.4.3.8 Skid marks

In this scenario braking skid marks were not observed either for the car or for the motorcycle.

4.4.3.9 ABS fitment on the car

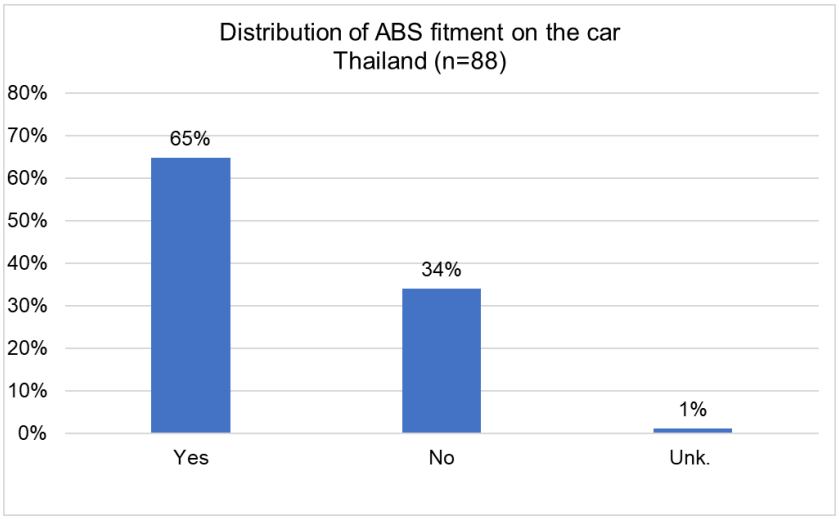


Figure 230: ABS fitment – Thailand – ANGULAR 3 SCENARIO

4.4.3.10 Motorcycle manoeuvre before crash

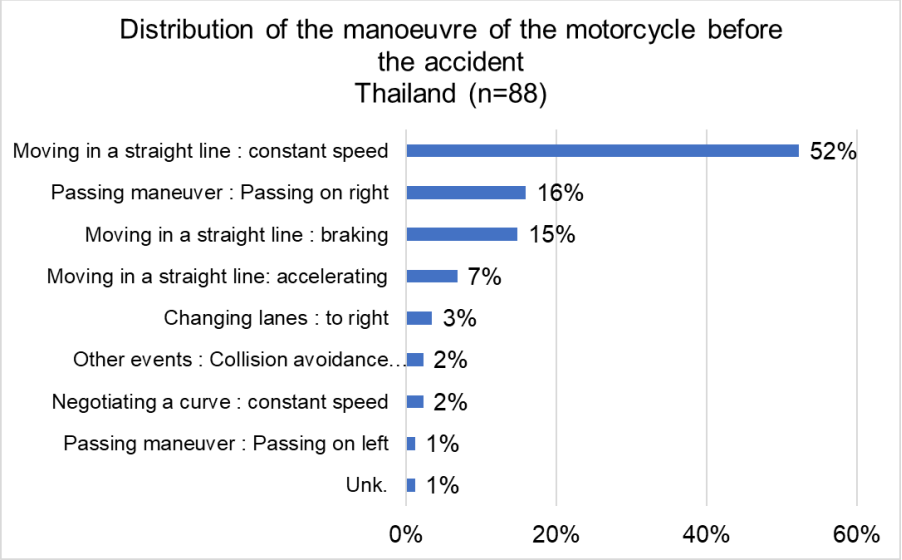


Figure 231: Motorcycle manoeuvre – Thailand – ANGULAR 3 SCENARIO

4.4.3.11 Car manoeuvre before crash

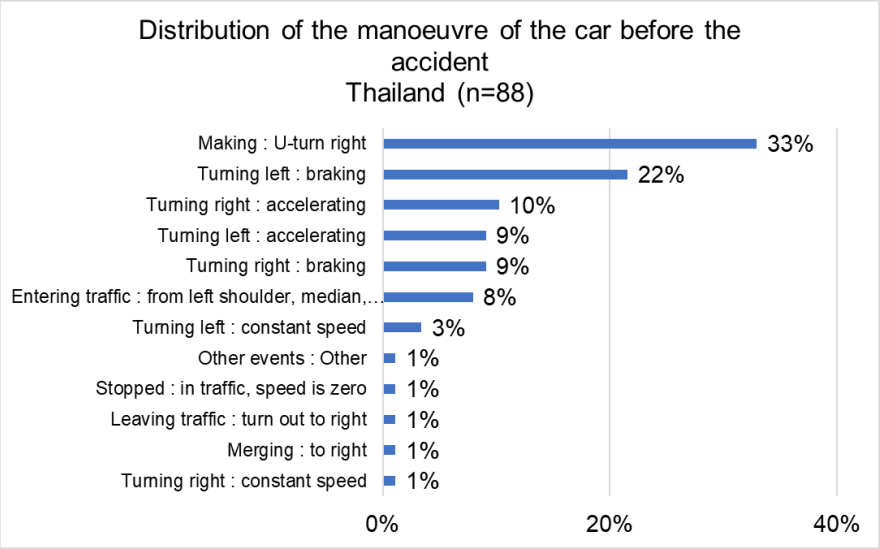


Figure 232: Car manoeuvre – Thailand – ANGULAR 3 SCENARIO

4.4.3.12 Avoidance action by vehicle

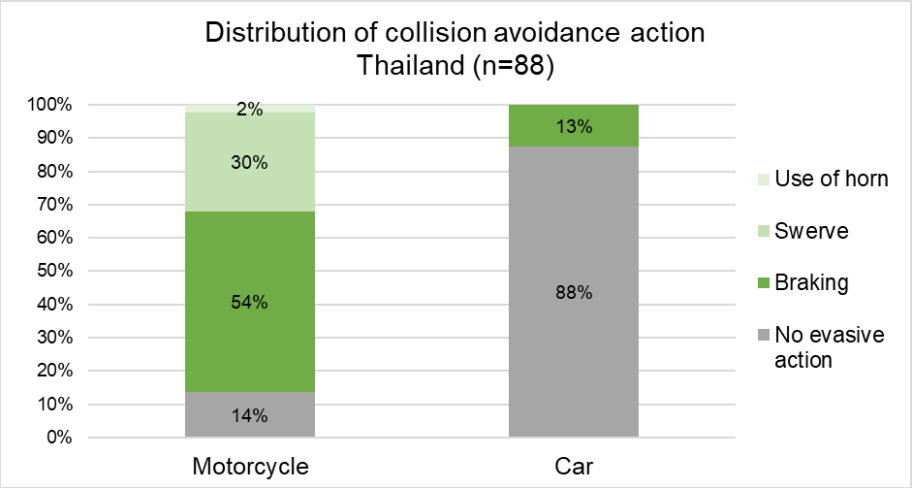


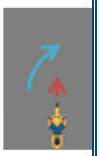
Figure 233: Avoidance action by vehicle – Thailand – ANGULAR 3 SCENARIO

4.4.3.13 Conclusion on accident characteristics

Table 60: Conclusion on accident characteristics – Thailand – ANGULAR 3 SCENARIO

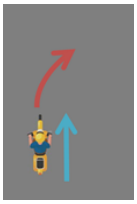
Accident characteristics	**ANGULAR 3**	*Thai data*
✓ *Almost all accidents happen without visibility obstruction (84-92%), 6% of motorcycle view obstructed by vehicle in front.* ✓ *49% of frontal impact and 51% of lateral impact for the motorcycle.* ✓ *61% of right side impact for the car.* ✓ *Mean initial speed: Car=27 kph and Motorcycle=62 kph*		

- ✓ *Mean collision speed: Car=19,7 kph and Motorcycle=52,6 kph*
- ✓ *65% of the car had ABS.*
- ✓ *The motorcycle goes straight at constant speed (52%), is passing on the right (16%), going straight braking (15%).*
- ✓ *The car is making a U-turn (33%), turning left (34%), turning right (19%).*
- ✓ *No avoidance action from the car (88%) but 86% of evasive action from the motorcycle. 54% of braking and 30 % of right swerving from the motorcycle.*



5 Angular scenario with motorcycle turning right

In this OASIM sub-scenario angular with motorcycle turning right, the car and the motorcycle are travelling in the same direction and the motorcycle is turning right across the path of the car. This scenario represents **6%** of the KSI accidents in the Malaysian database and **13%** in the Thai database.



5.1 Malaysian database

This paragraph is describing the distributions of the variables in the Malaysian database for the angular motorcycle turning right scenario. There are 76 accidents of this scenario in the Malaysian database.

5.1.1 Accident characteristics – general conditions

5.1.1.1 Weather conditions

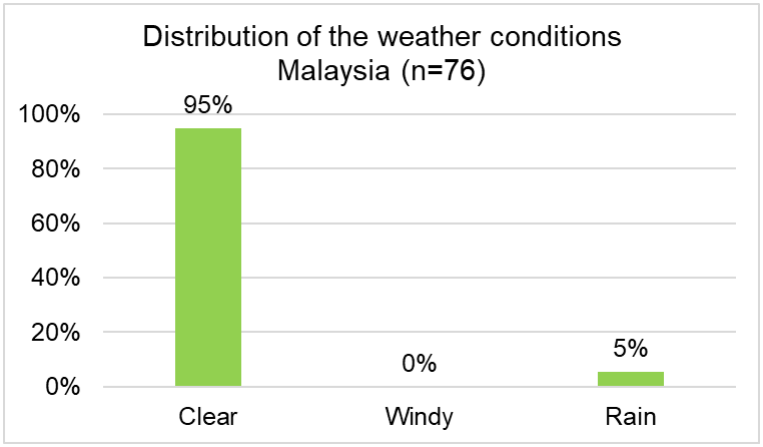


Figure 234: Weather conditions - Malaysia – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.1.1.2 Light conditions

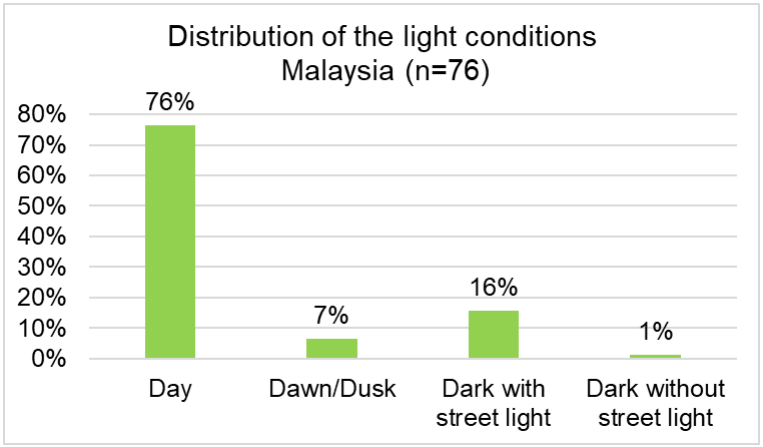


Figure 235: Light conditions - Malaysia - ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.1.1.3 Road surface conditions

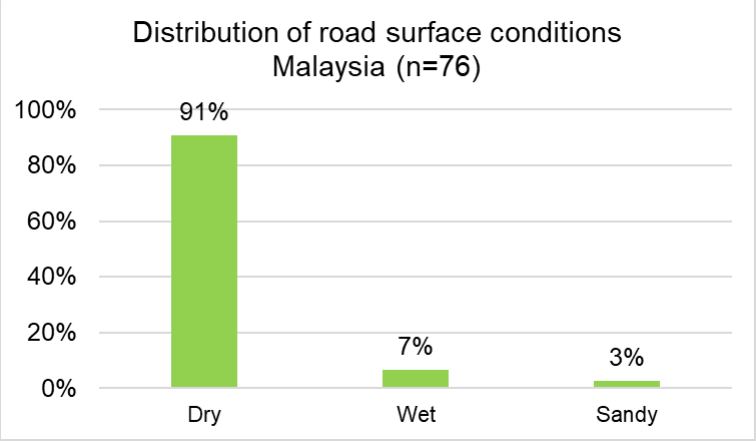


Figure 236: Road surface conditions – Malaysia – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.1.1.4 Conclusion on general accident conditions

Figure 237 : Conclusion on general accident conditions – Malaysia – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

General conditions	**ANGULAR MOTORCYCLE TURNING RIGHT**	*Malaysian data*

- ✓ *More than 90% of the accidents happen with clear weather.*
- ✓ *76% happening during the day (only 1% at night without lights).*
- ✓ *91% happening on dry road surface.*

5.1.2 Road characteristics

5.1.2.1 Location (city / urban)

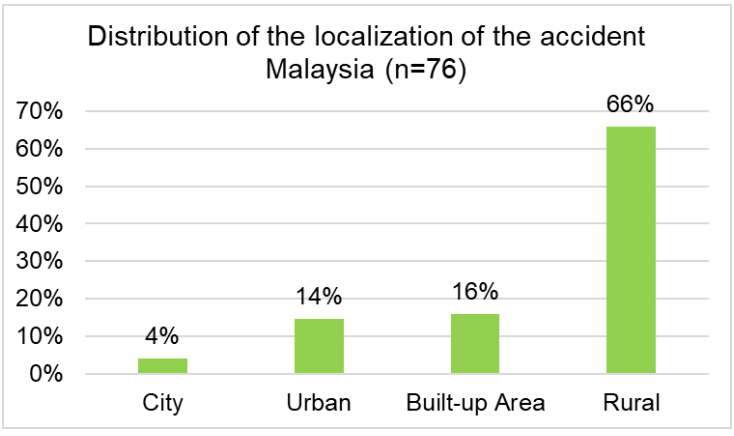


Figure 238: Localization of the accident – Malaysia – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.1.2.2 Road category

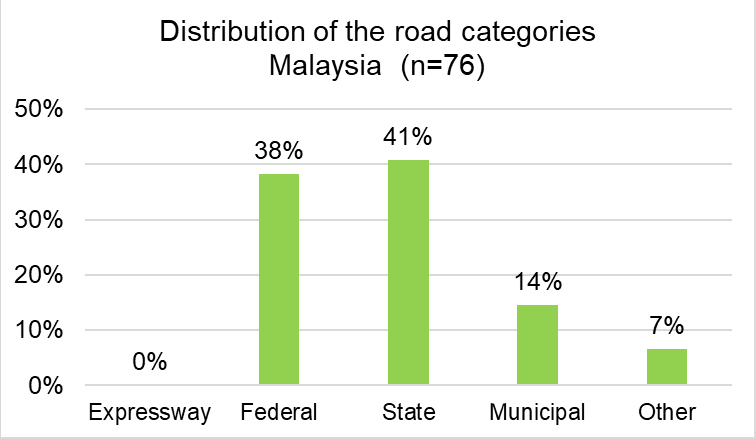


Figure 239: Road category – Malaysia – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.1.2.3 Road geometry

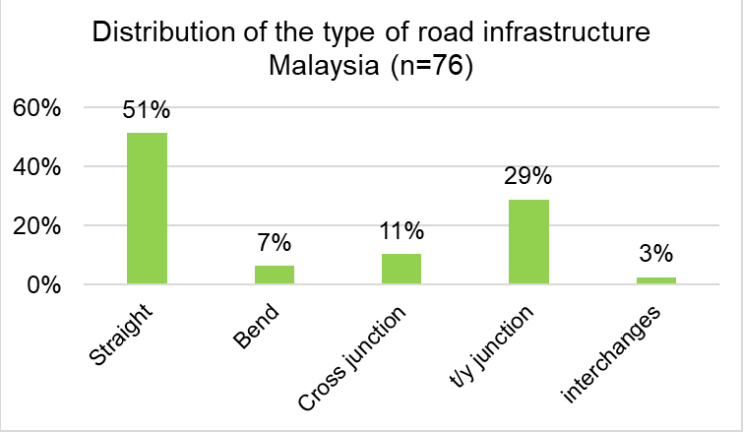


Figure 240: Road geometry – Malaysia – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.1.2.4 Lane marking

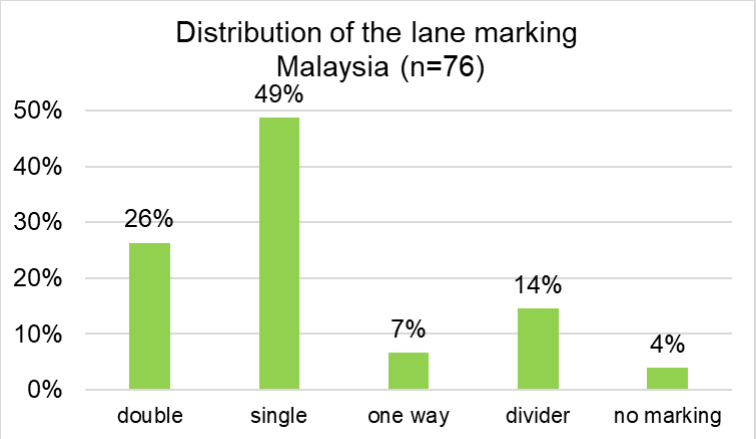


Figure 241: Lane marking – Malaysia – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.1.2.5 Speed limit

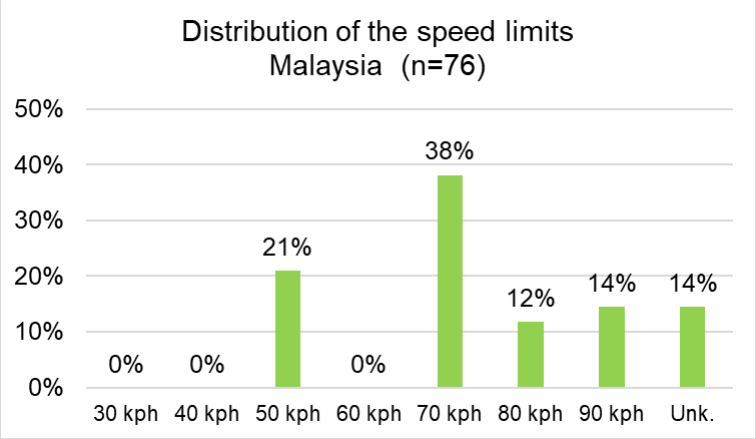


Figure 242: Speed limits – Malaysia – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.1.2.6 Conclusion on road characteristics

Table 61: Conclusion on road characteristics – Malaysia – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

Road characteristics	**ANGULAR MOTORCYCLE TURNING RIGHT**	*Malaysian data*

- ✓ *66% of the accidents happen in rural area (18% in urban or city) mostly on federal or state roads.*
- ✓ *Half of the accidents happens in a straight road, 40% happen in cross junction or T/Y junction.*
- ✓ *Mostly single lane marking (49%) and double lane marking (26%).*
- ✓ *Speed limits: 38% at 50 kph, 21% at 70 kph.*

5.1.3 Accident characteristics – vehicles

5.1.3.1 Motorcycle impact type

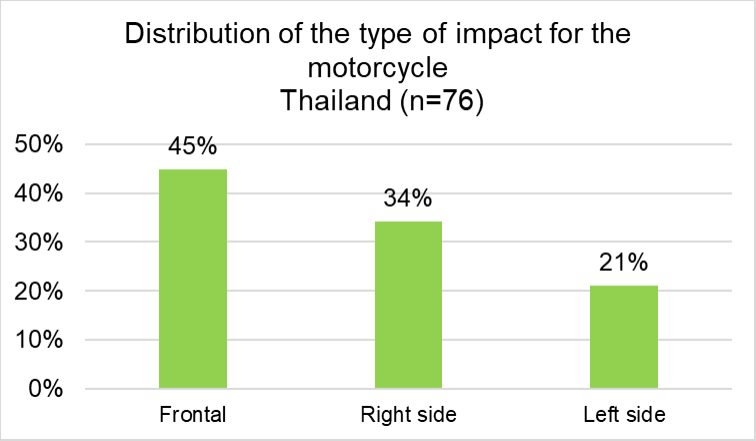


Figure 243: Motorcycle impact type – Malaysia – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.1.3.2 Motorcycle action before crash

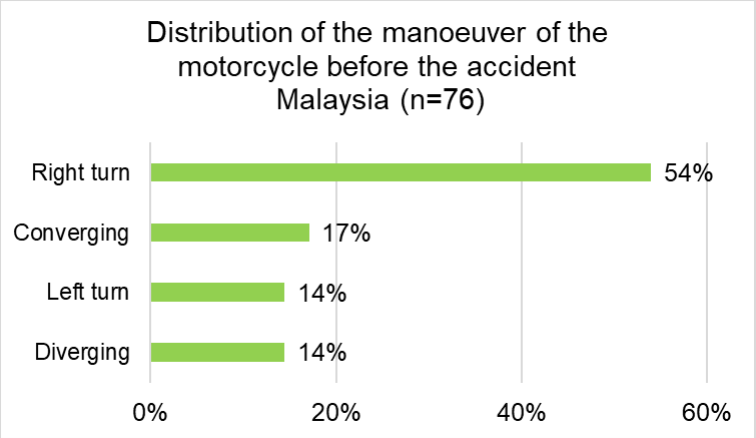


Figure 244: Motorcycle manoeuvre – Malaysia – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.1.3.3 Conclusion on vehicle characteristics

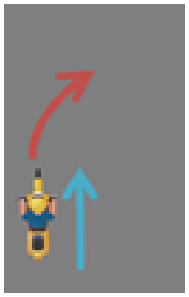
Table 62: Conclusion on vehicle characteristics – Malaysia – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

Vehicle characteristics	**ANGULAR MOTORCYCLE TURNING RIGHT**	*Malaysian data*
✓ *55% of lateral impact for the motorcycle, 45% frontal.* ✓ *Mainly changing lane action for the motorcycle: Right turning (54%) and converging (17%).*		

5.2 Thai database

To get more detail about the angular motorcycle turning right sub-scenario, the in-depth analysis is carried out with the Thai database. This OASIM sub-scenario represents **3,6%** of all the accidents and **5,1%** of the KSI accidents in the Thai database.

In this scenario, the motorcycle is turning right across the path of the car, the vehicles are travelling in the same direction. The Thai database records a pictogram that best represents the configuration of the accident. The scenario configuration is illustrated by the figure below:



(a)

(b)
car=50
motorcycle=51

Figure 245: (a) Illustration of ANGULAR MOTORCYCLE TURNING RIGHT scenario, (b) pictogram from the Thai database.

The following graphs provide in-depth description of the scenario. There are 23 cases from this scenario in the Thai database.

5.2.1 Accident characteristics – general conditions

5.2.1.1 Weather conditions

All accidents within this scenario happen in clear weather conditions.

5.2.1.2 Light conditions

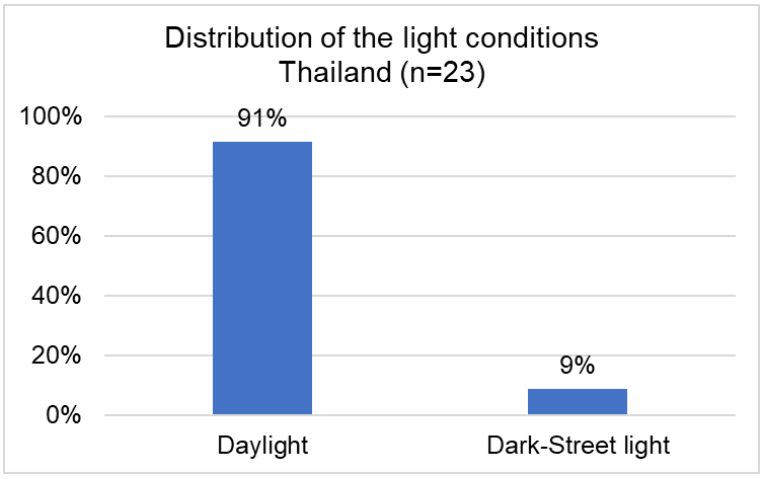


Figure 246: Light conditions - Thailand - ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.2.1.3 Road surface conditions

All accidents within this study happen on dry roads.

5.2.1.4 Conclusion on general accident conditions

Table 63: Conclusion on general accident conditions – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

General conditions	**ANGULAR MOTORCYCLE TURNING RIGHT**	*Thai data*
✓ *All accidents happen with clear weather conditions.* ✓ *91% happen during the day (9% at night with streetlights).* ✓ *All accidents happen on dry road surface conditions.*		

From both Malaysian and Thai data, this accidents scenario happens in good weather for more than 90%, during the day.

5.2.2 Road characteristics

5.2.2.1 Location (city / urban)

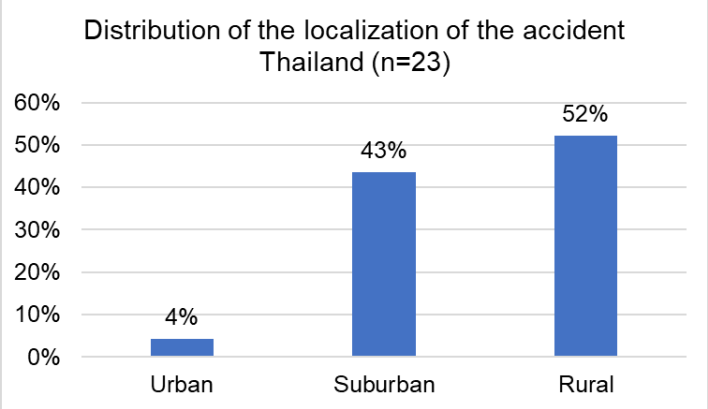


Figure 247: Localization of the accident –Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.2.2.2 Road category

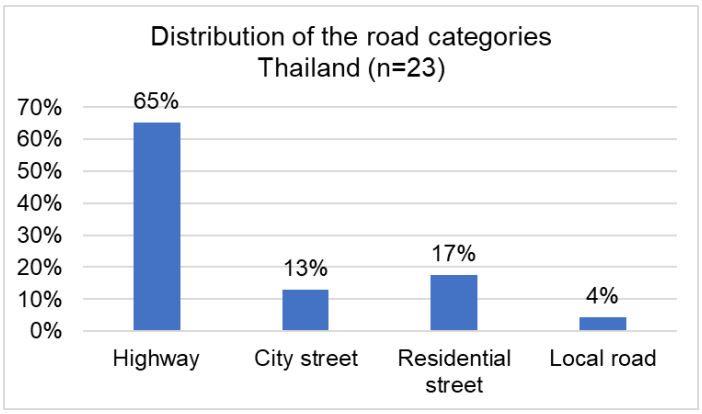


Figure 248: Road category – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

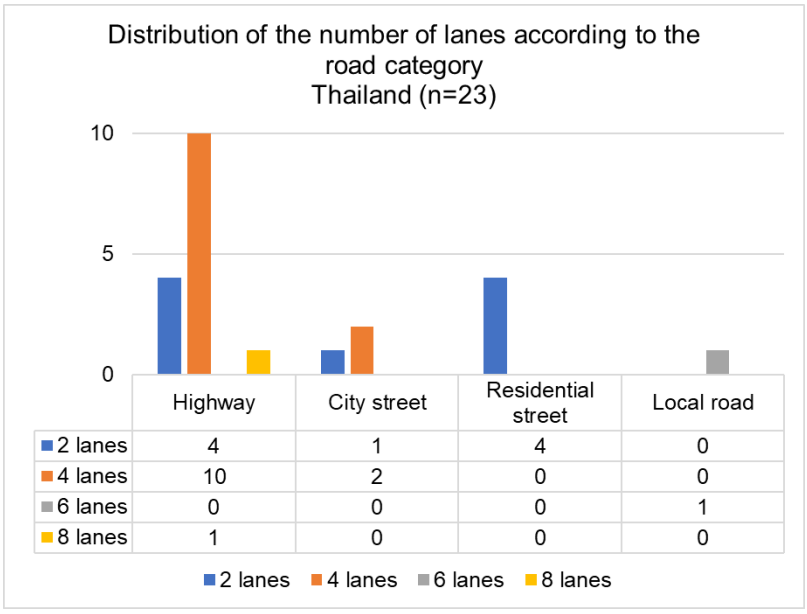


Figure 249: Road category and number of lanes – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.2.2.3 Configuration

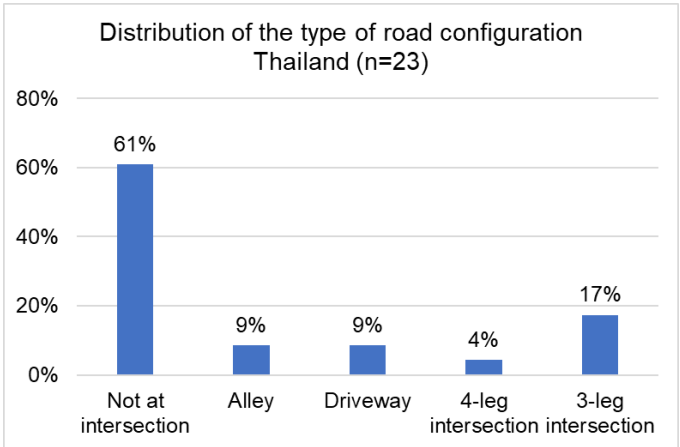


Figure 250: Configuration – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.2.2.4 Road geometry

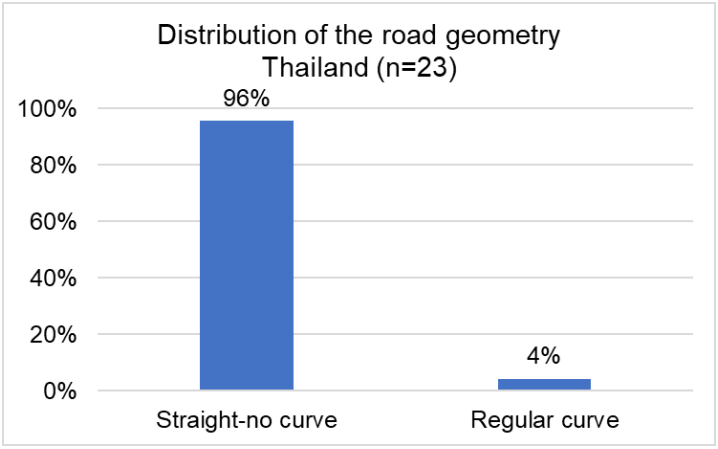


Figure 251: Road geometry – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.2.2.5 Slope

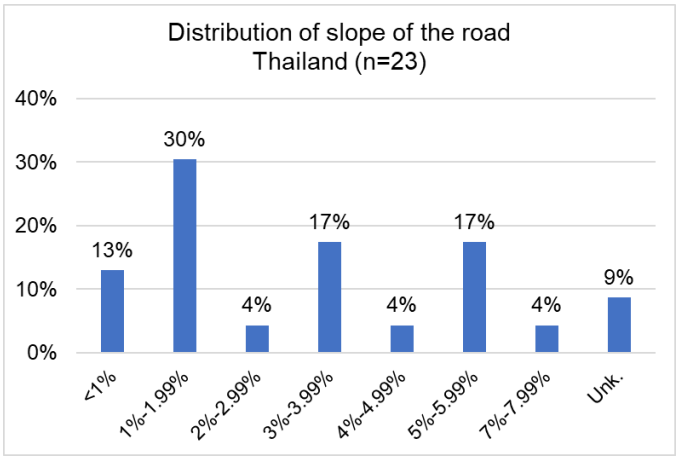


Figure 252: Slop of the road – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.2.2.6 Speed limit

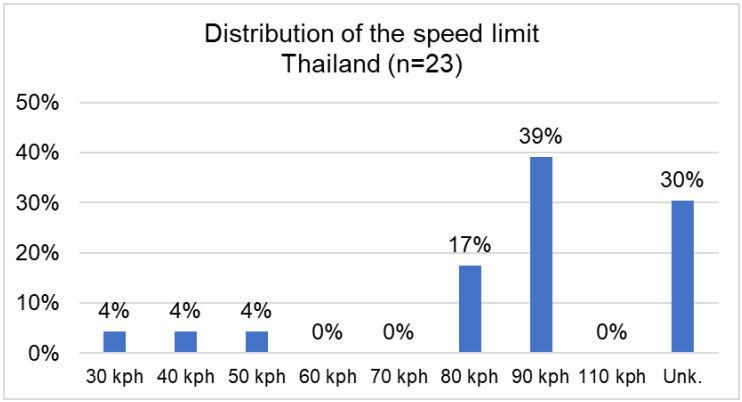


Figure 253: Speed limits – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.2.2.7 Number of the lane

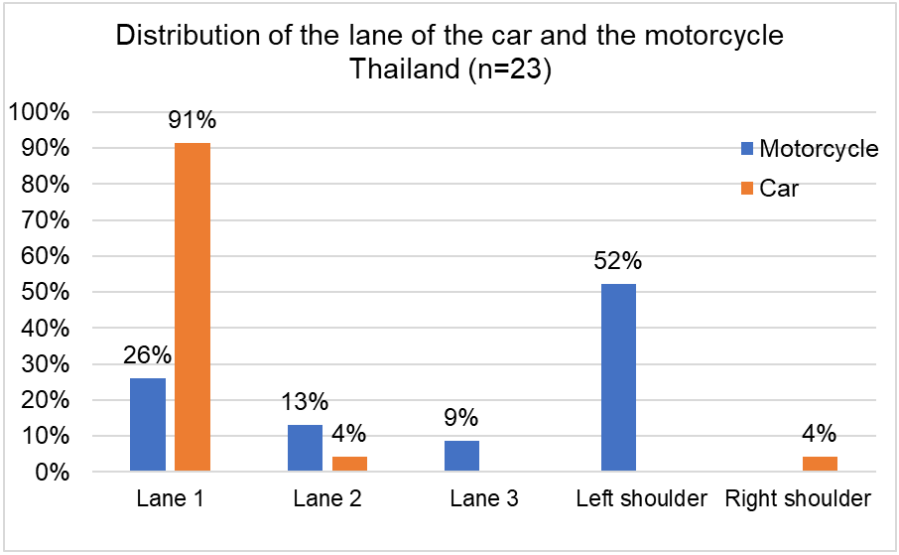
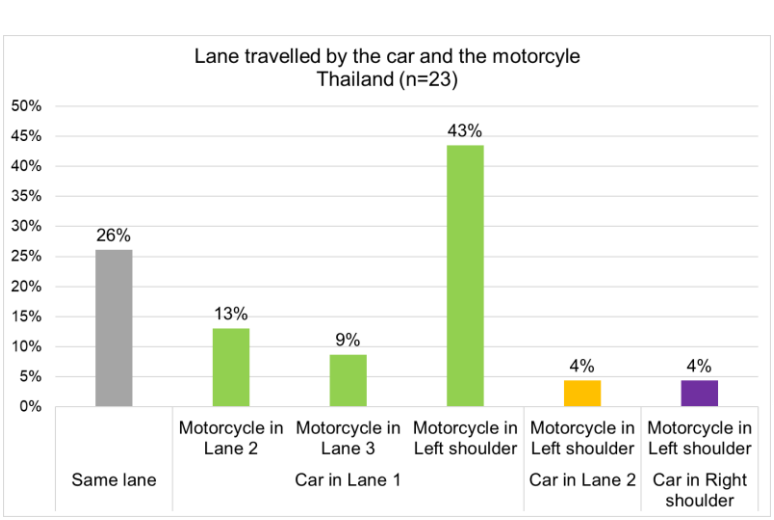


Figure 254: Lanes of the vehicles – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.2.2.8 Travelled lane



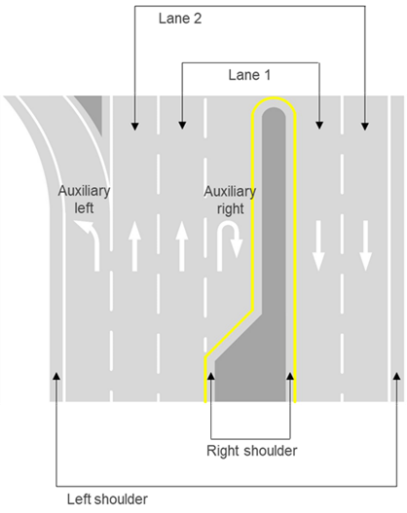


Figure 255: Vehicles on same lane – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.2.2.9 Conclusion on road characteristics

Table 64: Conclusion on road characteristics – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

Road characteristics	**ANGULAR MOTORCYCLE TURNING RIGHT**	*Thai data*
✓ *Mostly rural (52%) and suburban (43%) areas.* ✓ *Highway for 65% of the accidents, residential streets in 17% of the cases.*		

- ✓ *4 lanes or 2 lanes roads.*
- ✓ *Out of intersection configuration in 61% of the accidents, or in 3-leg or 4-leg intersection (21%).*
- ✓ *96% of the accidents happen in a straight road with less than 3% of slope.*
- ✓ *Scenario with high-speed limit: speed limit at 80 kph (17%) and 90 kph (30%).*
- ✓ *Car in lane 1 and motorcycle on left shoulder for 43% of the accidents, both vehicles in same lane in 23%.*

In both databases, the accident happen mostly in straight road. More than half of the cases occurred in rural areas, on roads such as highway or state roads, out of intersections.

5.2.3 Accident characteristics – vehicles

5.2.3.1 Visibility

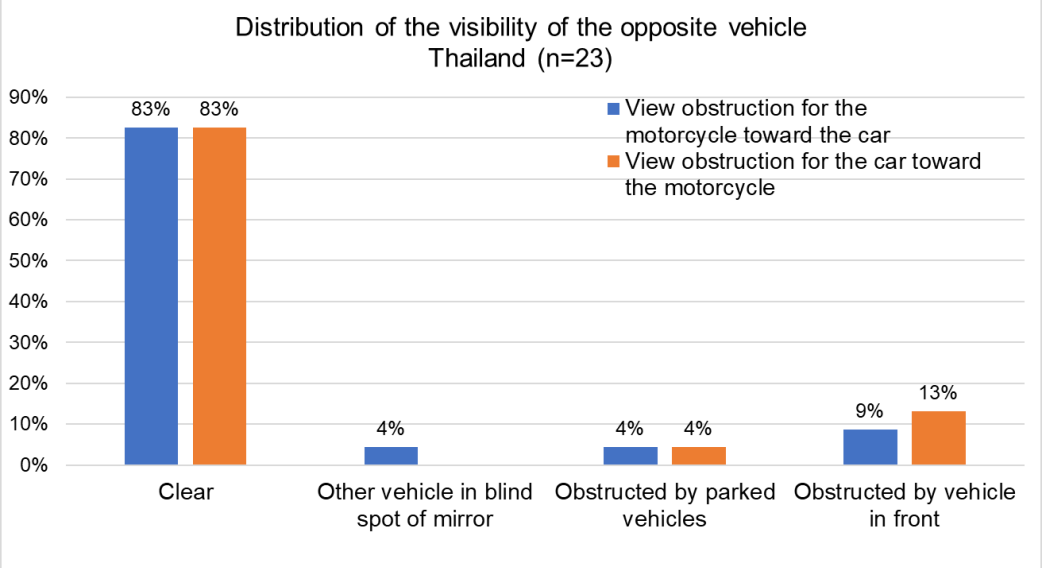
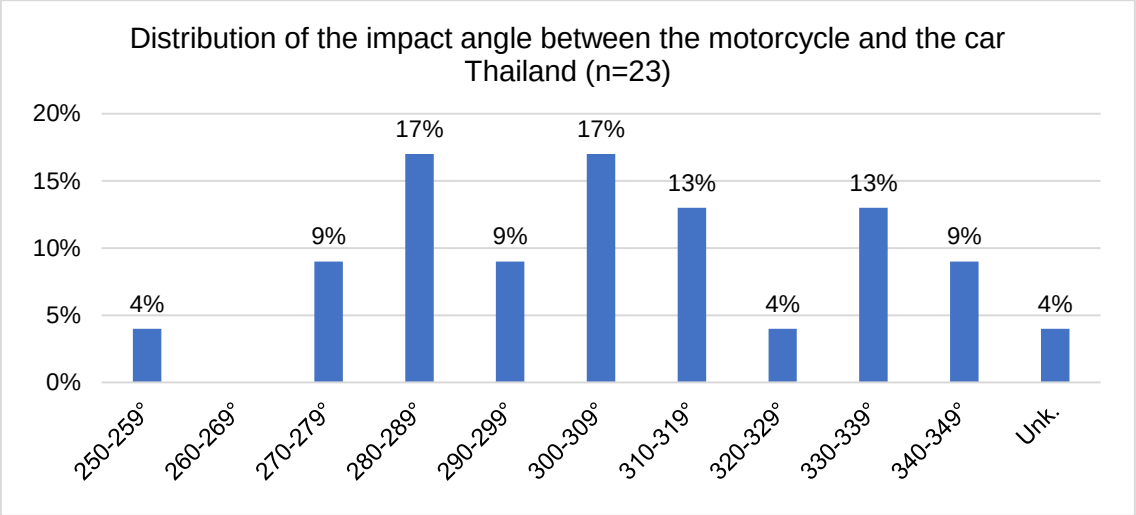


Figure 256: Visibility – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.2.3.2 Impact angle between the motorcycle and the car



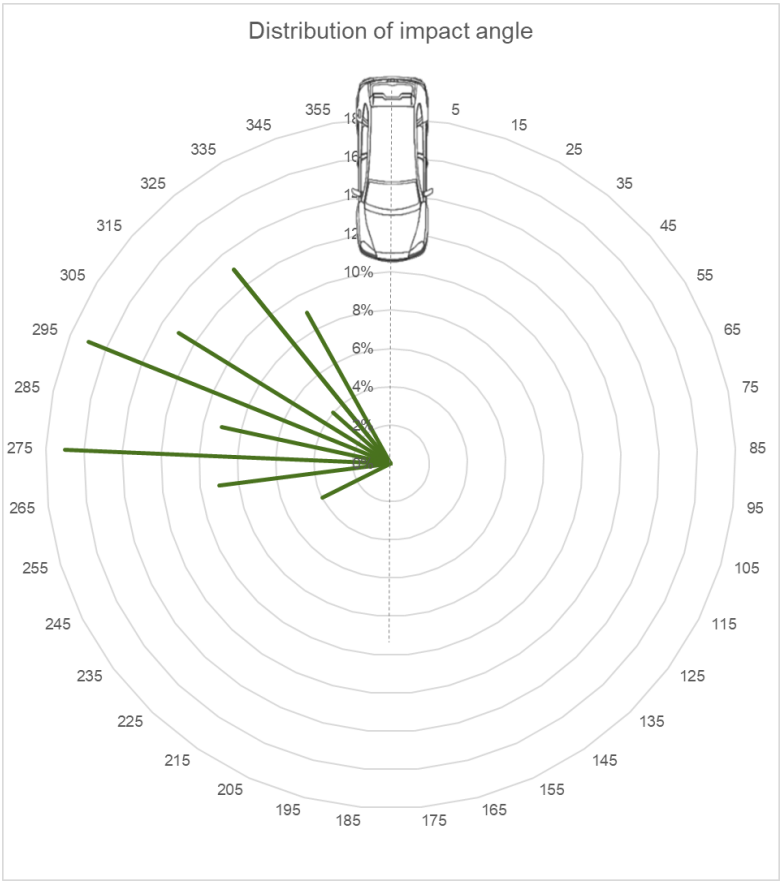


Figure 257: Impact angle – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.2.3.3 Motorcycle impact type

All motorcycles within this sub-scenario had a right side impact.

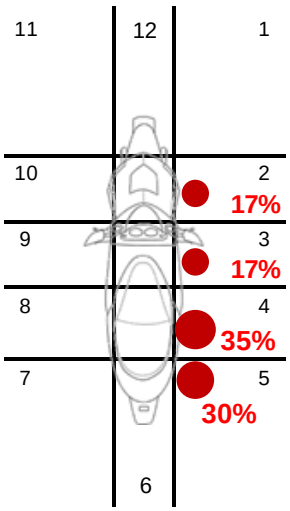


Figure 258: First collision point for the motorcycle – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.2.3.4 Car impact type

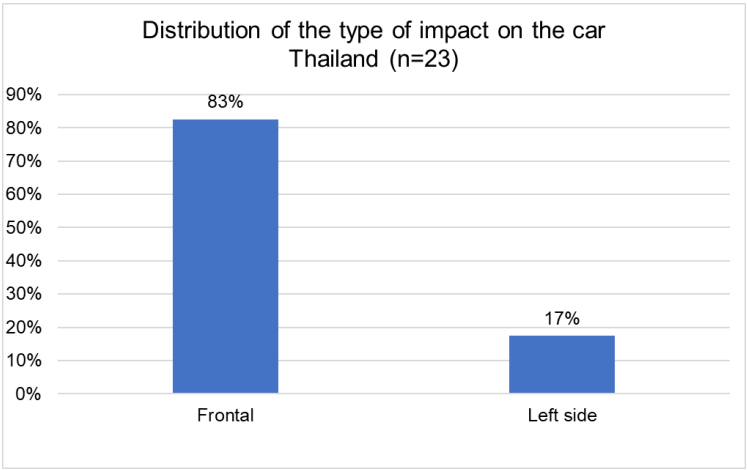


Figure 259: Type of impact for the car– Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

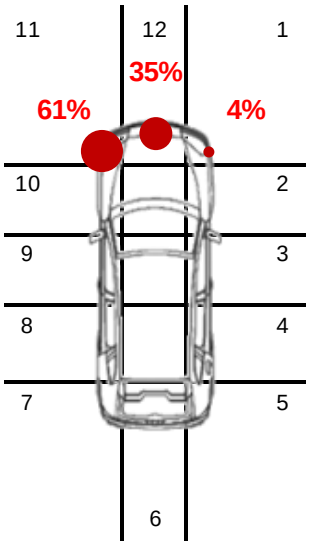


Figure 260: First collision point for the car – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.2.3.5 Initial speeds

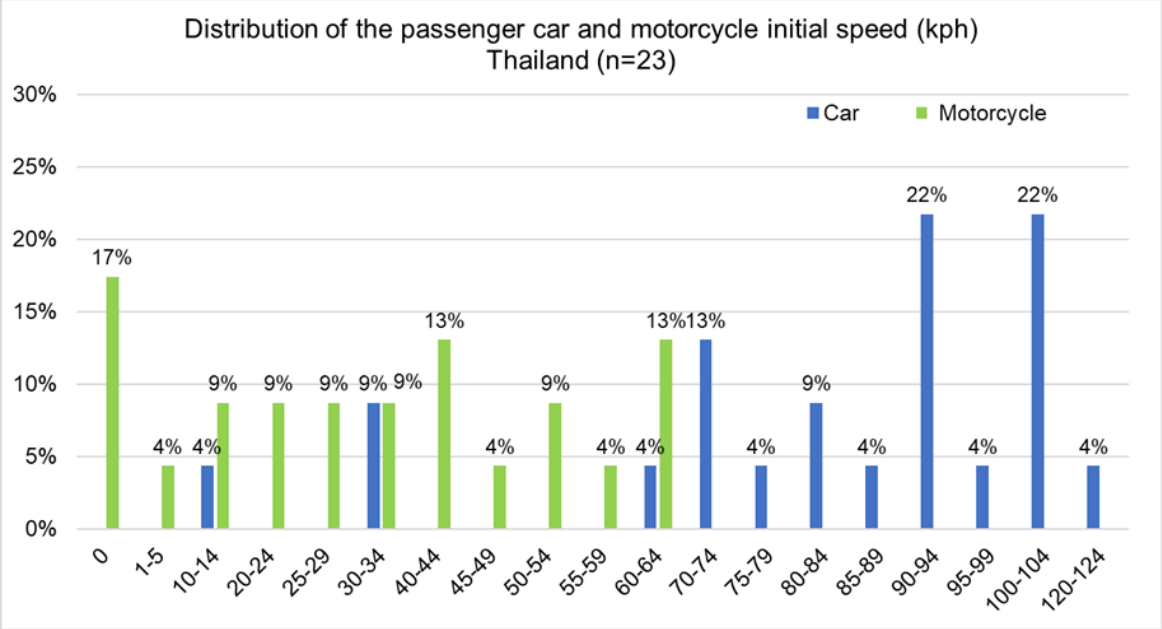


Figure 261: Initial speeds – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

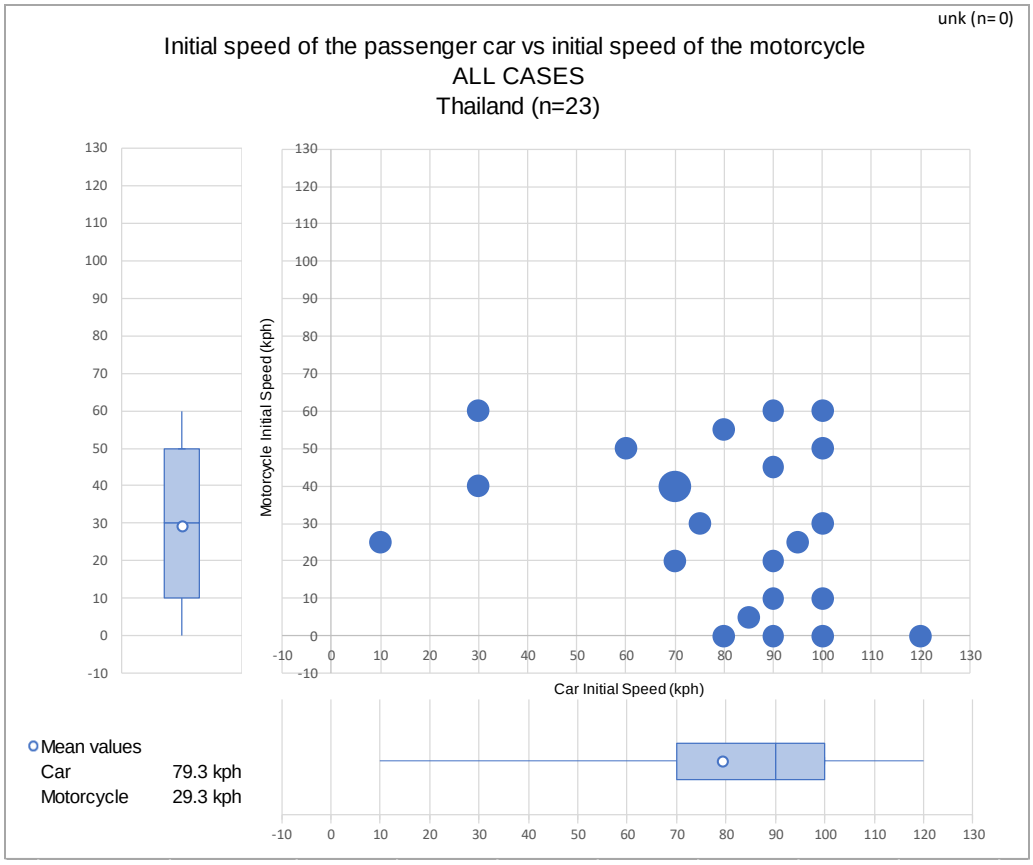


Figure 262: Initial speed of the car versus initial speed of the motorcycle, all cases – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

