MAIDS Urban Accidents

Report

10/09/2009

Executive Summary

In the last years powered two wheelers (PTWs) represented a valuable mobility solution for the increasing congestion of urban roads. However PTW riders are still one of the most vulnerable groups of road users and one of the main protagonists of road accidents.

The European Safer Urban Motorcycling (eSUM) - a European project co-funded by EC DG TREN Accident Research and by a consortium of urban and national authorities, PTW manufacturers and road safety investigators - started its activities in June 2008 with the intent of studying the motorcycling phenomenon within cities. The aim of this project is to identify, develop and demonstrate measures designed to deliver safer urban motorcycling, in the short, medium and long term.

ACEM, as contribution to this project, developed this analysis of the MAIDS[1] database to understand better the characteristics of urban PTW accidents and to identify the major risk factors.

Out of the 921 accidents of the MAIDS database, a sub-database of 666 urban accidents was selected and analyzed. The information about the type of area was originally coded for cases, but not for controls. In order to identify potential risk factors in urban accidents, additional data collection was required for the localization of the petrol stations where controls were gathered. Using the additional data available in the database and Google Earth Technology, the information was coded and implemented in the MAIDS database using the same methodology applied during the main study.

The analysis of the urban database underlines some typical characteristics. A clear commuting use of the powered two wheelers was suggested by the fact that accidents occurred more during the early morning and end of the day, mainly during the week days and when riders are travelling from home to work and vice versa.

This study confirms that the major cause of accident was due to a human error, although the environmental factor was found to be of bigger relevance in the urban accident causation, especially when view obstructions along both rider's and other vehicle driver's line of sight were present, and roadway surface was contaminated by maintenance defects.

PTW riders involved in urban accidents were found to be less trained and skilled than other riders, having less official training and more control unfamiliarity and skill deficiencies.

---

[1] **MAIDS : Motorcycle Accidents In Depth Study -** MAIDS is the most comprehensive in-depth data currently available for Powered Two-Wheelers (PTWs) accidents in Europe. The investigation was conducted during 3 years on 921 accidents from 5 countries using the OECD common research methodology. More information on http://www.maids-study.eu/index.html

A different pattern was found when single and fatal urban accidents were analyzed separately. These accidents showed to be less commuting related and more connected to some recreational activities: they occurred more during the evening and night hours and PTW rider was more prone to take risks, such as speeding over the posted speed limit, wearing helmets improperly or being alcohol impaired.

Contents

1.0. Introduction ……… 4

1.1. Background ……5

1.2. Methodology and definitions …………………………………………………………………………………………6

2.0 General characteristics ………………………………………………………………………………………………. 7

3.0 Urban accident causation ……………………………………………………………………………………………. 12

3.1 Primary contributing factors ……………………………………………………………………………………………. 12

3.2 Additional Human Contributing Factors ……………………………………………………………………………. 15

3.3 Additional Environmental contributing factors ……………………………………………………………………. 21

4.0 Time of urban accidents ……………………………………………………………………………………………. 25

5.0 Location of urban accidents ………………………………………………………………………………………. 29

6.0 People involved in urban accidents …………………………………………………………………………….. 35

7.0 Vehicles involved in urban accidents …………………………………………………………………………… 39

8.0 PTW rider injuries ………………………………………………………………………………………………….. 42

9.0 Single vehicle urban accidents …………………………………………………………………………………….. 44

10.0 Fatal Urban Accidents ……………………………………………………………………………………………….. 47

11.0 Conclusions …….. 50

12.0 Glossary ……… 52

Annex I – Single urban accident Tables 56

Annex II – Fatal urban accident Tables 67

1.0 Introduction

This analysis of the MAIDS database was developed by ACEM within the framework of the European Safer Urban Motorcycling (eSUM) Project.

This report describes the results of the analysis of the urban sub-database collected during the MAIDS project. The urban database was analyzed in order to understand the main characteristics and major causes of accidents, the time and location where these most occur. In addition, a separate study was performed on single and fatal accident to better identify which traits may differ them from multi-vehicle and non fatal accidents.

This chapter provides a background of the MAIDS research and a description of the methodology used for the analysis of the urban MAIDS database.

1.1 Background

The Motorcycle Accident In Depth Study (MAIDS) was developed in response to the necessity of having an in-depth data on European Power Two Wheeler (PTW) accidents. The study was made during the period 1999-2000 in five sampling areas located in Italy, Germany, Netherlands, Spain and France. The five research teams applied the internationally recognized OECD methodology[2] for on-scene in-depth motorcycle accident investigation in order to maintain consistency in the data collection.
A total of 921 accidents were investigated in details, where approximately 2000 variables were coded, including information on environmental factors, PTW and Other Vehicle (OV) mechanical factors, dynamics of the vehicle involved, human factors and factors which contributed to the accident causation.

In order to identify potential risk factors associated with PTW operation or use, accidents data were compared with 923 control cases collected within the PTW/rider population riding in the sampling areas. The control data collection methods involved conducting PTW rider

[2] Useful links for more information on the OECD common methodology:

http://www.maids-study.eu/pdf/MAIDS_MethodologyandProcess.pdf
http://www.oecd.org/document/38/0,3343,en_2649_34351_2079078_1_1_1_1,00.html

and passengers' interviews and PTW mechanical inspections at randomly selected petrol stations. For more details on the MAIDS project and methodology, please refer to the MAIDS Report 2.0, page 11-15.

The investigation included a full reconstruction of the accident; vehicles were inspected; witnesses to the accident were interviewed; and, subject to the applicable privacy laws, with the full cooperation and consent of both the injured person and the local authorities, pertinent medical records for the injured riders and passengers were collected. From this data, all the human, environmental and vehicle factors which contributed to the outcome of the accident were identified.

To provide comparative information on riders and PTWs that were not involved in accidents in the same sample areas, data was collected in a further 923 cases. The collection technique was specifically developed to meet the circumstances of this study and is commonly referred to as an exposure or case-control study. This exposure information on non-accident involved PTW riders was essential for establishing the significance of the data collected from the accident cases and the identification of potential risk factors in PTW accidents. For example, if 20% of non-accident involved PTWs in the sampling area were red, it would be significant if 60% of those PTWs involved in an accident were reported to be red, suggesting that there is an increased risk of riding a red PTW. On the other hand, if none of the PTWs in the accident sample were red, it would an interesting finding, needing further study.

Exposure data

In order to identify potential risk factors associated with PTW operation or use, it was necessary to compare the accident data with the characteristics of the PTW/rider population riding within each sampling area. This is referred to as a case control study wherein the cases (i.e., the accidents) are compared with an identical non-accident population (i.e., the circulating riding population within the sampling area). Statistical comparisons of the characteristics of this PTW/rider population and the accident population provide a method of estimating whether or not a risk factor (e.g., PTW style) is over or under-represented in the accident database and whether or not there is greater or less risk of being in an accident if that risk factor is present. It was the objective of this study to identify and examine as many of these risk factors as possible. This methodology has been used successfully in previous in-depth motorcycle accident studies (Hurt et al., 1980, Haworth et al., 1997).

Accident data collection

Each accident was investigated in detail, resulting in approximately 2000 variables for each accident case. Cooperative agreements were established with local regulatory agencies (e.g., police and hospitals) within each of the sampling areas. This maximized the amount of information which could be obtained during the in-depth investigations.

In order to identify accident cause and consequences, the investigation included a full reconstruction of the accident, including the documentation of human, environment and vehicle factors, and an identification of all accident contributing factors. Specific attention was paid to the conditions under which the accident took place, the initial conditions of the accident (e.g., vehicles, travel direction, roadway alignment, lighting, traffic controls, etc.), as well as to the pre-crash motions of all involved vehicles. Vehicles involved in the causation of the accident were defined as Other Vehicles (OV), whether or not they were struck. Intended motions (e.g., turning, negotiating a bend, etc.) as well as collision avoidance manoeuvres were investigated and coded. Detailed post-crash vehicle inspections provided investigators with information regarding the condition of the vehicle as well as evidence of contact damage, use of lights and marks on the tyre from braking. All of this information added to the accuracy and reliability of the in-depth accident reconstruction.

Accident reconstruction

Upon completion of the on-scene accident investigations, each research team completed a detailed reconstruction and accident causation worksheet describing all phases of the accident and all potential causes. Pre-crash motions of the PTW, PTW rider, passenger and all involved vehicles were determined and any collision avoidance manoeuvres were identified. Traditional accident reconstruction techniques were used to determine both pre-crash speeds and impact speeds of all vehicles.