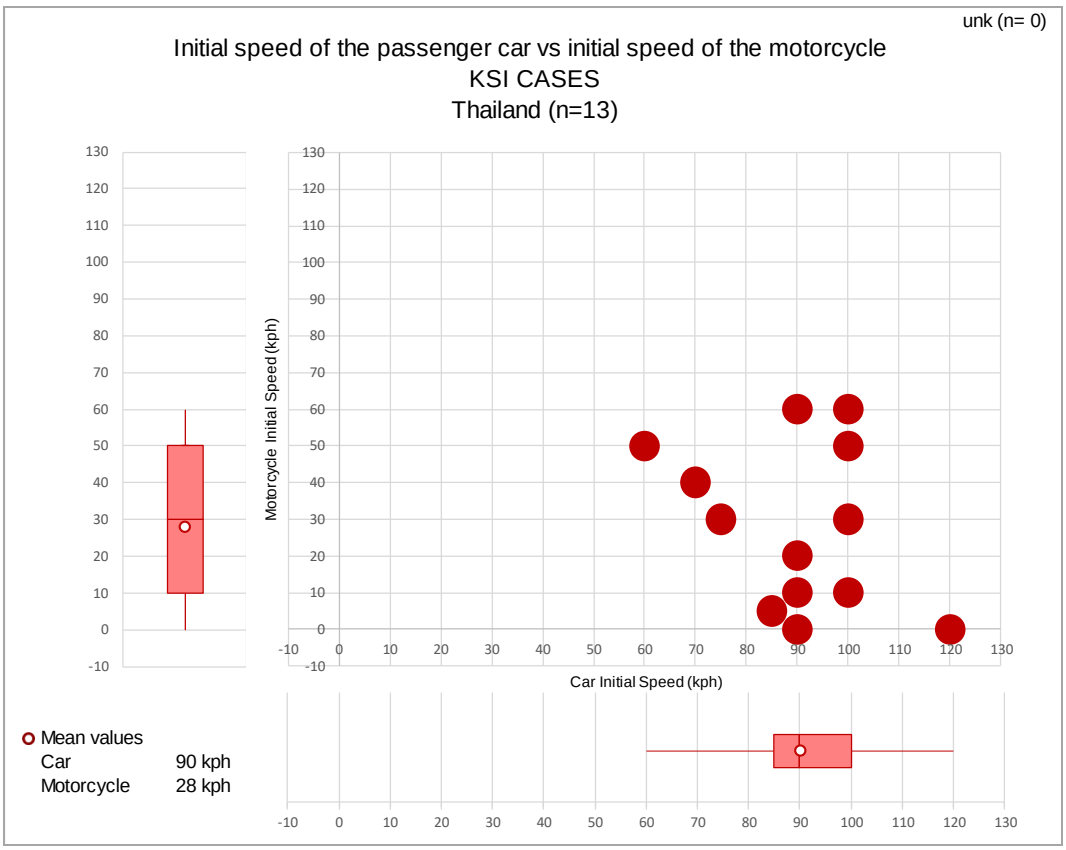


Figure 263: Initial speed of the car versus initial speed of the motorcycle, KSI cases – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

Table 65: Initial speeds value for the car and the motorcycle, all cases – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

All Accidents																									unk:	0
Number of cases	Passenger Car Initial Speed (kph)																									
Motorcycle Initial Speed (kph)	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
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70																										
75																										
80																										
85																										
90																										
95																										
100																										
105≤																										

Table 66: Initial speed values for the car and the motorcycle, KSI cases – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

KSI Accidents																										unk: 0
Number of cases	Passenger Car Initial Speed (kph)																									
	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Initial Speed (kph) 0																				1						1
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5.2.3.6 Collision speeds

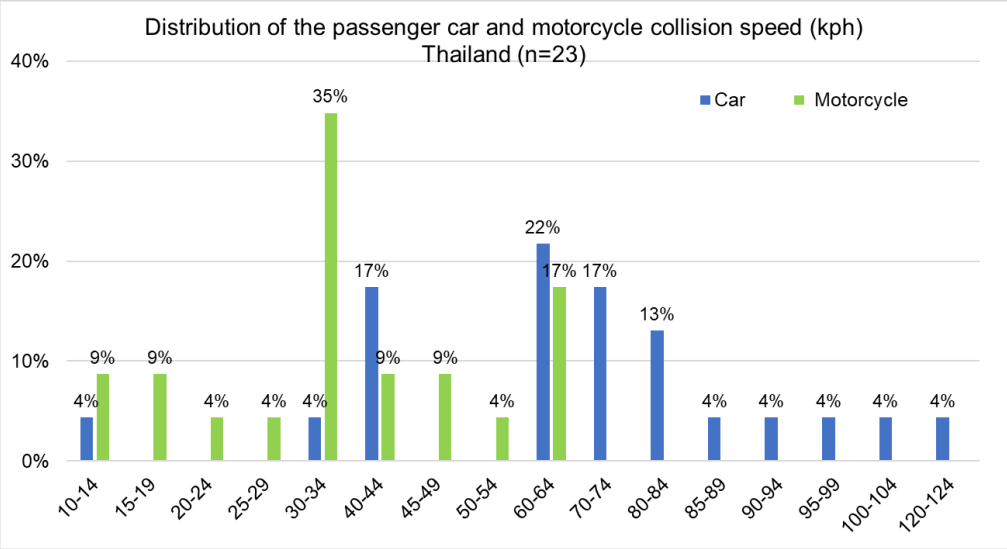

Figure 264: Collision speeds – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

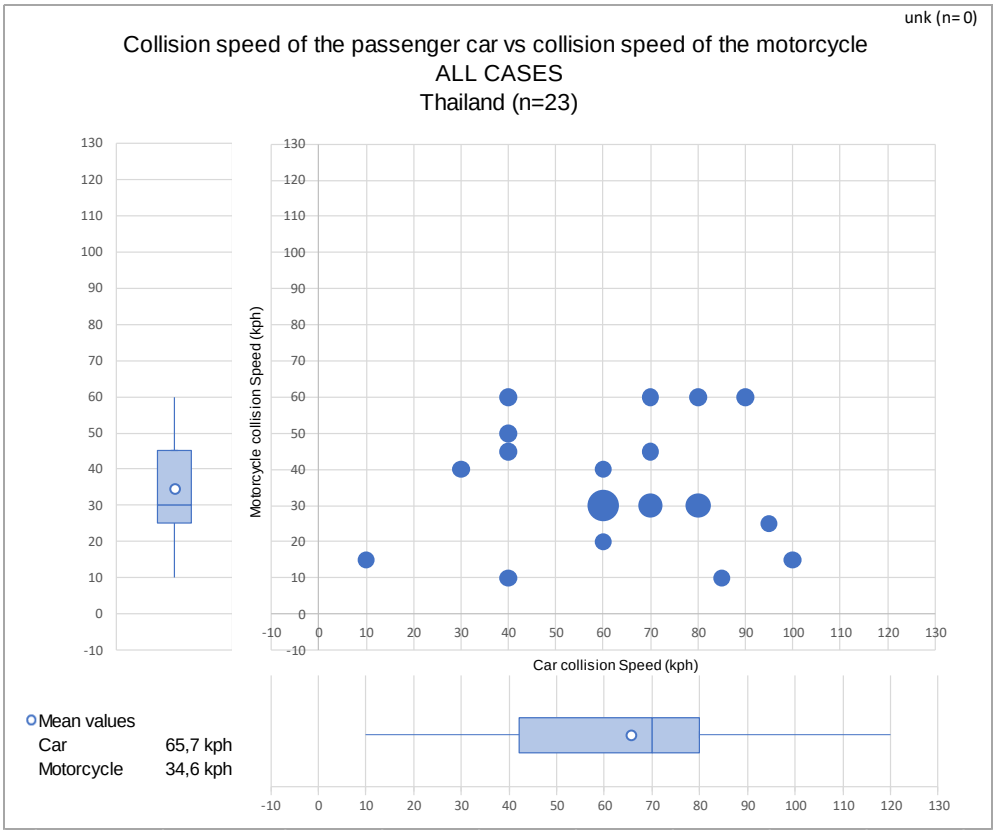

Figure 265: Collision speed of the car versus collision speed of the motorcycle, all cases – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

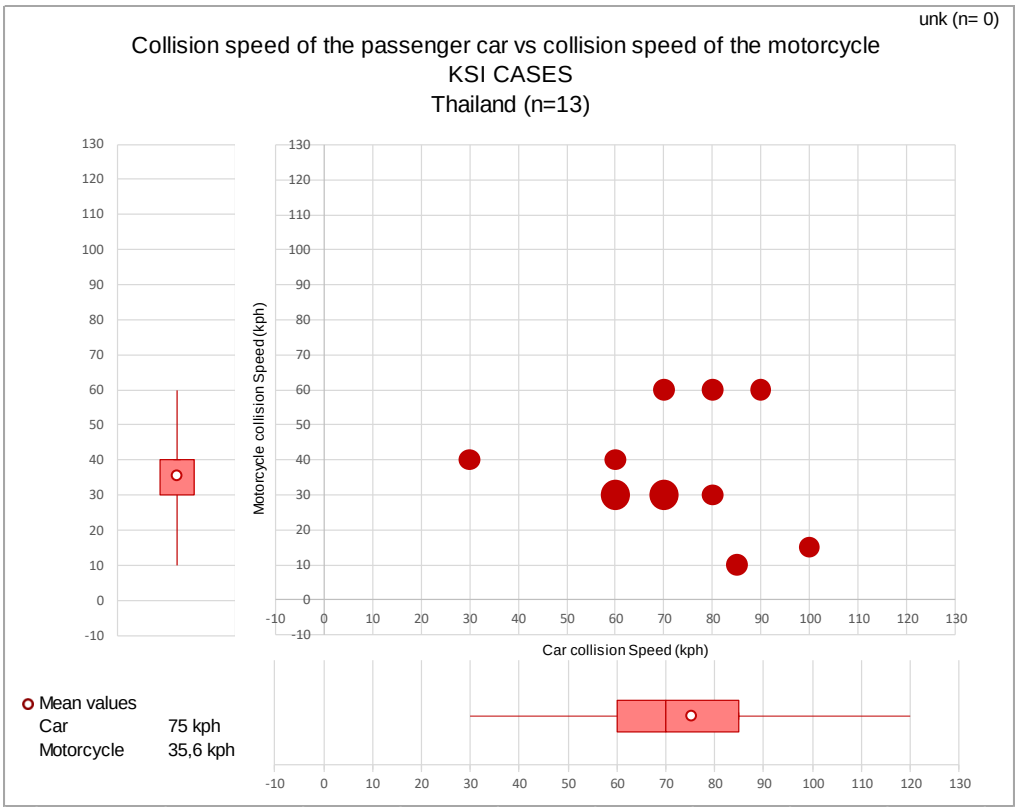

Figure 266: Collision speed of the car versus collision speed of the motorcycle, KSI cases – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

Table 67: Collision speed values for the car and the motorcycle, all cases – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

All Accidents																										unk:	0
Number of cases	Passenger Car Collision Speed (kph)																										
Motorcycle Collision Speed (kph)	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
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70																										
75																										
80																										
85																										
90																										
95																										
100																										
105≤																										

Table 68: Collision speed values for the car and the motorcycle, KSI cases – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

KSI Accidents																										unk:	0
Number of cases	Passenger Car Collision Speed (kph)																										
Motorcycle Collision Speed (kph)	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
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80																										
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100																										
105≤																										

5.2.3.7 Delta Initial velocity (kph) – calculated

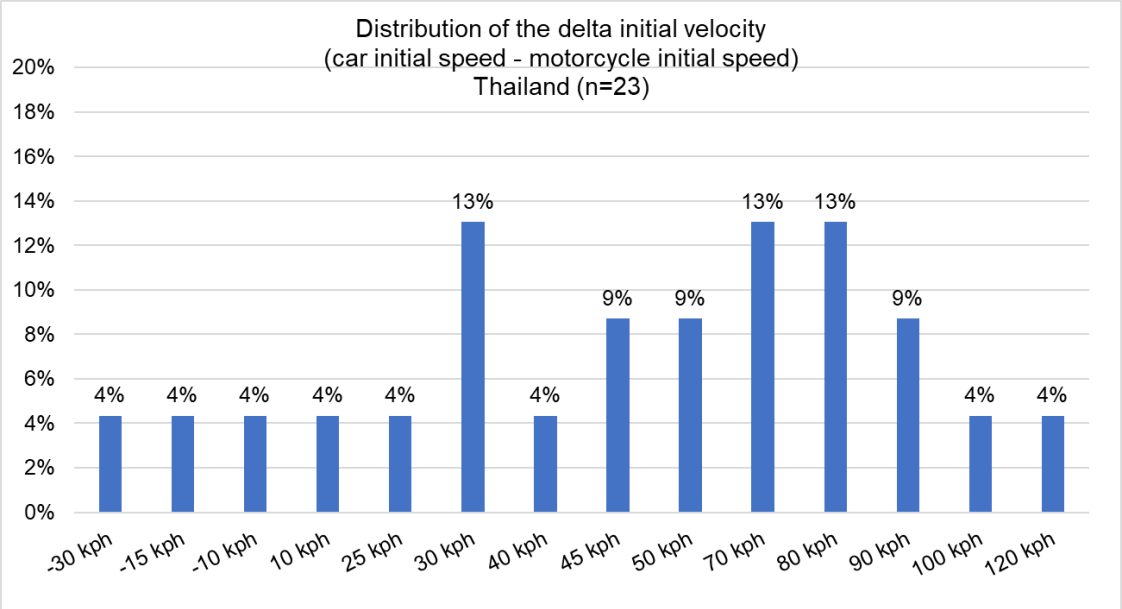


Figure 267: Delta initial velocity (kph) – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.2.3.8 Skid marks

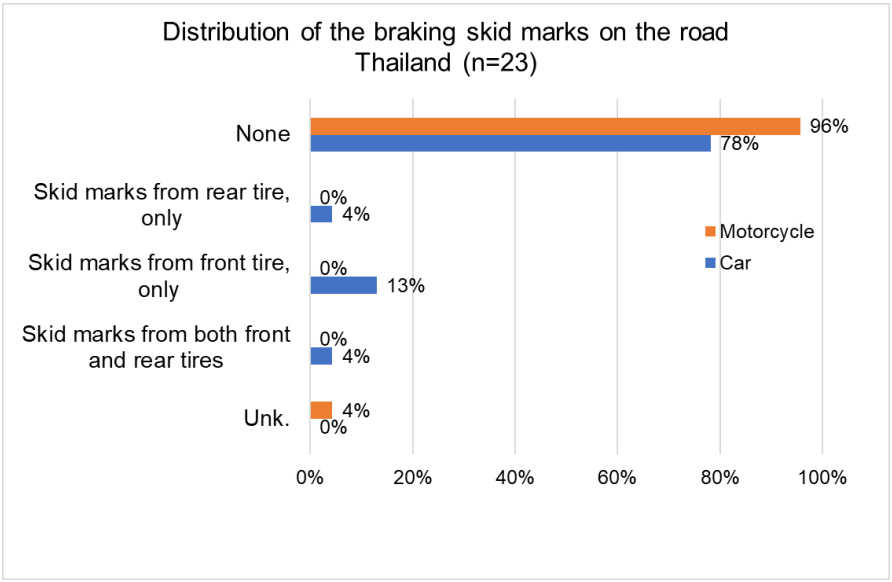


Figure 268: Skid marks – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.2.3.9 ABS fitment on the car

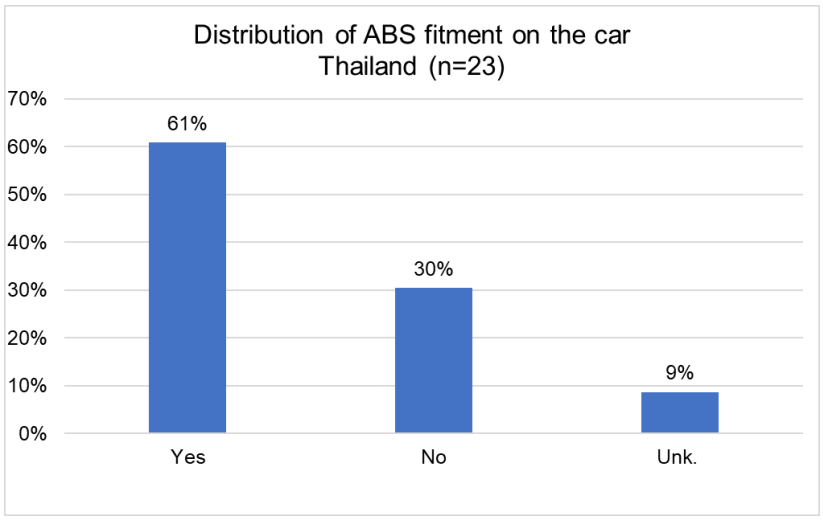


Figure 269: ABS fitment – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.2.3.10 Motorcycle manoeuvre before crash

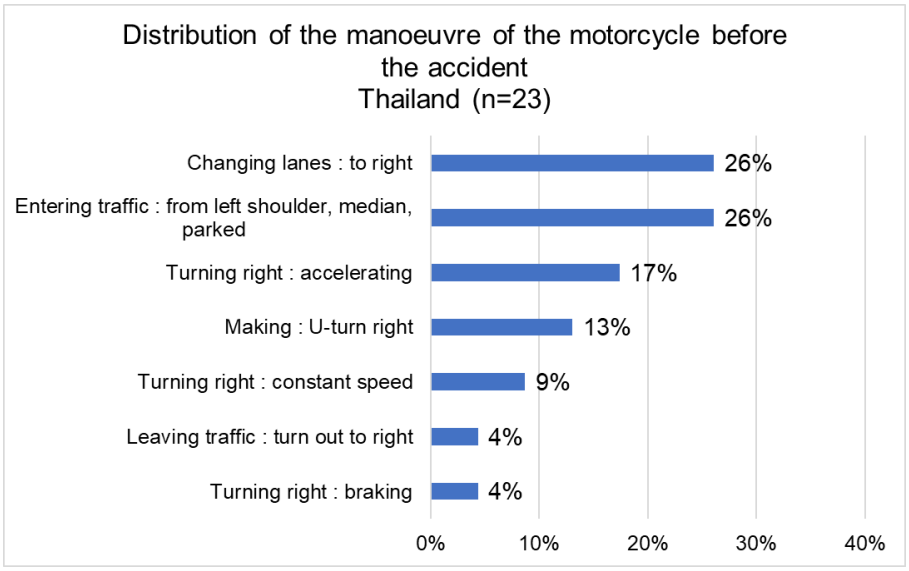


Figure 270: Motorcycle manoeuvre – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.2.3.11 Car manoeuvre before crash

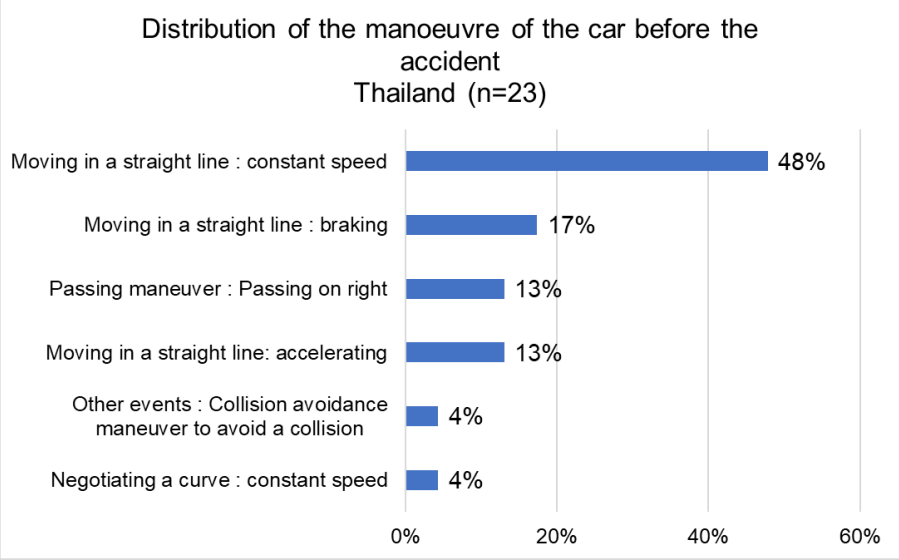


Figure 271: Car manoeuvre – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.2.3.12 Avoidance action by vehicle

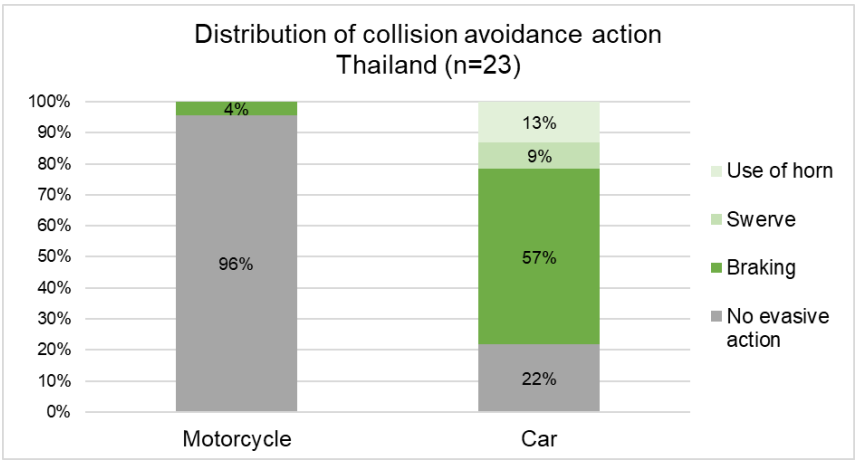


Figure 272: Avoidance action by vehicle – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

5.2.3.13 Conclusion on accident characteristics

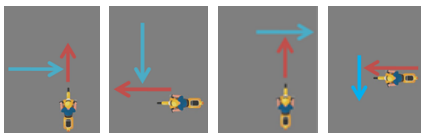
Table 69: Conclusion on accident characteristics – Thailand – ANGULAR MOTORCYCLE TURNING RIGHT SCENARIO

Accident characteristics	**ANGULAR MOTORCYCLE TURNING RIGHT**	*Thai data*
✓ *Clear visibility for more than 83% of the accidents (both car and motorcycle).* ✓ *100% right side impact on the motorcycle.* ✓ *83% of frontal impact on the car.*		

- ✓ *Mean initial speed: Car=79,3 kph and Motorcycle=29,3 kph*
- ✓ *Mean collision speed: Car=65,7 kph and Motorcycle=34,6 kph*
- ✓ *61% of the car had ABS.*
- ✓ *The motorcycle changes lane to the right (26%) or is entering the traffic (26%).*
- ✓ *The car mostly goes straight at constant speed (48%) or braking (17%).*
- ✓ *No avoidance action from the motorcycle and action from 78% of the cars which are mostly braking.*

6 Crossing scenario

The crossing accident scenario is defined as accidents with an angular collision, with lateral or frontal impact on the motorcycle, vehicles traveling in perpendicular directions (90°). This scenario represents **5%** of the KSI accidents in the Malaysian database and **7%** in the Thai database.



6.1 Malaysian database

This part is describing the distributions of the variables in the Malaysian database for the crossing scenario. It accounts for 59 accidents in this database.

6.1.1 Accident characteristics – general conditions

6.1.1.1 Weather conditions

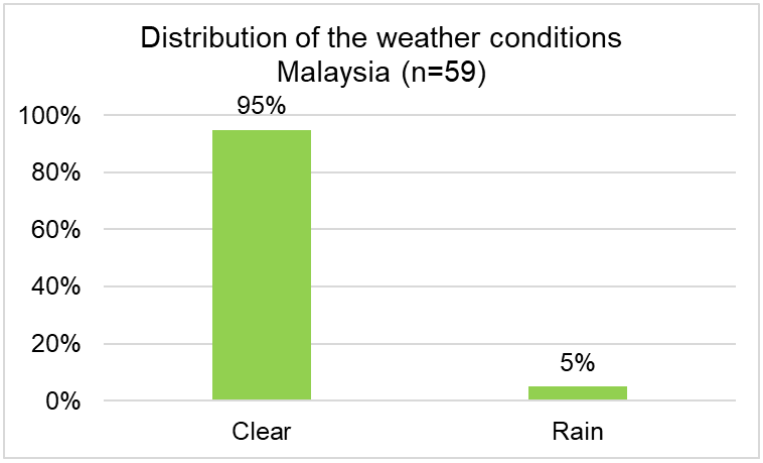


Figure 273: Weather conditions - Malaysia – CROSSING SCENARIO

6.1.1.2 Light conditions

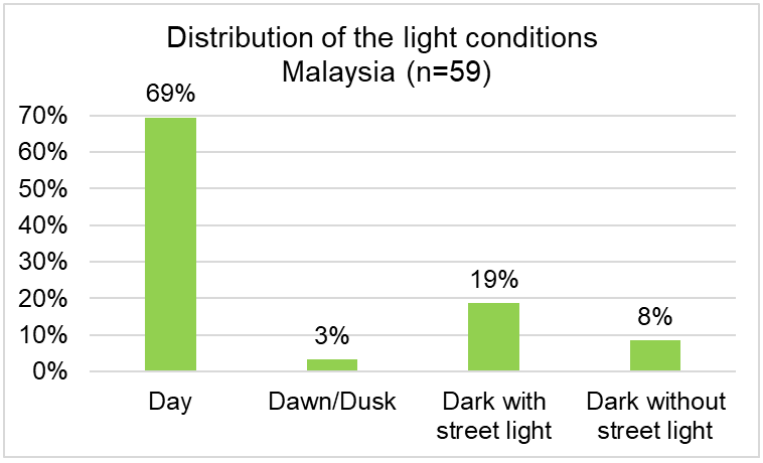


Figure 274: Light conditions - Malaysia – CROSSING SCENARIO

6.1.1.3 Road surface conditions

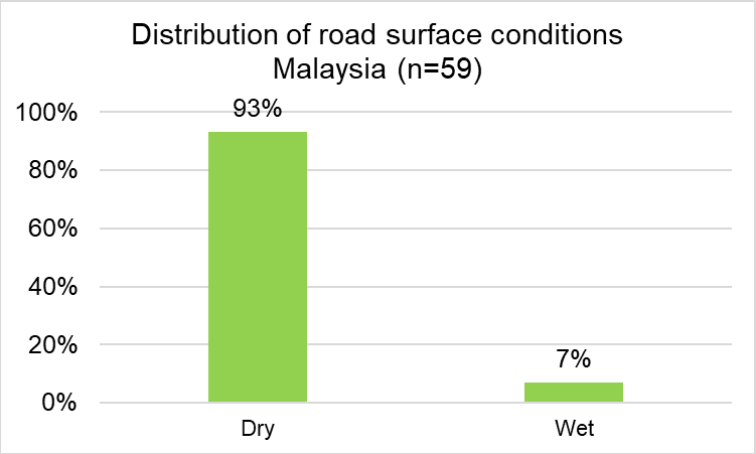


Figure 275: Road surface conditions – Malaysia – CROSSING SCENARIO

6.1.1.4 Conclusion on general accident conditions

Table 70: Conclusion on general accident conditions – Malaysia – CROSSING SCENARIO

General conditions	**CROSSING**	*Malaysian data*

- ✓ *95% of the accidents happen with clear weather.*
- ✓ *69% of the accidents happen during the day (8% at night without light and 19% at night with streetlights).*
- ✓ *93% occur on dry road surface.*

6.1.2 Road characteristics

6.1.2.1 Location (city / urban)

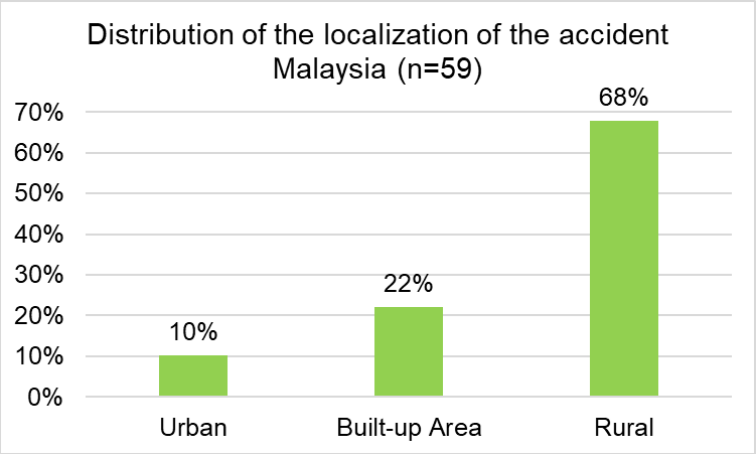


Figure 276: Localization of the accident – Malaysia –CROSSING SCENARIO

6.1.2.2 Road category

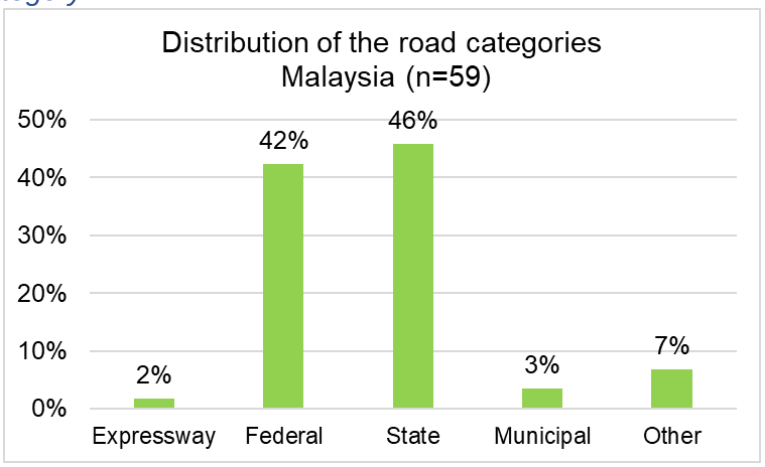


Figure 277: Road category – Malaysia – CROSSING SCENARIO

6.1.2.3 Road geometry

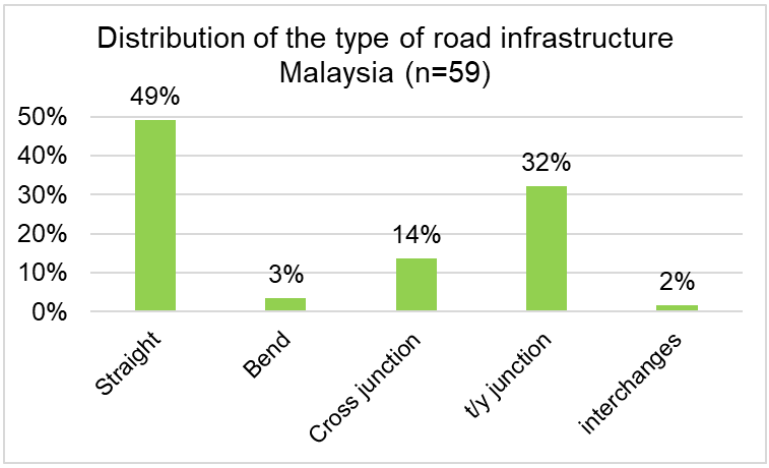


Figure 278: Road geometry – Malaysia – CROSSING SCENARIO

6.1.2.4 Lane marking

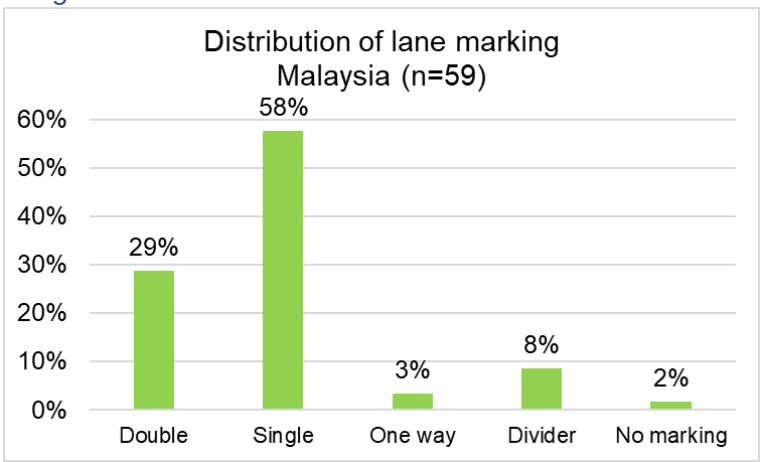


Figure 279: Lane marking – Malaysia – CROSSING SCENARIO

6.1.2.5 Speed limit

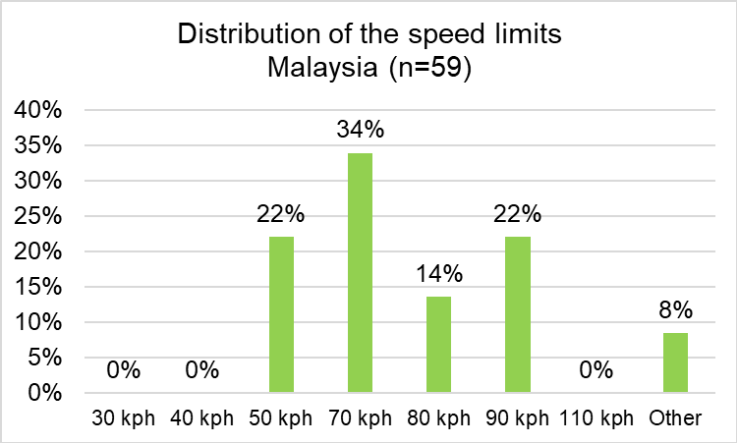


Figure 280: Speed limits – Malaysia – CROSSING SCENARIO

6.1.2.6 Conclusion on road characteristics

Table 71: Conclusion on road characteristics – Malaysia – CROSSING SCENARIO

Road characteristics	**CROSSING**	*Malaysian data*

- ✓ *68% of the accidents happen in rural area (34% in urban or city).*
- ✓ *Majority of state roads (46%) and federal road (42%).*
- ✓ *49% of the accidents happen in a straight road, 46% happen in intersection.*
- ✓ *Most of the accidents with single lane marking (58%). 2% had no marking.*
- ✓ *Speed limits: 34% at 70 kph, 12% at 50 kph and 90 kph.*

6.1.3 Accident characteristics – vehicles

6.1.3.1 Motorcycle impact type

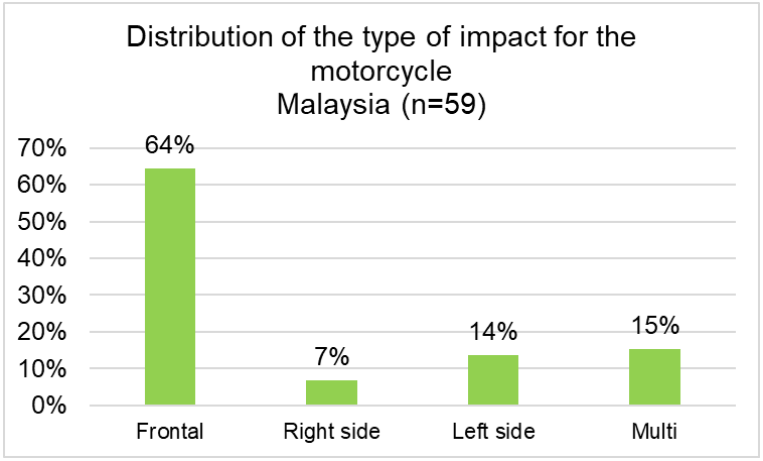


Figure 281: Motorcycle impact type – Malaysia – CROSSING SCENARIO

6.1.3.2 Motorcycle action before crash

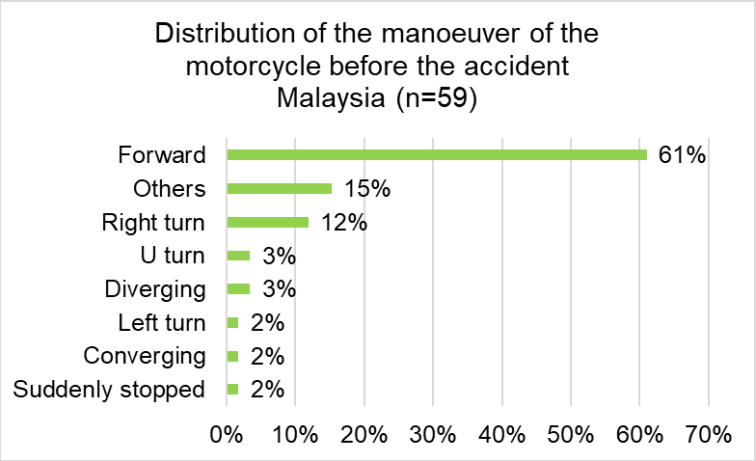


Figure 282: Motorcycle manoeuvre – Malaysia – CROSSING SCENARIO

6.1.3.3 Conclusion on vehicle characteristics

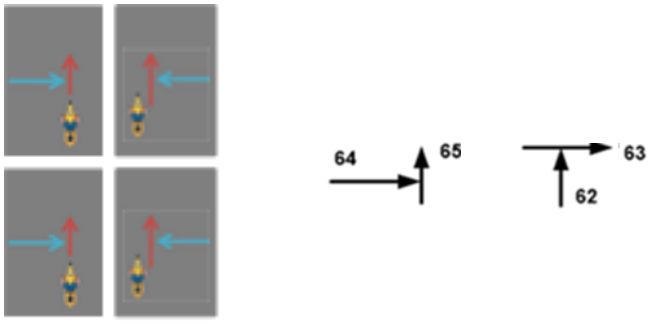
Table 72: Conclusion on vehicle characteristics – Malaysia – CROSSING SCENARIO

Vehicle characteristics	**CROSSING**	*Malaysian data*
✓ *64% of frontal impact for the motorcycle, 21% of lateral impact.* ✓ *Motorcycle going forward in 61% of the accidents, 12% turning right.*		

6.2 Thai database

This OASIM sub-scenario represents **8,3%** of all the accidents and **7,4%** of the KSI accidents in the Thai database.

In this scenario, the car and the motorcycle come from perpendicular direction, without change of direction. This configuration is illustrated by the figure below:



(a) (b)

Figure 283: (a) Illustration of the CROSSING scenario, (b) pictogram from the Thai database.

The following graphs provide in-depth description of the scenario. It accounts for 53 accidents in this database

6.2.1 Accident characteristics – general conditions

6.2.1.1 Weather conditions

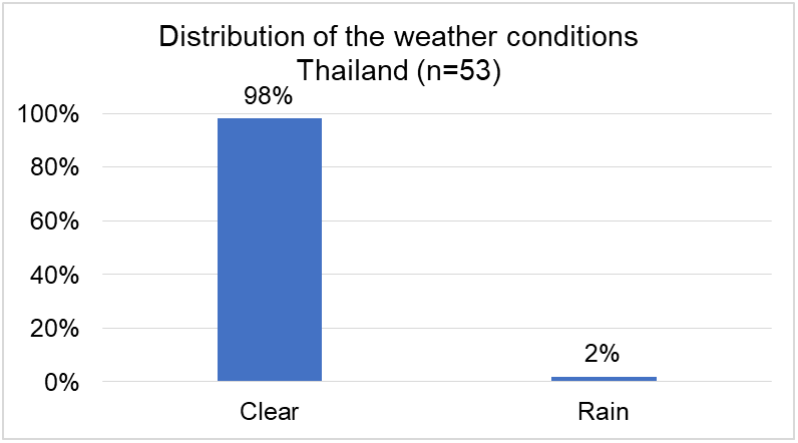


Figure 284: Weather conditions - Thailand – CROSSING SCENARIO

6.2.1.2 Light conditions

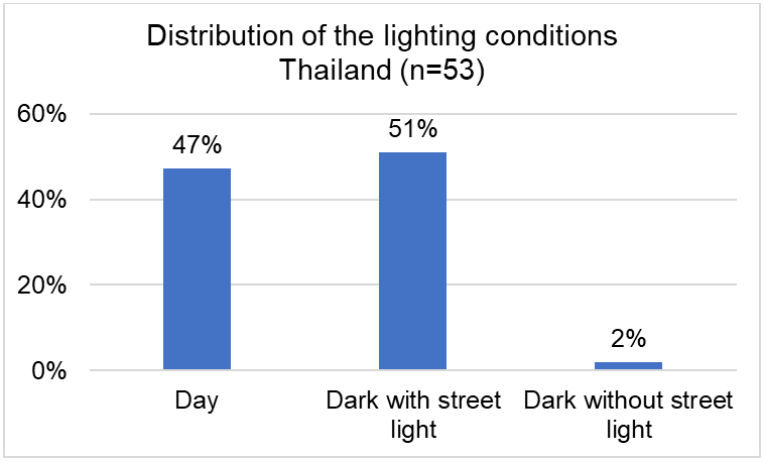


Figure 285: Light conditions - Thailand – CROSSING SCENARIO

6.2.1.3 Road surface conditions

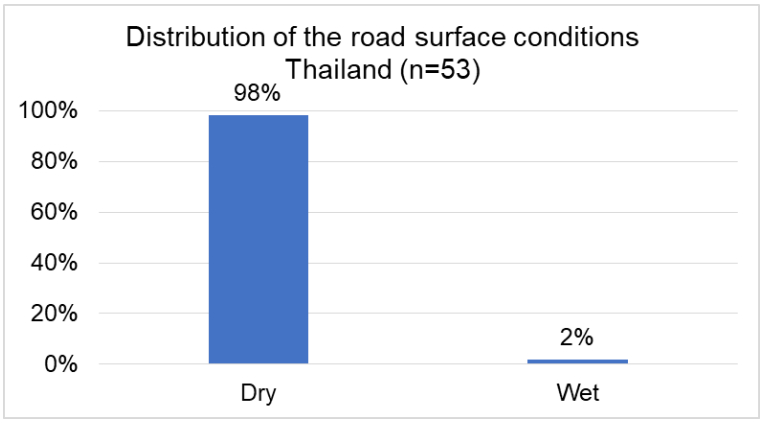


Figure 286: Road surface conditions – Thailand – CROSSING SCENARIO

6.2.1.4 Conclusion on general accident conditions

Table 73: Conclusion on general accident conditions – Thailand – CROSSING SCENARIO

General conditions	**CROSSING**	*Thai data*

- ✓ *98% of clear weather.*
- ✓ *Only 47% of accidents happen during the day, and 51% at night with streetlights (2% at night without streetlights).*
- ✓ *98% of accidents happen on dry road surface.*

About the environmental condition, even though the proportions are different for the Malaysian and Thai databases, it can be noticed that a significant number of cases occurr at night.

6.2.2 Road characteristics

6.2.2.1 Location (city/urban)

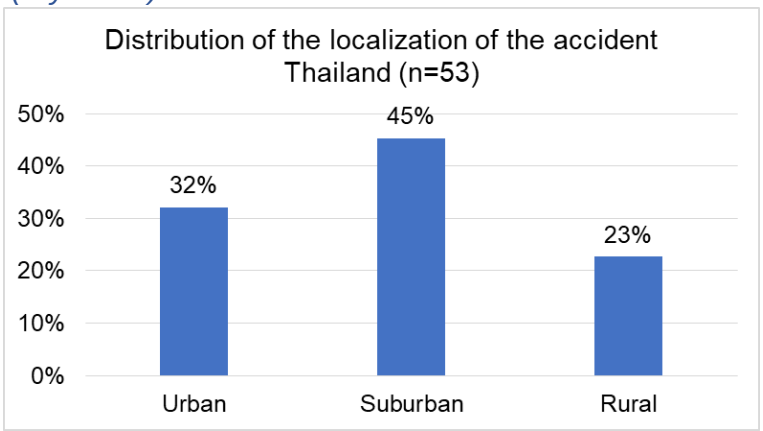


Figure 287: Localization of the accident –Thailand – CROSSING SCENARIO

6.2.2.2 Road category

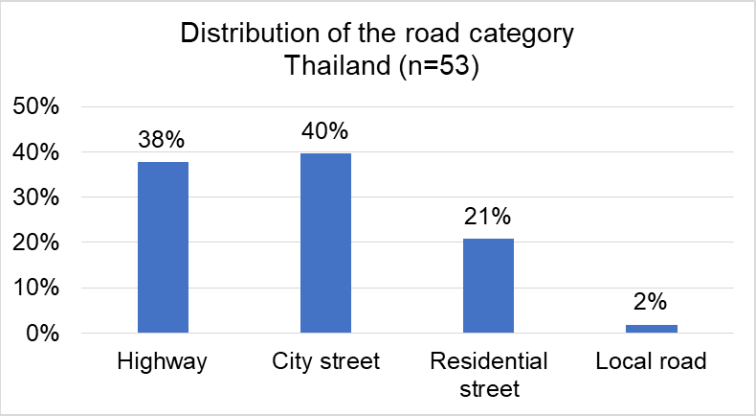
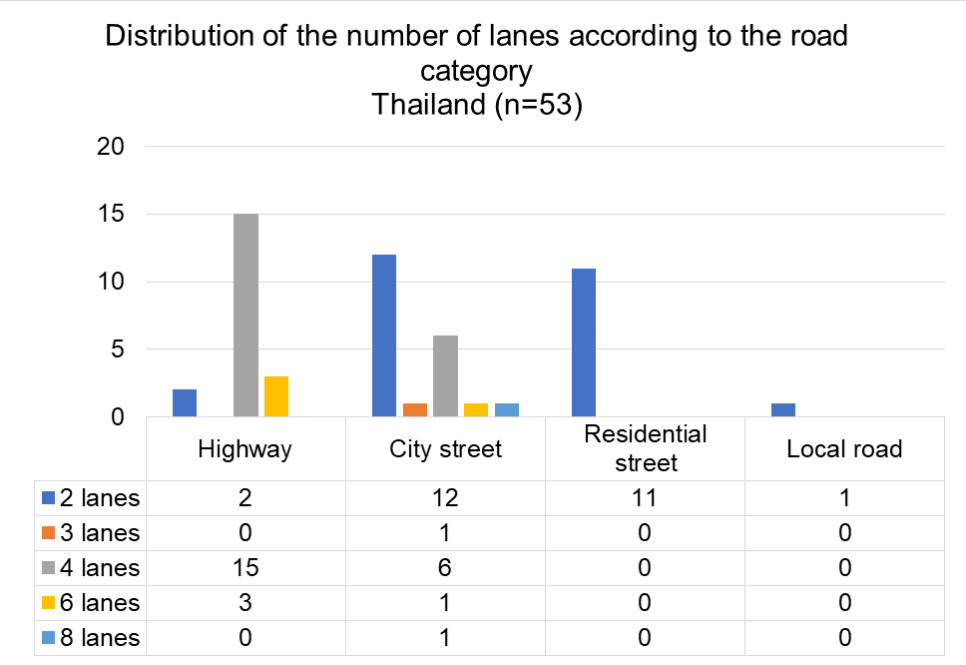


Figure 288: Road category – Thailand – CROSSING SCENARIO



	Highway	City street	Residential street	Local road
2 lanes	2	12	11	1
3 lanes	0	1	0	0
4 lanes	15	6	0	0
6 lanes	3	1	0	0
8 lanes	0	1	0	0

Figure 289: Road category and number of lanes – Thailand – CROSSING SCENARIO

6.2.2.3 Configuration

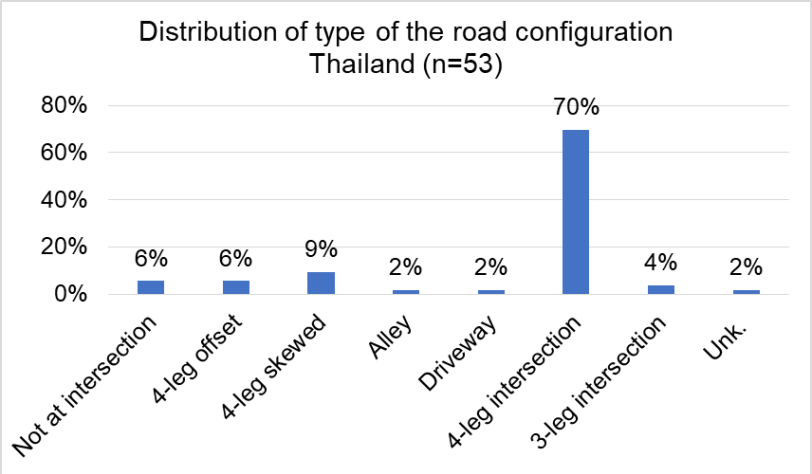


Figure 290: Configuration – Thailand – CROSSING SCENARIO

6.2.2.4 Road geometry

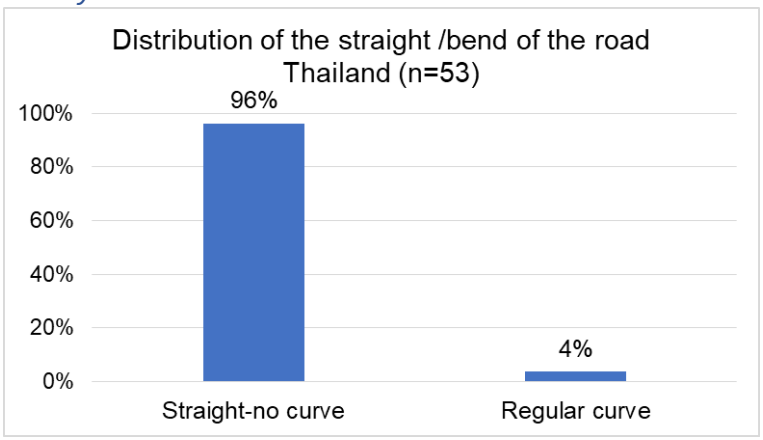


Figure 291: Road geometry – Thailand – CROSSING SCENARIO

6.2.2.5 Slope

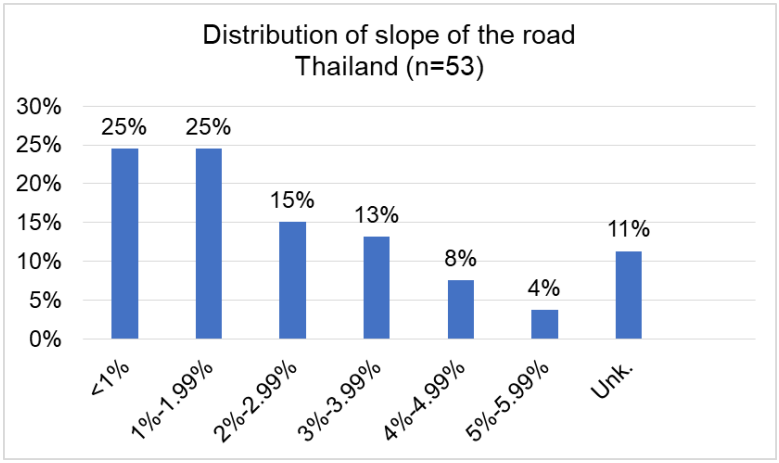


Figure 292: Slop of the road – Thailand – CROSSING SCENARIO

6.2.2.6 Speed limit

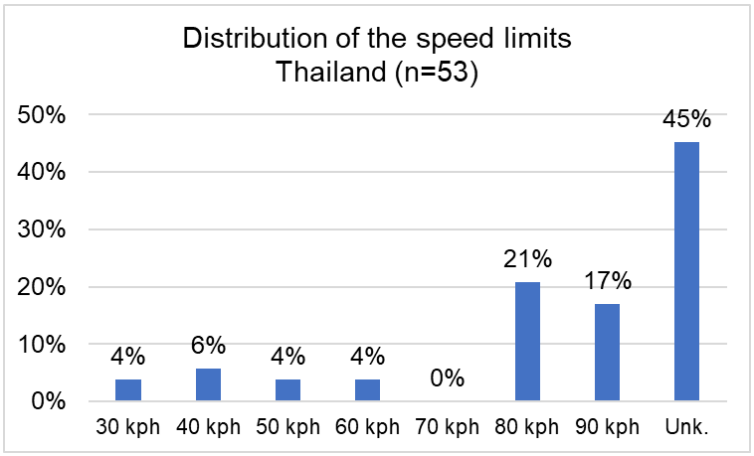


Figure 293: Speed limits – Thailand – CROSSING SCENARIO

6.2.2.7 Number of lanes

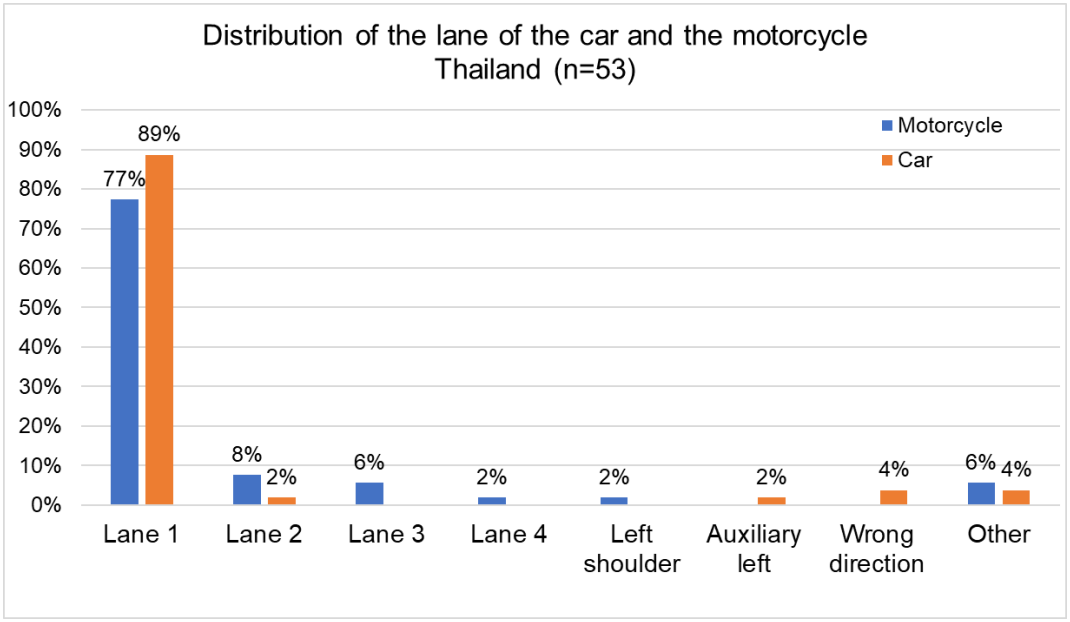
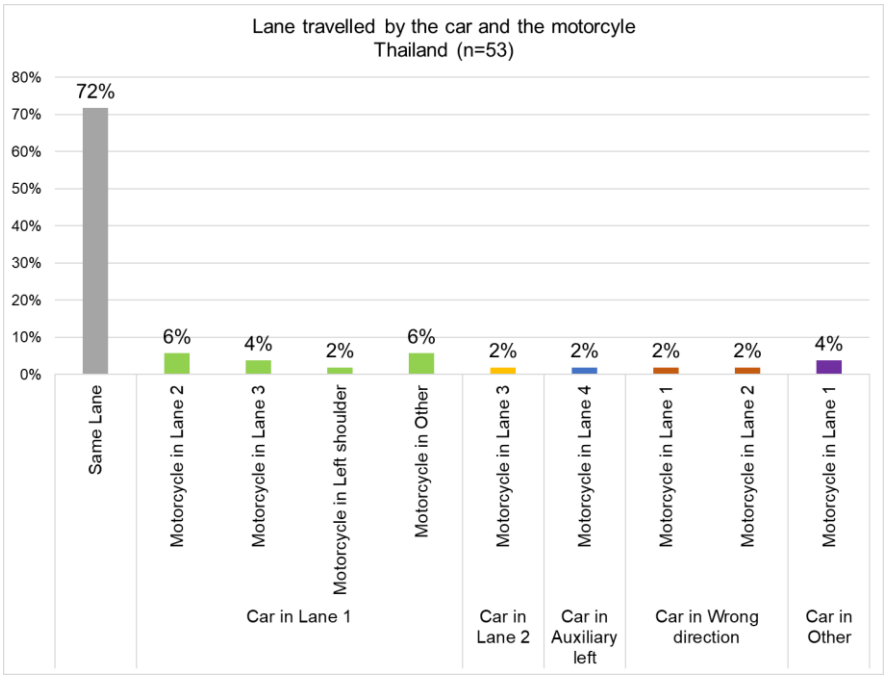


Figure 294: Lanes of the vehicles – Thailand – CROSSING SCENARIO

6.2.2.8 Travelled lane



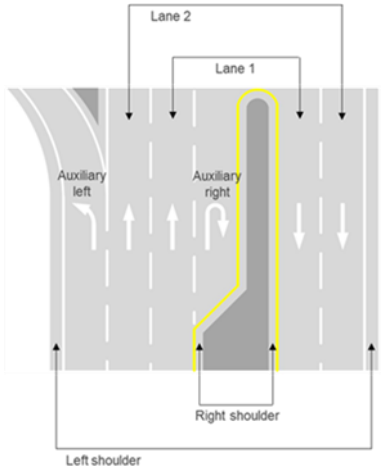


Figure 295: Vehicles on same lane – Thailand – CROSSING SCENARIO

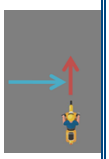
6.2.2.9 Conclusion on road characteristics

Table 74: Conclusion on road characteristics – Thailand – CROSSING SCENARIO

Road characteristics	**CROSSING**	*Thai data*

- ✓ *Mostly suburban (45%) and urban (32%) areas.*
- ✓ *40% of the accidents occur on city street, and highway (38%).*
- ✓ *Mainly 2-4 lanes.*
- ✓ *70% of the accidents happen in a 4-leg intersection.*
- ✓ *96% of the straight road.*
- ✓ *Speed limit mostly unknown (45%), 21% at 80 kph and 17% at 90 kph.*

- ✓ *The car and the motorcycle are in lane1 in 89% and 77% of the accidents.*
- ✓ *72% of the vehicles are in the same lane.*



The conclusions observed in Malaysia and Thailand are similar, with around 30% of accidents that happened in urban area. There is a more important proportion happening in intersection in the Thai data compared to the Malaysian data.