1.2 Methodology and definitions

This research analyzed all urban accidents contained in the MAIDS database. Cases were selected if the variable *A.3.1.1 Type of Area* was coded as “urban industrial”, “commercial, business, shopping”, “housing apartments”, “housing residential”, “urban school” or “urban park”.

During the MAIDS data collection, teams coded information on type of area only for cases, but unfortunately not for controls. In order to provide in this analysis a risk assessment of urban accident characteristics, the information was collected and coded in the MAIDS database using the available additional data. In fact the MAIDS database contains the name and address of petrol stations where controls data were collected, and thanks to the help of Google Earth technology, control files were classified according to their location. The new information was coded following the same criteria used for coding MAIDS cases.

The analysis of urban accident and control data has been performed comparing PTW legal categories, i.e. mopeds (mofas and mopeds) and motorcycles. According to European regulation, PTW vehicles have been divided into categories based upon their engine capacity and speed design. There are currently two main types of PTW legal categories: L1 and L3 vehicle categories.

A moped is defined as a two wheeled vehicle with an engine cylinder capacity not exceeding 50 cm^3 and a maximum design speed not exceeding 50 km/h. A moped is a L1 vehicle and might be designed with or without pedals.

A mofa is defined as a moped with a maximum design speed not exceeding 25 km/h. A mofa is a L1 vehicle and might be designed with or without pedals.

A motorcycle is defined as a two wheeled vehicle with an engine capacity exceeding 50 cm^3 and a maximum design speed exceeding 50 km/h. A motorcycle is a L3 vehicle.

This report will use the term PTW to describe all power two wheelers, the term L1 vehicle to describe mopeds and mofas and the term L3 vehicles to describe motorcycles.

Whenever possible, an additional urban data comparison was done between cases and controls to assess any possible risk factor. The MAIDS urban database was also analyzed to better understand the main characteristics of single accidents and fatal accidents.
A chi-square analysis was conducted to better understand the relationship between the accident data and the exposure data. The analysis tested the null hypothesis that there was no relationship between the accident and exposure variables. If the significance level (i.e., the p value for a two tailed test) of the computed chi-square statistic is below 0.05, then the two groups are considered to be significantly different and the null hypothesis was rejected.

2.0 General characteristics

On 921 cases contained in the MAIDS database 666 (72.3%) occurred in urban areas and 229 (24.9%) in rural areas. When accident cases were compared to the controls, it was found that urban locations were over-represented in PTW accidents (72.3% vs. 66.3%). The chi-square analysis shows that there was a significant difference between the control cases and the accident cases in terms of type of area. In 14% of the controls, it was not possible to determine a posteriori the location of the petrol station where subjects were collected.

Type of Area	Case		Control		Total	
	N	%	N	%	N	%
urban	666	72.3	612	66.3	1278	69.3
rural	229	24.9	182	19.7	411	22.3
other	26	2.8	0	0.0	26	1.4
unknown	0	0.0	129	14.0	129	7.0
Total	921	100	923	100	1844	100

Table 2.1 Type of Area

PTW legal category. Although urban accidents were more or less equally distributed among PTW legal categories, L1 vehicle were found to be more frequently involved than L3 vehicles (51.4% L1 cases vs. 48.6% of L3 cases). Moped accidents were also found to be over-represented in urban accidents when compared to the controls (51.4% L1 cases vs. 45.6% L1 controls). The difference between moped accidents and moped controls was significant. Motorcycle accidents on the other hand were found to be under-represented in urban accidents when compared to controls (48.6% L3 cases vs. 54.4% of L3 controls).

PTW legal category	Case		Control		Total	
	N	%	N	%	N	%
L1	342	51.4	279	45.6	621	48.6
L3	324	48.6	333	54.4	657	51.4
Total	666	100.0	612	100.0	1278	100.0

Table 2.2 PTW legal category

Number of fatalities. In fifty cases out of 666 the accident had a fatal outcome, representing the 7.5% of the MAIDS urban database. When considering PTW legal categories separately, it was found that L3 vehicles were more involved in fatal accidents than L1 vehicles (9.9% of L3 cases vs. 5.3% of L1 cases). In five cases (0.8%) involving a L3 vehicle the investigators were not able to collect data on the rider's trauma status.

PTW fatalities	L1		L3		Total	
	N	*%*	*N*	*%*	*N*	*%*
No	324	94.7	287	88.6	611	91.7
Yes	18	5.3	32	9.9	50	7.5
Unknown	0	0.0	5	1.5	5	0.8
Total	342	100	324	100	666	100

Table 2.3 Number of PTW fatalities

Collision partner. The majority of urban accidents (81.8%) were involving another motor vehicle during the collision. The second most common collision partner was found to be the roadway, present in 7.7% of the cases. These cases didn't exclude though the presence of another vehicle in the accident, it only indicates that during the accident events, the PTW rider lost control and impacted the roadway before any other possible impacts. PTW rider was impacting a parked vehicle or a fixed object in 3.2% and 4.2% of the urban cases. In 1.4% of cases the PTW rider was colliding with a pedestrian. Comparing PTW legal categories, L3 vehicles were found to collide more with roadway and fixed objects than L1 vehicles. In fact roadway collisions were counted in 10.5% of L3 cases and 5% of L1 cases, while fixed objects were present in 4.6% of L3 cases and 3.8% of L1 cases.

Collision Partner	L1		L3		Total	
	N	*%*	*N*	*%*	*N*	*%*
other motor vehicle	291	85.1	254	78.4	545	81.8
other motor vehicle parked	10	2.9	11	3.4	21	3.2
roadway	17	5.0	34	10.5	51	7.7
off road environment, fixed object	13	3.8	15	4.6	28	4.2
bicycle	3	0.9	1	0.3	4	0.6
pedestrian	3	0.9	6	1.9	9	1.4
animal	1	0.3	1	0.3	2	0.3
other	4	1.2	2	0.6	6	0.9
Total	342	100	324	100	666	100

Table 2.4 Collision partner

Number of other vehicle involved. In 89.6% of urban cases there were at least two parties involved in the accidents: in 85.3% of cases the PTW vehicle was crashing with one other vehicle, in 4.2% with two other vehicles and in one case (0.1%) the accident involved other three vehicles. In 69 cases the PTW rider was the only party involved in the accident events, representing the 10.4% of the MAIDS urban database. L3 vehicles were found to be more involved in single vehicle accidents than L1 vehicles (11.7% vs. 9.1%).

Number of OV involved	L1		L3		Total	
	N	*%*	*N*	*%*	*N*	*%*
Zero	31	9.1	38	11.7	69	10.4
One	297	86.8	271	83.6	568	85.3
Two	14	4.1	14	4.3	28	4.2
Three	0	0	1	0.3	1	0.1
Total	342	100	324	100	666	100

Table 2.5 Number of OV involved

Passengers and pedestrians. Pedestrians were present in 1.5% of urban accidents and it was found that motorcycles were more frequently involved in this type of collisions (1.9% vs. 0.9%).

Number of pedestrians	L1		L3		Total	
	N	*%*	*N*	*%*	*N*	*%*
Zero	339	99.1	317	97.8	656	98.5
One	3	0.9	6	1.9	9	1.4
Three	0	0.0	1	0.3	1	0.1
Total	342	100	324	100	666	100

Table 2.6 Number of pedestrians

PTW riders were carrying a passenger in 9.9% of cases: moped riders were found to transport more passengers than motorcycle riders (10.5% vs. 9.3%). Although at the time of data collection in some MAIDS countries it was not allowed to carry a passenger on mopeds, no major illegal behaviors were found, since the majority of cases with PTW passengers occurred in countries where this was a legal practice.

Number of passengers	L1		L3		Total	
	N	*%*	*N*	*%*	*N*	*%*
Zero	306	89.5	294	90.7	600	90.1
One	36	10.5	30	9.3	66	9.9
Total	342	100.0	324	100.0	666	100.0

Table 2.7 Number of passengers on PTW

Accident configuration. In 30.5% of urban cases the vehicles involved were travelling in a perpendicular path and in 11.1% the other vehicle turned left in front of the PTW. When PTW legal categories were compared, mopeds were found to be more involved in head on and OV into PTW, perpendicular path collisions (7.3% vs. 2.5% and 12% vs. 5.9%) while motorcycles were instead more prone to loose control and fall on roadway (13.3% vs. 6.7%).

.