6.2.3 Accident characteristics – vehicles

6.2.3.1 Visibility

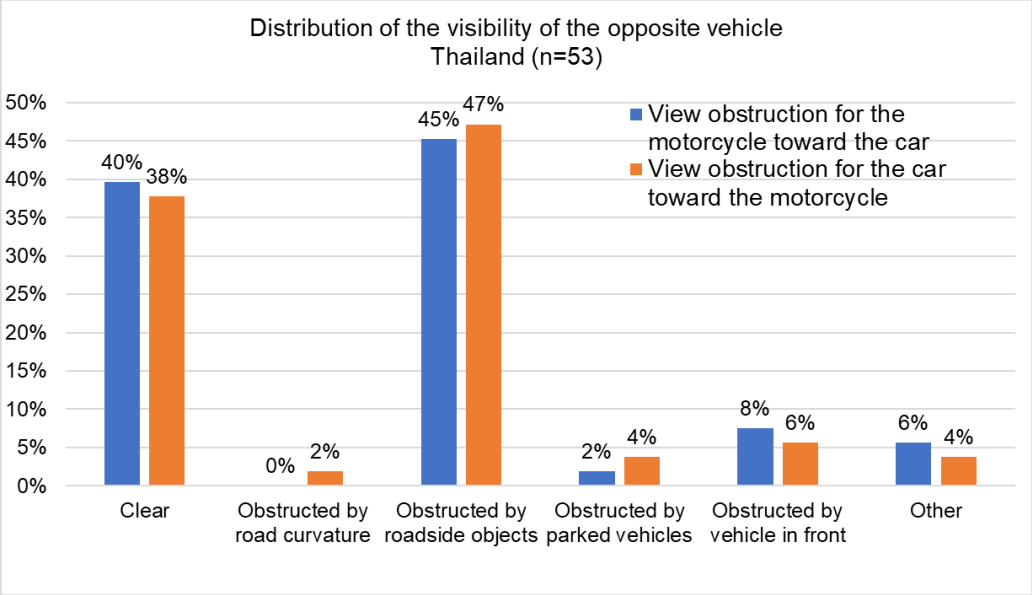
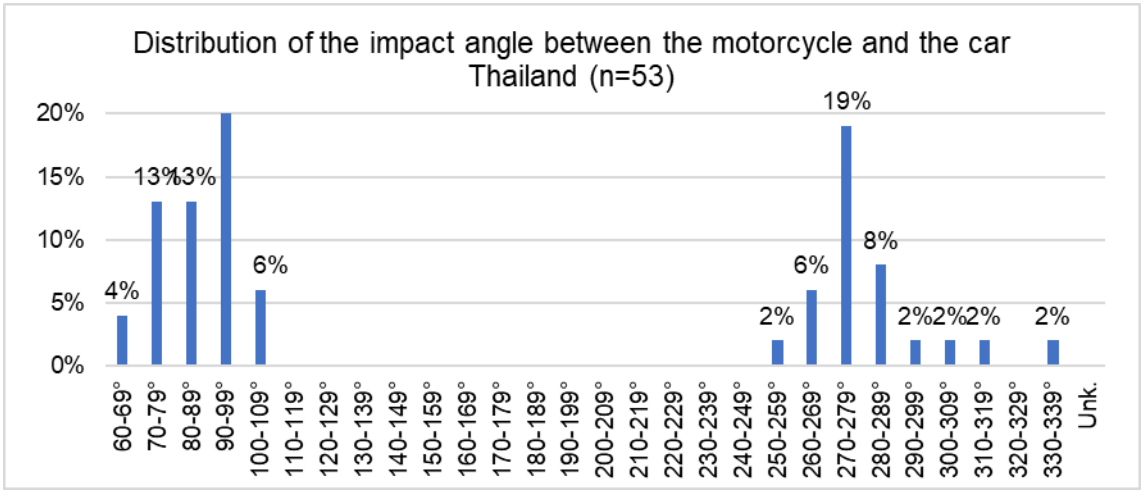


Figure 296: Visibility – Thailand – CROSSING SCENARIO

6.2.3.2 Impact angle between the motorcycle and the car



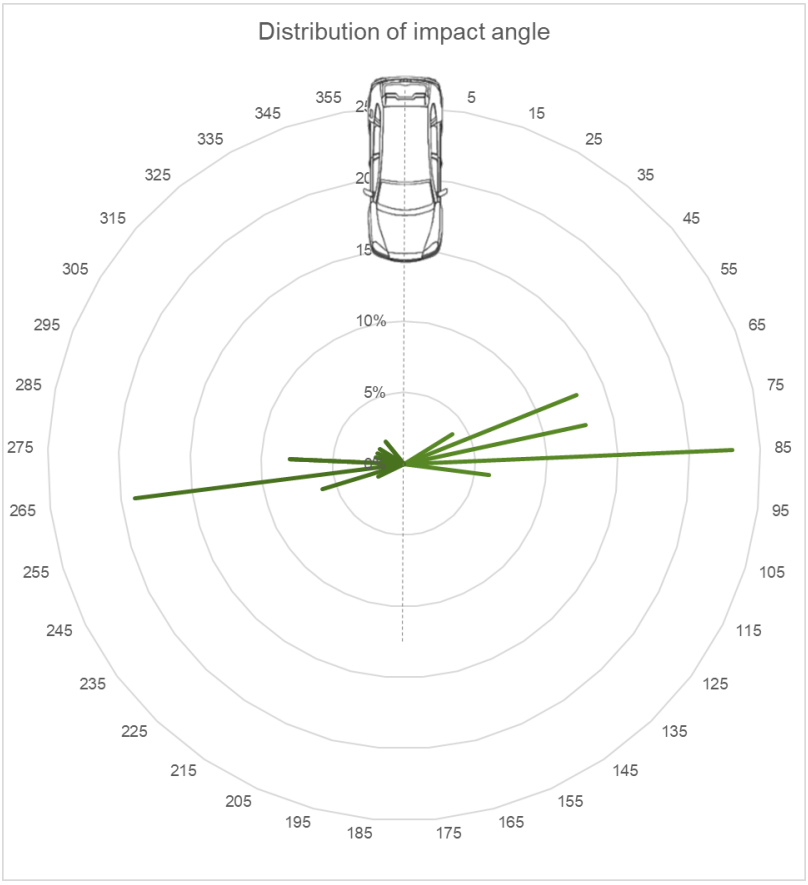


Figure 297: Impact angle – Thailand – CROSSING SCENARIO

6.2.3.3 Motorcycle impact type

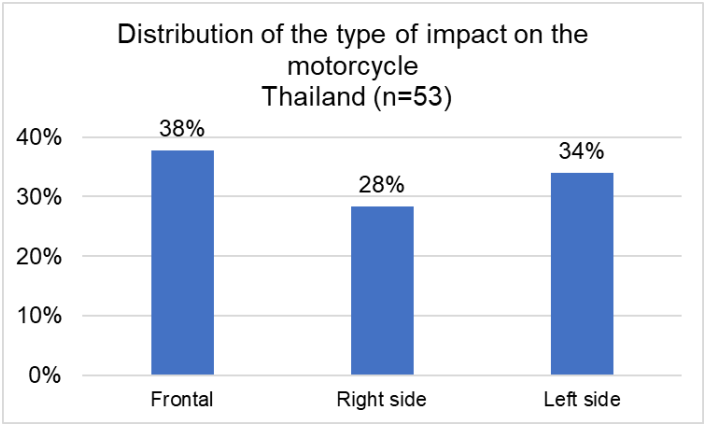


Figure 298: Type of impact for the motorcycle – Thailand – CROSSING SCENARIO

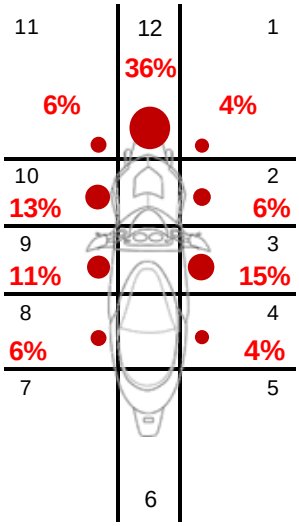


Figure 299: First collision point for the motorcycle – Thailand – CROSSING SCENARIO

6.2.3.4 Car impact type

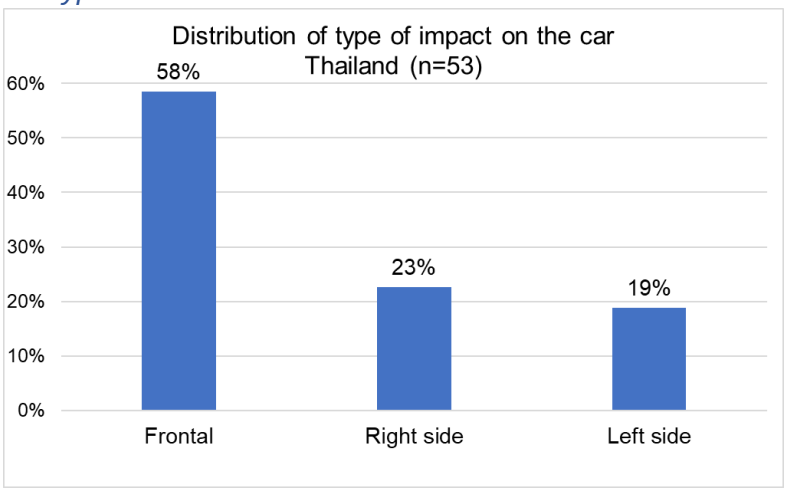


Figure 300: Type of impact for the car– Thailand – CROSSING SCENARIO

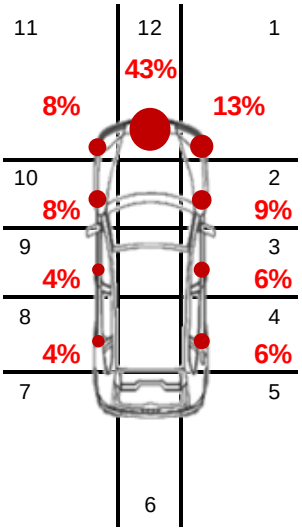


Figure 301: First collision point for the car – Thailand – CROSSING SCENARIO

6.2.3.5 Initial speeds

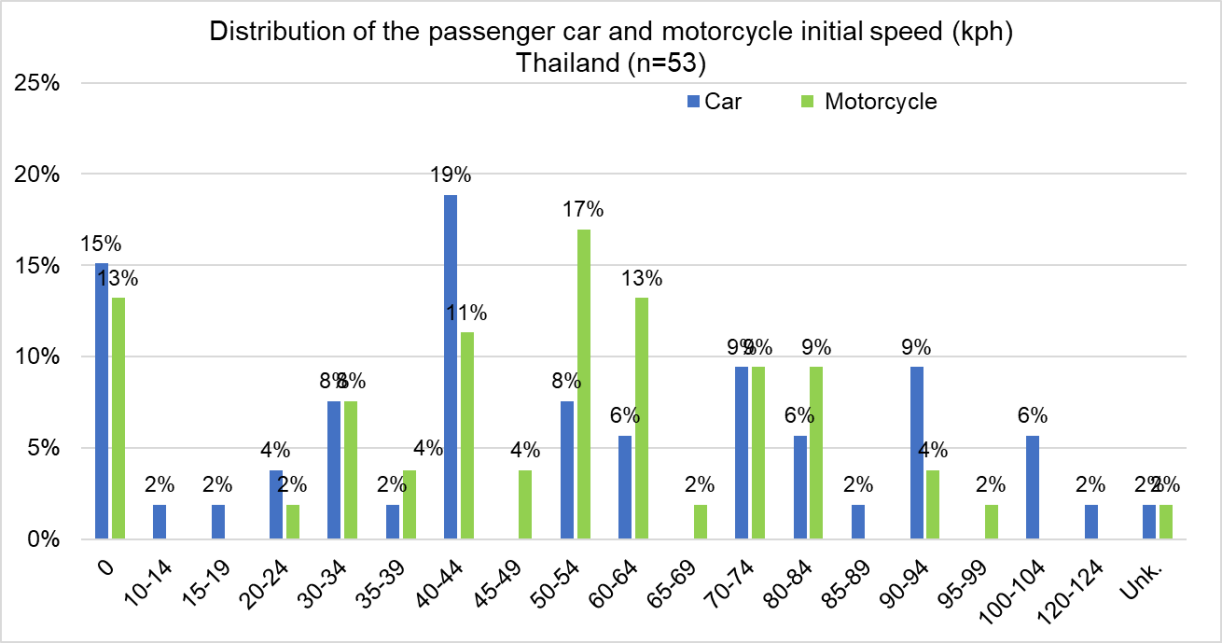


Figure 302: Initial speeds – Thailand – CROSSING SCENARIO

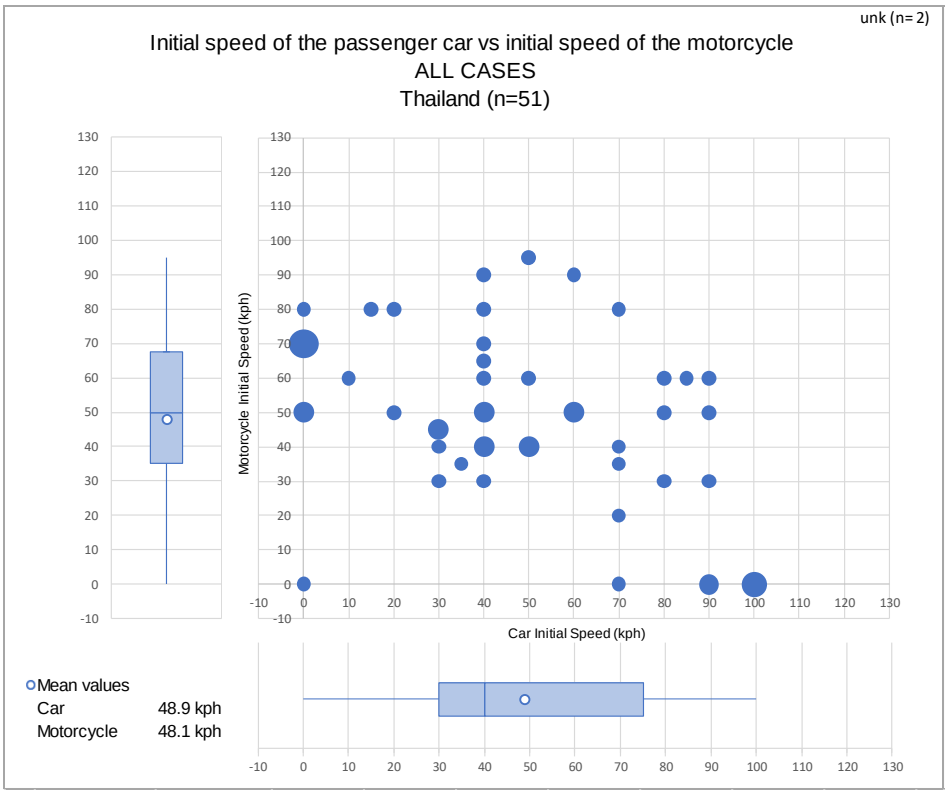


Figure 303: Initial speed of the car versus initial speed of the motorcycle, all cases – Thailand – CROSSING SCENARIO

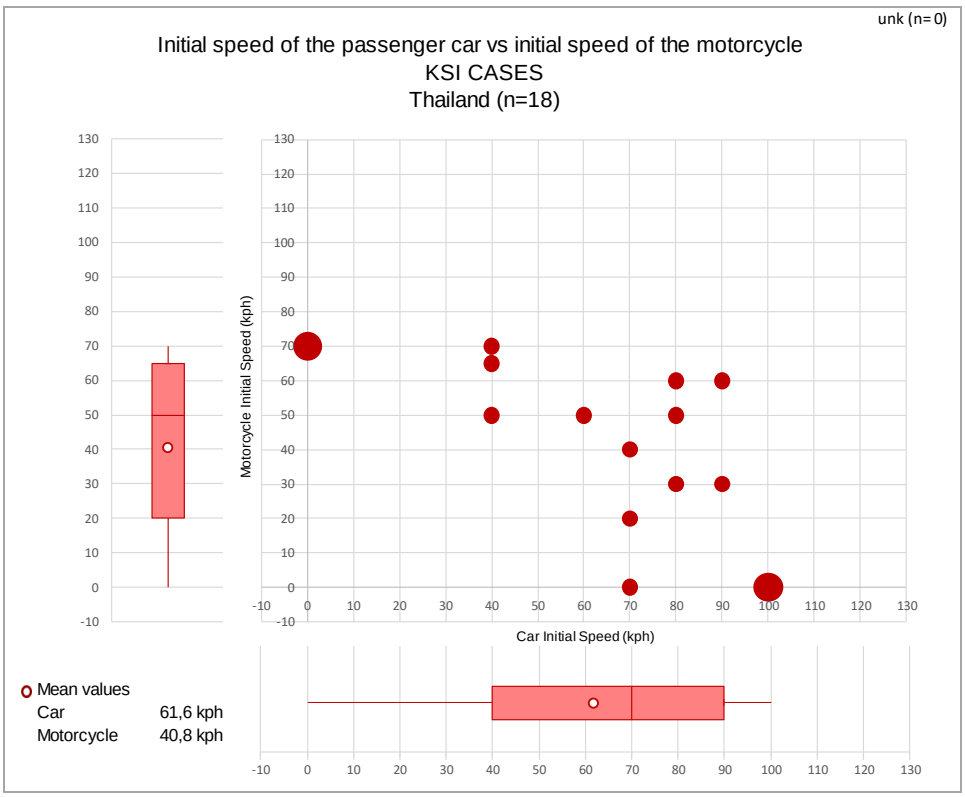


Figure 304: Initial speed of the car versus initial speed of the motorcycle, KSI cases – Thailand – CROSSING SCENARIO

Table 75: Initial speed values for the car and the motorcycle, all cases – Thailand – CROSSING SCENARIO

All Accidents																										unk:	2
Number of cases		Passenger Car Initial Speed (kph)																									
		0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Initial Speed (kph)	0	1															1				2		3				
	1																										
	5																										
	10																										
	15																										
	20																1										
	25																										
	30								1		1								1		1						
	35									1							1										
	40								1		2		2				1										
	45								2																		
	50	2					1				2				2				1		1						
	55																										
	60				1						1		1						1	1	1						
	65										1																
	70	4									1																
	75																										
	80	1				1	1				1						1										
	85																										
	90										1				1												
	95												1														
	100																										
	105≤																										

Table 76: Initial speed values for the car and the motorcycle, KSI cases – Thailand – CROSSING SCENARIO

KSI Accidents																										unk: 0
Number of cases		Passenger Car Initial Speed (kph)																								
		0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Initial Speed (kph)	0																1						3				
	1																										
	5																										
	10																										
	15																										
	20																1										
	25																										
	30																		1		1						
	35																										
	40																1										
	45																										
	50										1				1				1								
	55																										
	60																		1		1						
	65										1																
	70	3									1																
	75																										
	80																										
	85																										
	90																										
	95																										
	100																										
	105≤																										

6.2.3.6 Collision speeds

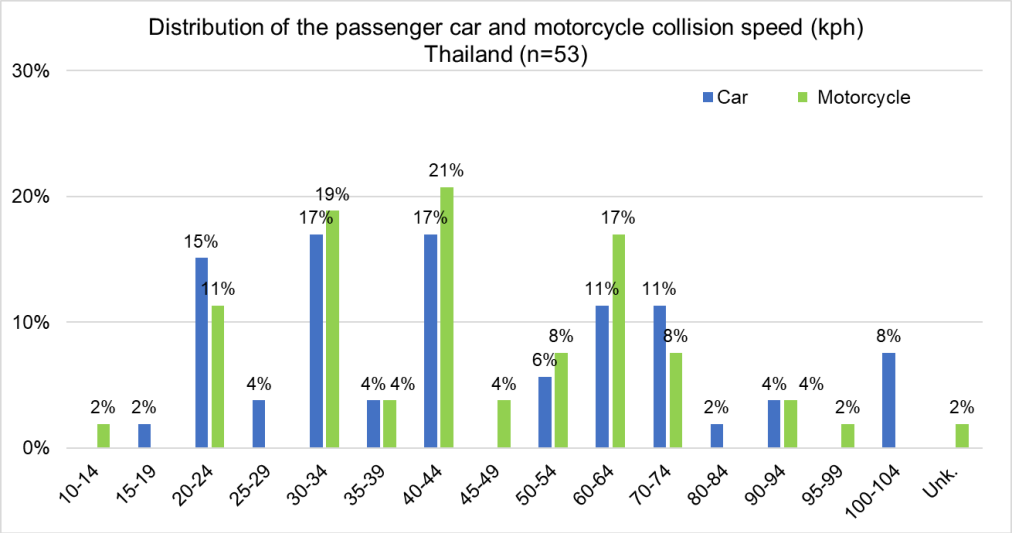


Figure 305: Collision speeds – Thailand – CROSSING SCENARIO

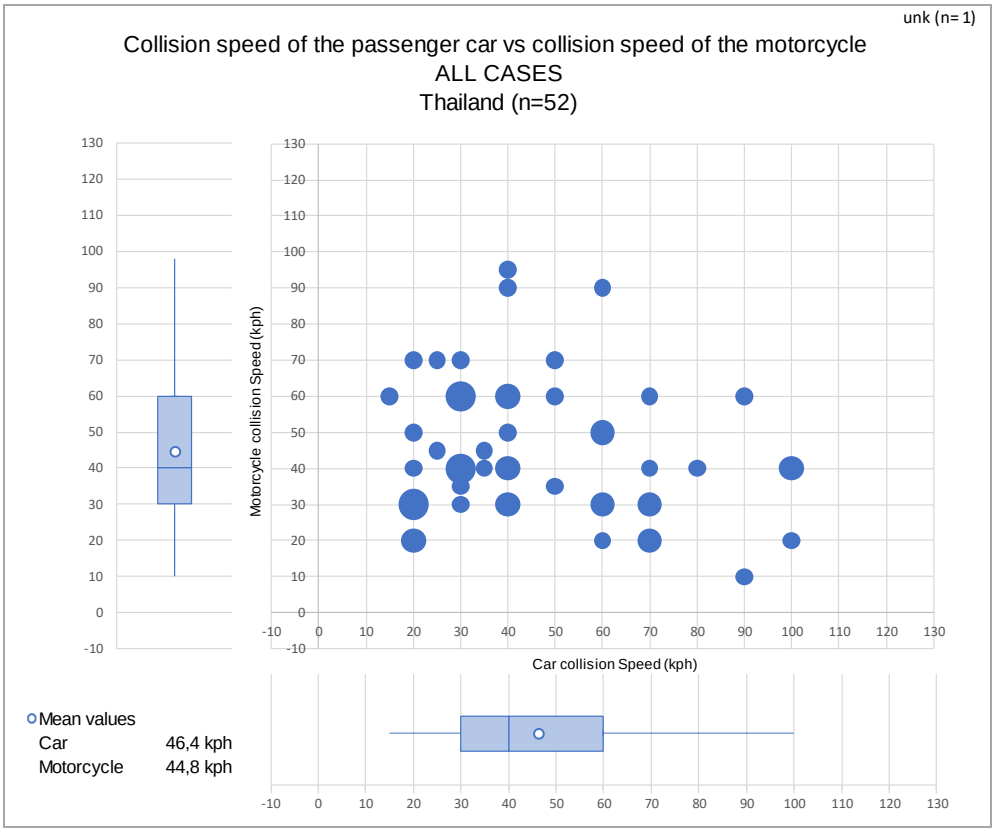


Figure 306: Collision speed of the car versus collision speed of the motorcycle, all cases – Thailand - CROSSING SCENARIO

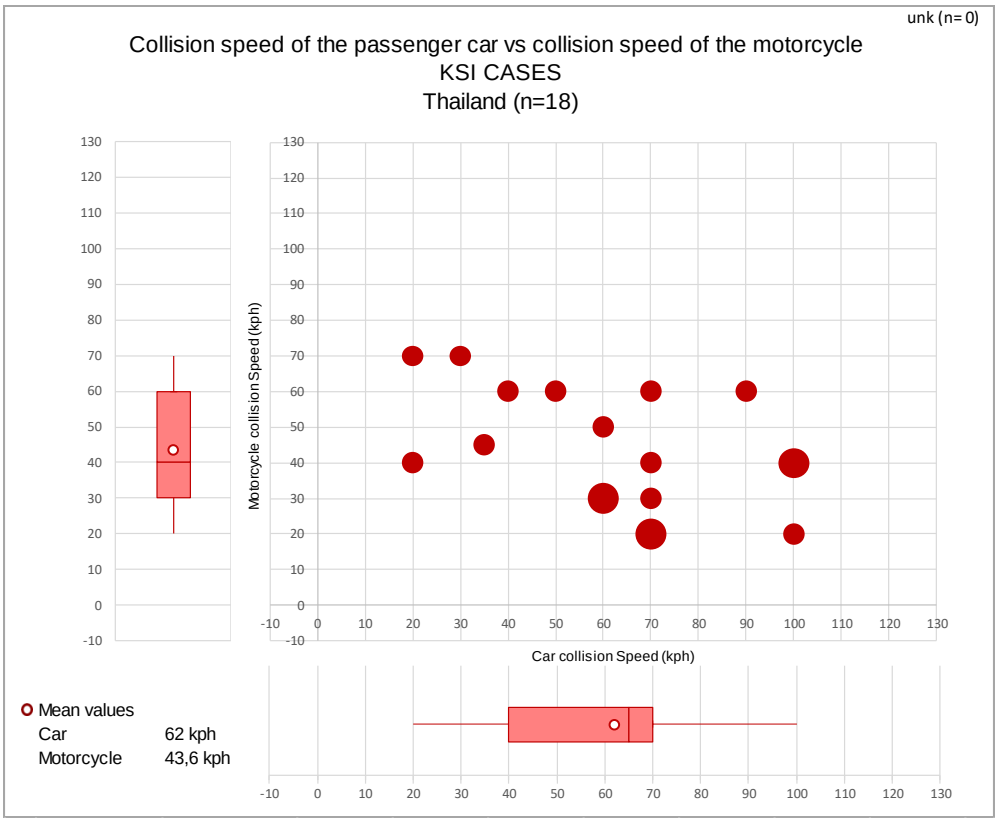


Figure 307: Collision speed of the car versus collision speed of the motorcycle, KSI cases – Thailand – CROSSING SCENARIO

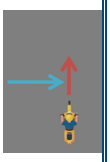


Table 77: Collision speed values for the car and the motorcycle, all cases – Thailand CROSSING SCENARIO

All Accidents																											unk:	1
Number of cases	Passenger Car Collision Speed (kph)																											
Motorcycle Collision Speed (kph)	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
0																										
1																										
5																										
10																				1						
15																										
20						2								1		2						1				
25																										
30						3		1		2				2		2										
35								1				1														
40						1		3	1	2						1		1				2				
45							1		1																	
50						1				1				2												
55																										
60					1			3		2		1				1				1						
65																										
70						1	1	1				1														
75																										
80																										
85																										
90										1				1												
95										1																
100																										
105≤																										

Table 78: Collision speed values for the car and the motorcycle, KSI cases – Thailand CROSSING SCENARIO

KSI Accidents																											unk:	0
Number of cases	Passenger Car Collision Speed (kph)																											
Motorcycle Collision Speed (kph)	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
0																										
1																										
5																										
10																										
15																										
20																2						1				
25																										
30														2		1										
35																										
40						1										1						2				
45									1																	
50														1												
55																										
60										1		1				1				1						
65																										
70						1		1																		
75																										
80																										
85																										
90																										
95																										
100																										
105≤																										

6.2.3.7 Delta initial velocity (kph) – calculated

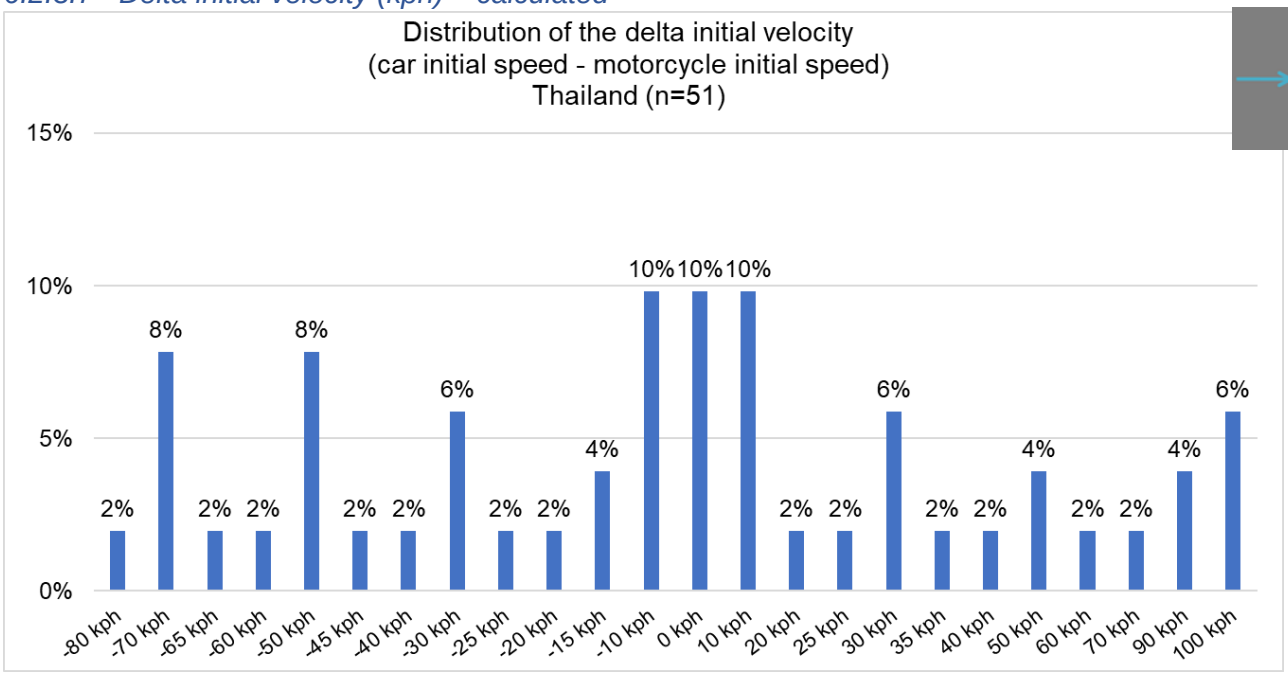


Figure 308: Delta initial velocity (kph)– Thailand – CROSSING SCENARIO

6.2.3.8 Skid marks

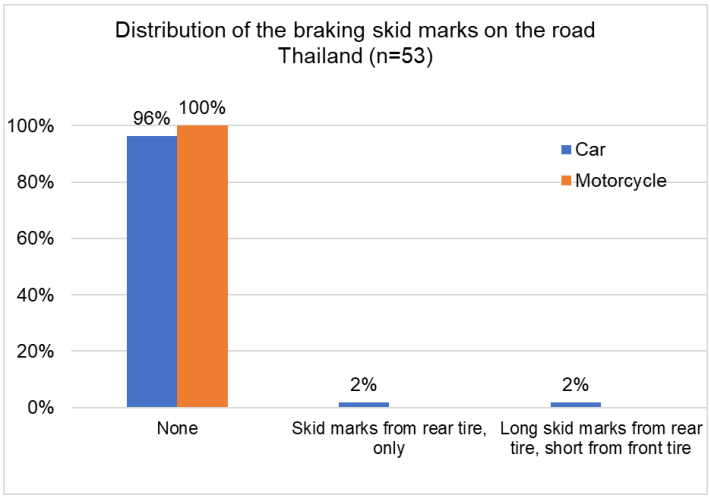


Figure 309: Skid marks – Thailand – CROSSING SCENARIO

6.2.3.9 ABS fitment on the car

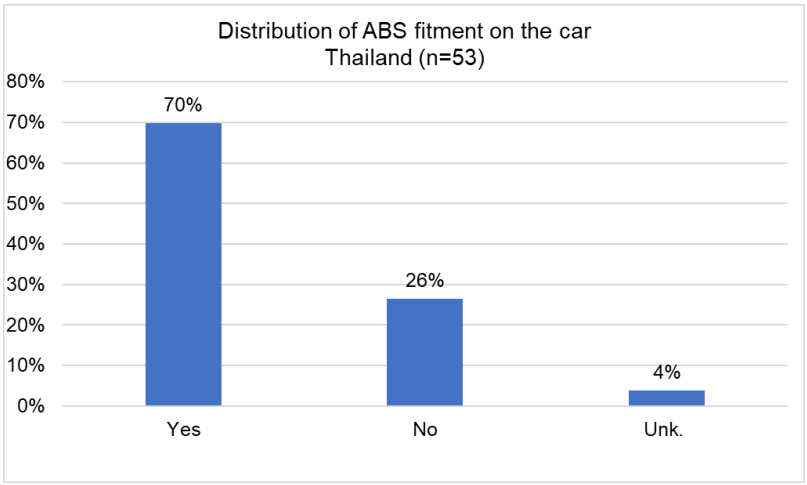


Figure 310: ABS fitment – Thailand – CROSSING SCENARIO

6.2.3.10 Motorcycle manoeuvre before crash

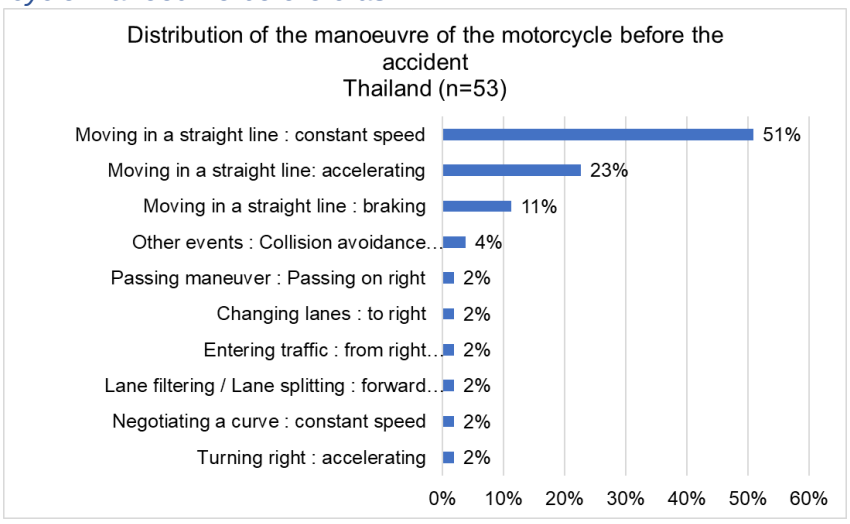


Figure 311: Motorcycle manoeuvre – Thailand – CROSSING SCENARIO

6.2.3.11 Car manoeuvre before crash

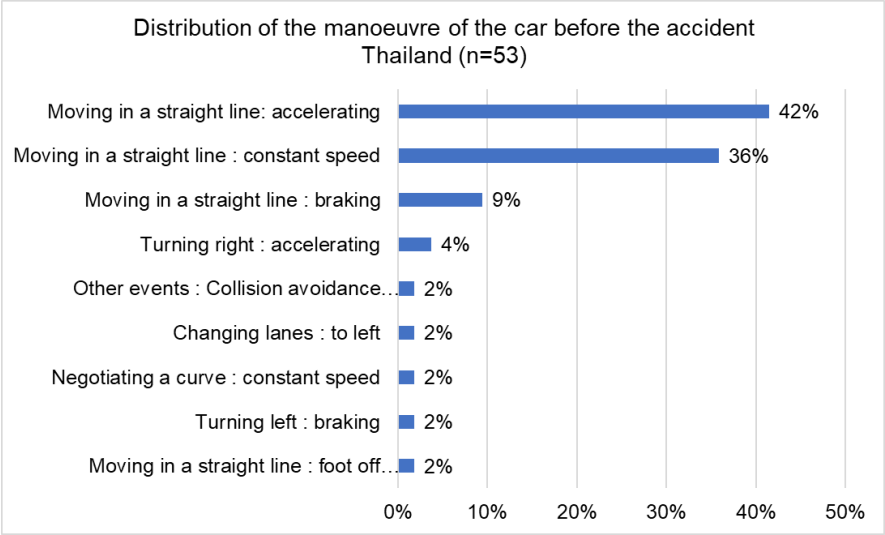


Figure 312: Car manoeuvre – Thailand – CROSSING SCENARIO

6.2.3.12 Avoidance action by vehicle

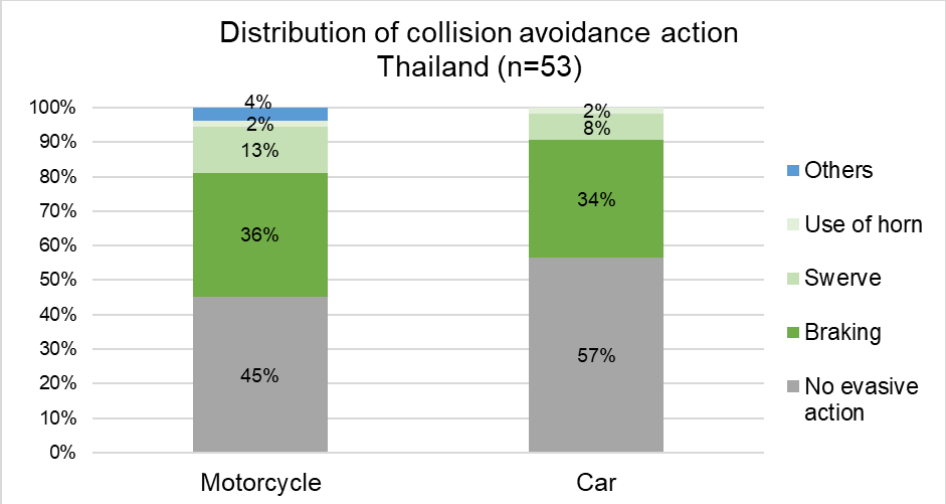


Figure 313: Avoidance action by vehicle – Thailand – CROSSING SCENARIO

6.2.3.13 Conclusion on accident characteristics

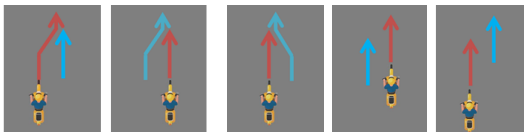
Table 79: Conclusion on accident characteristics – Thailand – CROSSING SCENARIO

Accident characteristics	**CROSSING**	*Thai data*
✓ *No visual obstruction for 40% of the vehicles, but the visibility is obstructed by roadside object in 45% of the accidents.* ✓ *38% frontal impact for the motorcycle, 34% left side, 28% right side.* ✓ *58% frontal impact for the car, 23% right side, 19% left side.*		

- ✓ *Mean initial speed: Car=48,9 kph and Motorcycle=48,1 kph*
- ✓ *Mean collision speed: Car=46,4 kph and Motorcycle=44,8 kph*
- ✓ *70% of the car had ABS.*
- ✓ *The motorcycle goes straight at constant speed (51%), straight accelerating (23%), straight braking (11%).*
- ✓ *The car goes mostly straight accelerating (42%), straight at constant speed (36%), straight braking (9%).*
- ✓ *Avoidance action: 36% of the motorcycle and 34% of the car brake.*

7 Side-swipe scenarios

The side-swipe scenarios concern accidents where both vehicles are travelling in the same direction and either entering the lane of the opposite vehicle or not. Side-swipe accidents scenarios represent **7%** of the KSI accidents in the Malaysian database and **6%** in the Thai database.



The side-swipe accidents scenarios consist in three side-swipe sub-scenarios which will be analysed with the Thai data, whereas the overall side-swipe accidents scenario is described with the Malaysian data, in the following paragraph.

7.1 Malaysian database

This paragraph is describing the distributions of the variables in the Malaysian database for the side-swipe scenario. It accounts for 105 accidents in this database.