Accident configuration	L1		L3		Total	
	N	%	N	%	N	%
head-on collision of PTW and OV	25	7.3	8	2.5	33	5.0
OV into PTW impact at intersection; paths perpendicular	41	12.0	19	5.9	60	9.0
PTW into OV impact at intersection; paths perpendicular	34	9.9	35	10.8	69	10.4
OV turning left in front of PTW, PTW perpendicular to OV path	38	11.1	36	11.1	74	11.1
PTW & OV in opp. dir., OV turns in front of PTW, MC impacting	20	5.8	32	9.9	52	7.8
PTW overtaking OV while OV turning left	20	5.8	23	7.1	43	6.5
PTW impacting rear of OV	22	6.4	27	8.3	49	7.4
PTW falling on roadway, no OV involvement	13	3.8	20	6.2	33	5.0
PTW falling on roadway in collision avoidance with OV	10	2.9	23	7.1	33	5.0
other (includes 16 different categories below 5%)	119	34.8	101	31.2	220	33.0
Total	342	100.0	324	100.0	666	100.0

Table 2.8 Accident configuration

Helmet. Helmet wearing was found to be a problem more for L1 riders than it was for L3 riders. In fact 18.1% of moped riders were not wearing a helmet at time of accident, compared to 0.3% of motorcycle riders. Moped riders were also found to have an unsafe attitude towards helmet wearing, since 5.5% of these did not adjust their helmets properly on head (1.9% L3 riders), and 10.8% did not fast them securely (4.3% L3 riders). When comparing urban accidents cases with the controls, no major differences were found, a part from a slight over-representation in accident of both L1 and L3 riders with not securely fastened helmets. It has to be noted though that the high percentage of not helmet wearing could be influenced by the fact that at time of data collection not all countries had a helmet wearing law. The size of helmet was also found to be more a problem for L1 than L3 riders. In fact in 7.6% of L1 cases helmets were too loose and in 0.6% too tight (2.8% and 0.3% for L3 riders).

Wearing helmet on head?		Case		Control		Total	
		N	*%*	*N*	*%*	*N*	*%*
L1	No	62	18.1	55	19.7	117	18.8
	Yes	269	78.7	224	80.3	493	79.4
	Unknown	11	3.2	0	0.0	11	1.8
	Total	342	100.0	279	100.0	621	100.0
L3	No	1	0.3	3	0.9	4	0.6
	Yes	320	98.8	330	99.1	650	98.9
	Unknown	3	0.9	0	0.0	3	0.5
	Total	324	100.0	333	100.0	657	100.0

Table 2.9 Helmet wearing

Was helmet properly adjusted on head?		Case		Control		Total	
		N	*%*	*N*	*%*	*N*	*%*
L1	Not applicable	*62*	*18.1*	*55*	*19.7*	*117*	*18.8*
	No	19	5.6	15	5.4	34	5.5
	Yes	223	65.2	208	74.5	431	69.4
	Unknown	38	11.1	1	0.4	39	6.3
	Total	342	100.0	279	100.0	621	100.0
L3	Not applicable	*1*	*0.3*	*3*	*0.9*	*4*	*0.6*
	No	6	1.9	4	1.2	10	1.5
	Yes	292	90.1	326	97.9	618	94.1
	Unknown	25	7.7	0	0.0	25	3.8
	Total	324	100.0	333	100.0	657	100.0

Table 2.10 Helmet properly adjusted on head

Was helmet securely fastened?		Case		Control		Total	
		N	*%*	*N*	*%*	*N*	*%*
L1	Not applicable	*62*	*18.1*	*55*	*19.7*	*117*	*18.8*
	No	37	10.8	26	9.3	63	10.1
	Yes	201	58.8	197	70.6	398	64.1
	Unknown	42	12.3	1	0.4	43	6.9
	Total	342	100.0	279	100.0	621	100.0
L3	Not applicable	*1*	*0.3*	*3*	*0.9*	*4*	*0.6*
	No	14	4.3	7	2.1	21	3.2
	Yes	283	87.4	323	97.0	606	92.2
	Unknown	26	8.0	0	0.0	26	4.0
	Total	324	100.0	333	100.0	657	100.0

Table 2.11 Helmet securely fastened on head

Helmet fit		Case		Control		Total	
		N	*%*	*N*	*%*	*N*	*%*
L1	Not applicable	*62*	*18.1*	*55*	*19.7*	*117*	*18.8*
	Acceptable fit	206	60.2	201	72.0	407	65.5
	Too large, too loose	26	7.6	18	6.5	44	7.1
	Too small, too tight	2	0.6	4	1.4	6	1.0
	Unknown	46	13.5	1	0.4	47	7.6
	Total	342	100.0	279	100.0	621	100.0
L3	Not applicable	*1*	*0.3*	*3*	*0.9*	*4*	*0.6*
	Acceptable fit	276	85.2	315	94.6	591	90.0
	Too large, too loose	9	2.8	13	3.9	22	3.3
	Too small, too tight	1	0.3	2	0.6	3	0.5

	Unknown	37	11.4	0	0.0	37	5.6
	Total	324	100.0	333	100.0	657	100.0

Table 2.12 Helmet fit

Findings on general urban accident characteristics

- 72.3% of MAIDS accidents occurred in urban areas
- L1 vehicles were found to be overrepresented
- 7.5% of urban accidents had a fatal outcome: L3 fatalities are higher than L1 fatalities
- 81.8% of urban accidents involved a collision partner
- 10.4% of accidents were single vehicle accidents: motorcycles had more single vehicle accidents
- 1.6% of accidents involved a pedestrian
- in 9.9% of cases the PTW rider was carrying a passenger
- in 30.5% of cases the vehicles were travelling perpendicular to each other
- Moped's riders were found to have an unsafe attitude towards helmet wearing.

3.0 Urban accident causation

3.1 Primary contributing factors

At the end of each case investigation, teams were meeting and discussing the factors that most contributed to the accident causation. Their judgment was based on the accident reconstruction, evidences on scene and interviews of witnesses and people involved. The analysis of the primary causes of the accident found that in 87% of cases, the event was caused by a human failure: in 51.7% of cases by the other vehicle driver and 35.3% by PTW riders. Sixty-four cases (9.6%) were caused by an environmental factor and two (0.3%) by a mechanical failure of the PTW vehicle. Comparing PTW legal categories, L1 riders were found to commit more failures than L3 riders (39.6% vs. 31.2%), therefore in L3 vehicle accidents the percentage of other vehicle driver's failures was found to be higher (54.9% vs. 48.5%).

Primary contributing factor	L1		L3		PTW	
	N	*%*	*N*	*%*	*N*	*%*
Human - PTW rider	134	39.2	101	31.2	235	35.3
Human - OV driver	166	48.5	178	54.9	344	51.7
Vehicle - PTW failure	1	0.3	1	0.3	2	0.3
Environment	32	9.4	32	9.9	64	9.6
Other failures	9	2.6	12	3.7	21	3.2
Total	342	100.0	324	100.0	666	100.0

Table 3.1 primary contributing factors

Primary PTW rider Contributing Factors. The most frequent error made by PTW rider was a failure in perceiving the upcoming danger, present in 37.9% of the cases caused by PTW rider. A failure in deciding the proper action or reaction to the upcoming danger was the second most frequent error made by the rider (32.3%), followed by a failure in reacting properly (14%) and in understanding correctly the situation (10.6%). Moped riders were found to commit more perception and decision failures than motorcycle riders (44% vs. 29.7% and 34.3% vs. 29.7%). Although the most frequent mistakes made by the motorcycle rider were still perception and decision failures (29.7%), they were found to make more comprehension and reaction failures than moped riders (14.9% vs. 7.5% and 18.8% vs. 10.4%).

Primary contributing factor - Human PTW rider	L1		L3		PTW	
	N	*%*	*N*	*%*	*N*	*%*
Perception failure	59	44.0	30	29.7	89	37.9
Comprehension failure	10	7.5	15	14.9	25	10.6
Decision failure	46	34.3	30	29.7	76	32.3
Reaction failure	14	10.4	19	18.8	33	14.0
Avoiding a different collision	2	1.5	2	2.0	4	1.7
Failure of unknown type	3	2.2	5	5.0	8	3.4
Total	134	100.0	101	100.0	235	100.0

Table 3.2 PTW Human contributing factors

Primary Other Vehicle Contributing Factors. In 75.6% of the cases where OV driver was at fault, a perception failure was the major cause of the accident, followed by decision failure (19.8%) and comprehension failure (2.9%). The other vehicle driver was found to make more perception failures when involved in accidents with mopeds (80.1% L1 vs. 71.3% L3) and more decision failures when involved with motorcycles (24.2% L3 vs. 15.1% L1).