7.1.1 Accident characteristics – general conditions

7.1.1.1 Weather conditions

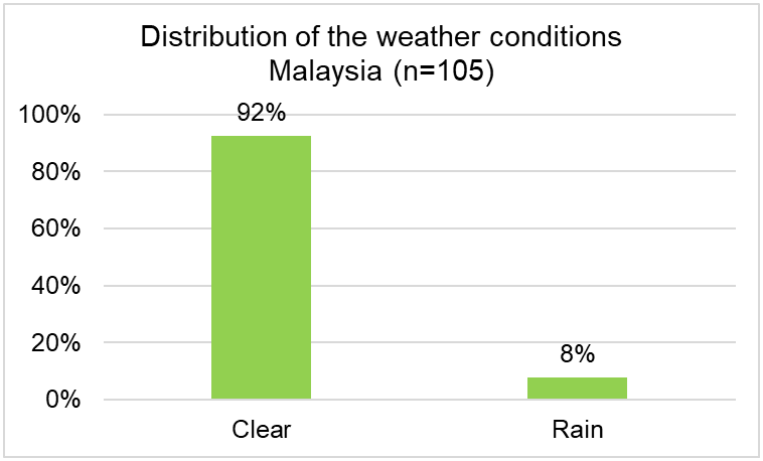


Figure 314: Weather conditions - Malaysia - SIDE-SWIPE SCENARIO

7.1.1.2 Light conditions

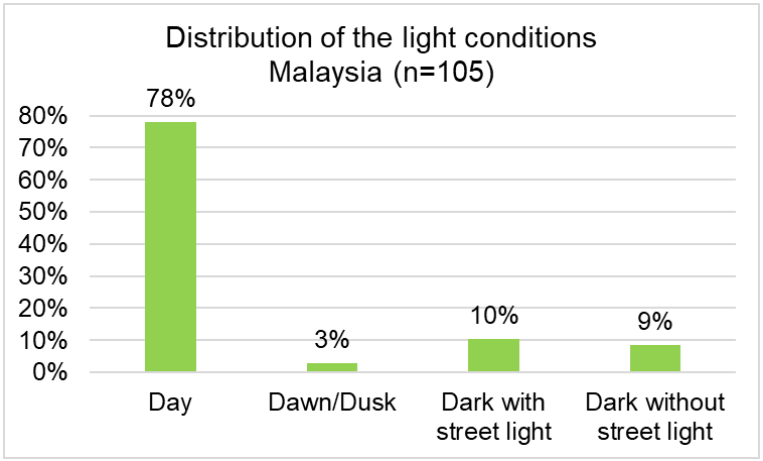


Figure 315: Light conditions - Malaysia - SIDE-SWIPE SCENARIO

7.1.1.3 Road surface conditions

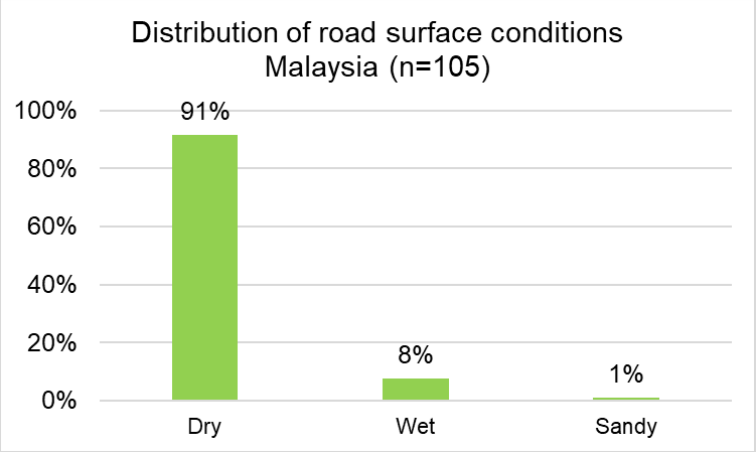


Figure 316: Road surface conditions – Malaysia – SIDE-SWIPE SCENARIO

7.1.1.4 Conclusion on general accident conditions

Table 80: Conclusion on general accident conditions – Malaysia – SIDE-SWIPE SCENARIO

General conditions	**SIDE-SWIPE**	*Malaysian data*

- ✓ *More than 90% of the accidents happen with clear weather.*
- ✓ *78% happen during the day (9% at night without light).*
- ✓ *91% of the accidents occur on dry road surface.*

7.1.2 Road characteristics

7.1.2.1 Location (city / urban)

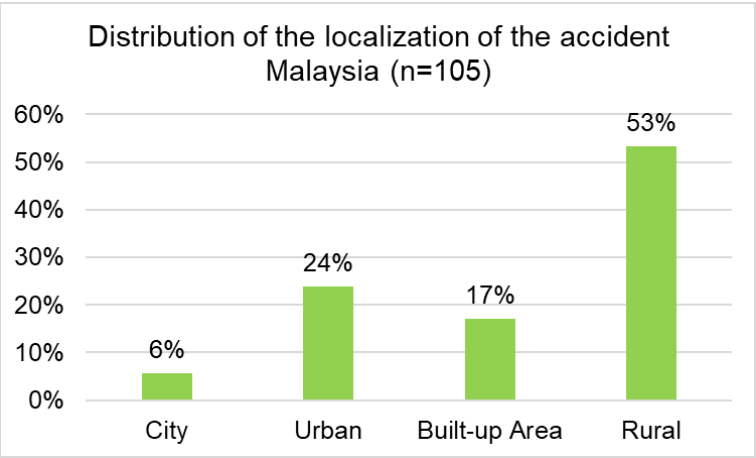


Figure 317: Localization of the accident – Malaysia – SIDE-SWIPE SCENARIO

7.1.2.2 Road category

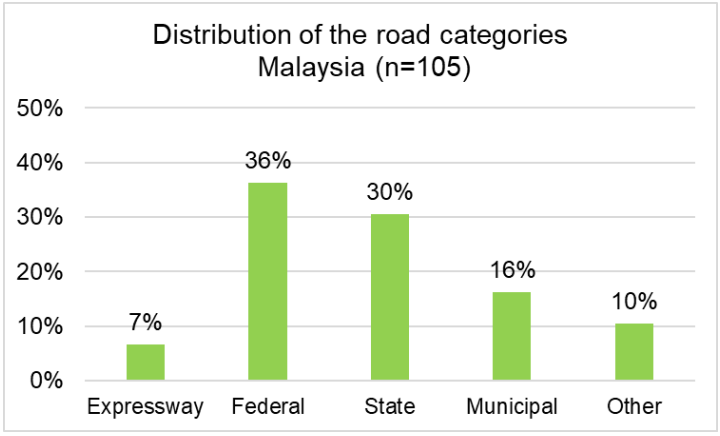


Figure 318: Road category – Malaysia – SIDE-SWIPE SCENARIO

7.1.2.3 Road geometry

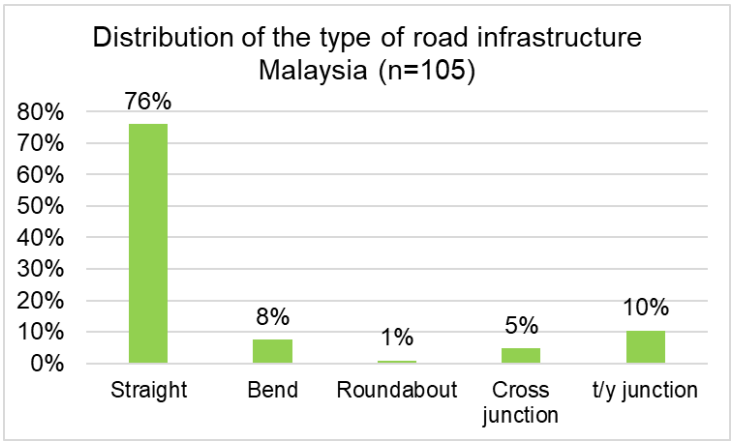


Figure 319: Road geometry – Malaysia – SIDE-SWIPE SCENARIO

7.1.2.4 Lane marking

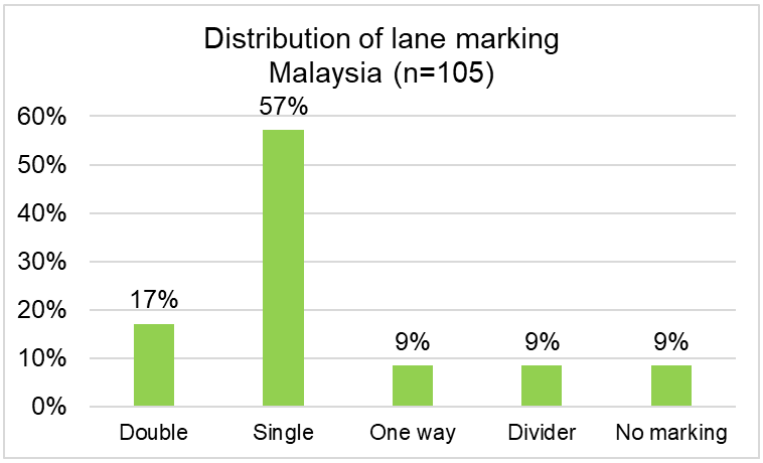


Figure 320: Lane marking – Malaysia – SIDE-SWIPE SCENARIO

7.1.2.5 Speed limit

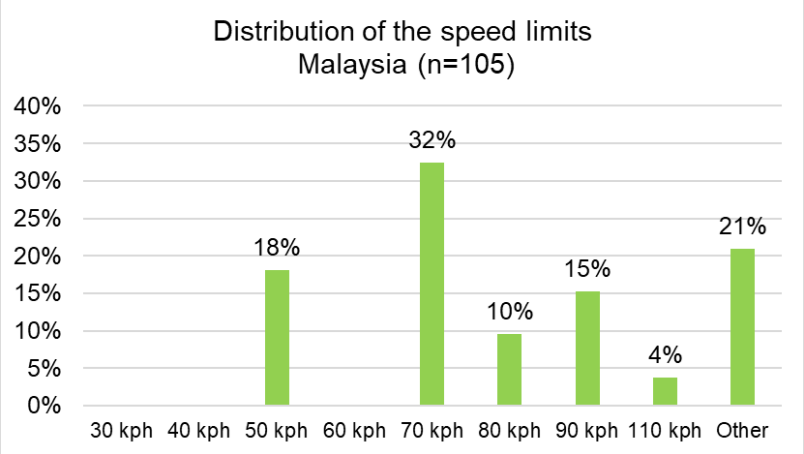


Figure 321: Speed limits – Malaysia – SIDE-SWIPE SCENARIO

7.1.2.6 Conclusion on road characteristics

Table 81: Conclusion on road characteristics – Malaysia – SIDE-SWIPE SCENARIO

Road characteristics	**SIDE-SWIPE**	*Malaysian data*

- ✓ *53% of the accidents happen in rural area (30% in urban or city).*
- ✓ *Majority of federal or state roads (36% and 30%).*
- ✓ *15% of the accidents happen in intersection.*
- ✓ *76% of the accidents happen in a straight road.*
- ✓ *Most of the accidents with single lane marking (57%), double lane marking (17%), one way in 9% of the cases.*
- ✓ *Speed limits: 32% at 70 kph, 18% at 50 kph and only 15% at 90 kph.*

7.1.3 Accident characteristics – vehicles

7.1.3.1 Motorcycle impact type

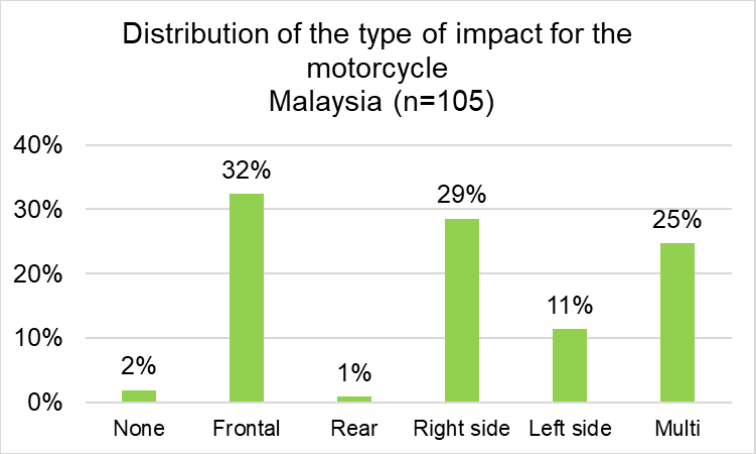


Figure 322: Motorcycle impact type – Malaysia – SIDE-SWIPE SCENARIO

7.1.3.2 Motorcycle action before crash

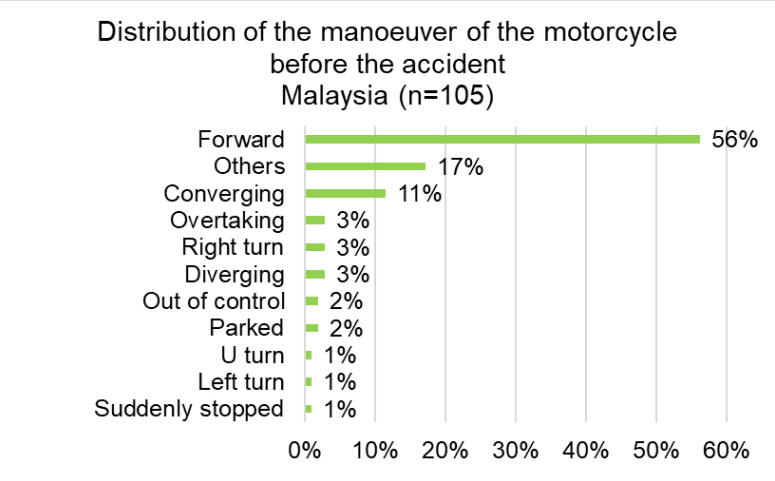


Figure 323: Motorcycle manoeuvre – Malaysia – SIDE-SWIPE SCENARIO

7.1.3.3 Conclusion on vehicle characteristics

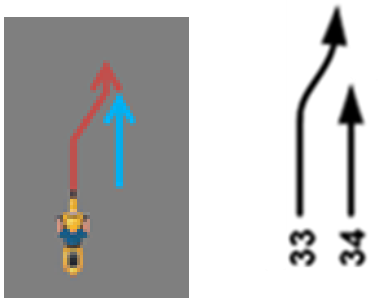
Table 82: Conclusion on vehicle characteristics – Malaysia – SIDE-SWIPE SCENARIO

Vehicle characteristics	**SIDE-SWIPE**	*Malaysian data*
✓ *32% of frontal impact for the motorcycle, 29% right side impact.* ✓ *Motorcycle going forward for most of the cases (56%) or converging (11%).*		

7.2 Thai database: Motorcycle merging toward the right within the lane of the car (Side-swipe 1)

This sub-scenario represents **2,8%** of all the accidents and **3,1%** of the KSI accidents in the Thai database.

In this sub-scenario, the car is going straight, and the motorcycle goes on the right, in the lane of the car. This configuration is illustrated by the figure below:



(a) (b)

Car=34
Motorcycle=33

Figure 324: (a) Illustration of the SIDE-SWIPE 1 scenario, (b) pictogram from the Thai database.

The following graphs provide in-depth description of the sub-scenario. It accounts for 18 accidents in this database.

7.2.1 Accident characteristics – general conditions

7.2.1.1 Weather conditions

In this sub-scenario, all accidents happen with a clear weather condition.

7.2.1.2 Light conditions

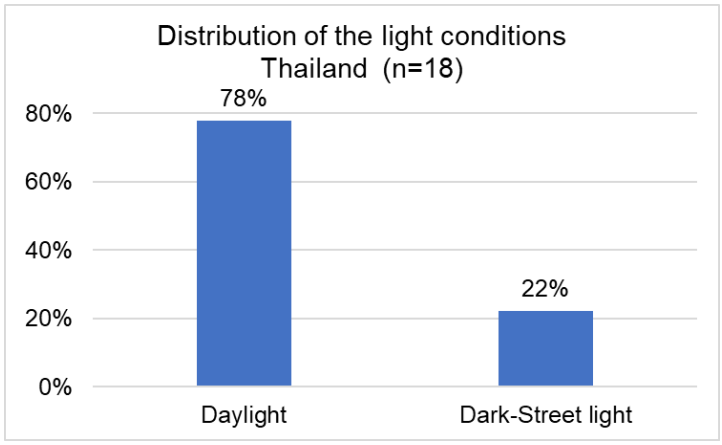


Figure 325: Light conditions - Thailand – SIDE-SWIPE 1 SCENARIO

7.2.1.3 Road surface conditions

In this sub-scenario, all accidents happen on a dry road surface.

7.2.1.4 Conclusion on general accident conditions

Table 83: Conclusion on general accident conditions – Thailand – SIDE-SWIPE 1 SCENARIO

General conditions	**SIDE-SWIPE 1**	*Thai data*
✓ *Clear weather for all the accidents.* ✓ *78% of the accidents happen during the day (22% at night with streetlights).* ✓ *Dry road surface for all the accidents.*		

The environmental conditions are similar in Thailand and Malaysia based on the databases, with the same proportion of cases occurring during the day, around three quarter.

7.2.2 Road characteristics

7.2.2.1 Location (city / urban)

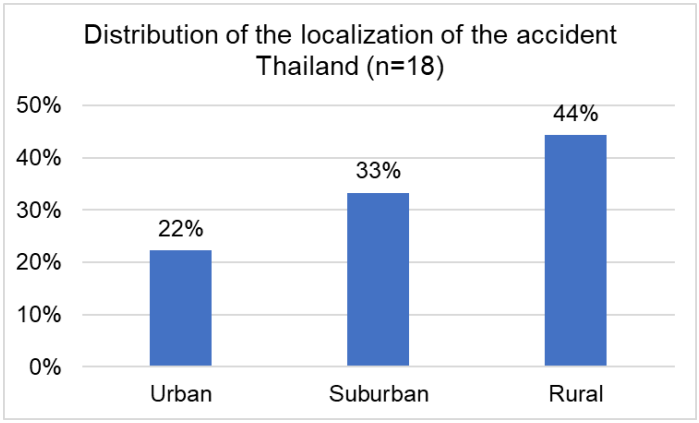


Figure 326: Localization of the accident –Thailand – SIDE-SWIPE 1 SCENARIO

7.2.2.2 Road category

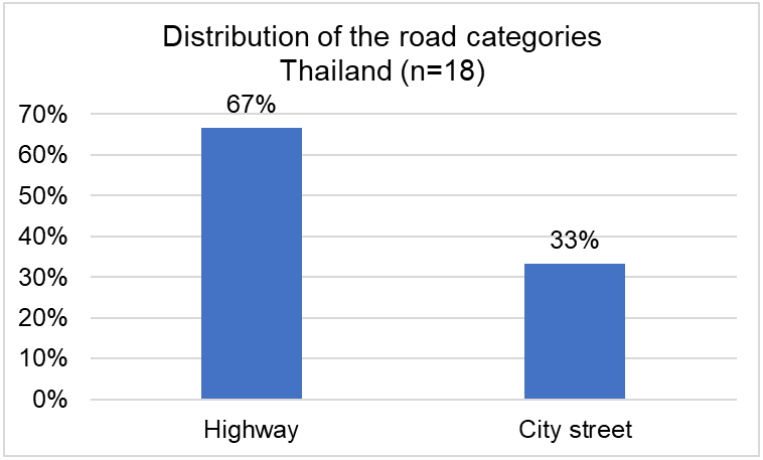
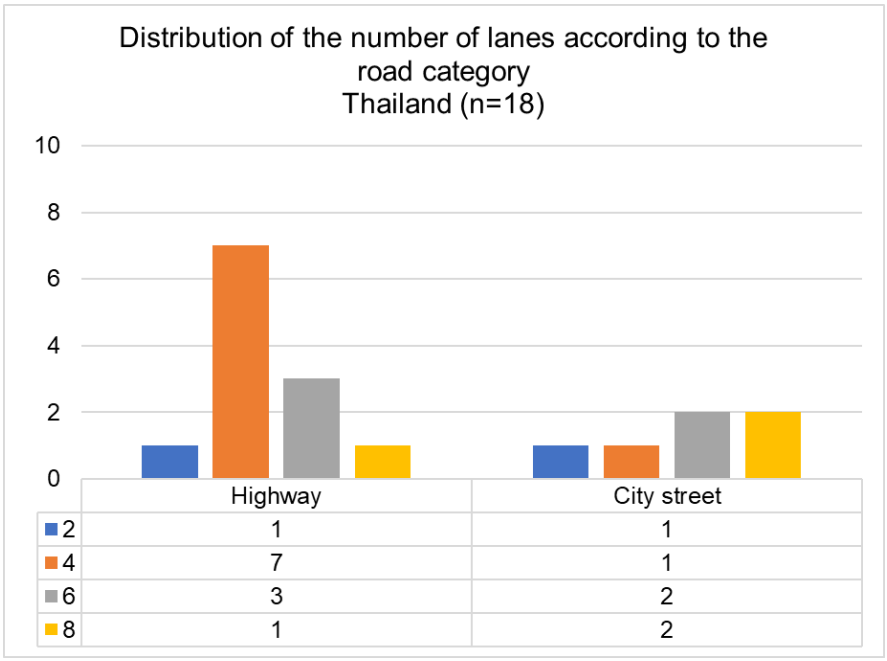
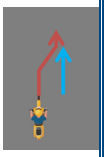


Figure 327: Road category – Thailand – SIDE-SWIPE 1 SCENARIO



	Highway	City street
2	1	1
4	7	1
6	3	2
8	1	2

Figure 328: Road category and number of lanes – Thailand – SIDE-SWIPE 1 SCENARIO



7.2.2.3 Configuration

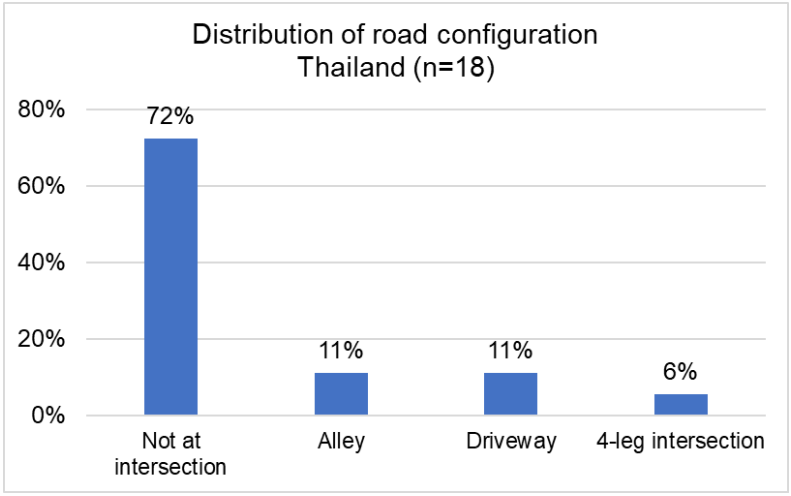


Figure 329: Configuration – Thailand – SIDE-SWIPE 1 SCENARIO

7.2.2.4 Road geometry

In this sub-scenario, all accidents happen on a straight road.

7.2.2.5 Slope

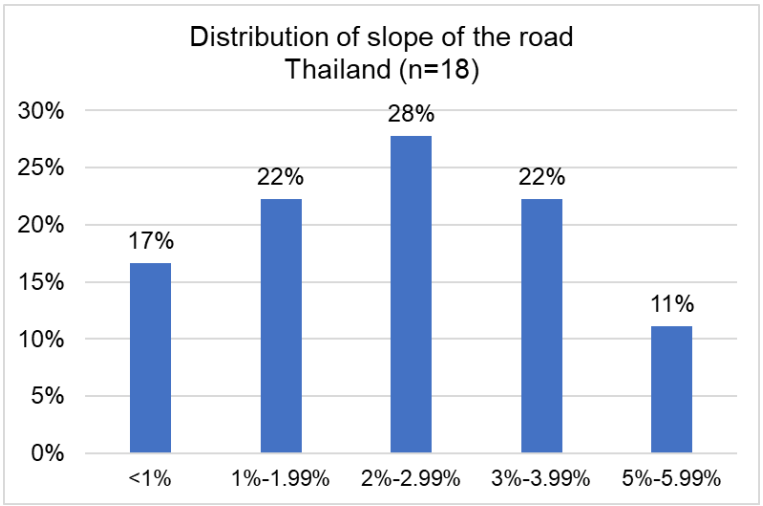
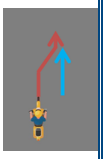


Figure 330: Slop of the road – Thailand – SIDE-SWIPE 1 SCENARIO



7.2.2.6 Speed limit

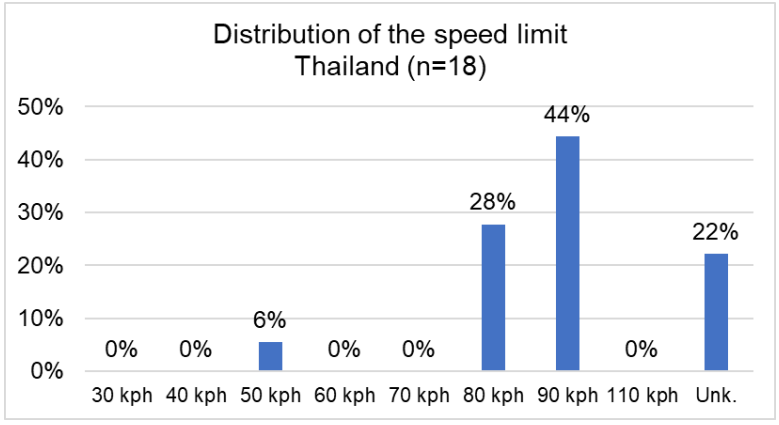


Figure 331: Speed limits – Thailand – SIDE-SWIPE 1 SCENARIO

7.2.2.7 Number of the lane

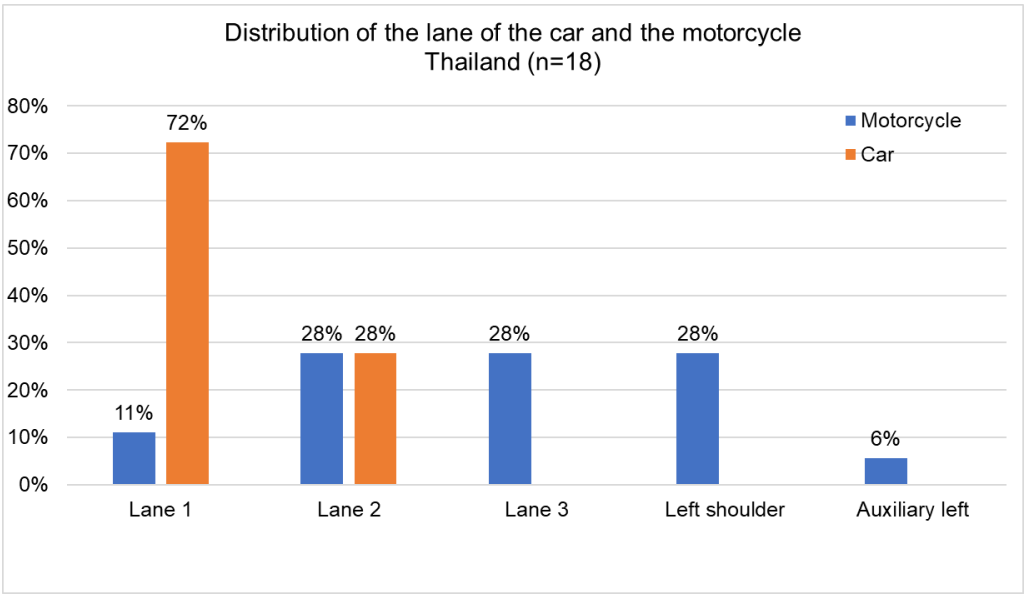
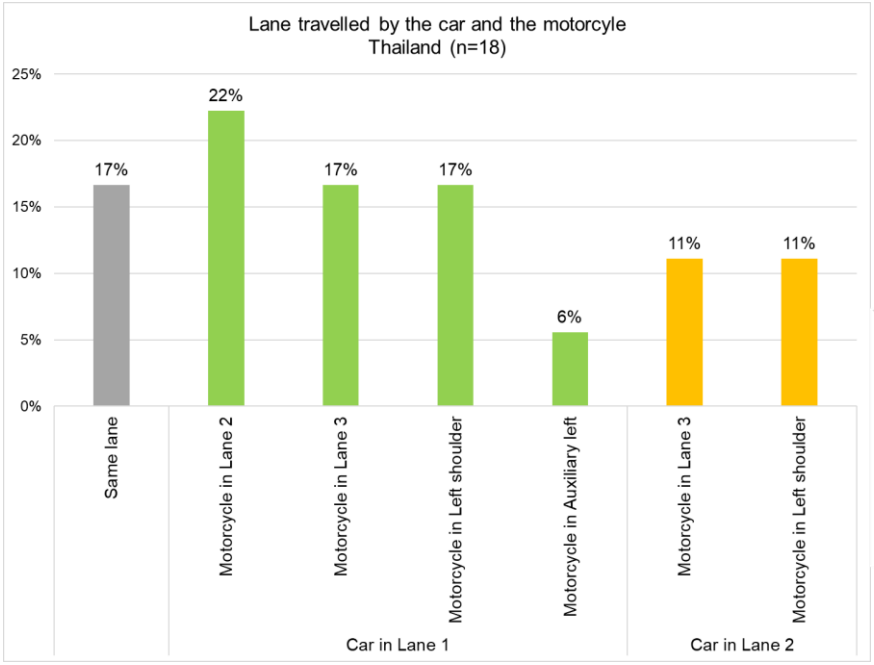


Figure 332: Lanes of the vehicles – Thailand – SIDE-SWIPE 1 SCENARIO

7.2.2.8 Travelled lane



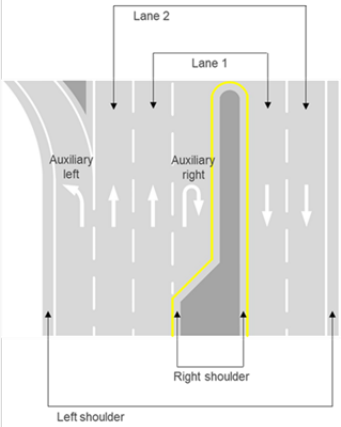


Figure 333: Vehicles on same lane – Thailand – SIDE-SWIPE 1 SCENARIO

7.2.2.9 Conclusion on road characteristics

Table 84: Conclusion on road characteristics – Thailand – SIDE-SWIPE 1 SCENARIO

Road characteristics	**SIDE-SWIPE 1**	*Thai data*

- ✓ *Mostly rural (44%) and suburban (33%) areas.*
- ✓ *37% of the accidents occur on highway and 33% in city street.*
- ✓ *4-6 lanes.*
- ✓ *72% of the accidents are out of intersection, 11% in alley and driveway.*
- ✓ *100% of the accidents happen in a straight road.*
- ✓ *Speed limit at 90 kph (44%) and 80 kph (28%).*
- ✓ *In 50% of the cases, the vehicles are in adjacent lanes, 17% in the same lane.*

From data observed in both countries, the road configuration is mostly a rural area, on a straight road, out of intersection. One third of the accidents happen on city streets.

7.2.3 Accident characteristics – vehicles

7.2.3.1 Visibility

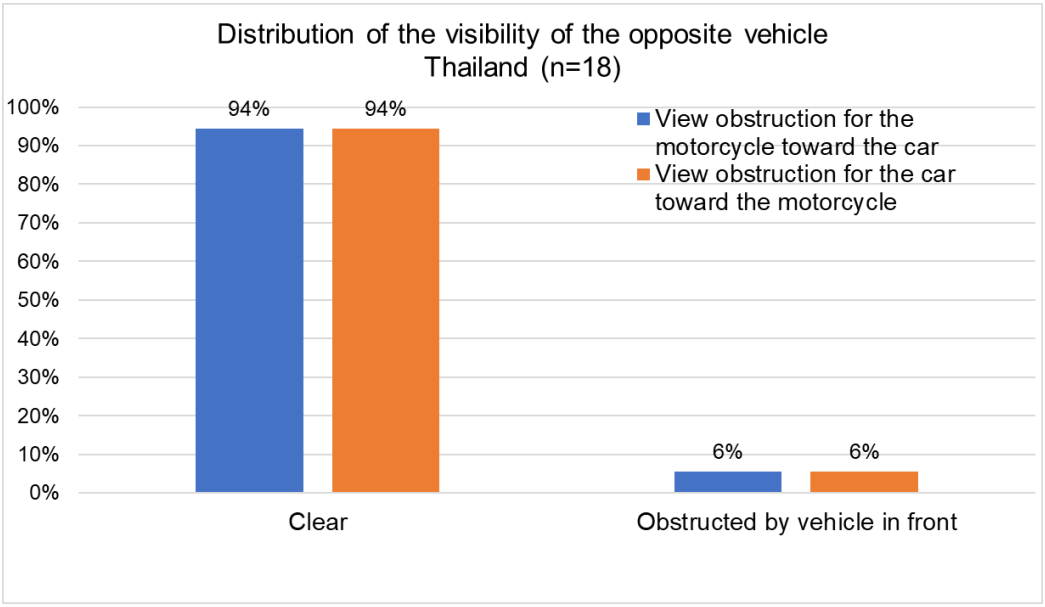
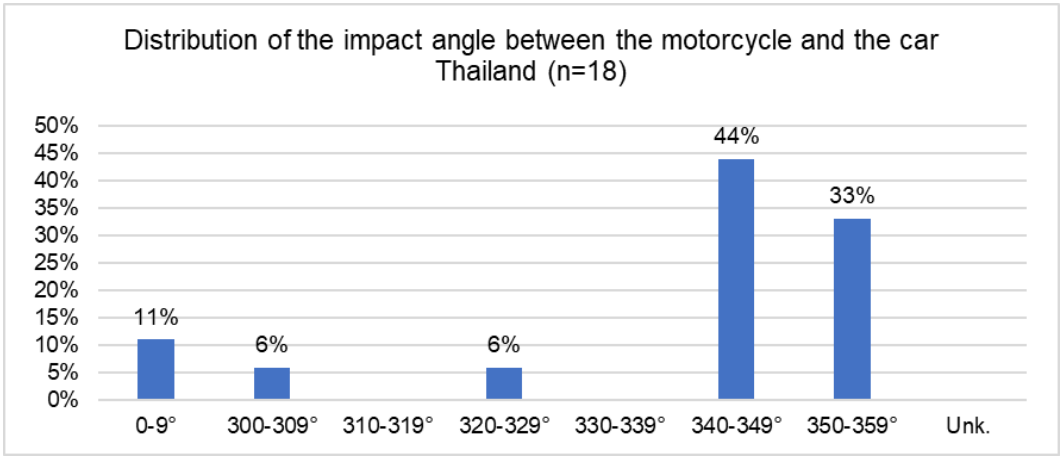


Figure 334: Visibility – Thailand – SIDE-SWIPE 1 SCENARIO

7.2.3.2 Impact angle between the motorcycle and the car



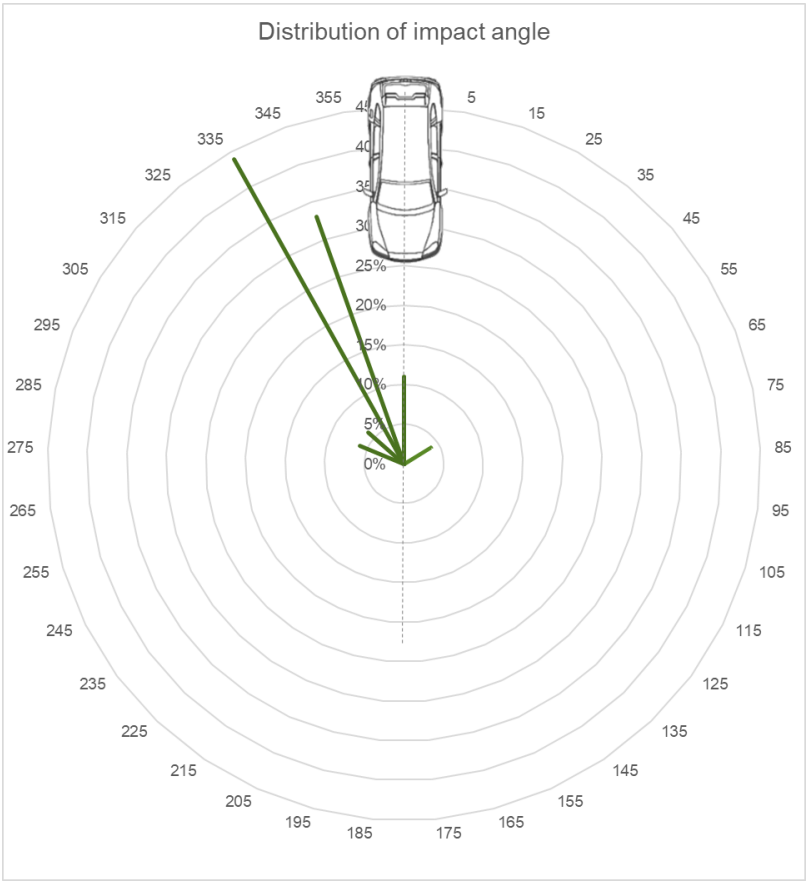


Figure 335: Impact angle – Thailand – SIDE-SWIPE 1 SCENARIO

7.2.3.3 Motorcycle impact type

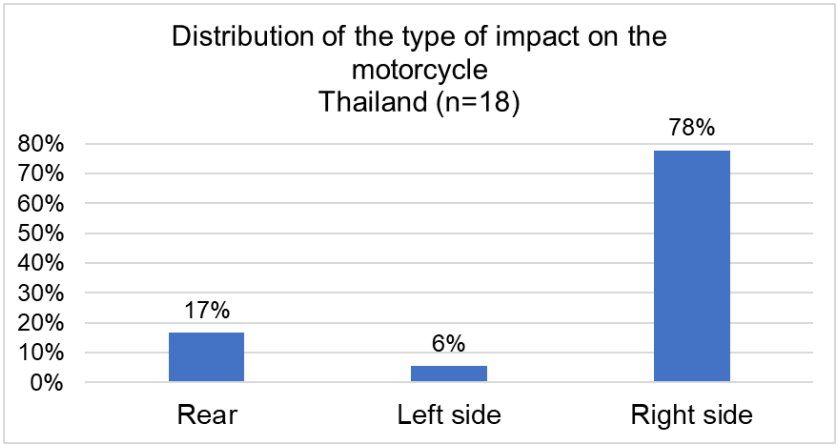


Figure 336: Type of impact for the motorcycle – Thailand – SIDE-SWIPE 1 SCENARIO

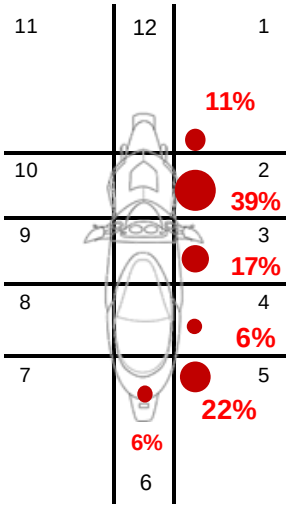


Figure 337: First collision point for the motorcycle – Thailand – SIDE-SWIPE 1 SCENARIO

7.2.3.4 Car impact type

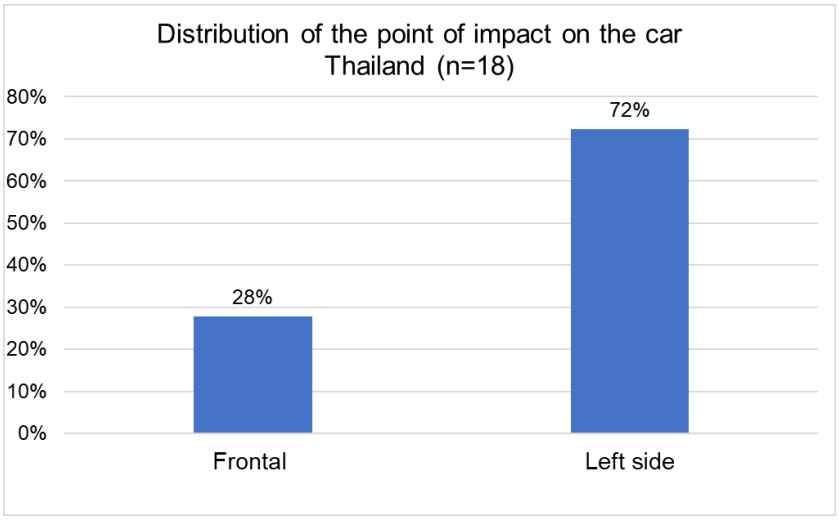


Figure 338: Type of impact for the car– Thailand – SIDE-SWIPE 1 SCENARIO

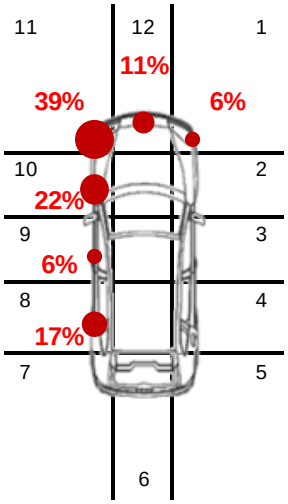


Figure 339: First collision point for the car – Thailand – SIDE-SWIPE 1 SCENARIO

7.2.3.5 Initial speeds

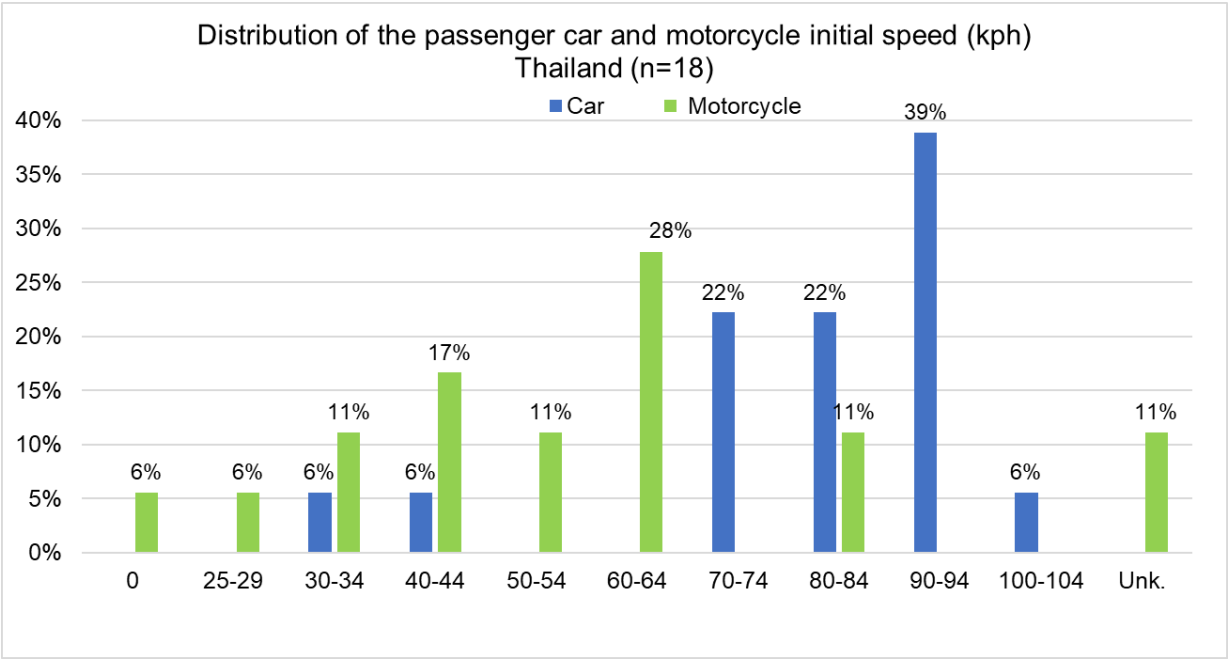


Figure 340: Initial speeds – Thailand – SIDE-SWIPE 1 SCENARIO

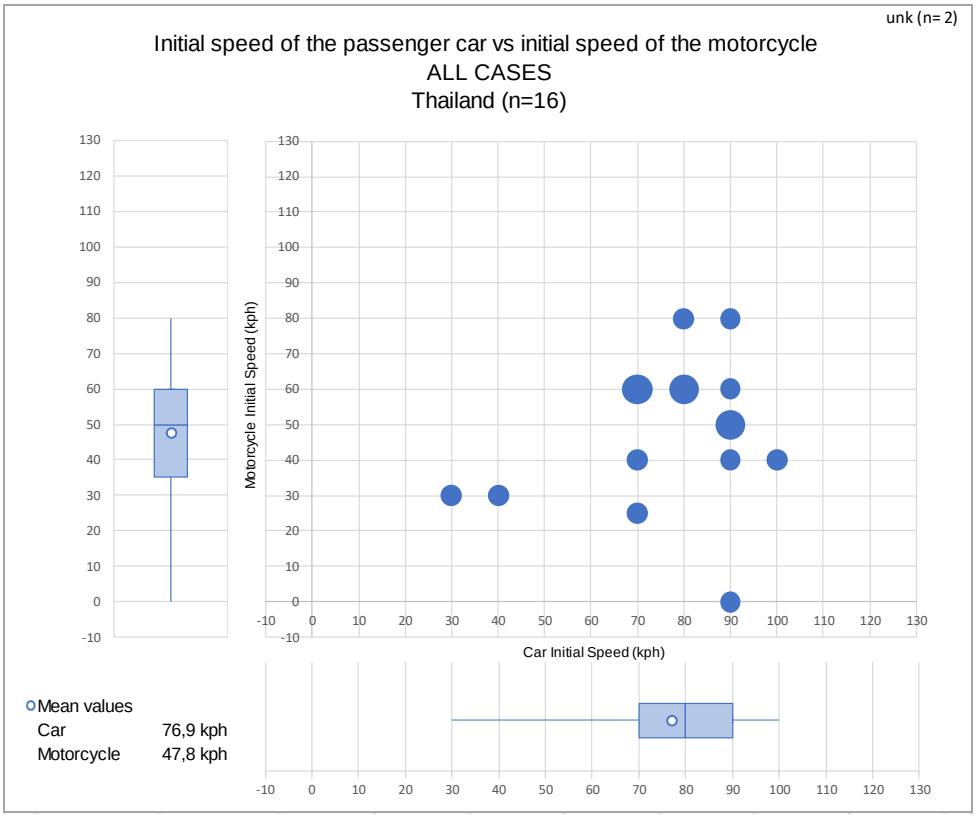


Figure 341: Initial speed of the car versus initial speed of the motorcycle, all cases – Thailand – SIDE-SWIPE 1 SCENARIO

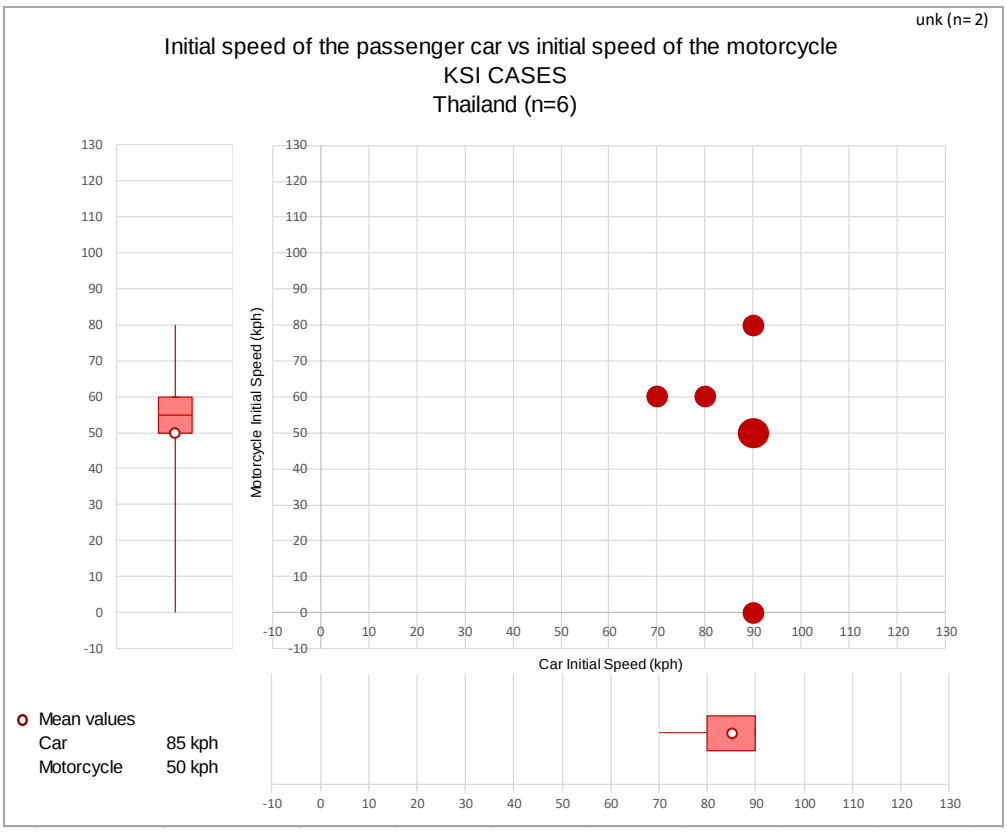


Figure 342: Initial speed of the car versus initial speed of the motorcycle, KSI cases – Thailand – SIDE-SWIPE 1 SCENARIO

Table 85: Initial speed values for the car and the motorcycle, all cases – Thailand – SIDE-SWIPE 1 SCENARIO

All Accidents																									unk:	2
Number of cases	Passenger Car Initial Speed (kph)																									
Motorcycle Initial Speed (kph)	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
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70																										
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80																		1		1						
85																										
90																										
95																										
100																										
105≤																										

Table 86: Initial speed values for the car and the motorcycle, KSI cases – Thailand – SIDE-SWIPE 1 SCENARIO

KSI Accidents																										unk:	2
Number of cases		Passenger Car Initial Speed (kph)																									
		0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Initial Speed (kph)	0																				1						
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	80																				1						
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	95																										
	100																										
	105≤																										

7.2.3.6 Collision speeds

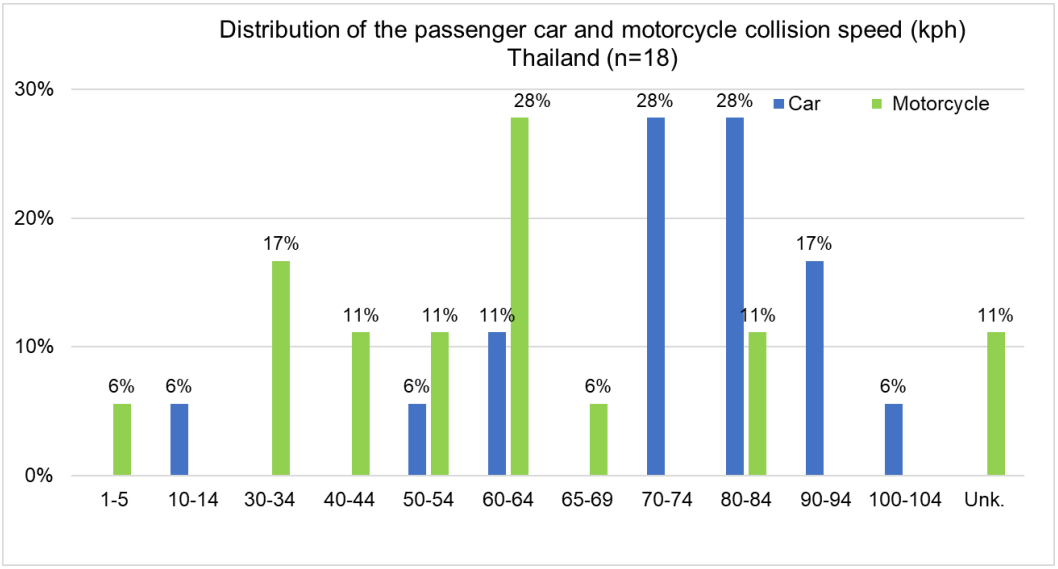

Figure 343: Collision speeds – Thailand – SIDE-SWIPE 1 SCENARIO

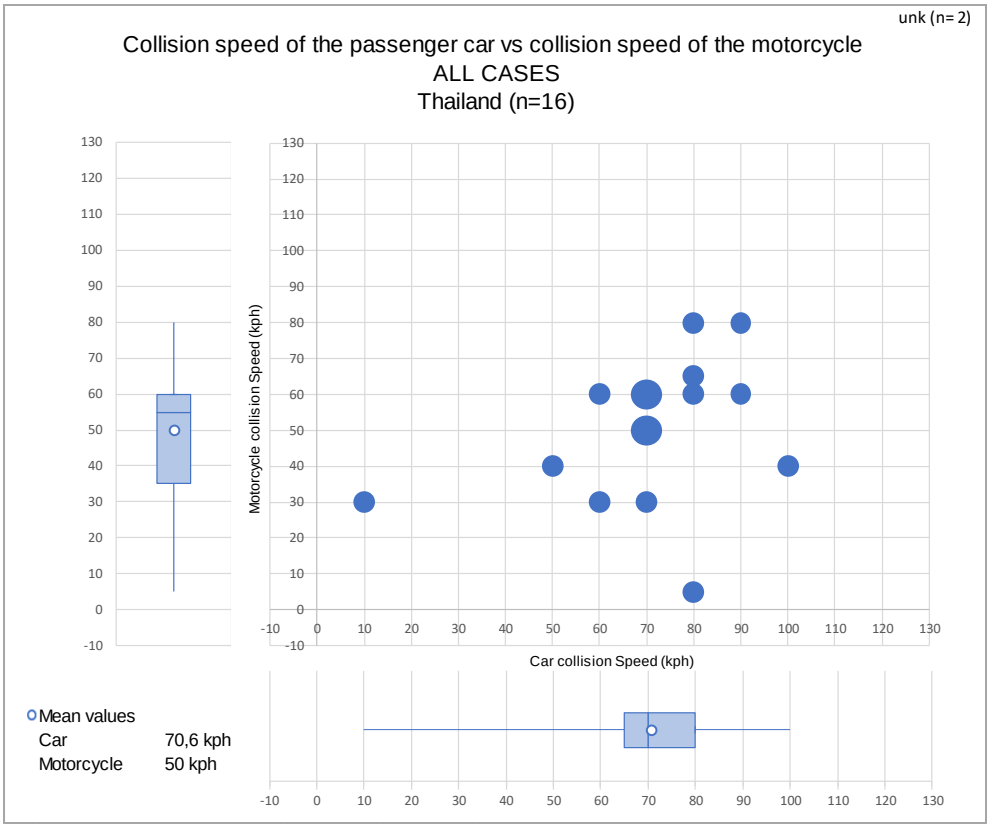

Figure 344: Collision speed of the car versus collision speed of the motorcycle, all cases – Thailand – SIDE-SWIPE 1 SCENARIO

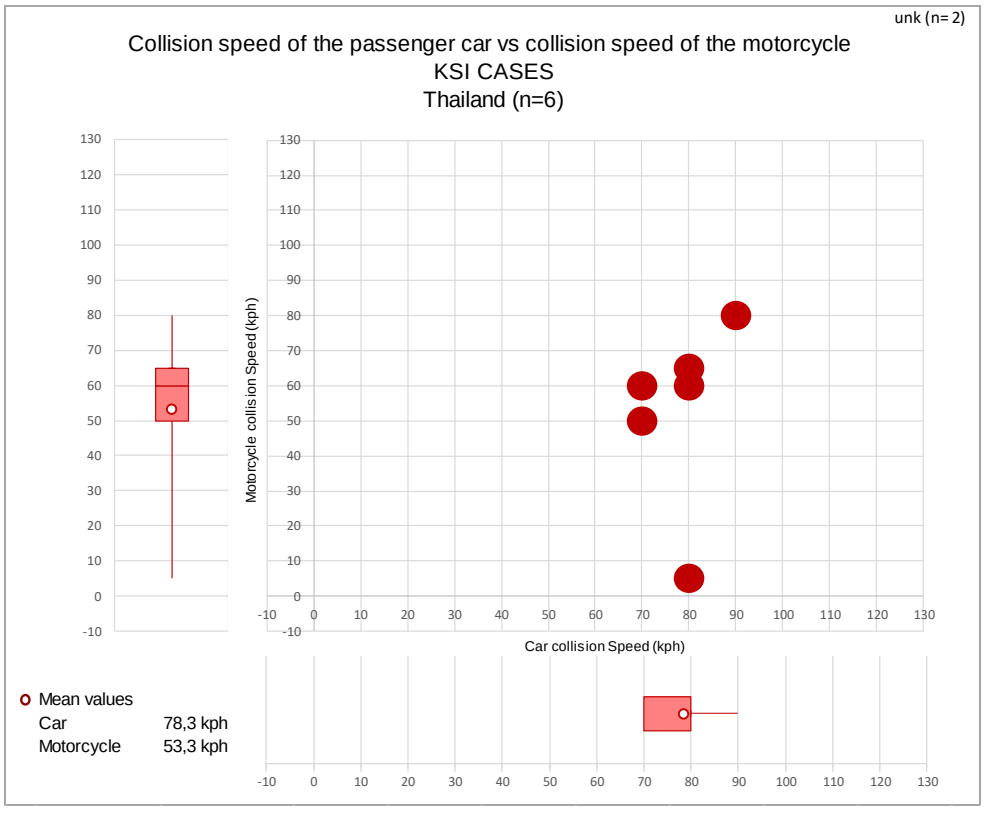

Figure 345: Collision speed of the car versus collision speed of the motorcycle, KSI cases – Thailand – SIDE-SWIPE 1 SCENARIO

Table 87: Collision speed values for the car and the motorcycle, all cases – Thailand – SIDE-SWIPE 1 SCENARIO

All Accidents																											unk:	2
Number of cases	Passenger Car Collision Speed (kph)																											
Motorcycle Collision Speed (kph)	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
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85																										
90																										
95																										
100																										
105≤																										

Table 88: Collision speed values for the car and the motorcycle, KSI cases – Thailand – SIDE SWIPE 1 SCENARIO

KSI Accidents																											unk:	2
Number of cases	Passenger Car Collision Speed (kph)																											
Motorcycle Collision Speed (kph)	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
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105≤																										

7.2.3.7 Delta Initial velocity (kph) – calculated

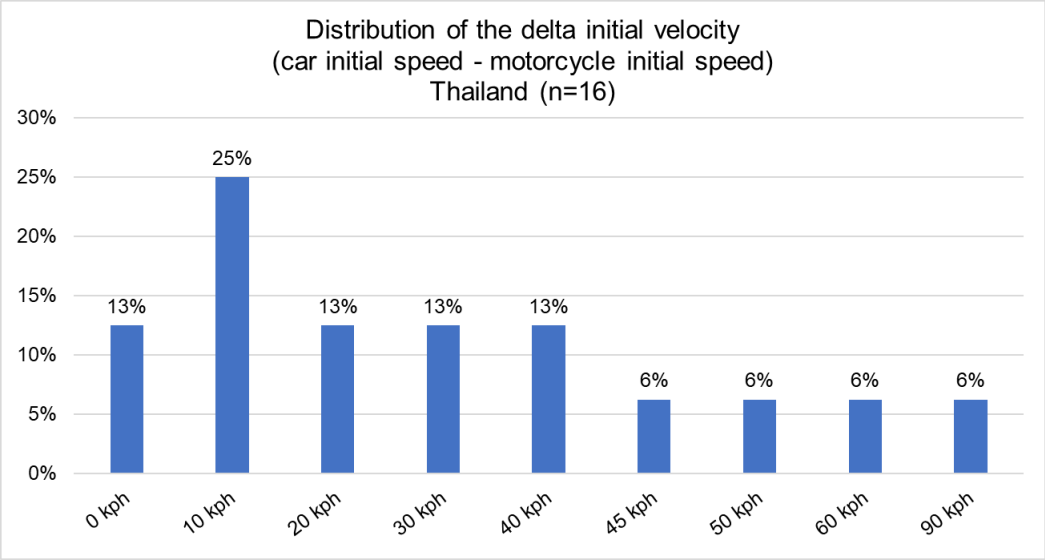


Figure 346: Delta initial velocity (kph) – Thailand – SIDE-SWIPE 1 SCENARIO

7.2.3.8 Skid marks

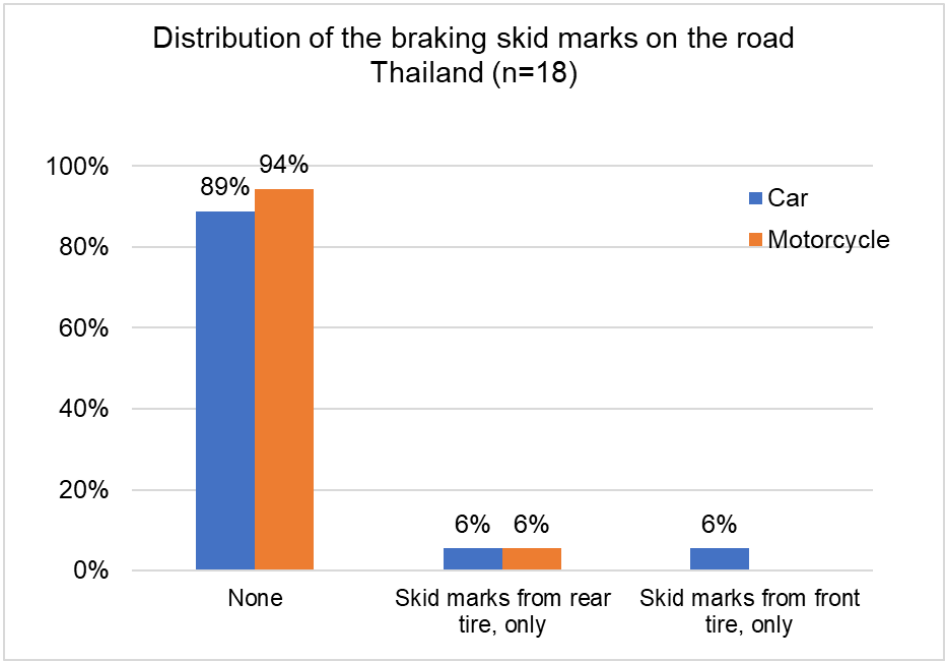


Figure 347: Skid marks – Thailand – SIDE-SWIPE 1 SCENARIO

7.2.3.9 ABS fitment on the car

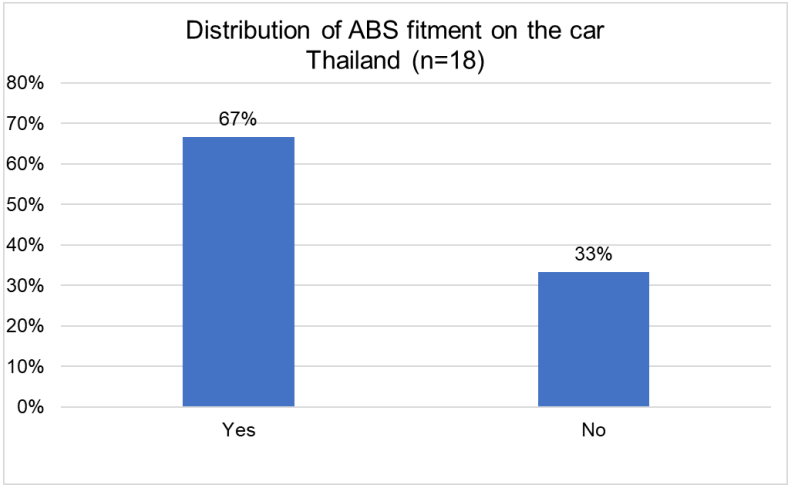


Figure 348: ABS fitment – Thailand – SIDE-SWIPE 1 SCENARIO

7.2.3.10 Motorcycle manoeuvre before crash

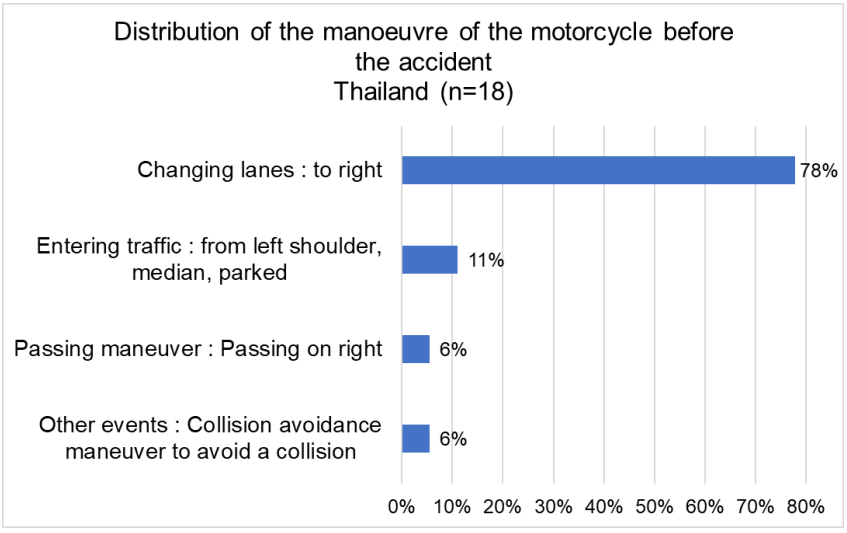


Figure 349: Motorcycle manoeuvre – Thailand – SIDE-SWIPE 1 SCENARIO

7.2.3.11 Car manoeuvre before crash

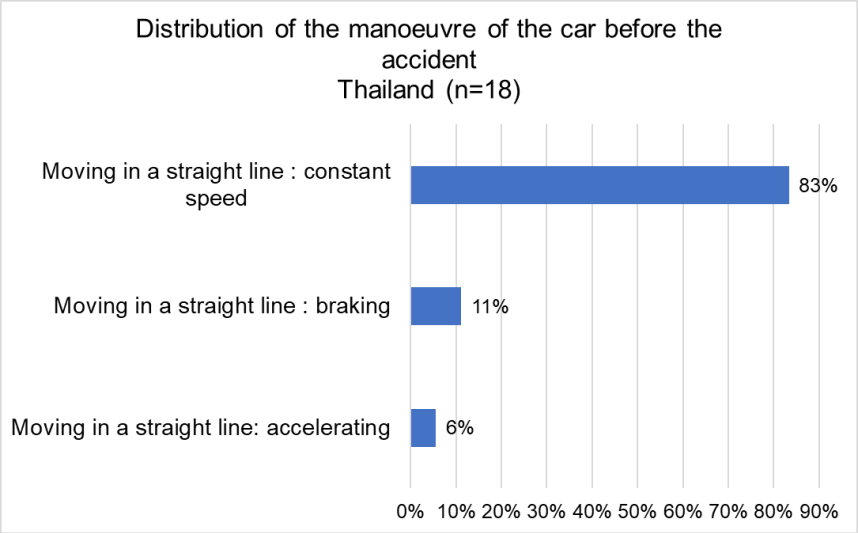


Figure 350: Car manoeuvre – Thailand – SIDE-SWIPE 1 SCENARIO

7.2.3.12 Avoidance action by vehicle

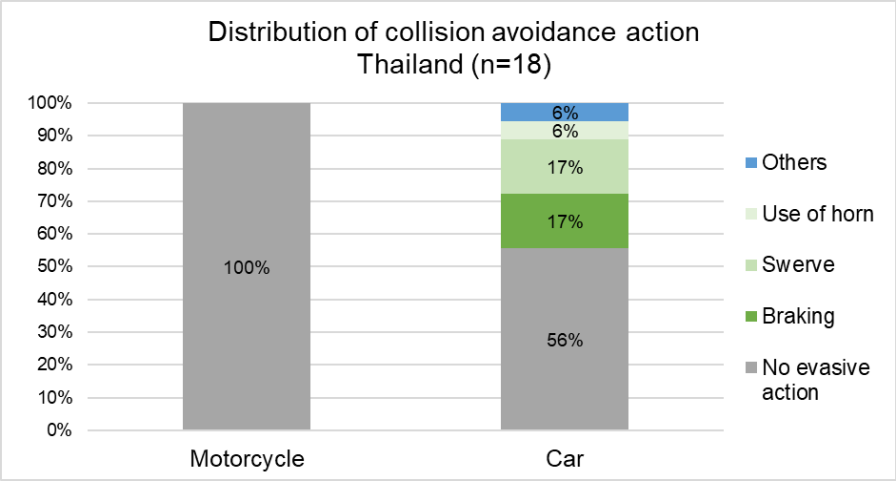


Figure 351: Avoidance action by vehicle – Thailand – SIDE SWIPE 1 SCENARIO

7.2.3.13 Conclusion on accident characteristics

Table 89: Conclusion on accident characteristics – Thailand – SIDE-SWIPE 1 SCENARIO

Accident characteristics	**SIDE-SWIPE 1**	*Thai data*

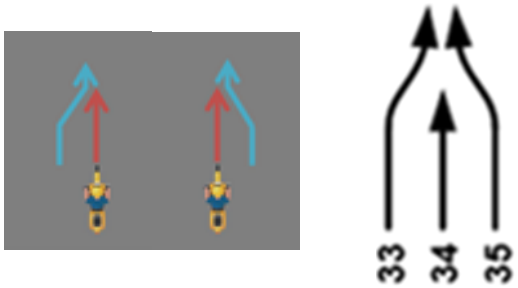
- ✓ *No obstruction visibility for the car and the motorcycle in almost all the cases (94%).*
- ✓ *94% of right side impact for the motorcycle, 83% of left side impact on the car.*
- ✓ *Mean initial speed: Car=76,9 kph and Motorcycle=47,8 kph*
- ✓ *Mean collision speed: Car=70,6 kph and Motorcycle=50 kph*
- ✓ *67% of the car had ABS.*

- ✓ *The motorcycle changes lane to the right in 78% or is entering the traffic from the left shoulder (11%).*
- ✓ *The car is going straight at constant speed (83%) or straight and braking (11%).*
- ✓ *No avoidance action from the motorcycle.*
- ✓ *44% of avoidance action from the car: 17% of them brakes and 17% swerves to the right.*

7.3 Thai database: Car entering the lane of the motorcycle from the left or from the right (Side-swipe 2)

The second side-swipe sub-scenario represents **3,8%** of all the accident and **2%** of the KSI accidents in the Thai database.

In this sub-scenario, the motorcycle is going straight, and the car is changing lane from the right or the left, in the lane of the motorcycle. This configuration is illustrated by the figure below:



(a) (b)
Car=33 or 35
Motorcycle=34

Figure 352: (a) Illustration of the SIDE-SWIPE 2 scenario, (b) pictogram from the Thai database.

The following graphs provide in-depth description of the sub-scenario. It accounts for 24 accidents in the Thai database.

7.3.1 Accident characteristics – general conditions

7.3.1.1 Weather conditions

All accidents in this sub-scenario occur with clear weather conditions.

7.3.1.2 Light conditions

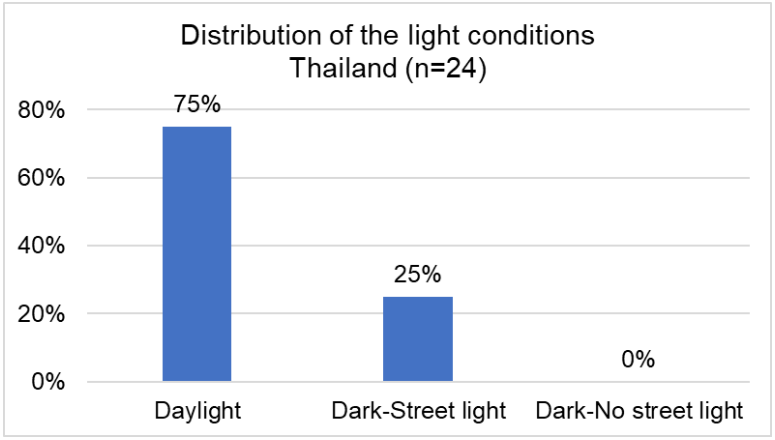


Figure 353: Light conditions - Thailand – SIDE-SWIPE 2 SCENARIO

7.3.1.3 Road surface conditions

All accidents in this sub-scenario happen on a dry road.

7.3.1.4 Conclusion on general accident conditions

Table 90: Conclusion on general accident conditions – Thailand – SIDE-SWIPE 2 SCENARIO

General conditions	**SIDE-SWIPE 2**	*Thai data*
✓ *Clear weather for 100% of the accidents.* ✓ *75% happen during the day (25% at night with streetlights).* ✓ *Dry road surface for 100% of the accidents.*		

The environmental conditions are similar in Thailand and Malaysia based on the databases, with the same proportion of cases occurring during the day, around three quarter.

7.3.2 Road characteristics

7.3.2.1 Location (city / urban)

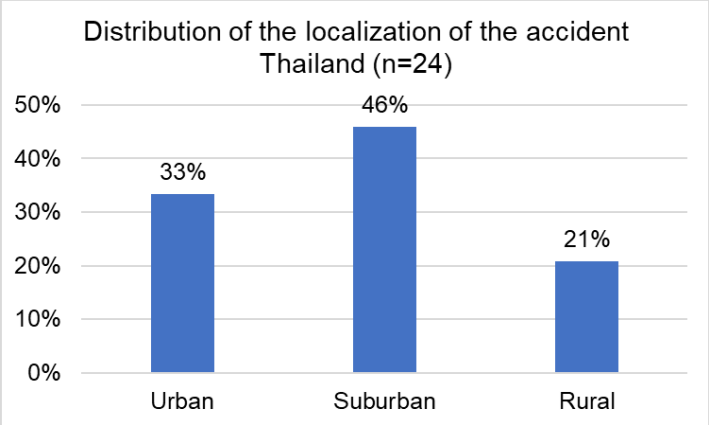


Figure 354: Localization of the accident –Thailand –SIDE-SWIPE 2 SCENARIO

7.3.2.2 Road category

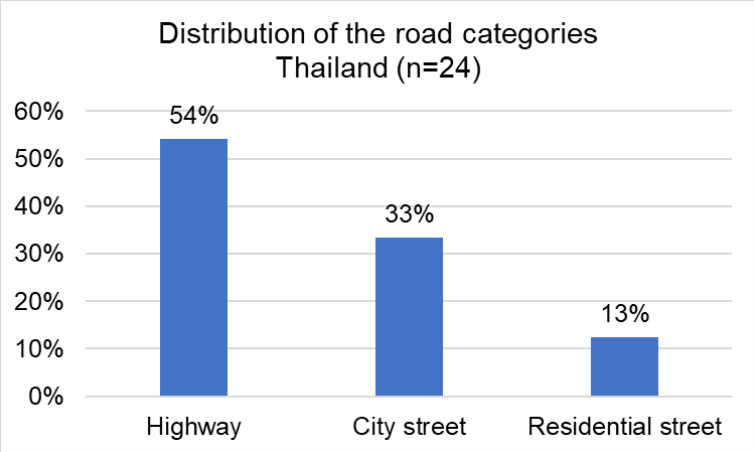
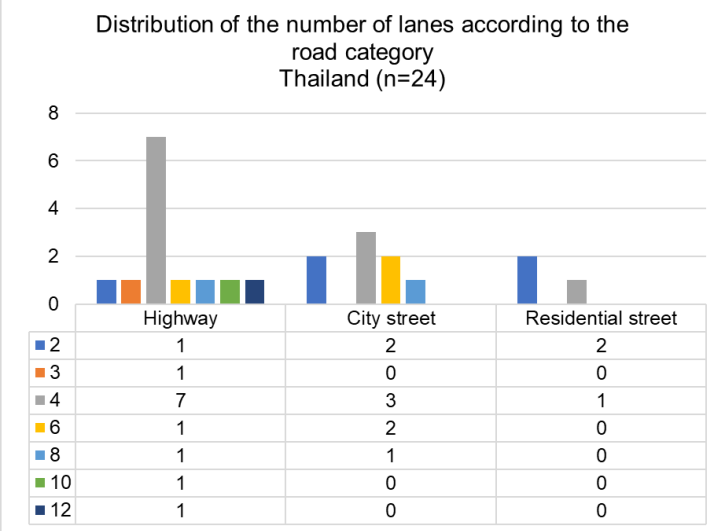


Figure 355: Road category – Thailand – SIDE-SWIPE 2 SCENARIO



	Highway	City street	Residential street
2	1	2	2
3	1	0	0
4	7	3	1
6	1	2	0
8	1	1	0
10	1	0	0
12	1	0	0

Figure 356: Road category and number of lanes – Thailand – SIDE-SWIPE 2 SCENARIO

7.3.2.3 Configuration

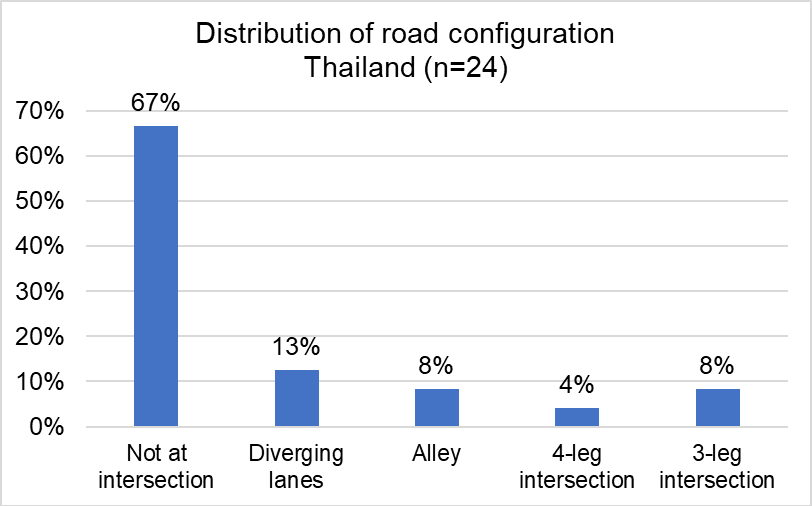


Figure 357: Configuration – Thailand – SIDE-SWIPE 2 SCENARIO

7.3.2.4 Road geometry

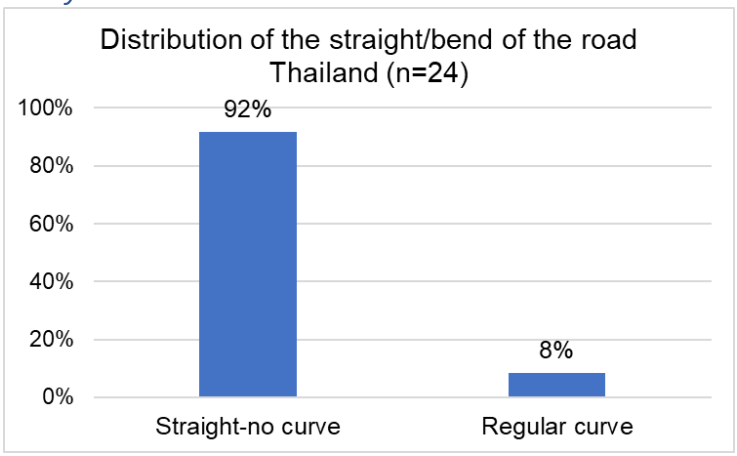


Figure 358: Road geometry – Thailand – SIDE-SWIPE 2 SCENARIO

7.3.2.5 Slope

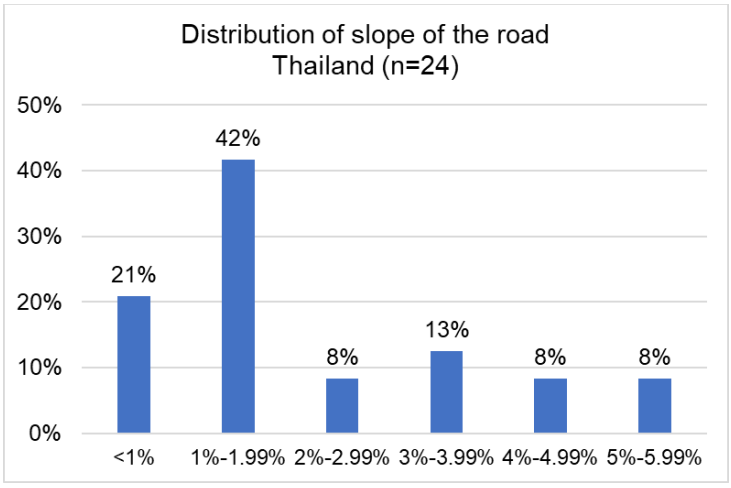


Figure 359: Slop of the road – Thailand – SIDE-SWIPE 2 SCENARIO

7.3.2.6 Speed limit

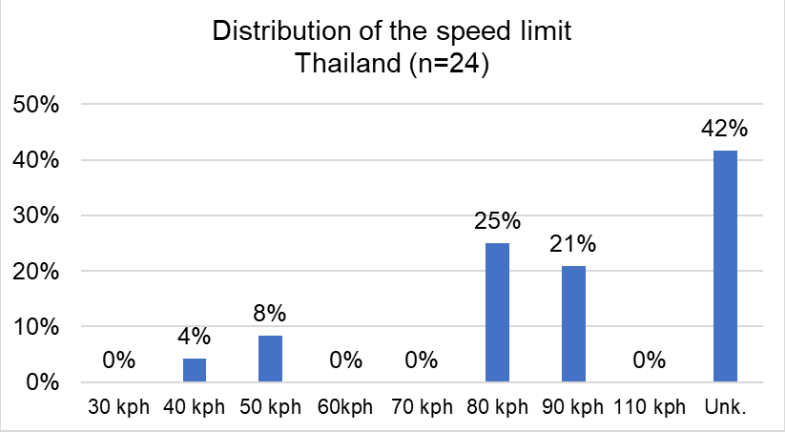


Figure 360: Speed limits – Thailand – SIDE-SWIPE 2 SCENARIO

7.3.2.7 Number of the lane

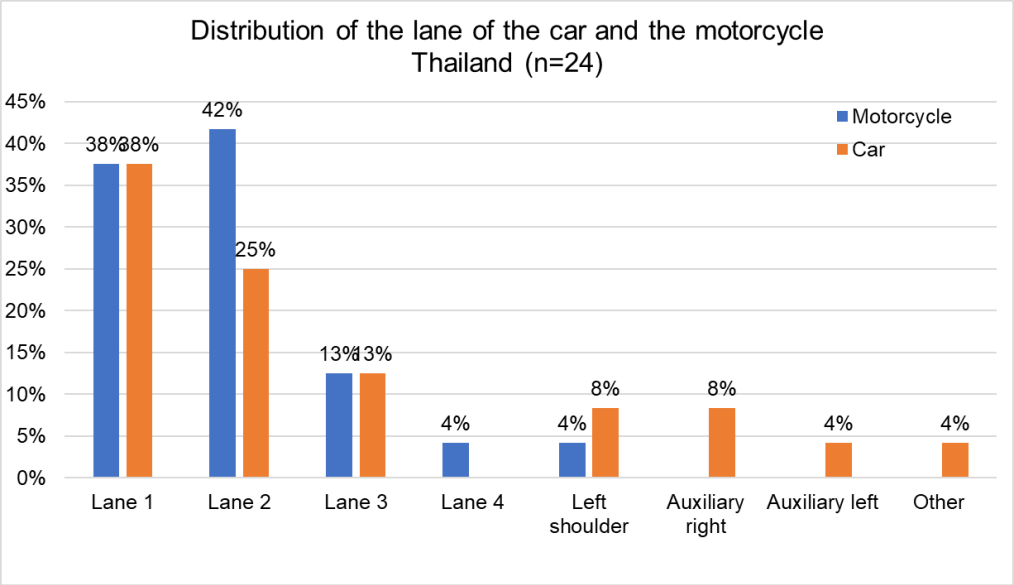
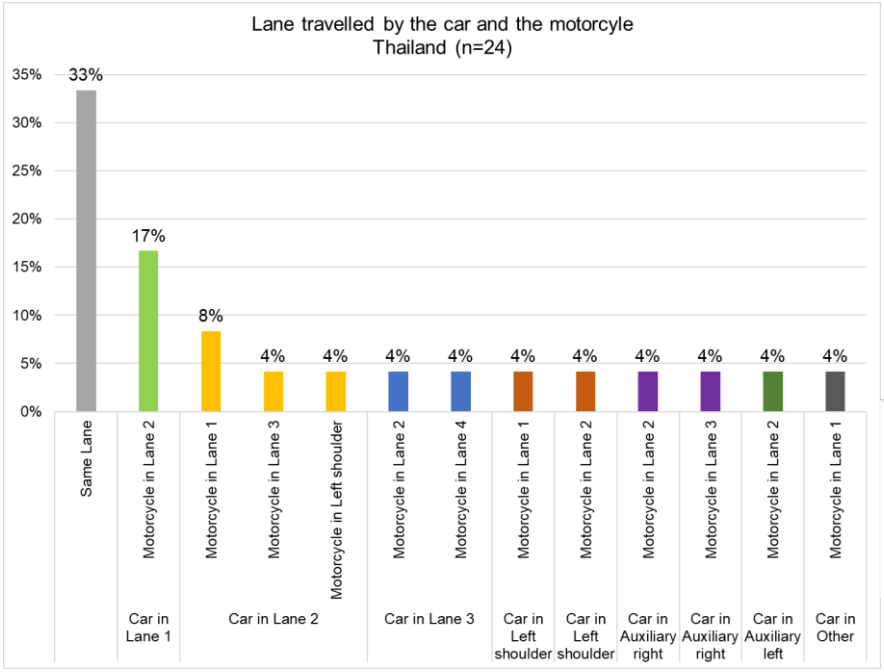


Figure 361: Lanes of the vehicles – Thailand – SIDE-SWIPE 2 SCENARIO

7.3.2.8 Travelled lane



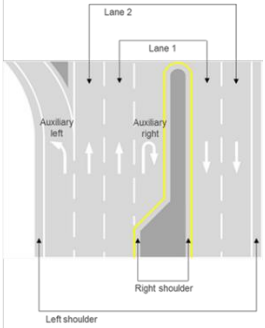


Figure 362: Vehicles on same lane – Thailand – SIDE-SWIPE 2 SCENARIO

7.3.2.9 Conclusion on road characteristics

Table 91: Conclusion on road characteristics – Thailand – SIDE-SWIPE 2 SCENARIO

Road characteristics	**SIDE-SWIPE 2**	*Thai data*

- ✓ *Mostly suburban (46%) and urban (33%) areas.*
- ✓ *54% of the accidents on highway, city street for 33%.*
- ✓ *4 lanes roads.*
- ✓ *67% of the accidents occur out of intersection, in diverging lane for 13%.*
- ✓ *92% of the accidents happen on a straight road.*
- ✓ *Speed limit at 80 kph (25%) and 90 kph (21%), lot of unknown values (42%).*
- ✓ *Vehicles in the same lane (33%) or in adjacent lanes (33%).*

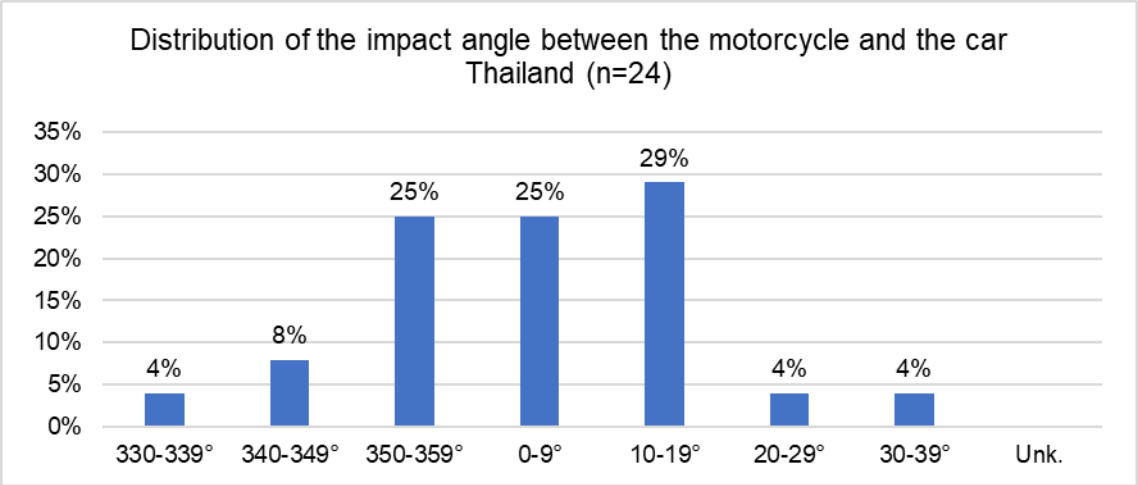
From data observed in both countries, the road configuration is mostly a rural area, on a straight road, out of intersection. One third of the accidents happen on city streets.

7.3.3 Accident characteristics – vehicles

7.3.3.1 Visibility

There is no view obstruction for the car and the motorcycle, in all accidents within this sub-scenario.

7.3.3.2 Impact angle between the motorcycle and the car



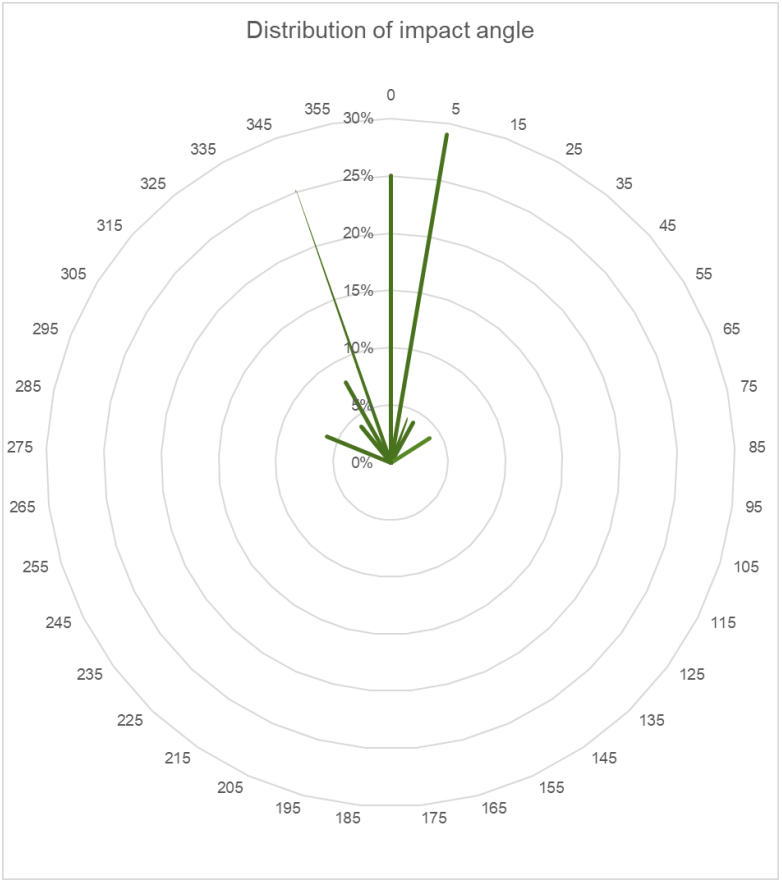


Figure 363: Impact angle – Thailand – SIDE-SWIPE 2 SCENARIO

7.3.3.3 Motorcycle impact type

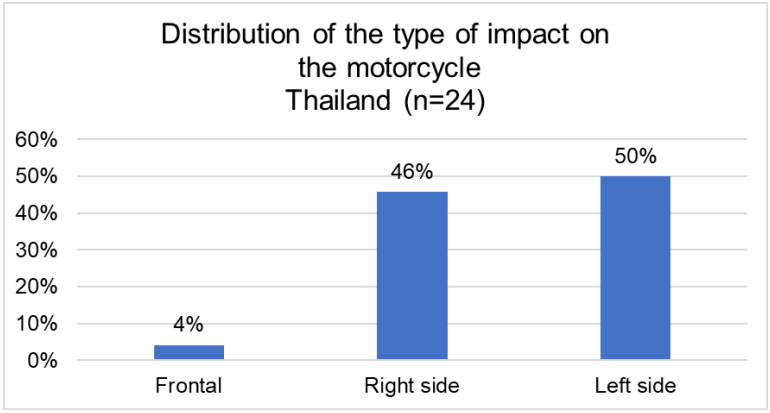


Figure 364: Type of impact for the motorcycle – Thailand – SIDE-SWIPE 2 SCENARIO

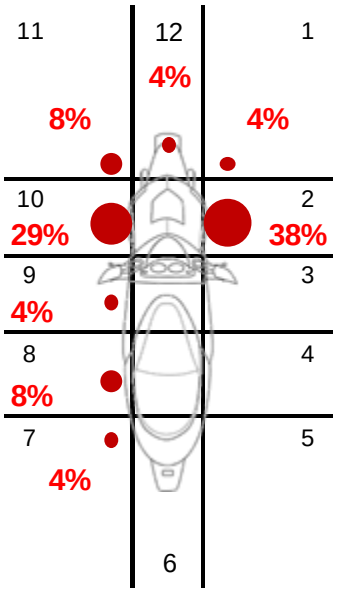


Figure 365: First collision point for the motorcycle – Thailand – SIDE-SWIPE 2 SCENARIO

7.3.3.4 Car impact type

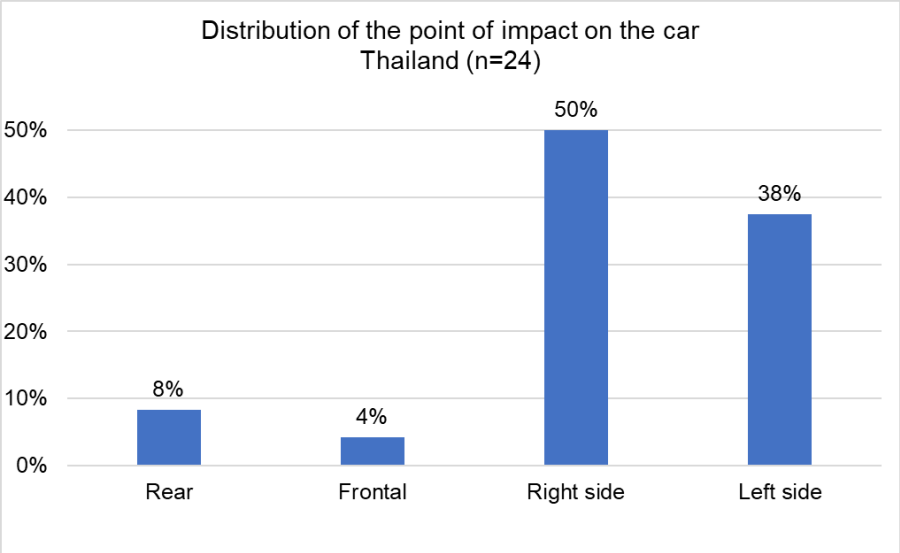


Figure 366: Type of impact for the car– Thailand – SIDE-SWIPE 2 SCENARIO

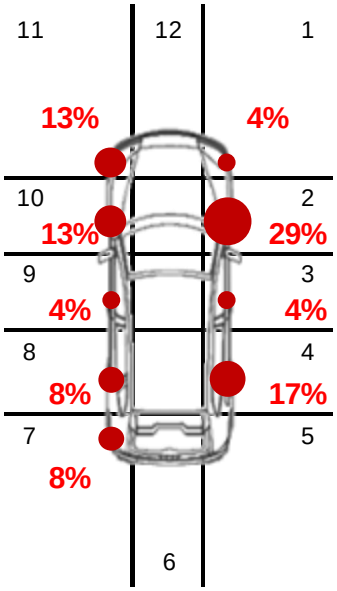


Figure 367: First collision point for the car – Thailand – SIDE-SWIPE 2 SCENARIO

7.3.3.5 Initial speeds

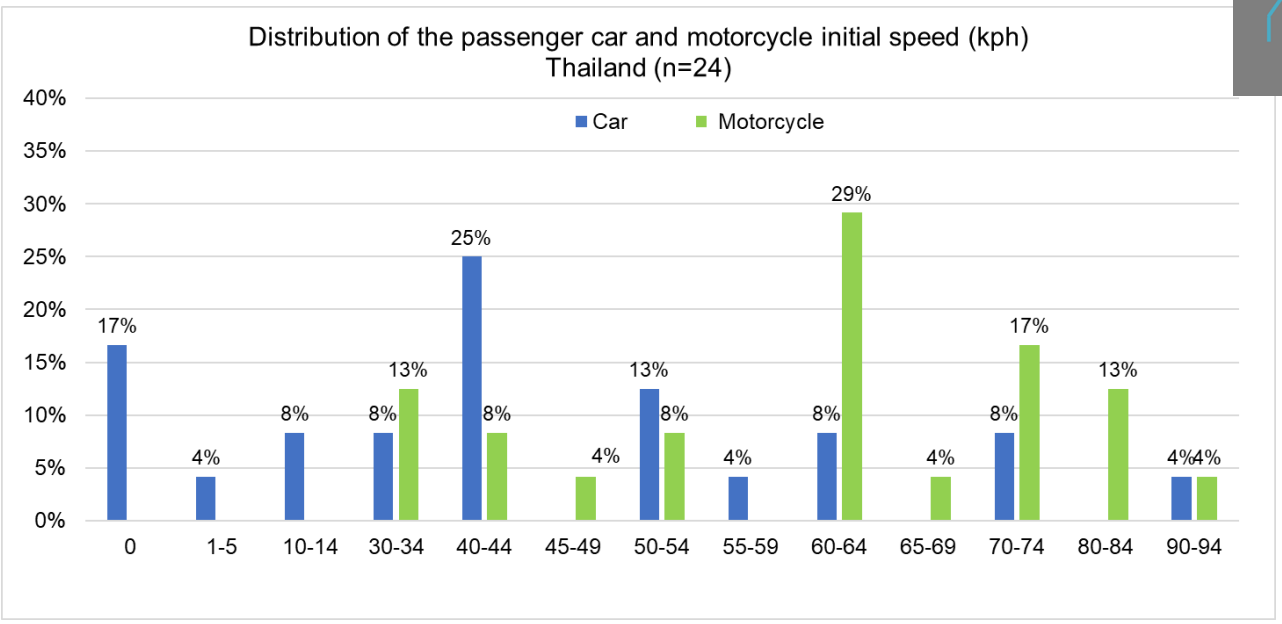


Figure 368: Initial speeds – Thailand – SIDE-SWIPE 2 SCENARIO

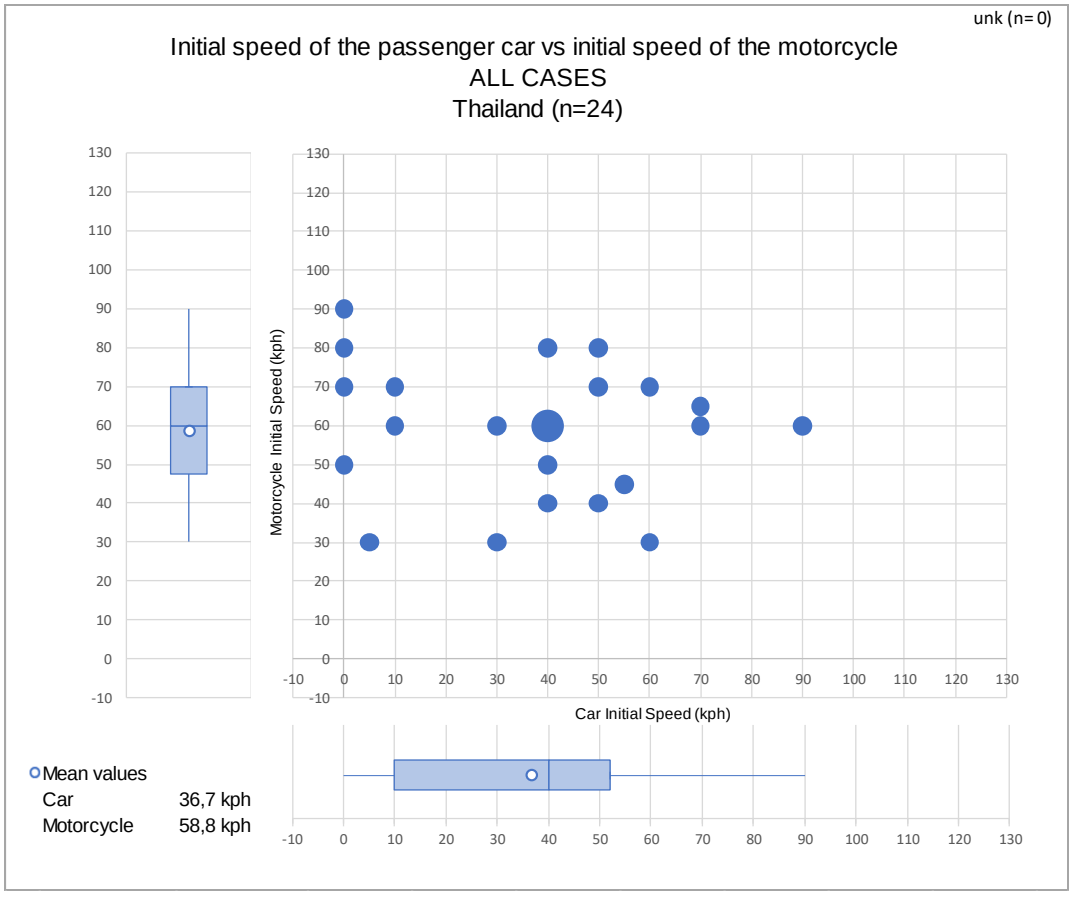


Figure 369: Initial speed of the car versus initial speed of the motorcycle, all cases – Thailand – SIDE-SWIPE 2 SCENARIO

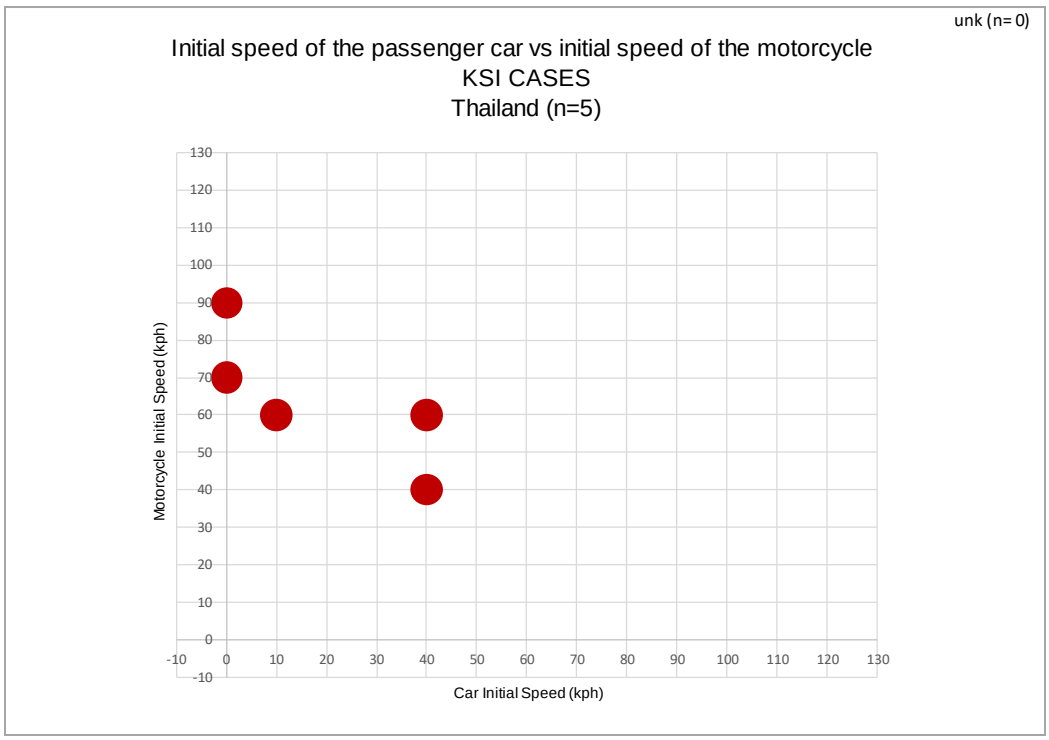


Figure 370: Initial speed of the car versus initial speed of the motorcycle, KSI cases – Thailand – SIDE-SWIPE 2 SCENARIO

Due to small sample size, statistics are not calculated.

Table 92: Initial speed values for the car and the motorcycle, all cases – Thailand – SIDE-SWIPE 2 SCENARIO

All Accidents																										unk: 0
Number of cases	Passenger Car Initial Speed (kph)																									
Motorcycle Initial Speed (kph)	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
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65																1										
70	1			1								1		1												
75																										
80	1									1		1														
85																										
90	1																									
95																										
100																										
105≤																										

Table 93: Initial speed values for the car and the motorcycle, KSI cases – Thailand – SIDE-SWIPE 2 SCENARIO

KSI Accidents																										unk: 0
Number of cases		Passenger Car Initial Speed (kph)																								
		0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Initial Speed (kph)	0																									
	1																									
	5																									
	10																									
	15																									
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	70	1																								
	75																									
	80																									
	85																									
	90	1																								
	95																									
	100																									
	105≤																									

7.3.3.6 Collision speeds

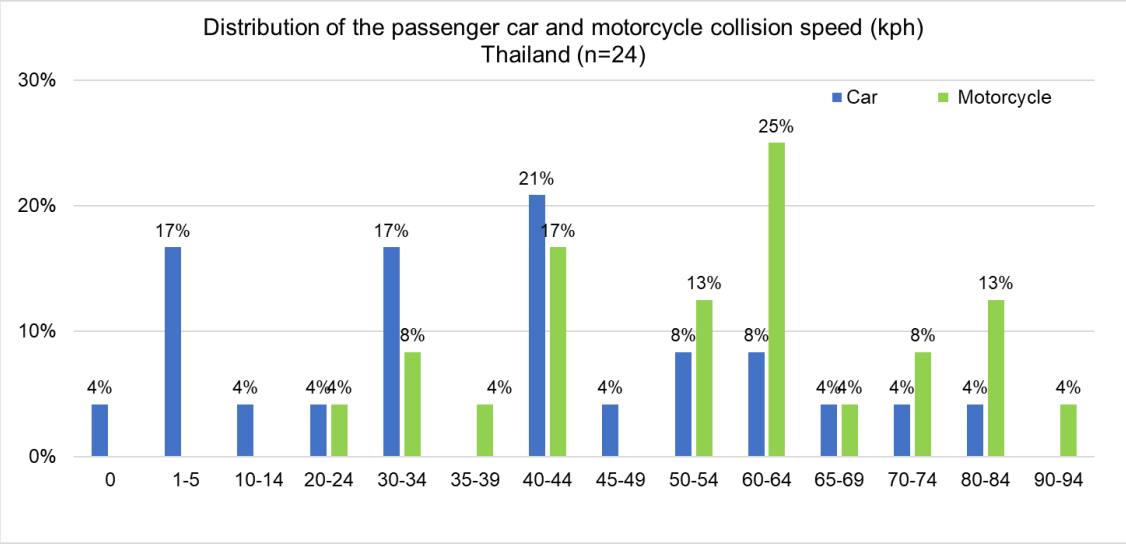

Figure 371: Collision speeds – Thailand – SIDE-SWIPE 2 SCENARIO

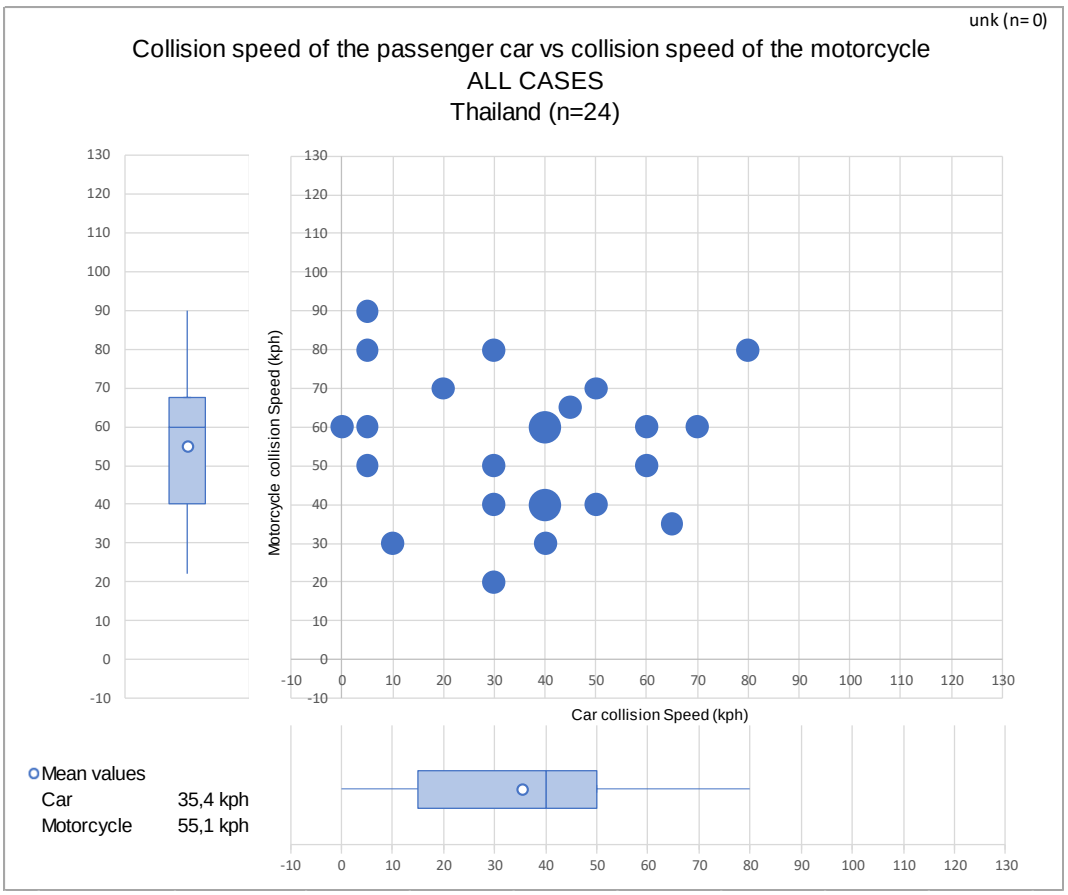

Figure 372: Collision speed of the car versus collision speed of the motorcycle, all cases – Thailand – SIDE-SWIPE 2 SCENARIO

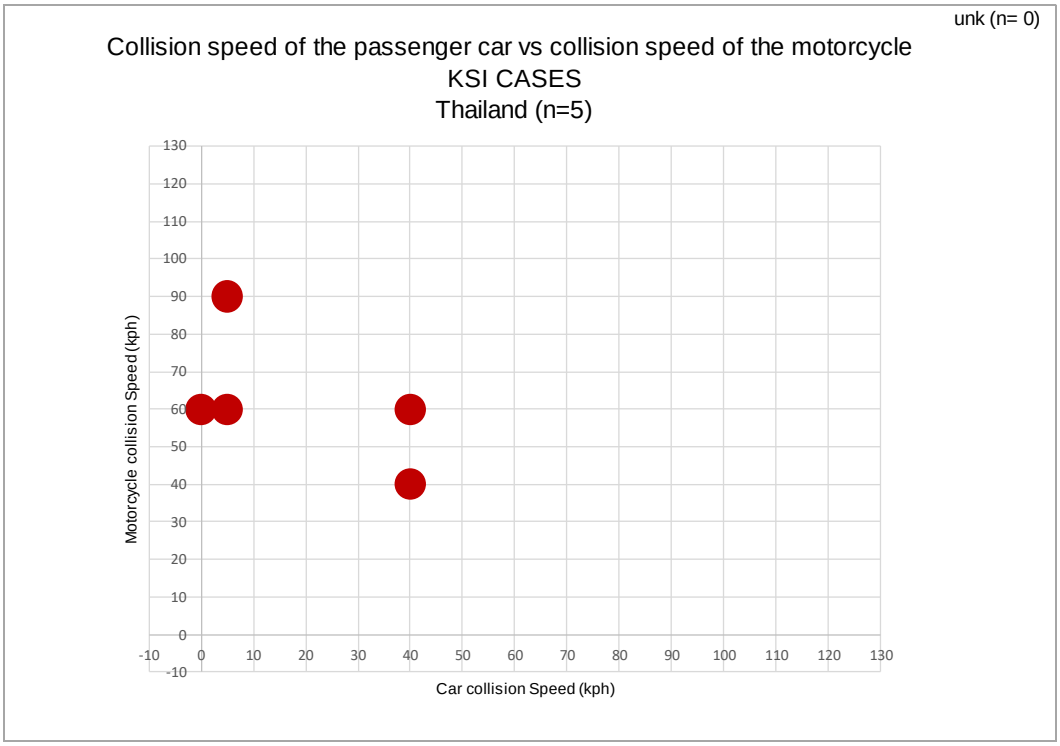

Figure 373: Collision speed of the car versus collision speed of the motorcycle, KSI cases – Thailand – SIDE-SWIPE 2 SCENARIO

Due to small sample size, statistics are not calculated.

Table 94: Collision speeds value for the car and the motorcycle, all cases – Thailand – SIDE-SWIPE 2 SCENARIO

All Accidents																										unk:	0
Number of cases	Passenger Car Collision Speed (kph)																										
	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Collision Speed (kph) 0																										
1																										
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15																										
20								1																		
25																										
30				1						1																
35															1											
40								1		2		1														
45																										
50			1					1						1												
55																										
60	1		1							2				1		1										
65											1															
70						1						1														
75																										
80			1					1										1								
85																										
90			1																							
95																										
100																										
105≤																										

Table 95: Collision speed values for the car and the motorcycle, KSI cases – Thailand SIDE-SWIPE 2 SCENARIO

KSI Accidents																										unk:	0
Number of cases	Passenger Car Collision Speed (kph)																										
	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Collision Speed (kph) 0																										
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75																										
80																										
85																										
90			1																							
95																										
100																										
105≤																										

7.3.3.7 Delta Initial velocity (kph) – calculated

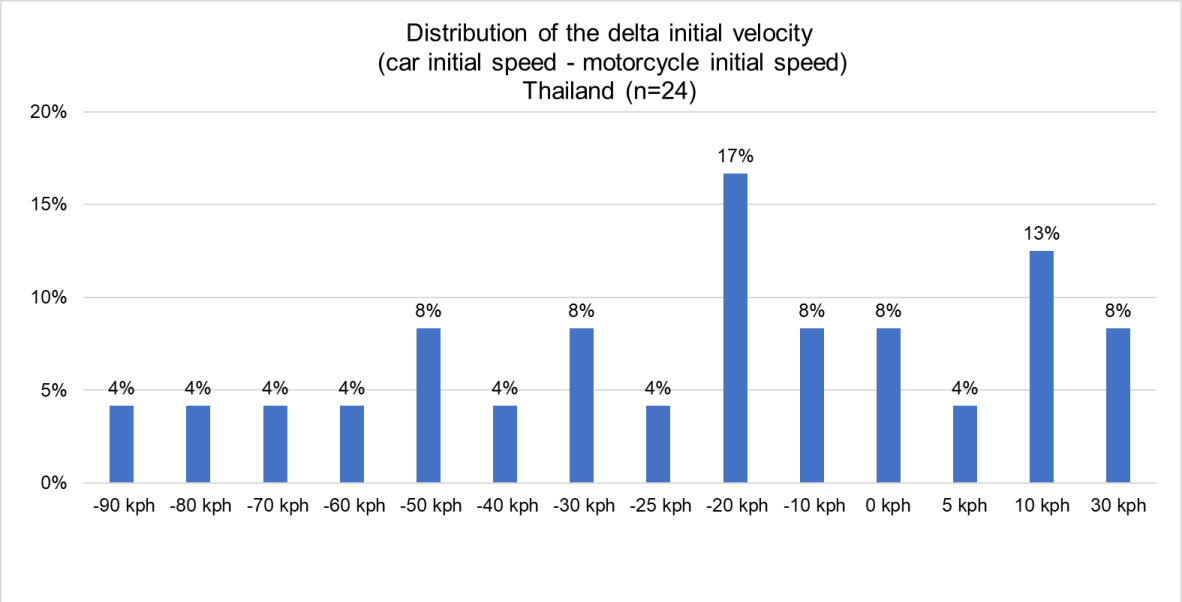


Figure 374: Delta initial velocity (kph) – Thailand –SIDE-SWIPE 2 SCENARIO

7.3.3.8 Skid marks

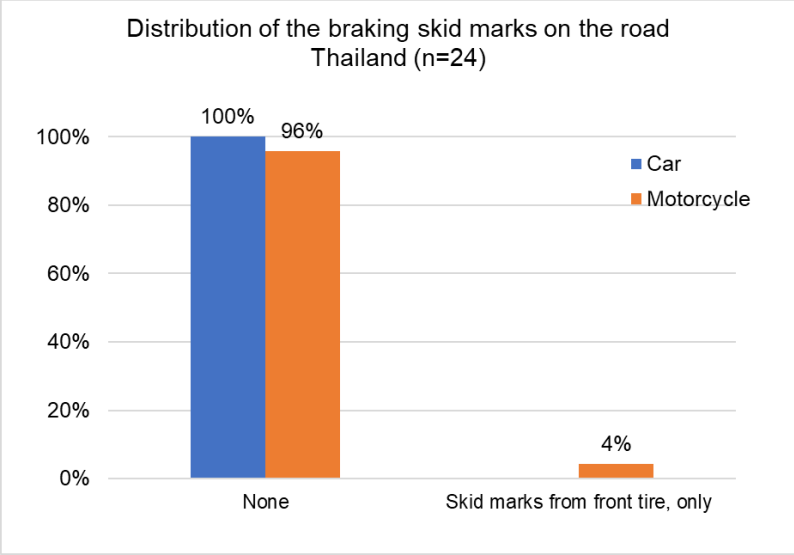


Figure 375: Skid marks – Thailand –SIDE-SWIPE 2 SCENARIO

7.3.3.9 ABS fitment on the car

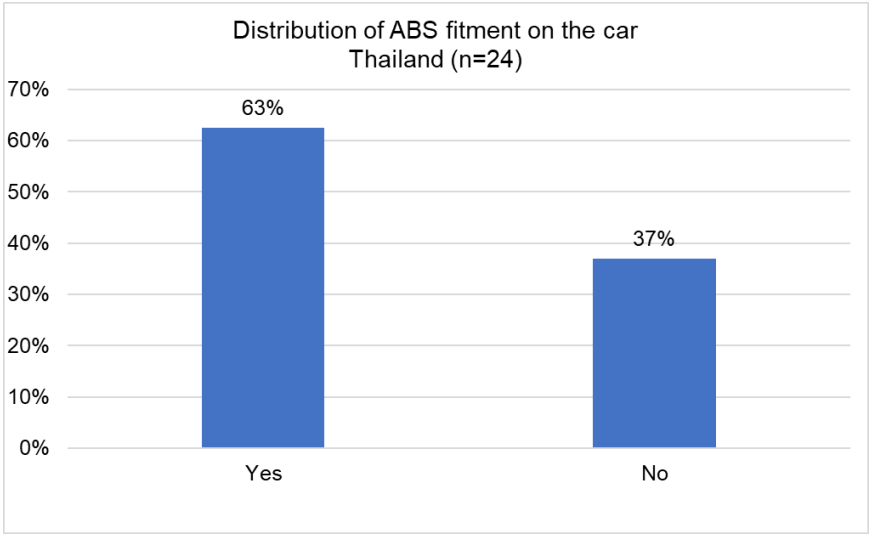


Figure 376: ABS fitment – Thailand – SIDE-SWIPE 2 SCENARIO

7.3.3.10 Motorcycle manoeuvre before crash

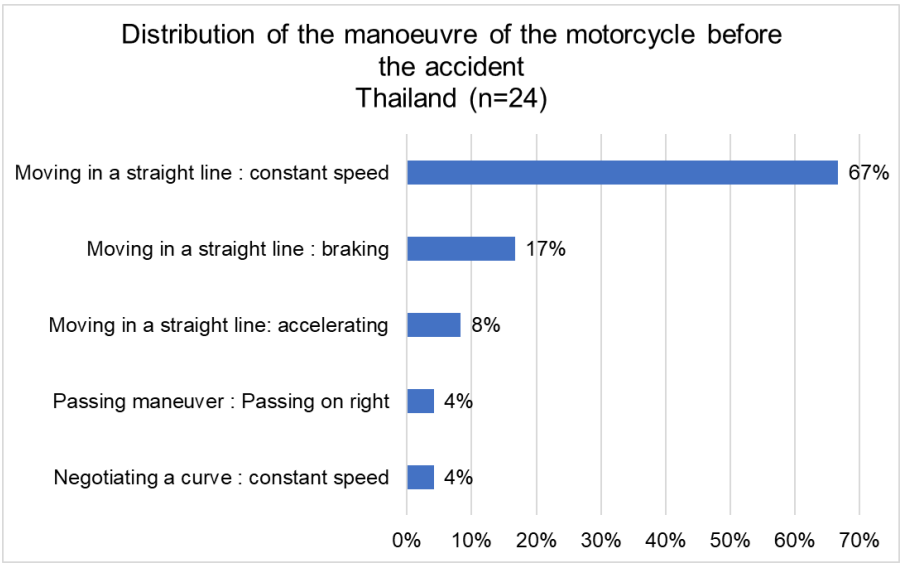


Figure 377: Motorcycle manoeuvre – Thailand – SIDE-SWIPE 2 SCENARIO

7.3.3.11 Car manoeuvre before crash

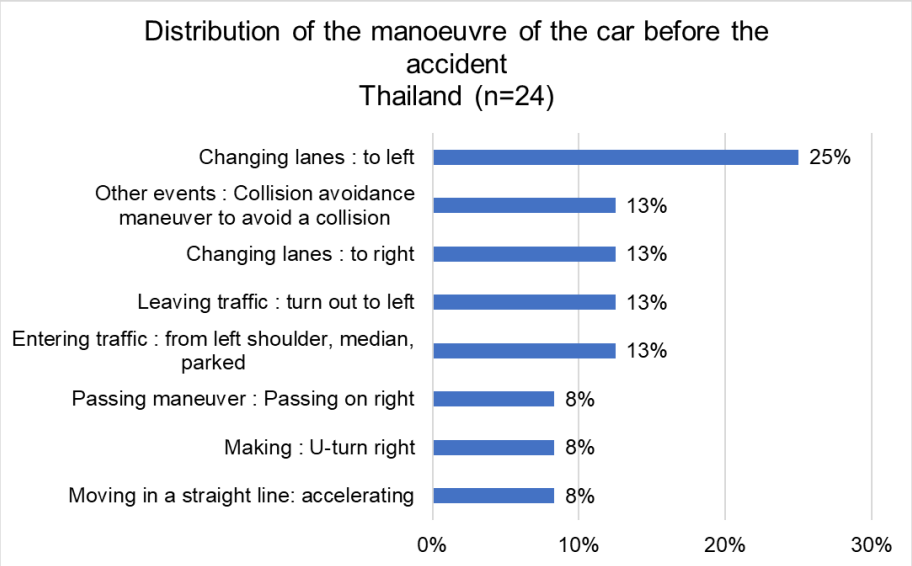


Figure 378: Car manoeuvre – Thailand – SIDE-SWIPE 2 SCENARIO

7.3.3.12 Avoidance action by vehicle

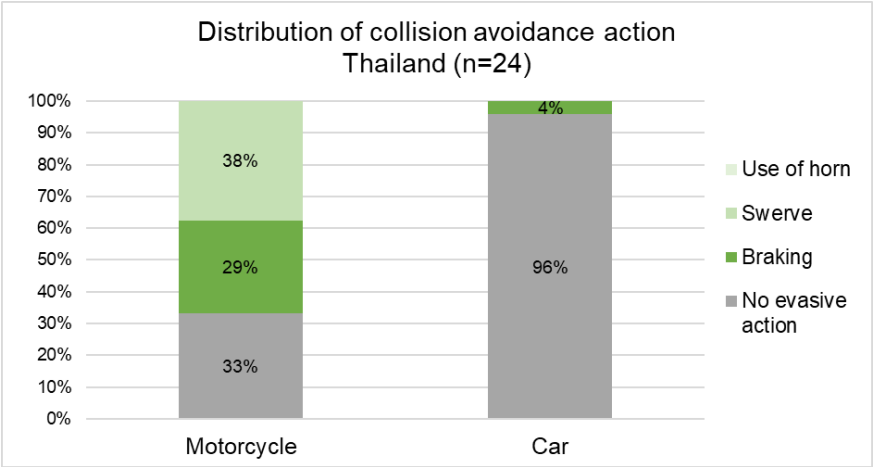


Figure 379: Avoidance action by vehicle – Thailand – SIDE-SWIPE 2 SCENARIO

7.3.3.13 Conclusion on accident characteristics

Table 96: Conclusion on accident characteristics – Thailand – SIDE-SWIPE 2 SCENARIO

Accident characteristics	**SIDE-SWIPE 2**	*Thai data*

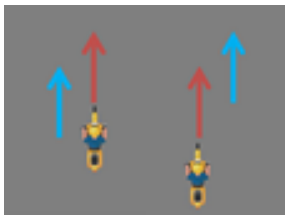
- ✓ *Clear visibility in 100% of the accidents.*
- ✓ *50% of left side impact and 46% of right side impact on the motorcycle.*
- ✓ *38% of left side impact and 50% of right side impact on the car.*
- ✓ *Mean initial speed: Car=36,7 kph and Motorcycle=58,8 kph*

- ✓ *Mean collision speed: Car=35,4 kph and Motorcycle=55,1 kph*
- ✓ *63% of the car had ABS.*
- ✓ *The motorcycle moves at constant speed, straight (67%) or straight and braking (17%) or straight and accelerating (8%).*
- ✓ *The car is changing lane to the left in 25% of the accidents, changing lane to the right in 13%. Also manoeuvre of entering and leaving the traffic.*
- ✓ *No avoidance action from the car.*
- ✓ *Avoidance action from 67% of the motorcycles: 29% braking and 38% swerving.*

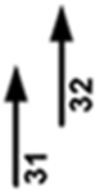
7.4 Thai database: Car and motorcycle going straight in same direction (Side-swipe 3)

The third OASIM side-swipe sub-scenario represents **2,8%** of all the accidents and **1,6%** of the KSI accidents in the Thai database.

In this sub-scenario, the car and the motorcycle are going straight, on the same direction, and collide with their sides. This configuration is illustrated by the figure below:



(a)



(b)
Car=31 or 32
Motorcycle=31 or 32

Figure 380: (a) Illustration of the SIDE-SWIPE 3 scenario, (b) pictogram from the Thai database.

The following graphs provide in-depth description of the scenario. It accounts for 10 cases in the Thai database.

7.4.1 Accident characteristics – general conditions

7.4.1.1 Weather conditions

All accidents of this sub-scenario occur with clear weather conditions.

7.4.1.2 Light conditions

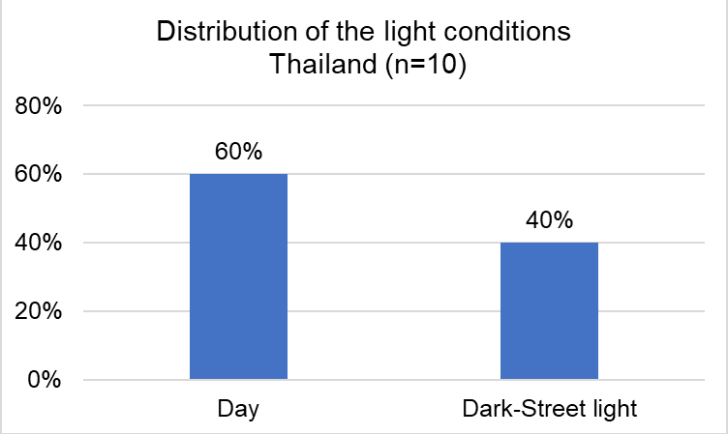


Figure 381: Light conditions - Thailand – SIDE-SWIPE 3 SCENARIO

7.4.1.3 Road surface conditions

All accidents of this sub-scenario occur on a dry road.

7.4.1.4 Conclusion on general accident conditions

Table 97: Conclusion on general accident conditions – Thailand – SIDE-SWIPE 3 SCENARIO

General conditions	**SIDE-SWIPE 3**	*Thai data*

- ✓ *Clear weather for all accidents.*
- ✓ *60% of the accidents happen during the day (40% at night with streetlights).*
- ✓ *Dry road surface for all accidents*

From the data observed with the Thai database, the proportion of accidents that happened in night condition is slightly higher that from Malaysian database.

7.4.2 Road characteristics

7.4.2.1 Location (city / urban)

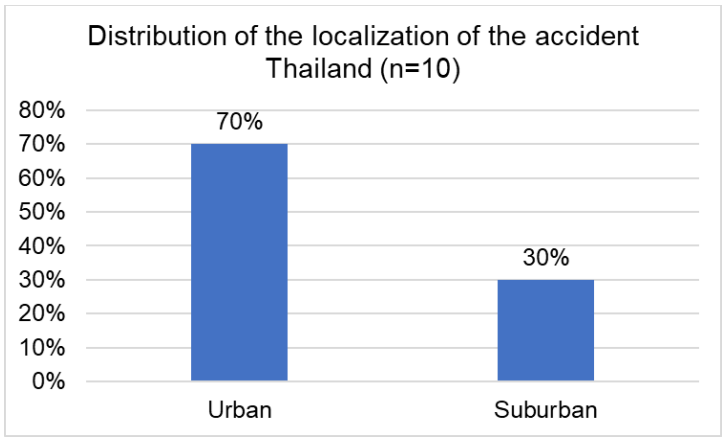


Figure 382: Localization of the accident –Thailand – SIDE-SWIPE 3 SCENARIO

7.4.2.2 Road category

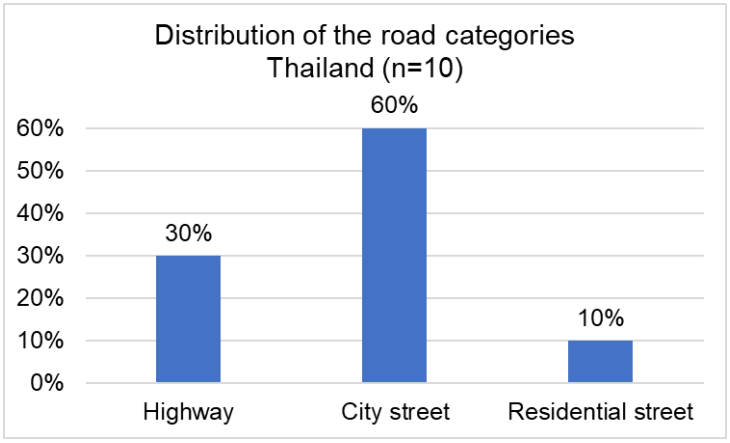


Figure 383: Road category – Thailand – SIDE-SWIPE 3 SCENARIO

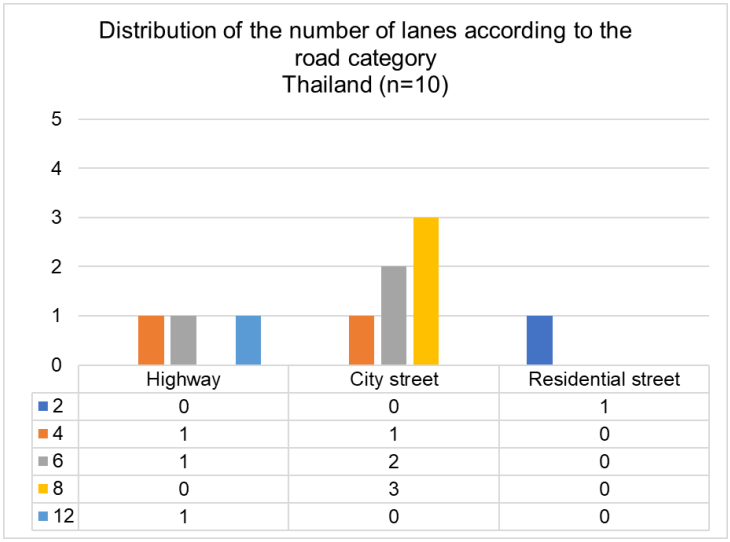


Figure 384: Road category and number of lanes – Thailand – SIDE-SWIPE 3 SCENARIO

7.4.2.3 Configuration

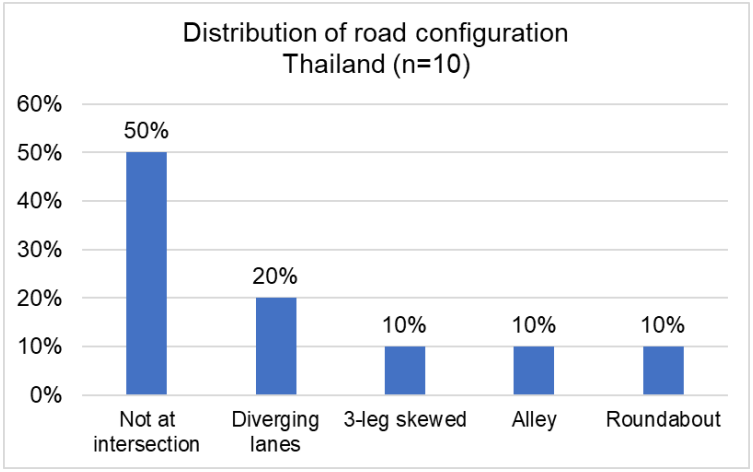


Figure 385: Configuration – Thailand – SIDE-SWIPE 3 SCENARIO

7.4.2.4 Road geometry

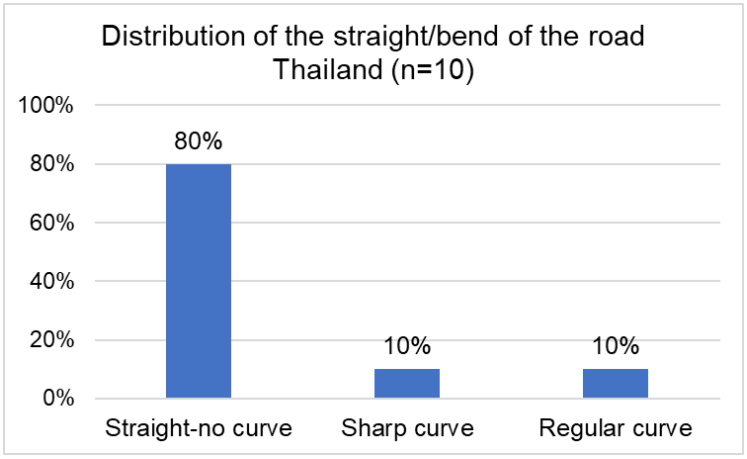


Figure 386: Road geometry – Thailand – SIDE-SWIPE 3 SCENARIO

7.4.2.5 Slope

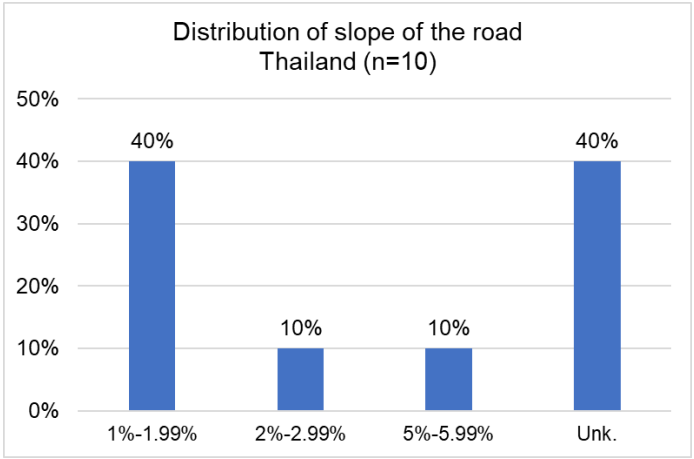


Figure 387: Slop of the road – Thailand – SIDE-SWIPE 3 SCENARIO

7.4.2.6 Speed limit

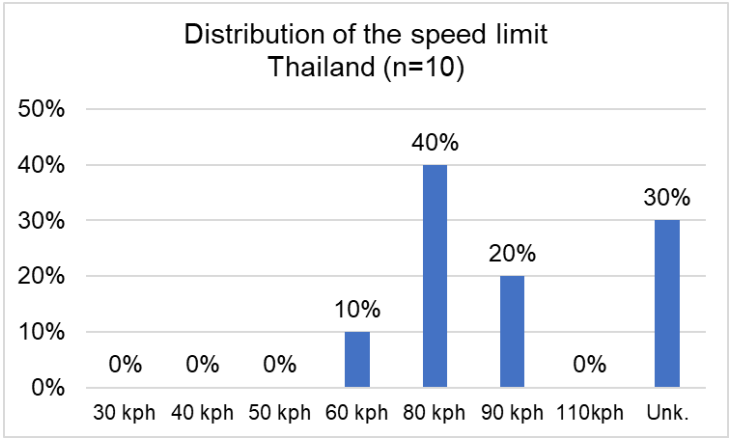


Figure 388: Speed limits – Thailand – SIDE-SWIPE 3 SCENARIO

7.4.2.7 Number of the lane

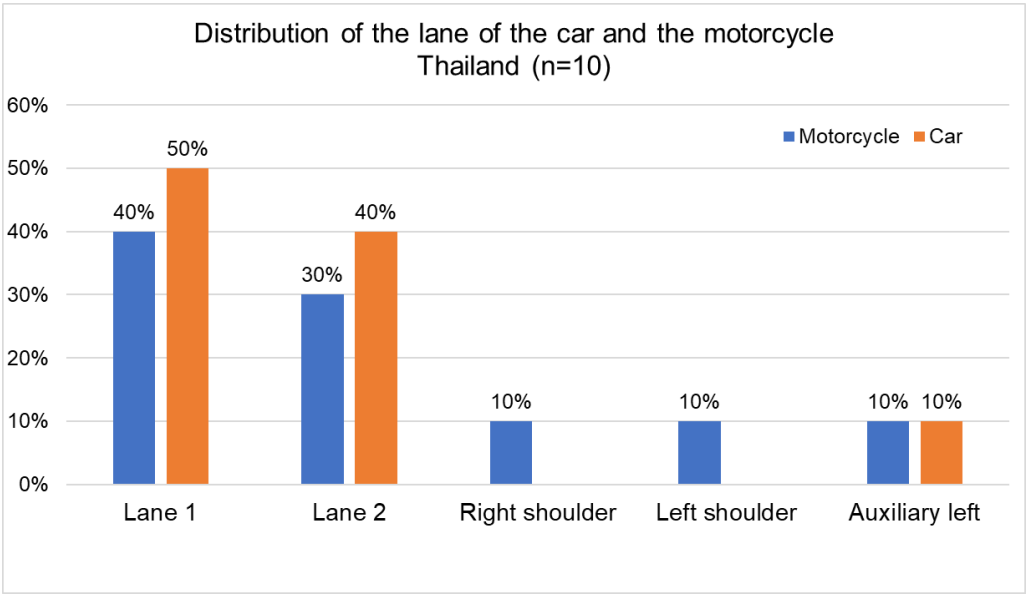


Figure 389: Lanes of the vehicles – Thailand – SIDE-SWIPE 3 SCENARIO

7.4.2.8 Travelled lane

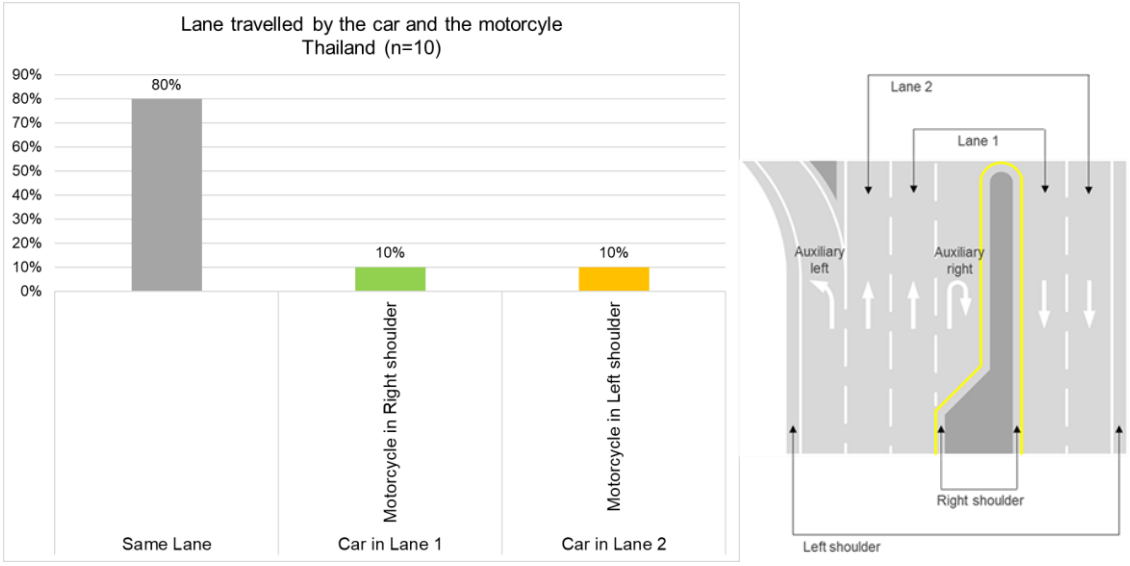


Figure 390: Vehicles on same lane – Thailand – SIDE-SWIPE 3 SCENARIO

7.4.2.9 Conclusion on road characteristics

Table 98: Conclusion on road characteristics – Thailand – SIDE-SWIPE 3 SCENARIO

Road characteristics	**SIDE-SWIPE 3**	*Thai data*

- ✓ *Mostly urban (70%) and suburban (30%) areas.*
- ✓ *Residential and city street for 70% of the accidents and 30% on highway.*
- ✓ *4-8 lanes roads.*
- ✓ *50% of the accidents are out of intersection, 20% in diverging lanes.*
- ✓ *80% of the accidents happen in a straight road.*
- ✓ *Speed limit at 80 kph (40%) and 90 kph (20%), lot of unknown values.*
- ✓ *80% of the vehicles were in the same lane, and 20% of the cases with motorcycles in adjacent shoulder.*

For this sub-scenario, the conclusion is different from Malaysia and Thai (it is may be due to the very small sample size of this sub-scenario in the Thai database). Indeed, from Thai data, this configuration happened mostly in urban area whereas it occurred in rural area from Malaysian data. However, its shows similar road configuration with most of the accidents happening out of intersection.

7.4.3 Accident characteristics – vehicles

7.4.3.1 Visibility

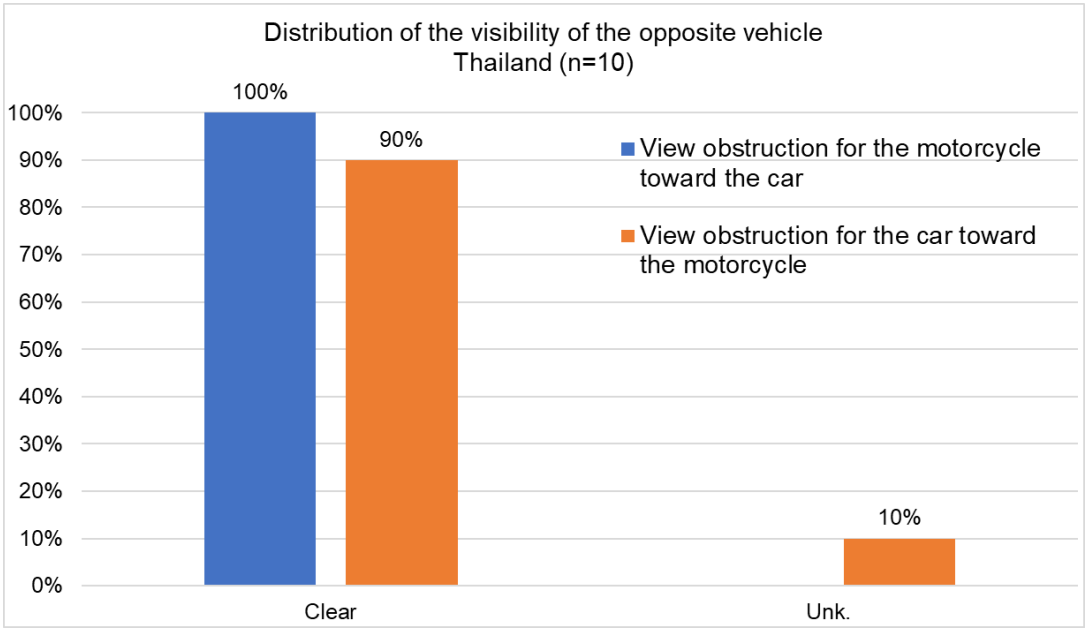
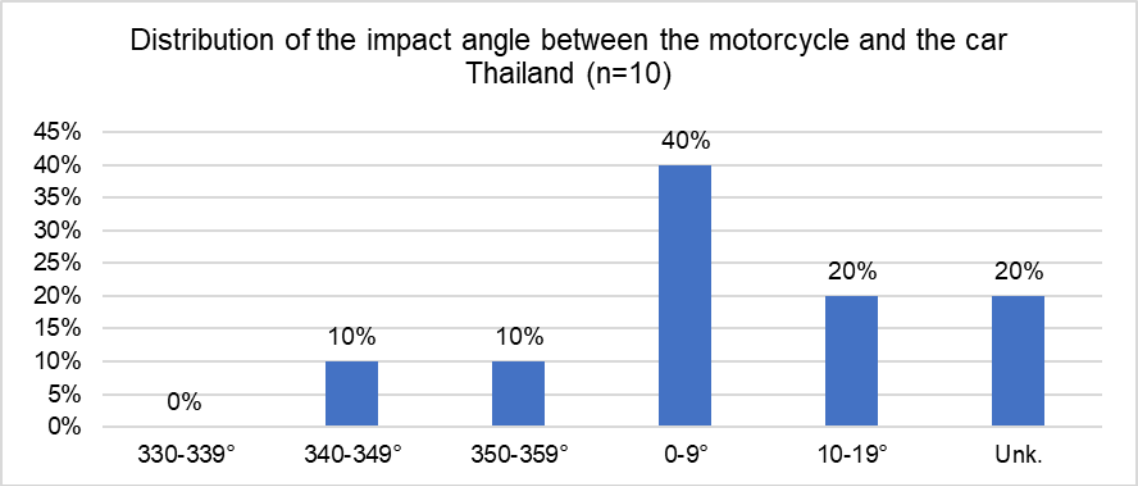


Figure 391: Visibility – Thailand – SIDE-SWIPE 3 SCENARIO

7.4.3.2 Impact angle between the motorcycle and the car



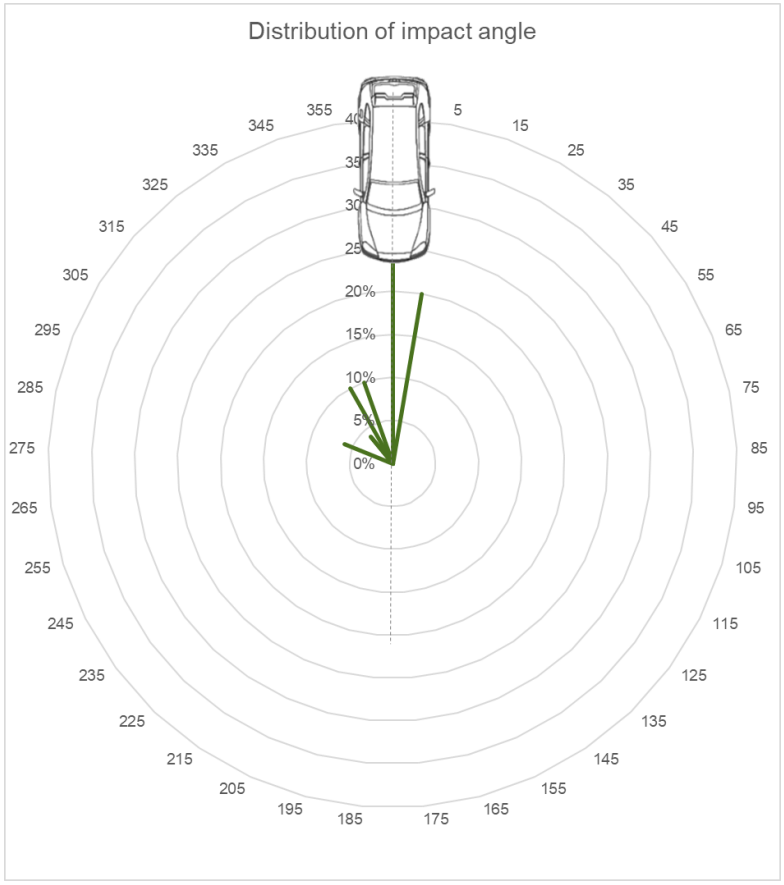


Figure 392: Impact angle – Thailand – SIDE-SWIPE 3 SCENARIO

7.4.3.3 Motorcycle impact type

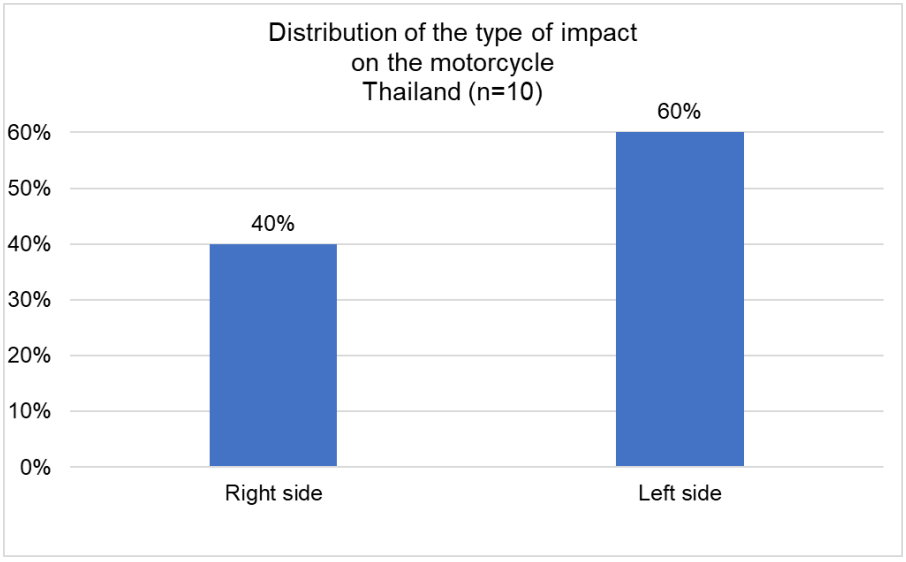


Figure 393: Type of impact for the motorcycle – Thailand – SIDE-SWIPE 3 SCENARIO

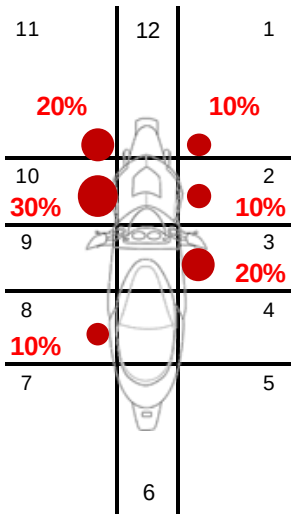


Figure 394: First collision point for the motorcycle – Thailand – SIDE-SWIPE 3 SCENARIO

7.4.3.4 Car impact type

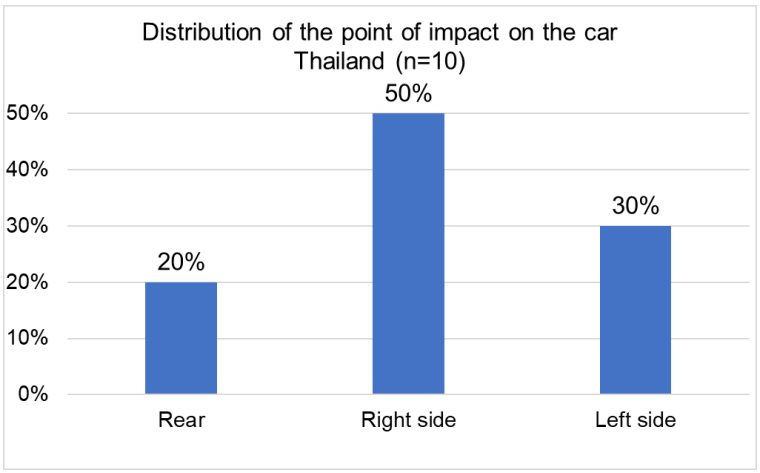


Figure 395: Type of impact for the car– Thailand – SIDE-SWIPE 3 SCENARIO

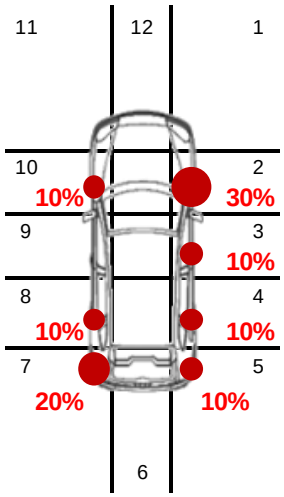


Figure 396: First collision point for the car – Thailand – SIDE-SWIPE 3 SCENARIO

7.4.3.5 Initial speeds

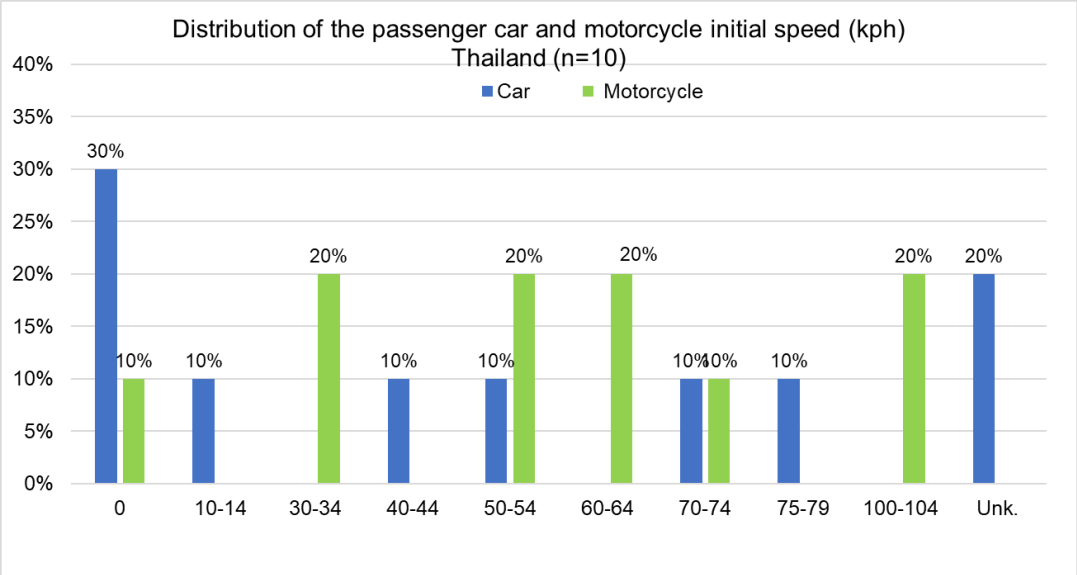


Figure 397: Initial speeds – Thailand – SIDE-SWIPE 3 SCENARIO

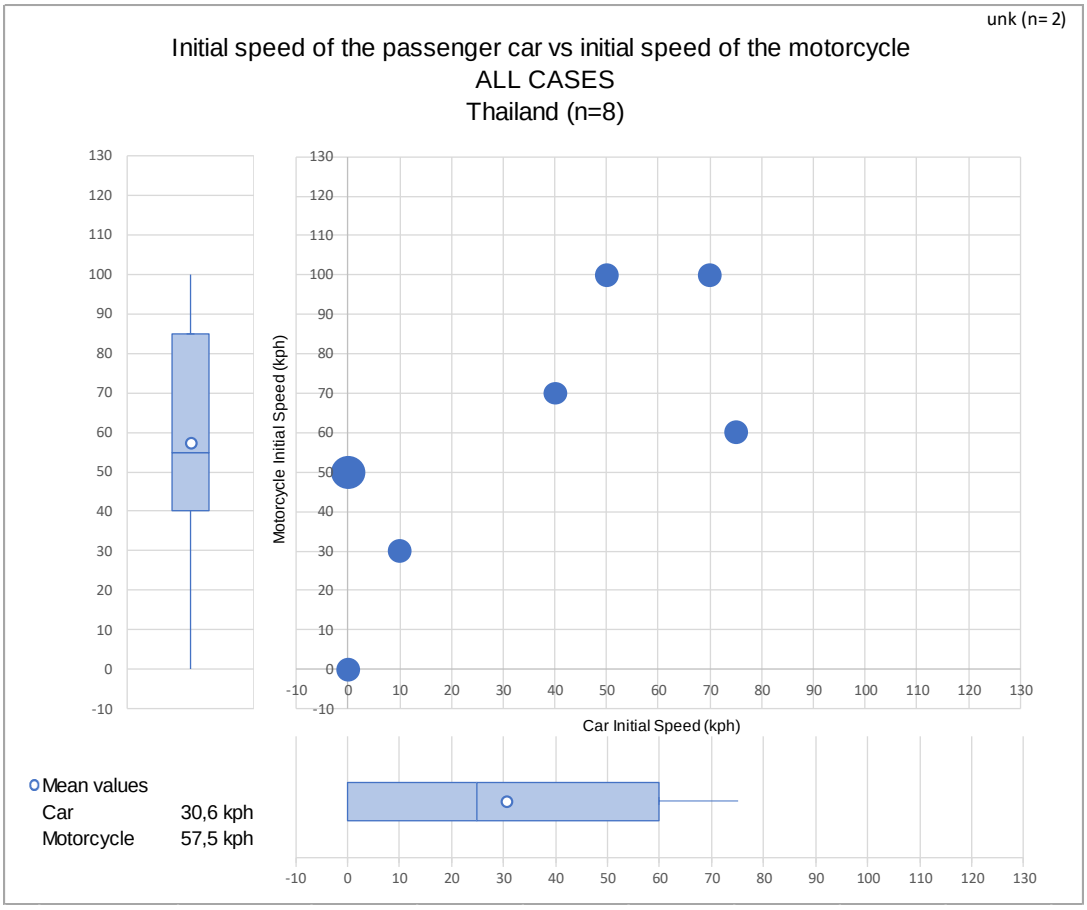


Figure 398: Initial speed of the car versus initial speed of the motorcycle, all cases – Thailand – SIDE-SWIPE 3 SCENARIO

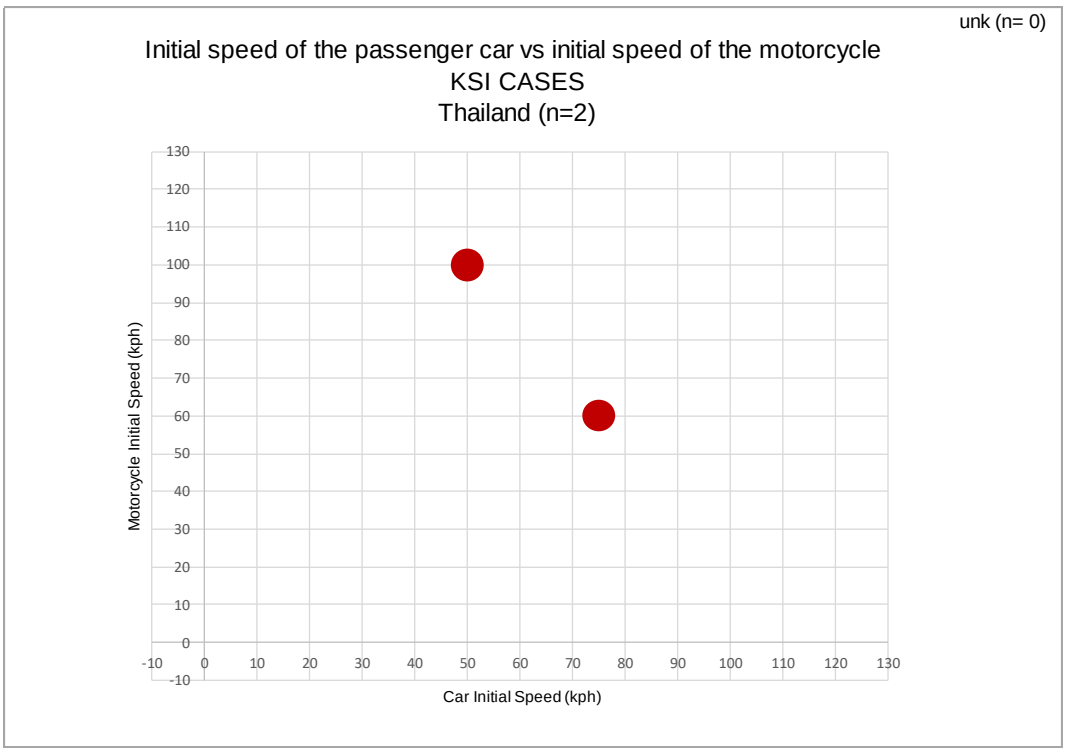


Figure 399: Initial speed of the car versus initial speed of the motorcycle, KSI cases – Thailand – SIDE-SWIPE 3 SCENARIO

Due to small sample size, statistics are not calculated.

Table 99: Initial speed values for the car and the motorcycle, all cases – Thailand – SIDE-SWIPE 3 SCENARIO

All Accidents																										unk: 2
Number of cases	Passenger Car Initial Speed (kph)																									
Motorcycle Initial Speed (kph)	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
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105≤																										

Table 100: Initial speed values for the car and the motorcycle, KSI cases – Thailand – SIDE-SWIPE 3 SCENARIO

KSI Accidents																											unk:	0
Number of cases		Passenger Car Initial Speed (kph)																										
		0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Initial Speed (kph)	0																										
	1																										
	5																										
	10																										
	15																										
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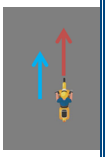

7.4.3.6 Collision speeds

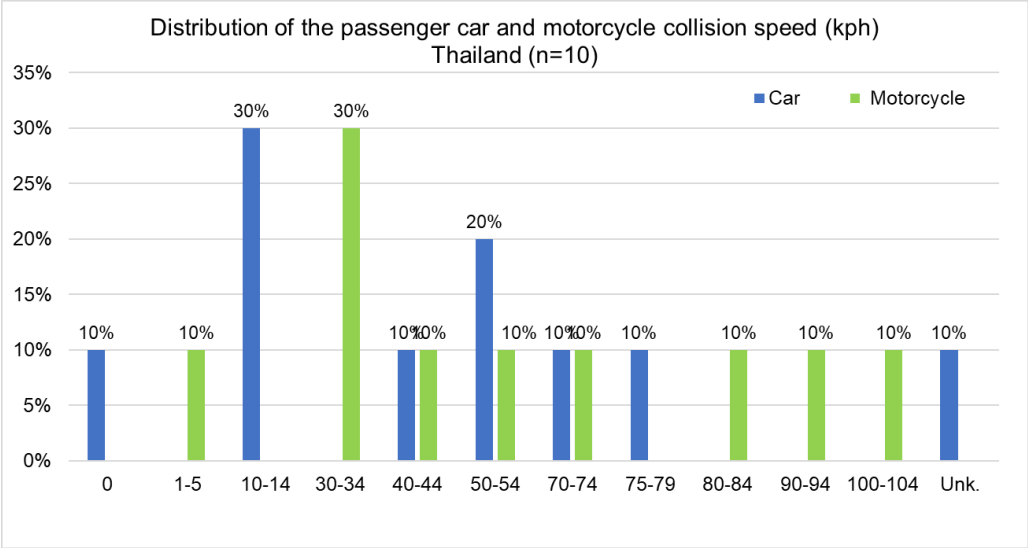

Figure 400: Collision speeds – Thailand – SIDE-SWIPE 3 SCENARIO

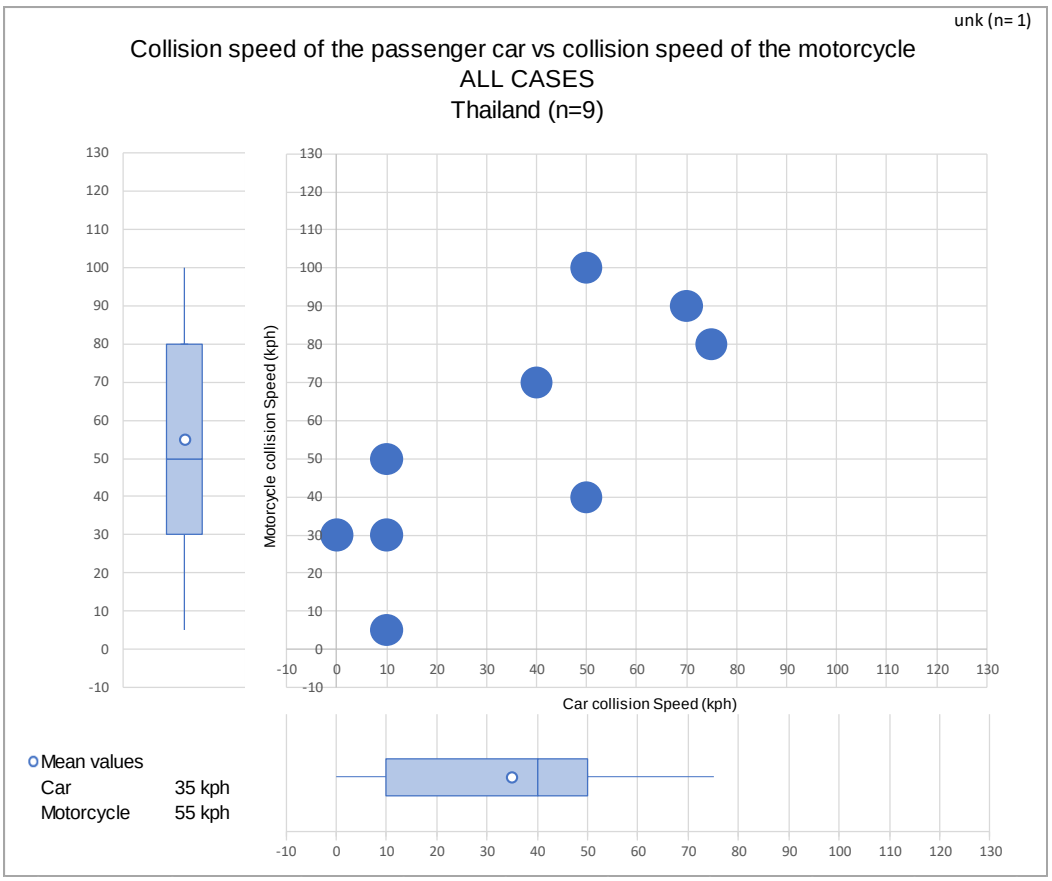

Figure 401: Collision speed of the car versus collision speed of the motorcycle, all cases – Thailand – SIDE-SWIPE 3 SCENARIO

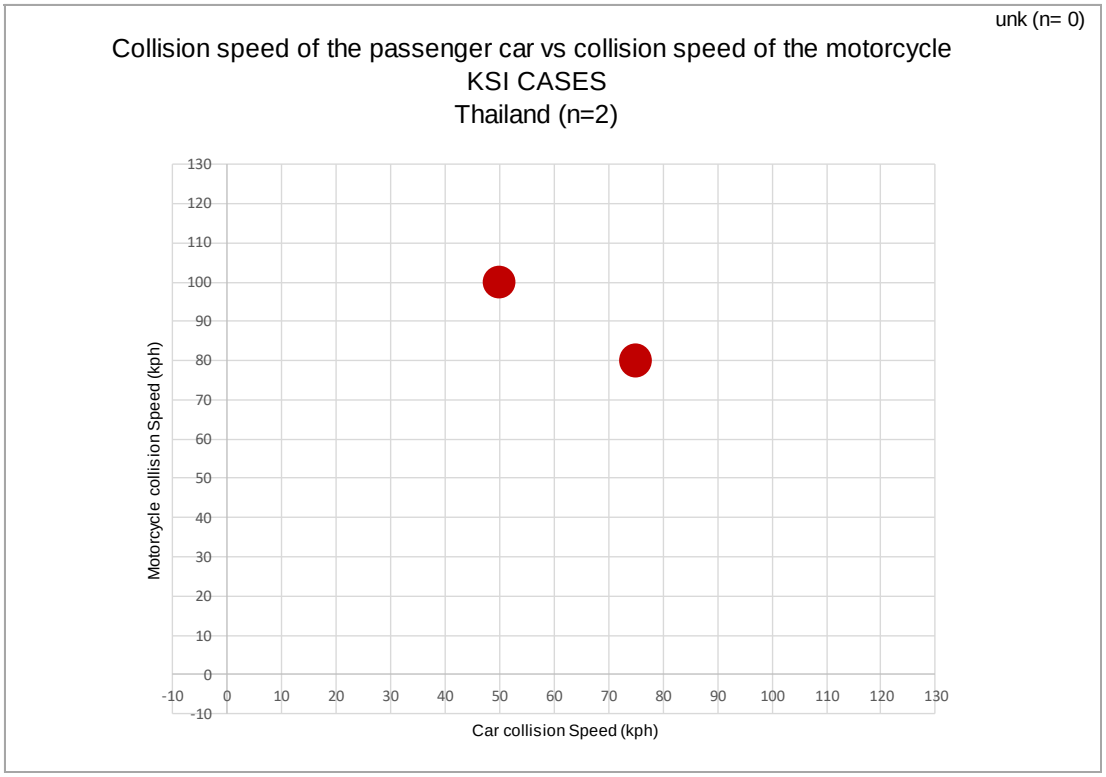

Figure 402: Collision speed of the car versus collision speed of the motorcycle, KSI cases – Thailand – SIDE-SWIPE 3 SCENARIO

Due to small sample size, statistics are not calculated.

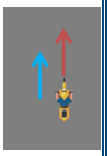

Table 101: Collision speed values for the car and the motorcycle, all cases – Thailand – SIDE-SWIPE 3 SCENARIO

All Accidents																											unk:	1
Number of cases	Passenger Car Collision Speed (kph)																											
	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Collision Speed (kph) 0																										
1																										
5				1																						
10																										
15																										
20																										
25																										
30	1			1																						
35																										
40												1														
45																										
50				1																						
55																										
60																										
65																										
70										1																
75																										
80																	1									
85																										
90																1										
95																										
100												1														
105≤																										

Table 102: Collision speed values for the car and the motorcycle, KSI cases – Thailand – SIDE-SWIPE 3 SCENARIO

KSI Accidents																											unk:	0
Number of cases	Passenger Car Collision Speed (kph)																											
	0	1	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105	110	115	120≤
Motorcycle Collision Speed (kph) 0																										
1																										
5																										
10																										
15																										
20																										
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60																										
65																										
70																										
75																										
80																	1									
85																										
90																										
95																										
100												1														
105≤																										

7.4.3.7 Delta Initial velocity (kph) – calculated

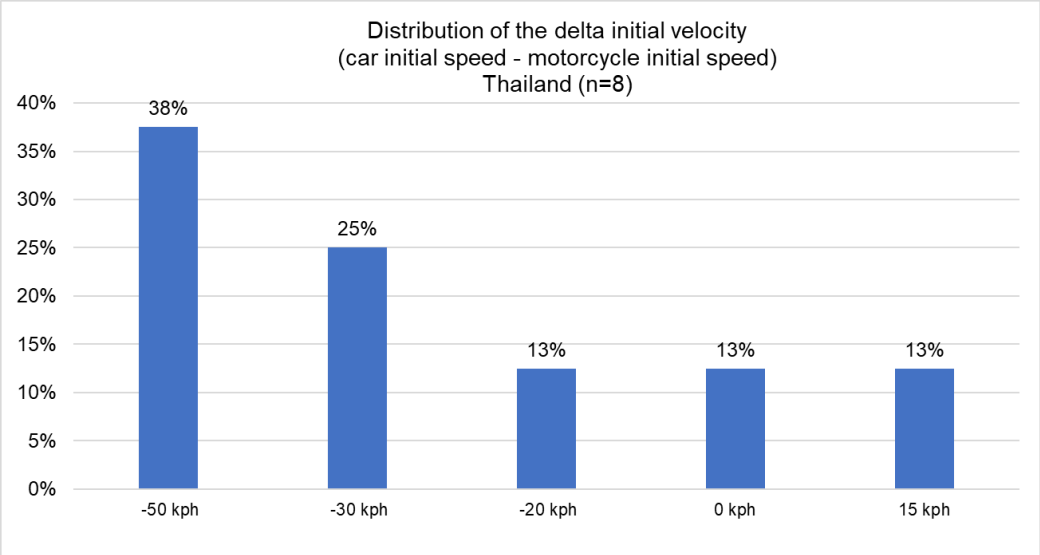


Figure 403: Delta initial velocity (kph) – Thailand – SIDE-SWIPE 3 SCENARIO

7.4.3.8 Skid marks

In this scenario braking skids marks were not observed either for the car nor for the motorcycle.

7.4.3.9 ABS fitment on the car

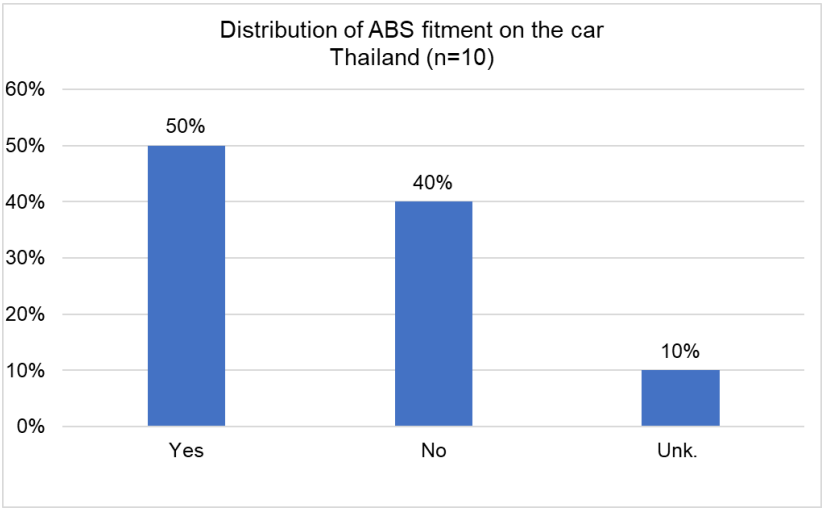


Figure 404: ABS fitment – Thailand – SIDE-SWIPE 3 SCENARIO

7.4.3.10 Motorcycle manoeuvre before crash

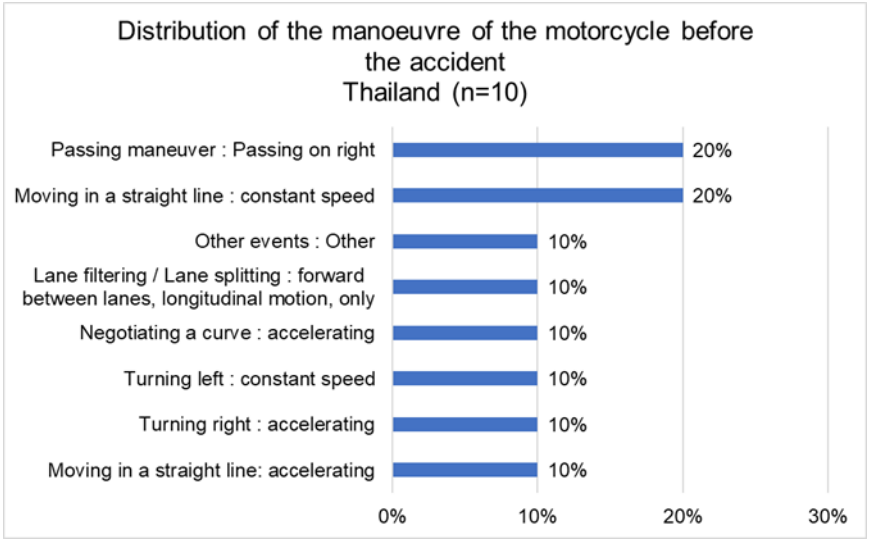


Figure 405: Motorcycle manoeuvre – Thailand – SIDE-SWIPE 3 SCENARIO

7.4.3.11 Car manoeuvre before crash

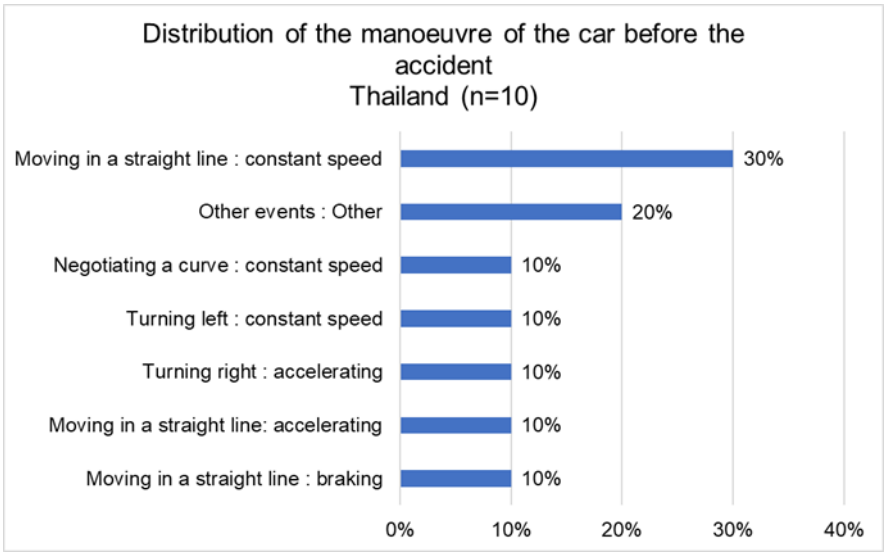


Figure 406: Car manoeuvre – Thailand – SIDE-SWIPE 3 SCENARIO

7.4.3.12 Avoidance action by vehicle

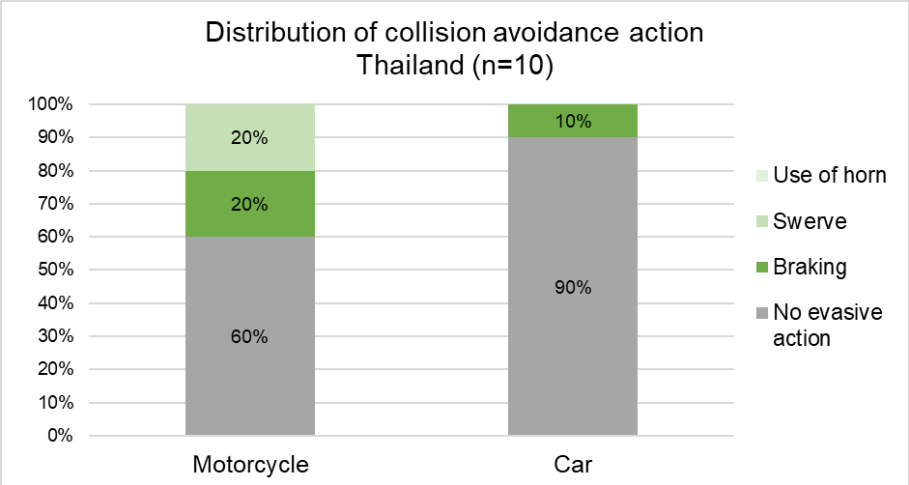


Figure 407: Avoidance action by vehicle – Thailand – SIDE-SWIPE 3 SCENARIO

7.4.3.13 Conclusion on accident characteristics

Table 103: Conclusion on accident characteristics – Thailand – SIDE-SWIPE 3 SCENARIO

Accident characteristics	**SIDE-SWIPE 3**	*Thai data*

- ✓ *Clear visibility for 90% of the accidents.*
- ✓ *100% side impact for the motorcycle (60% left side, 40% right side).*
- ✓ *50% right impact for the car, 30% left side and 20% rear impact.*
- ✓ *Mean initial speed: Car=30,6 kph and Motorcycle=55 kph*
- ✓ *Mean collision speed: Car=35 kph and Motorcycle=55 kph*
- ✓ *50% of the car had ABS.*
- ✓ *The motorcycle goes straight at constant speed (20%), or is passing right (20%), is turning (20%) or moving between lanes (10%).*
- ✓ *The car goes straight at constant speed (30%), is turning (20%).*
- ✓ *No avoidance action from the car (90%) and 40% of action from the motorcycle. The motorcycle tries to avoid the collision by braking or swerving.*

8 Review by sub-scenarios

Twelve sub-scenarios are identified through the Malaysian and Thai databases, thanks to the methodology develop in the project. The main issues, regarding the localisation, the manoeuvre, the visibility condition, and the collision speed, are presented for each of them below:

Rear-end: In this scenario, a high proportion of accidents in dark condition is observed. The cases mostly happen on a straight road, out of intersection. The mean collision speed of the car is among the highest (78 kph). In half of the cases, the car engaged an avoidance manoeuvre.

Head-on 1 (Car and motorcycle coming from opposite direction): About half of the cases happen at night. Around 20% of the motorcycle are travelling in the wrong direction. No visibility obstruction is noticed. Collision speeds are on the same range (62 kph for the car, 60 kph for the motorcycle).

Head-on 2 (Motorcycle changing lane and colliding with oncoming car): Both vehicles are in the same lane. All the motorcycles are passing from the right in this scenario. There is 36% of visibility obstruction due to vehicle in front. The collision speed is 71 kph for the motorcycle and 55 kph for the car.

Head-on 3 (Car changing lane and colliding with oncoming motorcycle): Half of the accidents occurs at night. 70% of cars are passing a vehicle on the right, there is 30% of cars with visibility obstruction. The collision speed is 55 kph for the motorcycle and 66,9 kph for the car.

Angular 1 (Car turning across the path of the motorcycle going straight): In this scenario, the car is turning or making a U-turn. The collision speed of the car is low compared to the one of the motorcycle (22 kph vs 60 kph). 39% of the cases happen in intersection and there was an obstruction to the visibility in 25% of the accidents.

Angular 2 (Car turning right in the path of the motorcycle, opposite direction): 46% of the accidents of this scenario happen in intersection and in urban or suburban areas (83%). The car is accelerating while turning right and the collision speed of the car is low (19 kph). A quarter of the cases happens with visibility obstruction due to road-side object.

Angular 3 (Car turning right or left in the path of the motorcycle, vehicles in same direction): This scenario mostly happens in suburban and urban areas, out of intersection. The car is making a U-turn, is tuning left or turning right. There is no visibility obstruction in this scenario. 85% of the motorcycles try to avoid the crash.

Angular with motorcycle turning right: This scenario mainly happens during daytime on straight road. The motorcycle is changing lane to the right or entering the traffic, its collision speed is lower than the car's one (34 kph vs. 65 kph).

Crossing: 70% of the accidents happen in a 4-leg intersection. The vehicles are going straight, and there is a visibility obstruction due to roadside object for 45% of the cases. The collision speeds are similar for the cars (46,4 kph) and the motorcycles (44,8 kph). There is a braking avoidance action for on third of the vehicles.

Side-swipe 1 (Motorcycle merging toward the right in the lane of the car): Within this scenario, all cases happen in a straight road, with clear condition and no visibility obstruction. The motorcycle is either changing lane or entering the traffic from the left. The collision speeds are 70 kph for the car and 50 kph for the motorcycle.

Side-swipe 2 (Car entering the lane of the motorcycle from the left or the right): The accidents occur in straight road, out of intersection. The car is changing lane and the motorcycle goes straight at constant speed. The collision speed is 35 kph for the car and 55 kph for the motorcycle. 38% of the motorcycles swerve to avoid the crash.

Side-swipe 3 (Car and motorcycle going straight in same direction): In this scenario, 80% of the cases occur on straight roads and 50% out of intersection. The collision speeds are 35 kph for the car and 52 kph for the motorcycle. The motorcycle is going straight or passing on the right or moving between the lanes.

In addition, the following table provides a summary of the proportions in the Thai database of each sub-scenarios, sorted by the KSI percentage order.

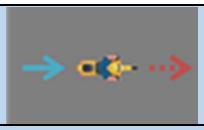
Table 104 :Proportion of each sub-scenario in the Thai database

Sub-Scenario	All Accidents	KSI Accidents
Angular 1 - Car turning across the path of the motorcycle	14.6%	14.8%
Crossing - Vehicles going straight perpendicularly R/L	8.3%	7.4%
Read-end - Car collide into the motorcycle	5.3%	6.6%
Angular - Motorcycle turning right across the path of the car, same direction	3.6%	5.1%
Head-on 1 - Both vehicles coming from opposite direction	4.1%	3.6%
Head-on 3 - Car doing a lane change, motorcycle coming from opposite direction	1.4%	3.5%
Angular 3 - Car turning R/L across the path of the motorcycle, same direction	13.8%	3.4%
Head-on 2 - Motorcycle doing a lane change, car coming from opposite direction	1.6%	3.1%
Side Swipe 1 - Motorcycle doing a lane change, same direction	2.8%	3.1%
Side Swipe 2 - Car doing a lane change, same direction	3.8%	2.0%
Angular 2 - Car turning into the path of the motorcycle	6.3%	1.9%
Side Swipe 3 - Both vehicles going straight, same direction	2.8%	1.6%

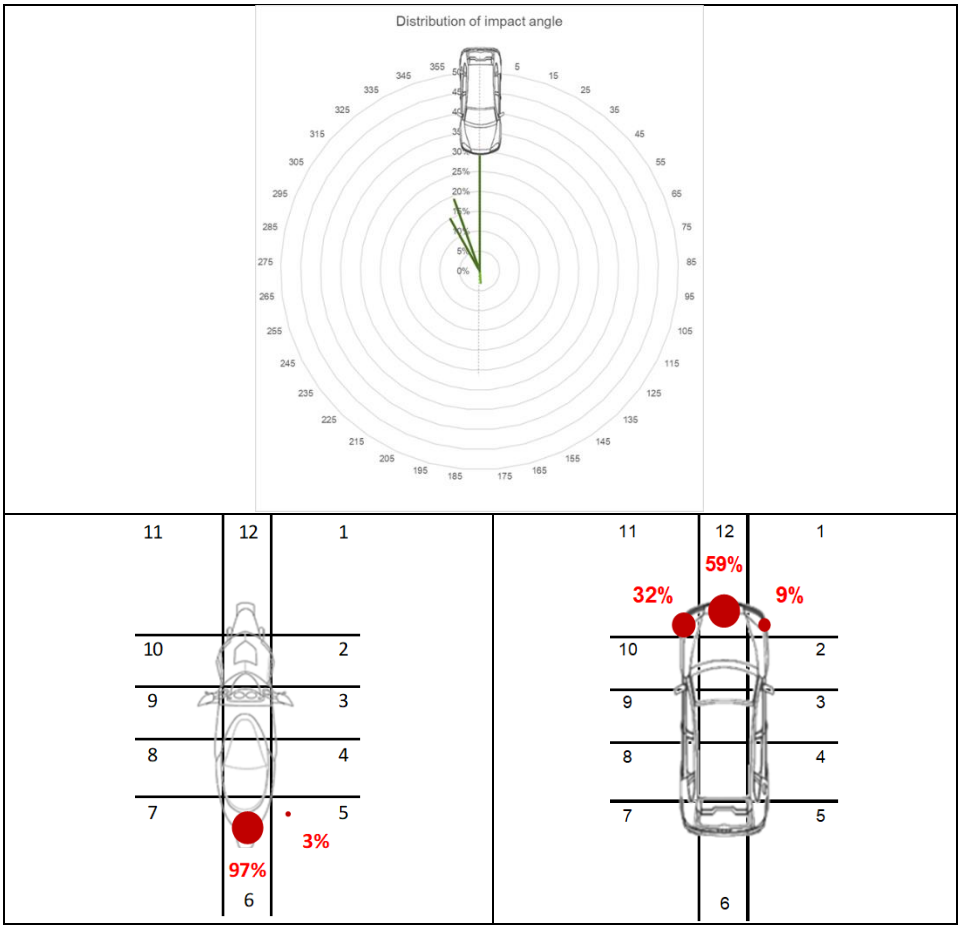
The next part is dedicated to a two pages gathering all the conclusions from both Malaysia and Thai databases by sub-scenarios, for general, road and vehicle characteristics of the accidents.

REAR-END

REAR-END	*Malaysian data*
General conditions ✓ *90% of the accidents happen with clear weather.* ✓ *Only 56% happening during the day (13% at night without light and 25% at night with streetlights).* ✓ *88% on dry road surface.*	
Road characteristics ✓ *52% of the accidents happen in rural area (34% in urban or city).* ✓ *Majority of federal or state roads.* ✓ *83% of the accidents happen in a straight road, 15% happen in intersection.* ✓ *Most of the accidents with single lane marking (79%).* ✓ *Speed limits: 33% at 70 kph, 17% at 50 kph and 19% at 90 kph.*	
Vehicle characteristics ✓ *100% of rear impact for the motorcycle.* ✓ *Motorcycle going forward in 52 % of the accidents, 8% diverging, turning right and converging (6%).*	

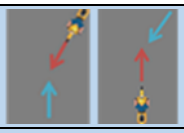
REAR-END		*Thai data*
General conditions ✓ *91% of clear weather.* ✓ *53% of the accidents happen during the day (12% at night without streetlights).* ✓ *91% of the accidents happen on a dry road surface.*		
Road characteristics ✓ *Mostly suburban (50%) and rural (26%) areas.* ✓ *76% of the accidents occur on highway, 2-4-6 lanes but up to 12 lanes.* ✓ *76% of the accidents are out of intersection.* ✓ *Almost all the accidents happen in a straight road (97%).* ✓ *Speed limit at 90 kph (44%) and 80 kph (16%).* ✓ *In 62% of the accidents, the cars are in lane 1 and the motorcycle in lane 2 in 41%.* ✓ *41% of the vehicles are in the same lane, 24% of the cars are in lane 1 and the motorcycle in lane 2.*		
Accident characteristics		

- ✓ *Clear visibility in the accident for 80% of the cases, 9% of vehicle obstruction for the car.*
- ✓ *100% rear impact for the motorcycle, 100% of frontal impact on the car.*
- ✓ *Mean initial speed: Car=87,7 kph and Motorcycle=44,7 kph*
- ✓ *Mean collision speed: Car=77,7 kph and Motorcycle=45,6 kph*
- ✓ *Only 3% of tire skid marks for the car.*
- ✓ *71% of the car had ABS.*
- ✓ *The motorcycle goes straight at constant speed (62%).*
- ✓ *The car goes straight at constant speed (53%) or is changing lane to the right (26%).*
- ✓ *No avoidance action from the motorcycle (97%).*
- ✓ *44% of the cars try to avoid the crash: braking (32%), swerving to the right (6%).*

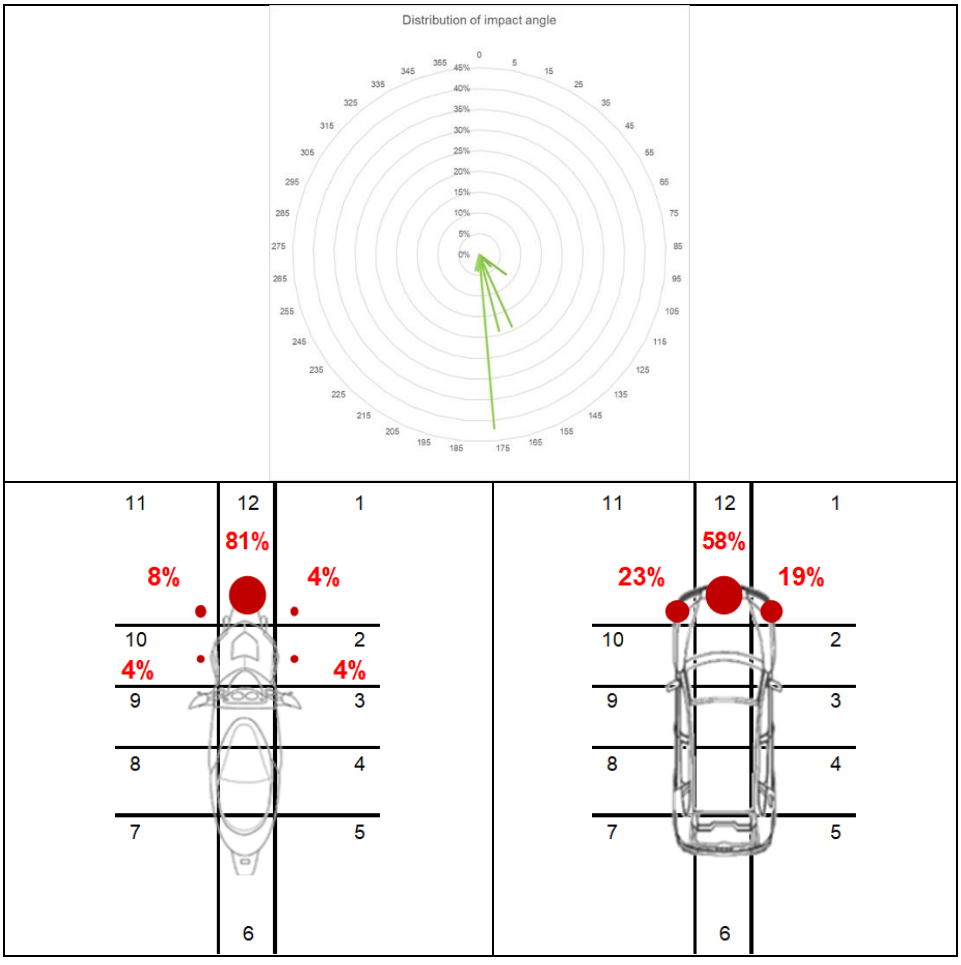


HEAD-ON 1: Car and motorcycle coming from opposite direction, frontal collision

HEAD-ON	*Malaysian data*
General conditions ✓ *92% of the accidents happen with clear weather.* ✓ *51% happening during the day (24% at night with streetlight, 20% at night without light).* ✓ *89% on dry road surface.*	
Road characteristics ✓ *59% of the accidents happen in rural area (23% in urban or city).* ✓ *Majority of federal or state roads (36%).* ✓ *65% of the accidents happen in a straight road, 19% happen in a curve.* ✓ *Most of the accidents with single lane marking (52%). 5% have no marking.* ✓ *Speed limits: 36% at 70 kph, 20% at 50 kph.*	
Vehicle characteristics ✓ *65% of frontal impact for the motorcycle, 23% of multiple impacts.* ✓ *Motorcycle going forward in 48 % of the accidents, and 30% of others manoeuvres not specified.*	

HEAD-ON 1 	*Thai data*
General conditions ✓ *Clear weather for all the cases.* ✓ *46% of the accidents happen during the day (42% at night with streetlights).* ✓ *Dry road surface for all the cases.*	
Road characteristics ✓ *Mostly rural (46%) and suburban (35%) areas.* ✓ *40% of the accidents occur on local roads.* ✓ *2-4 lanes roads.* ✓ *81% of the accidents are out of intersection.* ✓ *77% of the accidents happen in a straight road.* ✓ *Speed limit at 90 kph (31%) and 80 kph (12%), 42% of unknown values.* ✓ *92% of the cars are in lane 1, and 23% of the motorcycles are travelling in the wrong way.*	
Accident characteristics	

- ✓ *Clear visibility for 96% of the accidents, one case of obstruction due to road curvature.*
- ✓ *92% frontal impact for the motorcycle.*
- ✓ *100% frontal impact for the car.*
- ✓ *Mean initial speed: Car=75,8 kph and Motorcycle=62,8 kph*
- ✓ *Mean collision speed: Car=62,1 kph and Motorcycle=60,1 kph*
- ✓ *50% of the car had ABS.*
- ✓ *The motorcycle goes straight at constant speed (42%) or is crossing the opposite lane of traffic (23%).*
- ✓ *The car goes straight at constant speed (46%) or is negotiating a curve (15%).*
- ✓ *Avoidance action for 62% of the cars and 20% of the motorcycles. The cars mostly brake and the motorcycles swerve.*

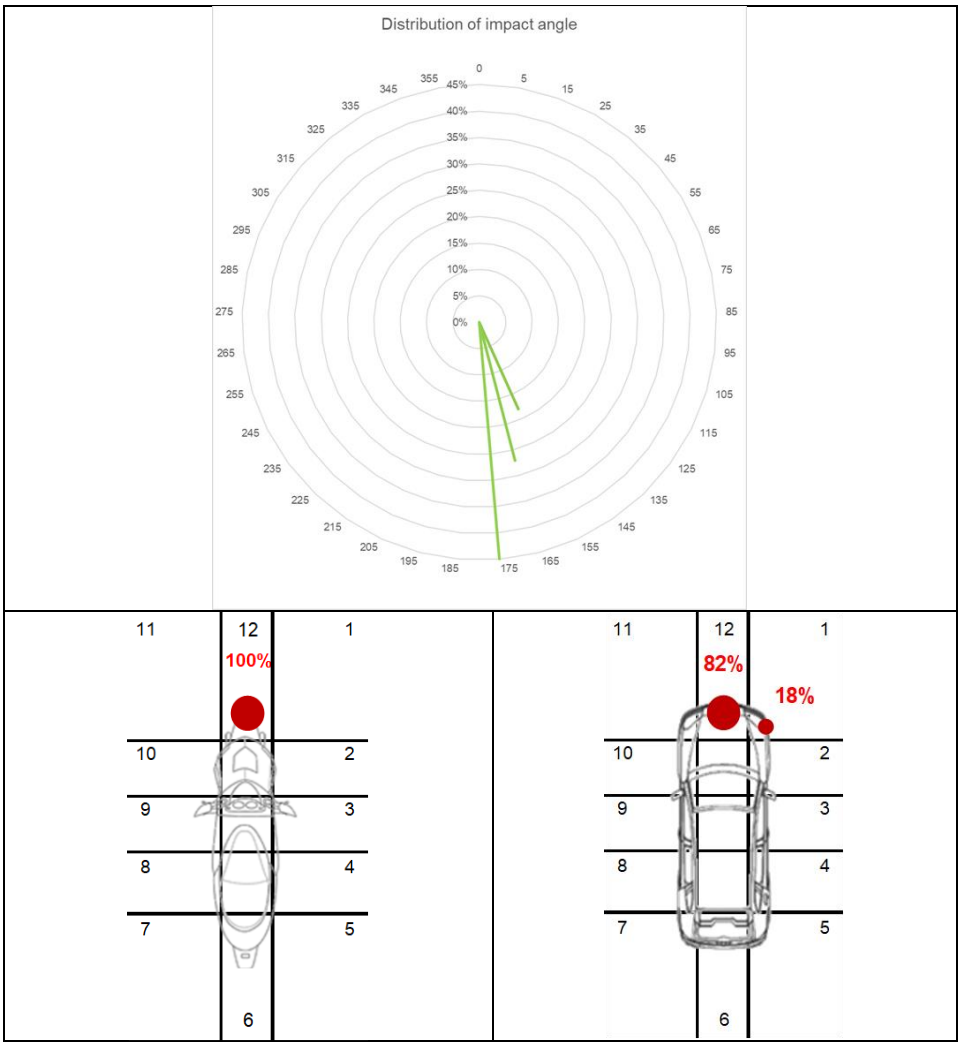


HEAD-ON 2: Motorcycle changing lane and colliding with oncoming car

HEAD-ON	*Malaysian data*
General conditions ✓ *92% of the accidents happen with clear weather.* ✓ *51% happening during the day (24% at night with streetlight, 20% at night without light).* ✓ *89% on dry road surface.*	
Road characteristics ✓ *59% of the accidents happen in rural area (23% in urban or city).* ✓ *Majority of federal or state roads (36%).* ✓ *65% of the accidents happen in a straight road, 19% happen in a curve.* ✓ *Most of the with single lane marking (52%). 5% had no marking.* ✓ *Speed limits: 36% at 70 kph, 20% at 50 kph.*	
Vehicle characteristics ✓ *65% of frontal impact for the motorcycle, 23% of multiple impacts.* ✓ *Motorcycle going forward in 48 % of the accidents, and 30% of others manoeuvres not specified.*	

HEAD-ON 2 	*Thai data*
General conditions ✓ *Clear weather for 91% of the cases.* ✓ *55% of the accidents happen during the day (36% at night with streetlights).* ✓ *Dry road surface for 91% of the cases.*	
Road characteristics ✓ *Mostly rural (64%) area.* ✓ *36% of the accidents occur on highways and 27% on residential streets.* ✓ *2 lanes roads.* ✓ *91% of the accidents are out of intersection.* ✓ *63% of the accidents happen in a straight road, 27% in a curve.* ✓ *Speed limit mostly unknown (55%), 18% at 80 kph and 90 kph.* ✓ *All the vehicles are in the same lane.*	
Accident characteristics	

- ✓ *36% of the accidents with visibility obstruction due to vehicles in front, 9% due to road curvature.*
- ✓ *100% frontal impact for the motorcycle.*
- ✓ *91% frontal impact for the car.*
- ✓ *Mean initial speed: Car=62,3 kph and Motorcycle=73,2 kph*
- ✓ *Mean collision speed: Car=55 kph and Motorcycle=71,1 kph*
- ✓ *64% of the car had ABS.*
- ✓ *All motorcycles pass on the right.*
- ✓ *The car goes straight at constant speed (64%) or is negotiating a curve (18%).*
- ✓ *Avoidance action for 45% of the cars and 18% of the motorcycles. The cars mostly brake.*

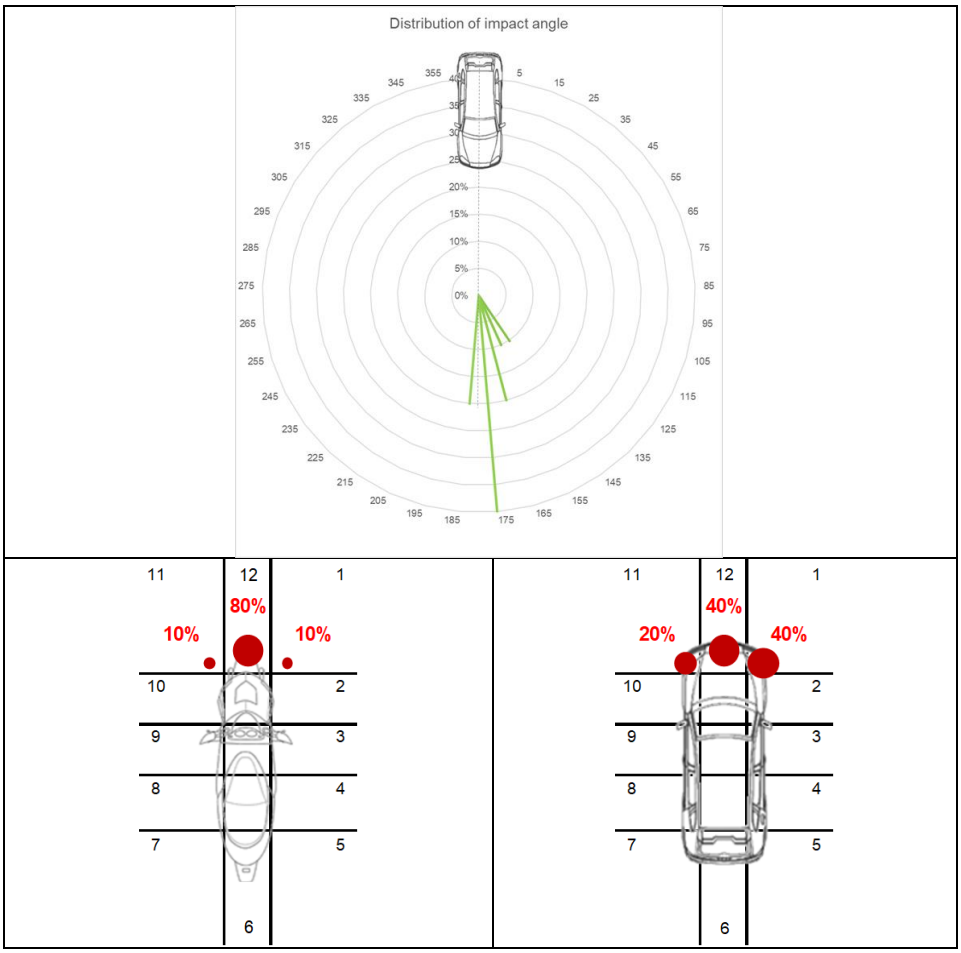


HEAD-ON 3: Car changing lane and colliding with oncoming motorcycle

HEAD-ON	*Malaysian data*
General conditions ✓ *92% of the accidents happen with clear weather.* ✓ *51% happening during the day (24% at night with streetlight, 20% at night without light).* ✓ *89% on dry road surface.*	
Road characteristics ✓ *59% of the accidents happen in rural area (23% in urban or city).* ✓ *Majority of federal or state roads (36%).* ✓ *65% of the accidents happen in a straight road, 19% happen in a curve.* ✓ *Most of the with single lane marking (52%). 5% had no marking.* ✓ *Speed limits: 36% at 70 kph, 20% at 50 kph.*	
Vehicle characteristics ✓ *65% of frontal impact for the motorcycle, 23% of multiple impacts.* ✓ *Motorcycle going forward in 48 % of the accidents, and 30% of others manoeuvres not specified.*	

HEAD-ON 3		*Thai data*
General conditions ✓ *Clear weather for all the cases.* ✓ *50% of the accidents happen during the day (30% at night with streetlights).* ✓ *Dry road surface for all the cases.*		
Road characteristics ✓ *50% in rural area and 50% in suburban area.* ✓ *40% of the accidents occur on highways and 30% on residential streets.* ✓ *2 lanes roads.* ✓ *80% of the accidents are out of intersection.* ✓ *70% of the accidents happen in a straight road.* ✓ *Speed limit is mainly unknow (60%), 20% at 50 kph.* ✓ *90% of the vehicles were in lane1, both in the same lane.*		
Accident characteristics ✓ *Clear visibility for 40% of the motorcycles and 30% of the cars. Visibility obstructed by a vehicle in front for 30% of the cars and 20% of the motorcycles.* ✓ *90% frontal impact for the motorcycle.*		

- ✓ *90% frontal impact for the car.*
- ✓ *Mean initial speed: Car=71,2 kph and Motorcycle=57,5 kph*
- ✓ *Mean collision speed: Car=66,9 kph and Motorcycle=55 kph*
- ✓ *80% of the car had ABS.*
- ✓ *The motorcycle goes straight at constant speed (70%) or is negotiating a curve at constant speed (20%).*
- ✓ *The car is passing on right in 70% of the cases.*
- ✓ *Avoidance action for 60% of the cars and the motorcycles. The cars mostly brake and the motorcycles swerve and brake.*



ANGULAR 1: Car turning across the path of the motorcycle going straight

ANGULAR MOTORCYCLE GOING STRAIGHT	*Malaysian data*

General conditions

- ✓ *More than 90% of the accidents happen with clear weather.*
- ✓ *68% happening during the day (10% at night without light).*
- ✓ *90% on dry road surface.*

Road characteristics

- ✓ *64% of the accidents happen in rural area (19% in urban area or city).*
- ✓ *Majority of federal or state roads.*
- ✓ *55% of the accidents happen in a straight road, 37% happen in intersection*
- ✓ *Most of the accidents with single lane marking (66%) and double lane marking (21%)*
- ✓ *Speed limits: 39% at 70 kph, 17% at 50 kph and only 16% at 90 kph.*

Vehicle characteristics

- ✓ *81% of frontal impact for the motorcycle, 19% lateral.*
- ✓ *Motorcycle going forward for the majority of the cases (71%).*

ANGULAR 1  *Thai data*

General conditions

- ✓ *Clear weather for 99% of the accidents.*
- ✓ *57% happen during the day (4% at night with streetlights).*
- ✓ *Dry road surface conditions for 98% of the accidents.*

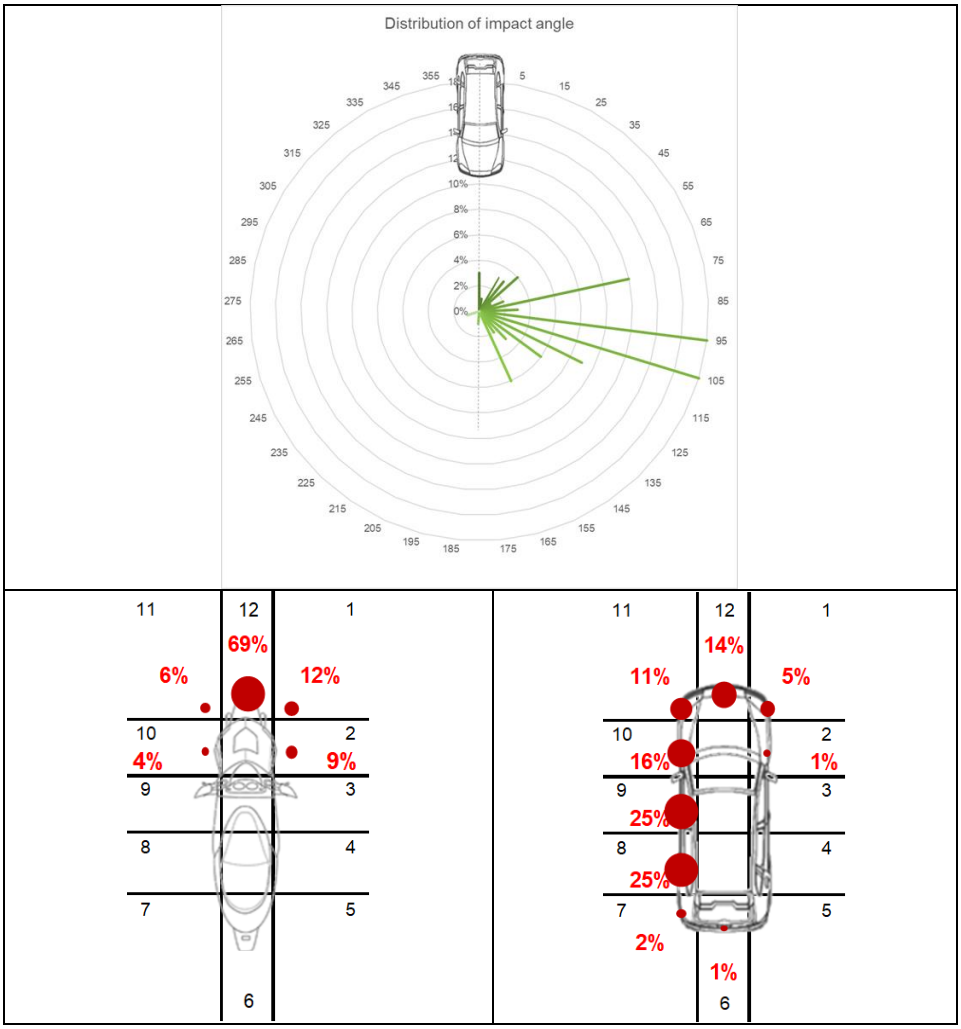
Road characteristics

- ✓ *Mostly urban (43%) and suburban (40%) areas.*
- ✓ *City streets for 55% of the accidents and 34% on highway.*
- ✓ *4-6 lanes in city streets and 2-4 lanes on highway.*
- ✓ *25% of the accidents are out of intersection, 39% in 3-leg/4-leg intersection.*
- ✓ *94% of the accidents happen in a straight road.*
- ✓ *Speed limit at 80 kph (26%) and 90 kph (18%), lot of unknown values.*
- ✓ *In 36% of the accidents, the car is in lane 1 and the motorcycle in lane 2. 31% of the vehicles are in the same lane, 36% in adjacent lanes.*

Accident characteristics

- ✓ *25% of cars and motorcycles have obstruction visibility due to vehicle in front.*
- ✓ *70% frontal impact for the motorcycle.*
- ✓ *77% of left side impact for the car.*
- ✓ *Mean initial speed: Car=17,7 kph and Motorcycle=67,6 kph*

- ✓ *Mean collision speed: Car=22,4 kph and Motorcycle=59,9 kph*
- ✓ *68% of the car had ABS.*
- ✓ *The motorcycle goes straight at constant speed (69%), straight accelerating (10%), straight braking (10%).*
- ✓ *The car is turning right and accelerating (66%) or making a U-turn (22%).*
- ✓ *No avoidance action from the car (82%) and action from the motorcycle (71%). The motorcycle tries to avoid the collision by braking (65%) or swerving (33%).*



ANGULAR 2: Car turning right in the path of the motorcycle, opposite direction

ANGULAR	*Malaysian data*
General conditions	

- ✓ *More than 90% of the accidents happen with clear weather.*
- ✓ *68% happening during the day (10% at night without light).*
- ✓ *90% on dry road surface.*

Road characteristics

- ✓ *64% of the accidents happen in rural area (19% in urban area or city).*
- ✓ *Majority of federal or state roads.*
- ✓ *55% of the accidents happen in a straight road, 37% happen in intersection*
- ✓ *Most of the accidents with single lane marking (66%) and double lane marking (21%)*
- ✓ *Speed limits: 39% at 70 kph, 17% at 50 kph and only 16% at 90 kph.*

Vehicle characteristics

- ✓ *81% of frontal impact for the motorcycle, 19% lateral.*
- ✓ *Motorcycle going forward for the majority of the cases (71%).*

ANGULAR 2		*Thai data*

General conditions

- ✓ *Clear weather in 93% of the accidents.*
- ✓ *60% happen during the day (3% at night with streetlights).*
- ✓ *7% of wet road surface.*

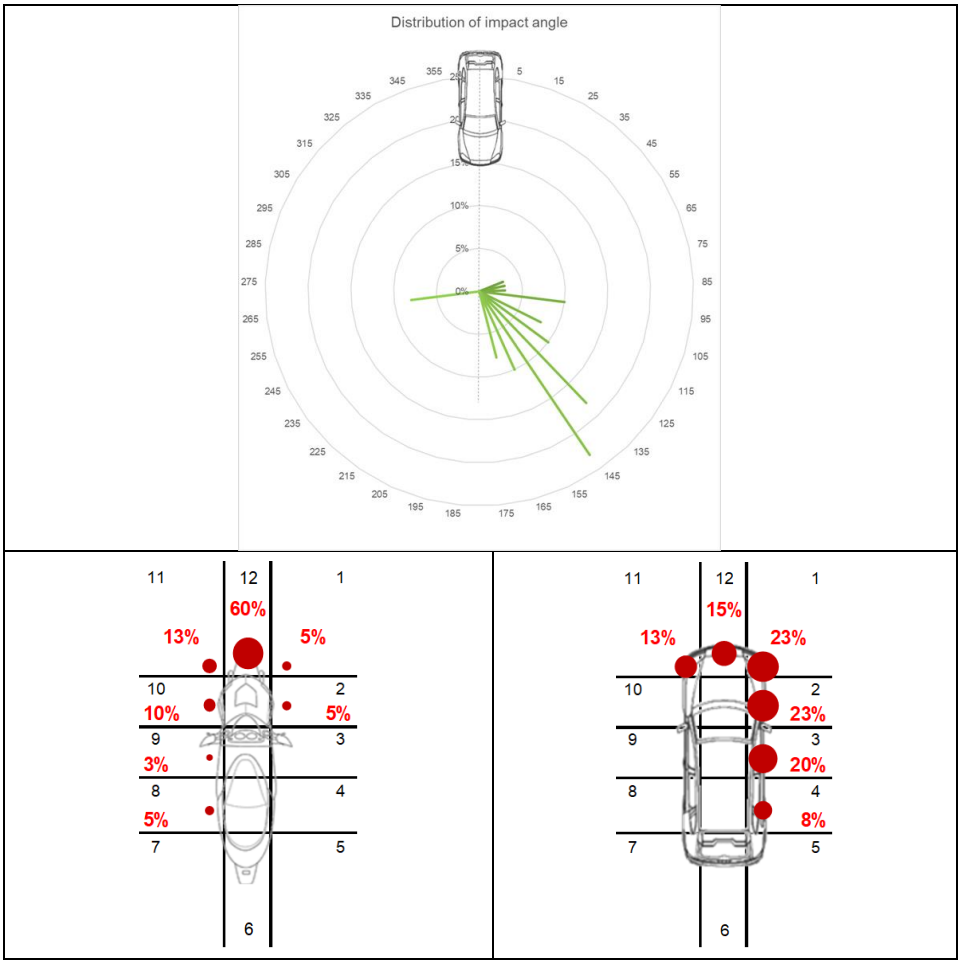
Road characteristics

- ✓ *Mostly urban (40%) and suburban (43%) areas.*
- ✓ *City streets for 68% of the accidents, only 13% on highway.*
- ✓ *2-4 lanes roads.*
- ✓ *Mostly in intersection (46%), or alley (28%) and driveway (20%).*
- ✓ *90% of the accidents happen in a straight road.*
- ✓ *Speed limit at 80 kph (23%) and 90 kph (13%), lot of unknown values.*
- ✓ *Vehicles in the same lane in 68% of the cases.*

Accident characteristics

- ✓ *38% of cars and motorcycles have clear visibility, around 25% have roadside object obstruction, then visibility obstructed by vehicle in front or parked vehicles.*
- ✓ *68% frontal impact for the motorcycle.*
- ✓ *70% right side impact for the car.*
- ✓ *Mean initial speed: Car=14,4 kph and Motorcycle=64 kph*
- ✓ *Mean collision speed: Car=18,7 kph and Motorcycle=52,4 kph*

- ✓ *73% of the car had ABS.*
- ✓ *The motorcycle moves at constant speed, straight (70%) or in a curve (8%) or braking (8%).*
- ✓ *The car is turning right and accelerating in 73% of the accident or turning right and braking in 15% of the cases.*
- ✓ *No avoidance action from the car (73%) and action from the motorcycle (60%). The motorcycle and the car try to avoid the collision mostly by braking.*



ANGULAR 3: Car turning right or left in the path of the motorcycle, same direction

ANGULAR	*Malaysian data*
General conditions	

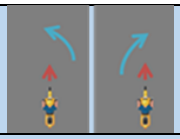
- ✓ *More than 90% of the accidents happen with clear weather.*
- ✓ *68% happening during the day (10% at night without light).*
- ✓ *90% on dry road surface.*

Road characteristics

- ✓ *64% of the accidents happen in rural area (19% in urban area or city).*
- ✓ *Majority of federal or state roads.*
- ✓ *55% of the accidents happen in a straight road, 37% happen in intersection*
- ✓ *Most of the accidents with single lane marking (66%) and double lane marking (21%)*
- ✓ *Speed limits: 39% at 70 kph, 17% at 50 kph and only 16% at 90 kph.*

Vehicle characteristics

- ✓ *81% of frontal impact for the motorcycle, 19% lateral.*
- ✓ *Motorcycle going forward for the majority of the cases (71%).*

ANGULAR 3		*Thai data*

General conditions

- ✓ *Clear weather for 95% of the accidents.*
- ✓ *74% of the accidents happen during the day (3% at night with streetlights).*
- ✓ *95% of the accidents happen on dry road surface.*

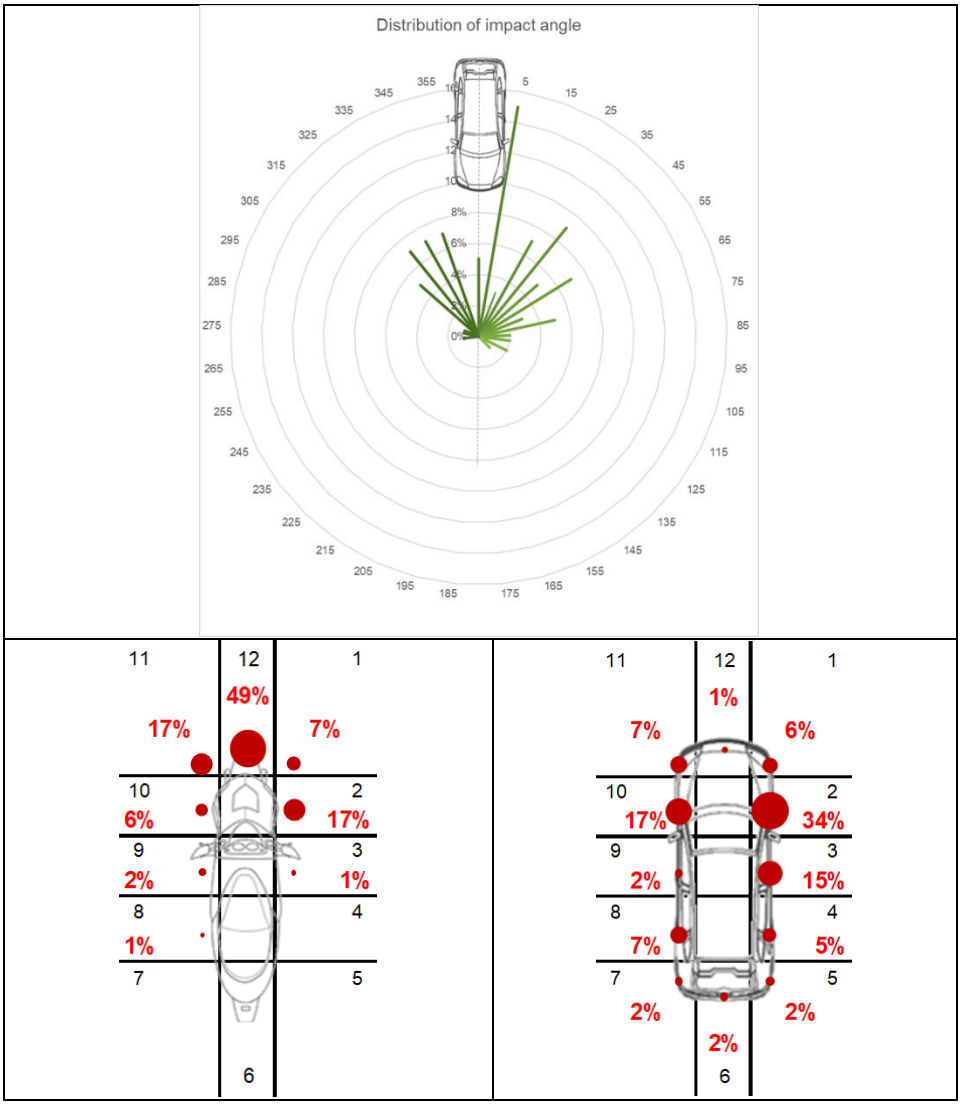
Road characteristics

- ✓ *Mostly suburban (47%) and urban (36%) areas.*
- ✓ *Half of the accidents occurs in city street, then highway (30%).*
- ✓ *Mainly 2 or 4 lanes roads.*
- ✓ *45% of the accidents are out of intersection, 20% in driveways and 18% in 3-leg/4-leg intersection.*
- ✓ *97% of the accidents happen in a straight road.*
- ✓ *Speed limit mainly unknown (45%) otherwise 18% at 90 kph and 16% at _0 kph.*
- ✓ *In 38% of accidents the vehicles are in the same lane, 28% in adjacent lanes.*

Accident characteristics

- ✓ *Almost all accidents happen without visibility obstruction (84-92%), 6% of motorcycle view obstructed by vehicle in front.*
- ✓ *49% of frontal impact and 51% of lateral impact for the motorcycle.*
- ✓ *61% of right side impact for the car.*
- ✓ *Mean initial speed: Car=27 kph and Motorcycle=62 kph*
- ✓ *Mean collision speed: Car=19,7 kph and Motorcycle=52,6 kph*

- ✓ *65% of the car had ABS.*
- ✓ *The motorcycle goes straight at constant speed (52%), is passing on the right (16%), going straight braking (15%).*
- ✓ *The car is making a U-turn (33%), turning left (34%), turning right (19%).*
- ✓ *No avoidance action from the car (88%) but 86% of evasive action from the motorcycle. 54% of braking and 30 % of right swerving from the motorcycle.*



ANGULAR: Motorcycle turning right in the path of the car, same direction

ANGULAR MOTORCYCLE TURNING RIGHT	*Malaysian data*
General conditions	
✓ *More than 90% of the accidents happen with clear weather.*	

- ✓ *76% happening during the day (only 1% at night without lights).*
- ✓ *91% happening on dry road surface.*

Road characteristics

- ✓ *66% of the accidents happen in rural area (18% in urban or city) mostly on federal or state roads.*
- ✓ *Half of the accidents happens in a straight road, 40% happen in cross junction or T/Y junction.*
- ✓ *Mostly single lane marking (49%) and double lane marking (26%).*
- ✓ *Speed limits: 38% at 50 kph, 21% at 70 kph.*

Vehicle characteristics

- ✓ *55% of lateral impact for the motorcycle, 45% frontal.*
- ✓ *Mainly changing lane action for the motorcycle: Right turning (54%) and converging (17%).*

ANGULAR MOTORCYCLE TURNING RIGHT		*Thai data*

General conditions

- ✓ *All accidents happen with clear weather conditions.*
- ✓ *91% happen during the day (9% at night with streetlights).*
- ✓ *All accidents happen on dry road surface conditions.*

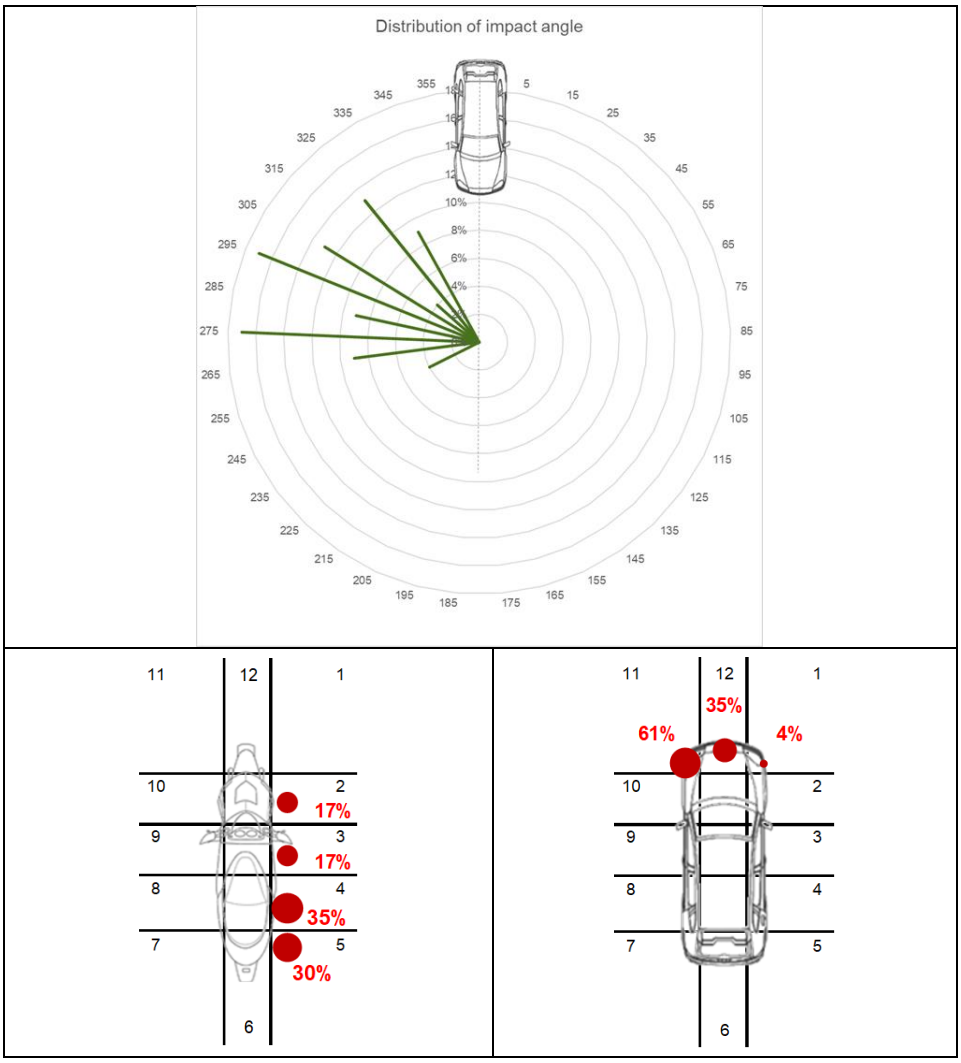
Road characteristics

- ✓ *Mostly rural (52%) and suburban (43%) areas.*
- ✓ *Highway for 65% of the accidents, residential streets in 17% of the cases.*
- ✓ *4 lanes or 2 lanes roads.*
- ✓ *Out of intersection configuration in 61% of the accidents, or in 3-leg or 4-leg intersection (21%).*
- ✓ *96% of the accidents happen in a straight road with less than 3% of slope.*
- ✓ *Scenario with high-speed limit: speed limit at 80 kph (17%) and 90 kph (30%).*
- ✓ *Car in lane 1 and motorcycle on left shoulder for 43% of the accidents, both vehicles in same lane in 23%.*

Accident characteristics

- ✓ *Clear visibility for more than 83% of the accidents (both car and motorcycle).*
- ✓ *100% right side impact on the motorcycle.*
- ✓ *83% of frontal impact on the car.*
- ✓ *Mean initial speed: Car=79,3 kph and Motorcycle=29,3 kph*

- ✓ *Mean collision speed: Car=65,7 kph and Motorcycle=34,6 kph*
- ✓ *61% of the car had ABS.*
- ✓ *The motorcycle changes lane to the right (26%) or is entering the traffic (26%).*
- ✓ *The car mostly goes straight at constant speed (48%) or braking (17%).*
- ✓ *No avoidance action from the motorcycle and action from 78% of the cars which are mostly braking.*



CROSSING

CROSSING	*Malaysian data*
General conditions	
✓ *95% of the accidents happen with clear weather.*	

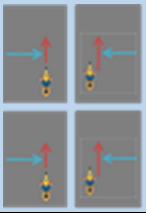
- ✓ *69% of the accidents happen during the day (8% at night without light and 19% at night with streetlights).*
- ✓ *93% occur on dry road surface.*

Road characteristics

- ✓ *68% of the accidents happen in rural area (34% in urban or city).*
- ✓ *Majority of state roads (46%) and federal roads (42%).*
- ✓ *49% of the accidents happen in a straight road, 46% happen in intersection.*
- ✓ *Most of the accidents with single lane marking (58%). 2% had no marking.*
- ✓ *Speed limits: 34% at 70 kph, 12% at 50 kph and 90 kph.*

Vehicle characteristics

- ✓ *64% of frontal impact for the motorcycle, 21% of lateral impact.*
- ✓ *Motorcycle going forward in 61 % of the accidents, 12% turning right.*

CROSSING		*Thai data*

General conditions

- ✓ *98% of clear weather.*
- ✓ *Only 47% of accidents happen during the day, and 51% at night with streetlights (2% at night without streetlights).*
- ✓ *98% of accidents happen on dry road surface.*

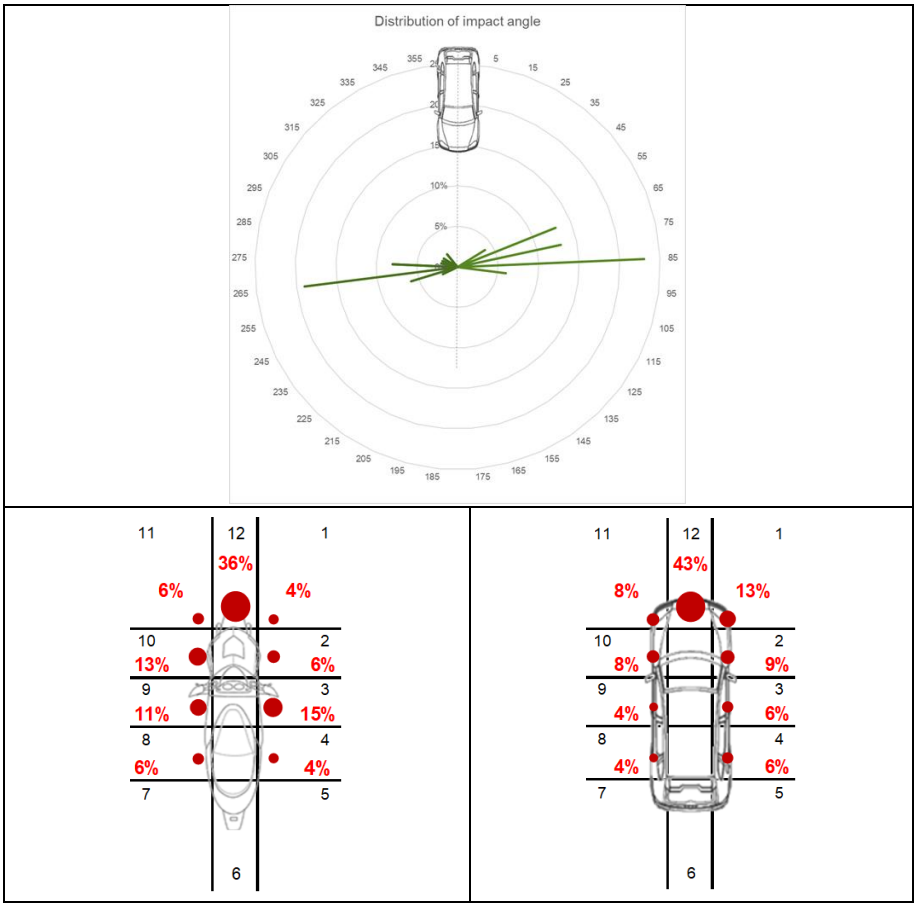
Road characteristics

- ✓ *Mostly suburban (45%) and urban (32%) areas.*
- ✓ *40% of the accidents occur on city street, and highway (38%).*
- ✓ *Mainly 2-4 lanes.*
- ✓ *70% of the accidents happen in a 4-leg intersection.*
- ✓ *96% of the straight road.*
- ✓ *Speed limit mostly unknown (45%), 21% at 80 kph and 17% at 80 kph.*
- ✓ *The car and the motorcycle are in lane1 in 89% and 77% of the accidents.*
- ✓ *72% of the vehicles are in the same lane.*

Accident characteristics

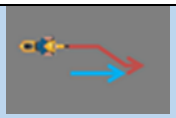
- ✓ *No visual obstruction for 40% of the vehicles, but the visibility is obstructed by roadside object in 45% of the accidents.*
- ✓ *38% frontal impact for the motorcycle, 34% left side, 28% right side.*

- ✓ *58% frontal impact for the car, 23% right side, 19% left side.*
- ✓ *Mean initial speed: Car=48,9 kph and Motorcycle=48,1 kph*
- ✓ *Mean collision speed: Car=46,4 kph and Motorcycle=44,8 kph*
- ✓ *70% of the car had ABS.*
- ✓ *The motorcycle goes straight at constant speed (51%), straight accelerating (23%), straight braking (11%).*
- ✓ *The car goes straight accelerating (42%), straight at constant speed (36%), straight braking (9%).*
- ✓ *Avoidance action: 36% of the motorcycle and 34% of the car brake.*

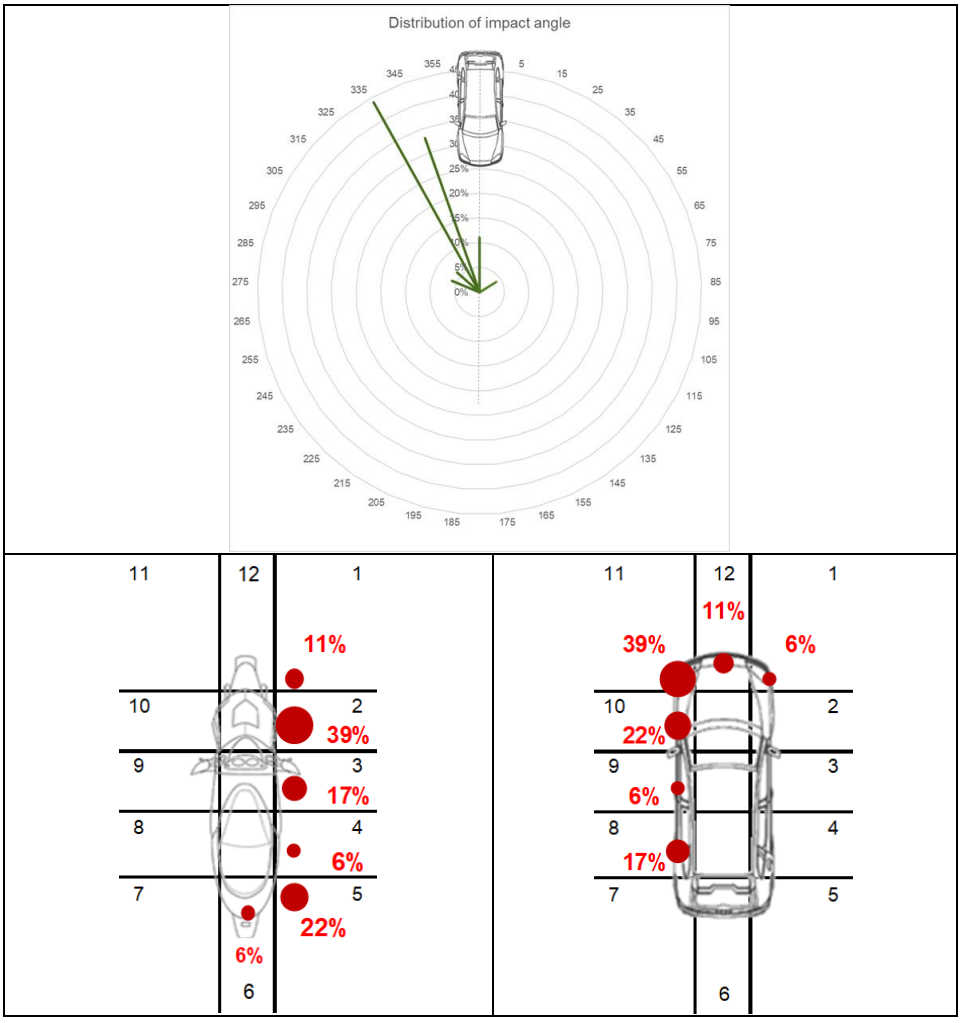


SIDE-SWIPE 1: Motorcycle merging toward the right in the lane of the car

SIDE-SWIPE	*Malaysian data*
General conditions ✓ *More than 90% of the accidents happen with clear weather.* ✓ *78% happen during the day (9% at night without light).* ✓ *91% of the accidents occur on dry road surface.*	
Road characteristics ✓ *53% of the accidents happen in rural area (30% in urban or city).* ✓ *Majority of federal or state roads (36% and 30%).* ✓ *15% of the accidents happen in intersection.* ✓ *76% of the accidents happen in a straight road.* ✓ *Most of the accidents with single lane marking (57%), double lane marking (17%), one way in 9% of the cases.* ✓ *Speed limits: 32% at 70 kph, 18% at 50 kph and only 15% at 90 kph.*	
Vehicle characteristics ✓ *32% of frontal impact for the motorcycle, 29% right side impact.* ✓ *Motorcycle going forward for most of the cases (56%), converging (11%).*	

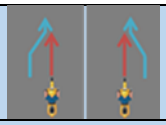
SIDE-SWIPE 1		*Thai data*
General conditions ✓ *Clear weather for all the accidents.* ✓ *78% of the accidents happen during the day (22% at night with streetlights).* ✓ *Dry road surface for all the accidents.*		
Road characteristics ✓ *Mostly rural (44%) and suburban (33%) areas.* ✓ *37% of the accidents occur on highway and 33% in city street.* ✓ *4-6 lanes.* ✓ *72% of the accidents are out of intersection, 11% in alley and driveway.* ✓ *100% of the accidents happen in a straight road.* ✓ *Speed limit at 90 kph (44%) and 80 kph (28%).* ✓ *In 50% of the cases, the vehicles are in adjacent lanes, 17% in the same lane.*		
Accident characteristics ✓ *No obstruction visibility for the car and the motorcycle in almost all the cases (94%).*		

- ✓ *94% of right side impact for the motorcycle, 83% of left side impact on the car.*
- ✓ *Mean initial speed: Car=76,9 kph and Motorcycle=47,8 kph*
- ✓ *Mean collision speed: Car=70,6 kph and Motorcycle=50 kph*
- ✓ *67% of the car had ABS.*
- ✓ *The motorcycle changes lane to the right in 78% or is entering the traffic from the left shoulder (11%).*
- ✓ *The car is going straight at constant speed (83%) or straight and braking (11%).*
- ✓ *No avoidance action from the motorcycle.*
- ✓ *44% of avoidance action from the car: 17% of them brakes and 17% swerves to the right.*

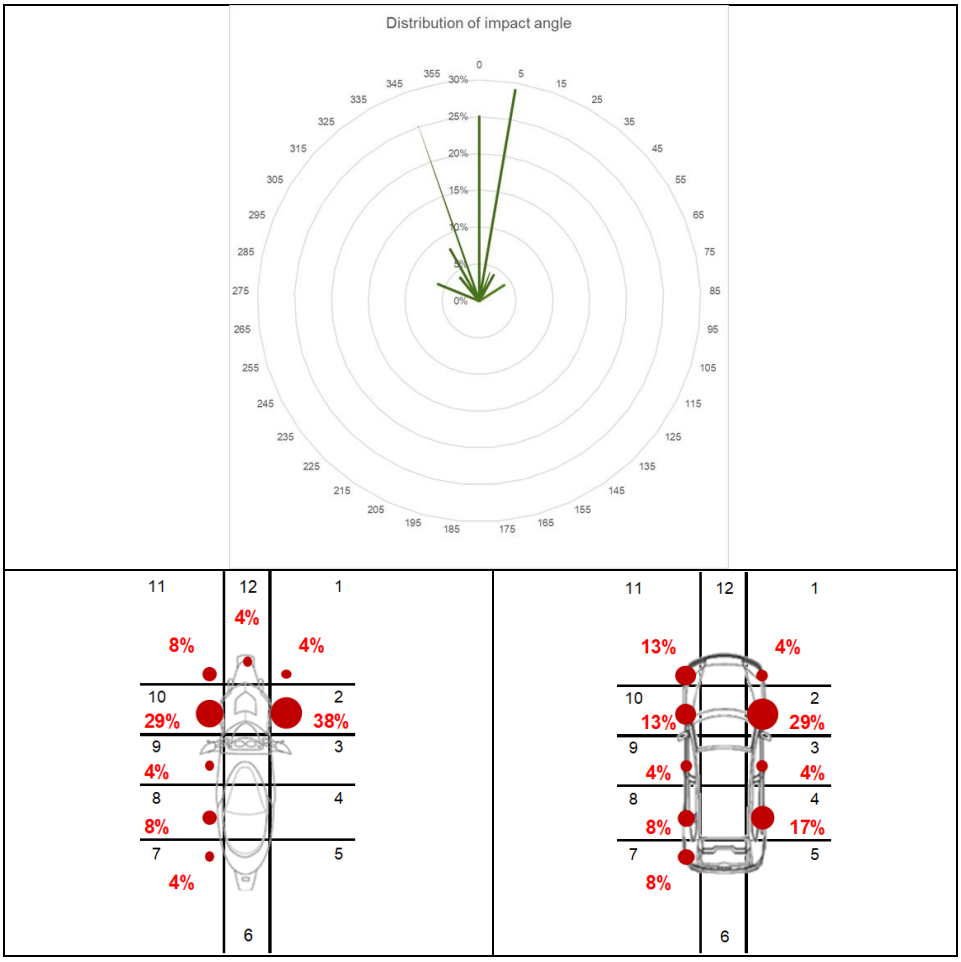


SIDE-SWIPE 2: Car entering the lane of the motorcycle from the left or from the right

SIDE-SWIPE	*Malaysian data*
General conditions	
✓ *More than 90% of the accidents happen with clear weather.* ✓ *78% happen during the day (9% at night without light).* ✓ *91% of the accidents occur on dry road surface.*	
Road characteristics	
✓ *53% of the accidents happen in rural area (30% in urban or city).* ✓ *Majority of federal or state roads (36% and 30%).* ✓ *15% of the accidents happen in intersection.* ✓ *76% of the accidents happen in a straight road.* ✓ *Most of the accidents with single lane marking (57%), double lane marking (17%), one way in 9% of the cases.* ✓ *Speed limits: 32% at 70 kph, 18% at 50 kph and only 15% at 90 kph.*	
Vehicle characteristics	
✓ *32% of frontal impact for the motorcycle, 29% right side impact.* ✓ *Motorcycle going forward for most of the cases (56%), converging (11%).*	

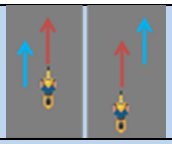
SIDE-SWIPE 2 	*Thai data*
General conditions	
✓ *Clear weather for 100% of the accidents.* ✓ *75% happen during the day (25% at night with streetlights).* ✓ *Dry road surface for 100% of the accidents.*	
Road characteristics	
✓ *Mostly suburban (46%) and urban (33%) areas.* ✓ *54% of the accidents on highway, city street for 33%.* ✓ *4 lanes roads.* ✓ *67% of the accidents occur out of intersection, in diverging lane for 13%.* ✓ *92% of the accidents happen on a straight road.* ✓ *Speed limit at 80 kph (25%) and 90 kph (21%), lot of unknown values (42%).* ✓ *Vehicles in the same lane (33%) or in adjacent lanes (33%).*	
Accident characteristics	
✓ *Clear visibility in 100% of the accidents.* ✓ *50% of left side impact and 46% of right side impact on the motorcycle.*	

- ✓ *38% of left side impact and 50% of right side impact on the car.*
- ✓ *Mean initial speed: Car=36,7 kph and Motorcycle=58,8 kph*
- ✓ *Mean collision speed: Car=35,4 kph and Motorcycle=55,1 kph*
- ✓ *63% of the car had ABS.*
- ✓ *The motorcycle moves at constant speed, straight (67%) or straight and braking (17%) or straight and accelerating (8%).*
- ✓ *The car is changing lane to the left in 25% of the accidents, changing lane to the right in 13%. Also manoeuvre of entering and leaving the traffic.*
- ✓ *No avoidance action from the car.*
- ✓ *Avoidance action from 67% of the motorcycles: 29% braking and 38% swerving.*

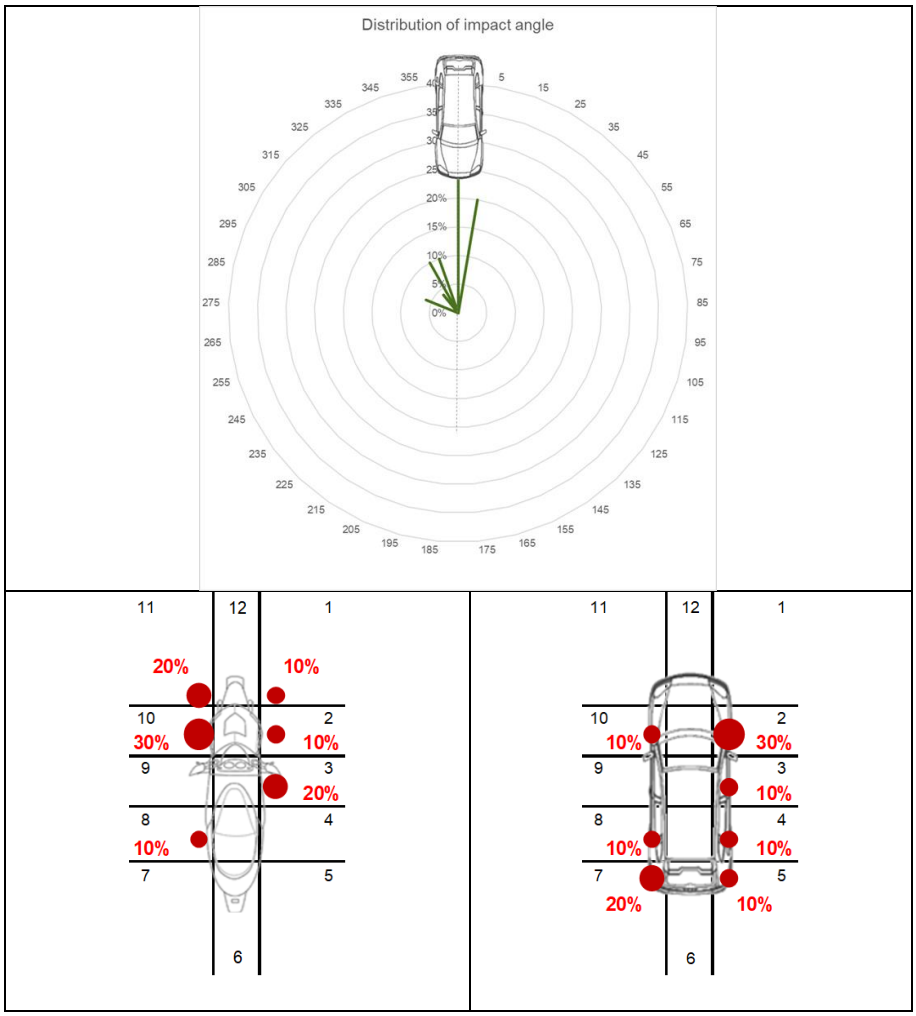


SIDE-SWIPE 3: Car and motorcycle going straight in same direction

SIDE-SWIPE	*Malaysian data*
General conditions ✓ *More than 90% of the accidents happen with clear weather.* ✓ *78% happen during the day (9% at night without light).* ✓ *91% of the accidents occur on dry road surface.*	
Road characteristics ✓ *53% of the accidents happen in rural area (30% in urban or city).* ✓ *Majority of federal or state roads (36% and 30%).* ✓ *15% of the accidents happen in intersection.* ✓ *76% of the accidents happen in a straight road.* ✓ *Most of the accidents with single lane marking (57%), double lane marking (17%), one way in 9% of the cases.* ✓ *Speed limits: 32% at 70 kph, 18% at 50 kph and only 15% at 90 kph.*	
Vehicle characteristics ✓ *32% of frontal impact for the motorcycle, 29% right side impact.* ✓ *Motorcycle going forward for most of the cases (56%), converging (11%).*	

SIDE-SWIPE 3 	*Thai data*
General conditions ✓ *Clear weather for all accidents.* ✓ *60% of the accidents happen during the day (40% at night with streetlights).* ✓ *Dry road surface for all accidents*	
Road characteristics ✓ *Mostly urban (70%) and suburban (30%) areas.* ✓ *Residential and city street for 70% of the accidents and 30% on highway.* ✓ *4-8 lanes roads.* ✓ *50% of the accidents are out of intersection, 20% in diverging lanes.* ✓ *80% of the accidents happen in a straight road.* ✓ *Speed limit at 80 kph (40%) and 90 kph (20%), lot of unknown values.* ✓ *80% of the vehicles were in the same lane, and 20% of the cases with motorcycles in adjacent shoulder.*	
Accident characteristics	

- ✓ *Clear visibility for 90% of the accidents.*
- ✓ *100% side impact for the motorcycle (60% left side, 40% right side).*
- ✓ *50% right impact for the car, 30% left side and 20% rear impact.*
- ✓ *Mean initial speed: Car=30,6 kph and Motorcycle=55 kph*
- ✓ *Mean collision speed: Car=35 kph and Motorcycle=55 kph*
- ✓ *50% of the car had ABS.*
- ✓ *The motorcycle goes straight at constant speed (20%), or is passing right (20%), is turning (20%) or moving between lanes (10%).*
- ✓ *The car goes straight at constant speed (30%), is turning (20%).*
- ✓ *No avoidance action from the car (90%) and 40% of action from the motorcycle. The motorcycle tries to avoid the collision by braking or swerving.*



9 Conclusion

In a first step, the analysis of the Malaysian national database and the Thai in-depth database, based on three common variables, highlighted the most frequent and critical car-to-motorcycle accidents. Data recorded for Malaysia provides less detailed information about the accident characteristics and vehicle manoeuvres. Then, the Thai in-depth database provides lots of details and was used to describe the accident situations within sub-scenarios by including the car manoeuvre. Therefore, the Thai in-depth database was analysed to provide all the parameters of the sub-scenarios clustered, such as vehicle manoeuvres, initial and collision speeds, impact point and angle.

Among the twelve car-to-motorcycle accidents sub-scenarios identified, around one quarter is represented by **Angular scenarios with the motorcycle going straight**. The most critical sub-scenarios within these accident situations are the Car Turning Right Across the Path of the Motorcycle (14.8% of KSI from Thai database), followed by the Car turning Right or Left Across the Path of the Motorcycle - same direction (3.4% of KSI), and Car Turning into the Path of the Motorcycle. The next most frequent one is the **Read-end scenarios**, more than 60% of this scenario correspond to the motorcycle colliding with the car however this situation cannot be covered by ADAS systems on the car and is not further analysed. Therefore, Rear-end Car to Motorcycle with the motorcycle going slower is studied (6.6% of KSI). The third most frequent scenario is represented by the **Head-on** situations. The most critical sub-scenario is Both Vehicle Coming Straight from Opposite Direction (3.6% KSI), followed by the Car doing a Lane Change, with the Motorcycle coming from Opposite Direction (3.1% KSI) and the similar reversed situation with the Motorcycle doing the Lane Change (3.1%).

Regarding the overall description of the accident scenarios from the two databases, it seems that the characteristics of the accidents are similar, except for the localisation. In Malaysia, most of the accident scenarios analysed occur in rural area, whereas the proportion of accidents happening in urban or suburban area is higher in the data collected in the Thai database. That may be related to the in-depth methodology, in which the investigators have to be close to the accidents to be sure to be able to gather all the needed information, therefore accidents in rural area may be less reachable.

Most of the accidents happened with a clear weather and a dry road surface during the day. It shows the importance of developing ADAS systems to improve the safety of the motorcycle road users. In most of cases the visibility of the road user is clear, however obstructions appear to be significant in the crossing scenario and in the head-on scenario where either the car or the motorcycle is changing lane (passing by on the right). This analysis shows the diversity of the car and motorcycle impact speeds encountered in the different scenarios. The Rear-end scenario, Vehicles Coming Straight from Opposite Direction (head-on 1), Motorcycle merging toward the right in the lane of the car (side-swipe 1) scenarios are characterised by high car impact speed whereas the vehicles with turning manoeuvre exhibit the lowest velocity.

In summary, the WP1 accident data study has identified the most common and critical situations between a car and a motorcycle based on relevant data from Malaysian and Thailand. Those countries represent after Indonesia, the area with the most important number of cars registered, a fleet composed of half motorcycle. So, those two countries show a mixed traffic, relevant to highlight the different accident configurations between one car and one motorcycle. They provide the best compromise to have an overview of the most challenging car-to-motorcycle accidents configuration in the ASEAN region, taking into account the available data.

Annex 1

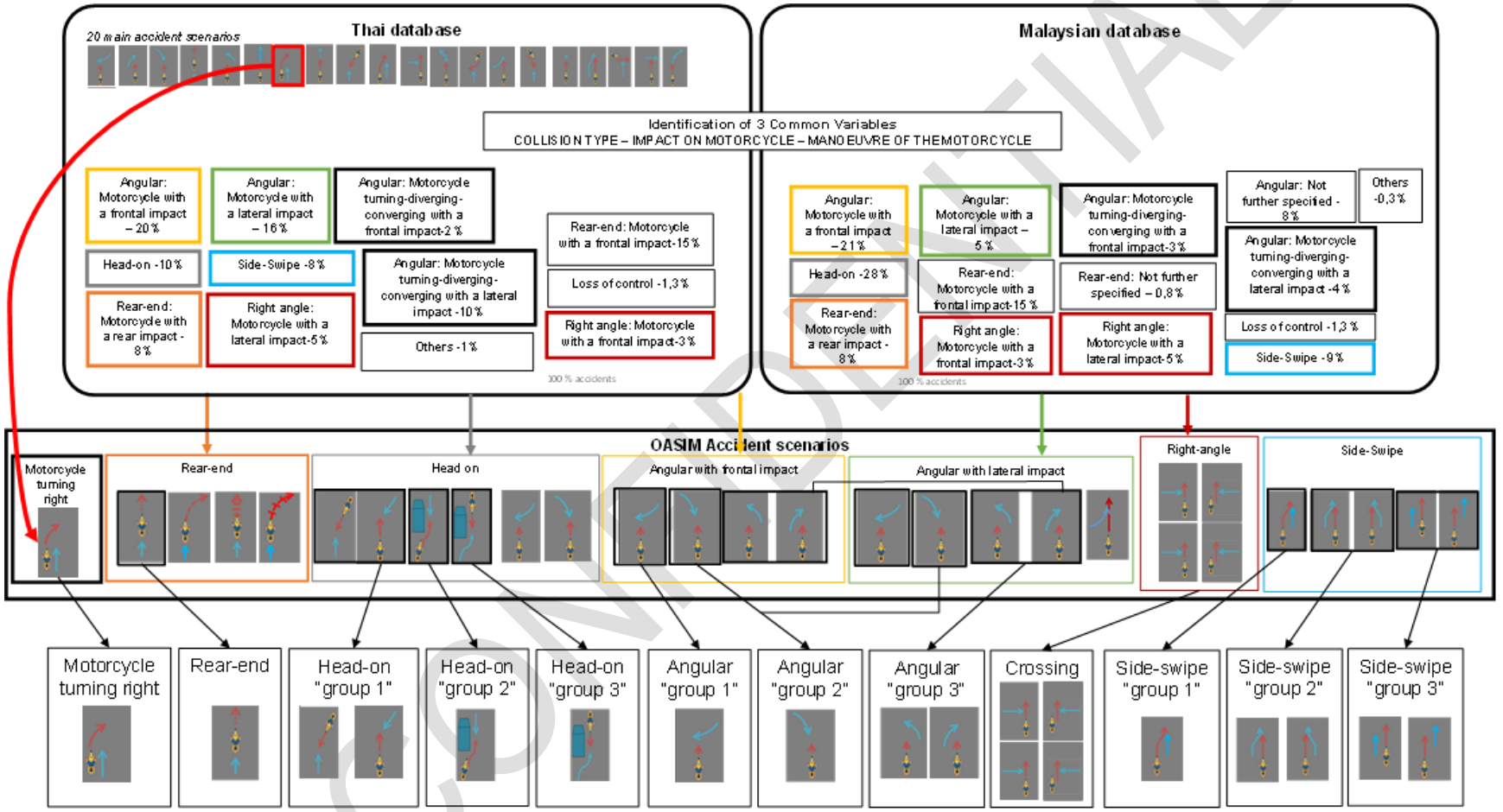
Table of illustration

Annex 2

List of tables

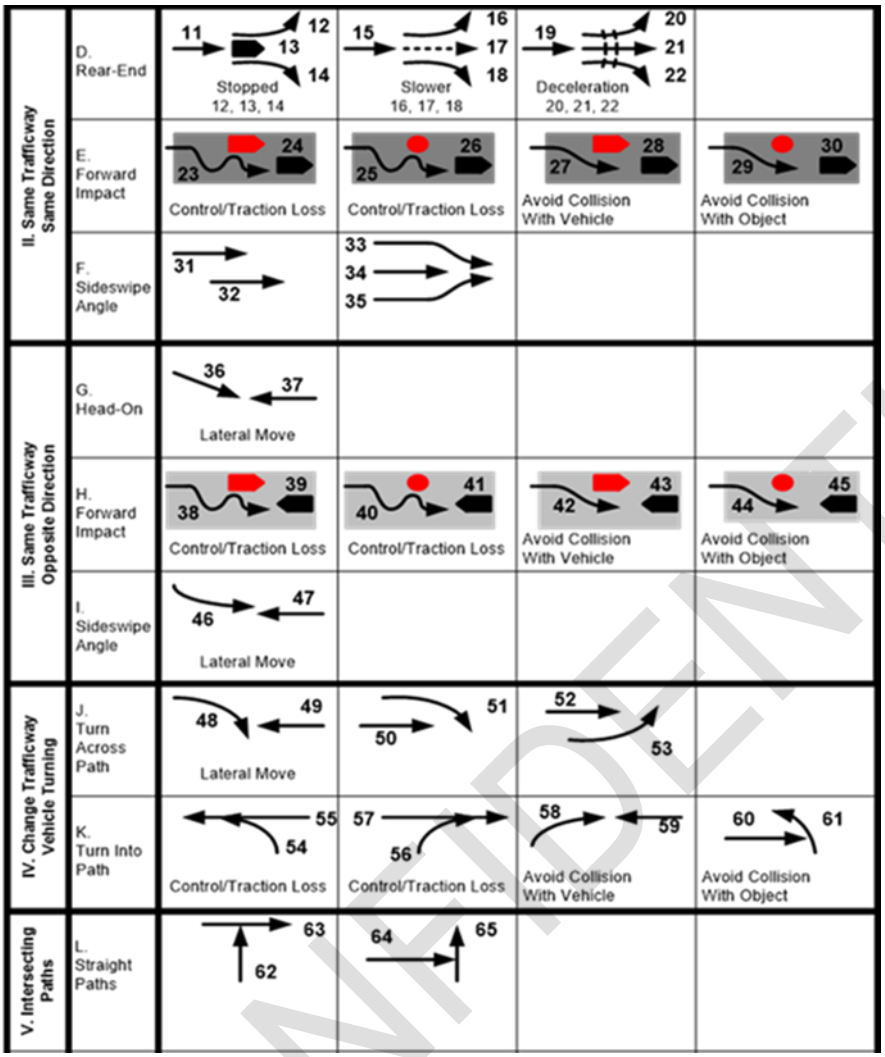
Annex 3

The method followed to identify the main sub-scenario accident within the WP1 is as below:

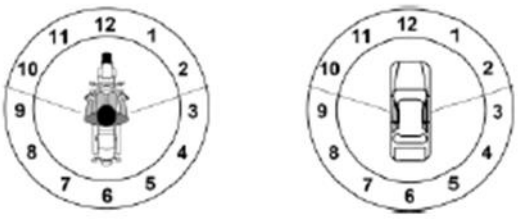


Annex 4

The following illustration provides a view of the Thai database pictogram.



The following table gives the localisation of the impact point on the motorcycle and on the car.



Annex 5

	% Day	Road configuration	% Intersection	Car manoeuvre	MC manoeuvre	Car Collision Speed	MC Collision Speed	% Avoidance action (car)	% Obstruction (car)
REAR-END	53%	76%	24%	Going straight	Going straight	77 kph	45 kph	44%	20%
HEAD-ON 1	46%	46%	19%	Going straight constant speed or passing on the right	Going straight constant speed	62 kph	60 kph	62%	4%
HEAD-ON 2	55%	64%	9%			55 kph	71 kph	45%	70%
HEAD-ON 3	50%	50%	20%			66 kph	55 kph	60%	70%
ANGULAR 1	57%	55%	75%	Turning right/left or U-turn	Going straight constant speed	22 kph	59 kph	18%	29%
ANGULAR 2	60%	68%	46%			18 kph	52 kph	27%	62%
ANGULAR 3	74%	50%	55%			19 kph	52 kph	12%	16%
MC TURNING RIGHT	91%	65%	31%	Going straight	Changing lane, entering the trafic	65 kph	34 kph	78%	17%
CROSSING	47%	40%	94%	Going straight in acceleration or constant speed	Going straight in acceleration or constant speed	46 kph	44 kph	34%	60%
SIDE-SWIPE 1	78%	37%	28%	Going straight, changing lane or entering the trafic	Changing lane, entering the trafic, going straight	70 kph	50 kph	44%	6%
SIDE-SWIPE 2	75%	54%	33%			35 kph	55 kph	0%	0%
SIDE-SWIPE 3	60%	30%	50%			35 kph	55 kph	10%	10%

MC = Motorcycle

Highway

Rural

City street