Primary contributing factor - Human OV driver	L1		L3		PTW	
	N	*%*	*N*	*%*	*N*	*%*
Perception failure	133	80.1	127	71.3	260	75.6
Comprehension failure	6	3.6	4	2.2	10	2.9
Decision failure	25	15.1	43	24.2	68	19.8
Reaction failure	1	0.6	1	0.6	2	0.6
OV post-crash motions from a prior collision	0	0.0	2	1.1	2	0.6
other vehicle avoiding a different collision	0	0.0	1	0.6	1	0.3
other vehicle driver failure, unknown type	1	0.6	0	0.0	1	0.3
Total	166	100.0	178	100.0	344	100.0

Table 3.3 OV driver Human contributing factors

Primary Vehicle and Environmental Contributing Factors. Only 2 cases on 666 urban accidents were caused by a mechanical failure of the PTW vehicle, mainly due to a pre-existing PTW maintenance related problem. Among the environmental factors, stationary and mobile view obstructions were found to cause more urban accidents (39.1%), followed by a roadside element (14.1%), a roadway maintenance or design defect and a traffic control problem (7.8%). Mopeds riders were found to be more affected by view obstructions than motorcycle riders (53.1% vs. 25.0%). L3 vehicle accidents, on the other hand, were caused more by roadside environment, traffic control problems and manoeuvres by another vehicle not involved in the accident.

Primary contributing factor - Environmental	L1		L3		PTW	
	N	*%*	*N*	*%*	*N*	*%*
roadway design defect	3	9.4	2	6.3	5	7.8
roadway maintenance defect	3	9.4	2	6.3	5	7.8
traffic control problem, temporary traffic obstruction	1	3.1	4	12.5	5	7.8
view obstruction, mobile or stationary	17	53.1	8	25.0	25	39.1
roadside environment factor, animal and pedestrian	4	12.5	5	15.6	9	14.1
adverse weather	0	0.0	3	9.4	3	4.7
some maneuver of another vehicle, not involved in the collision	4	12.5	8	25.0	12	18.8
Total	32	100.0	32	100.0	64	100.0

Table 3.4 Environmental primary contributing factors

Secondary Contributing Factors. Among all secondary contributing factors, 42.9% of them were related to the PTW rider's failure, followed by the 28.0% of OV driver failures and 15.4% of environmental factors. When comparing the PTW legal categories, it was found that OV driver failures were contributing more in motorcycle accidents (27.4% vs. 28.7%), while the environment was affecting more moped accidents (17.8% vs. 12.4%).

Contributing factors	L1		L3		PTW	
	N	*%*	*N*	*%*	*N*	*%*
Human - PTW rider	377	43.0	301	42.8	678	42.9
Human - OV driver	240	27.4	202	28.7	442	28.0
Vehicle - PTW failure	21	2.4	7	1.0	28	1.8
Vehicle - OV failure	6	0.7	2	0.3	8	0.5
Environment	156	17.8	87	12.4	243	15.4
Other failures	53	6.0	41	5.8	94	5.9
Unknown	24	2.7	64	9.1	88	5.6
Total	877	100.0	704	100.0	1581	100.0

Table 3.5 Secondary contributing factors

3.2 Additional Human Contributing Factors

Together with the primary and secondary contributing factors, investigating teams had to evaluate what other elements might have played a role in the accident events.

Alcohol impairment. In 3.3% of urban cases the PTW rider was found to have drunk alcohol before the accident and in 1.2% the rider was significantly impaired. The other vehicle driver was found to have drunk in 2.3% of cases and to be significantly impaired in 1.2%. Among PTW riders, moped riders were found to be the ones to have drunk most (4.7% L1 vs. 1.9% L3) and to be most significantly impaired (2% L1 vs. 0.3% L3).

Alcohol/drug involvement	L1		L3		PTW		OV	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
None	310	90.6	310	95.7	620	93.1	545	91.3
Alcohol use, only	16	4.7	6	1.9	22	3.3	14	2.3
Drug use, only	3	0.9	1	0.3	4	0.6	4	0.7
alcohol and drug use	2	0.6	0	0.0	2	0.3	0	0.0
unknown	11	3.2	7	2.2	18	2.7	34	5.7
Total	342	100.0	324	100.0	666	100.0	597	100.0
Alcohol/drug impairment	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Not applicable	310	90.6	310	95.7	620	93.1	546	91.5
No impairment	2	0.6	3	0.9	5	0.8	5	0.8
not significantly impaired	7	2.0	1	0.3	8	1.2	3	0.5
significantly impaired	7	2.0	1	0.3	8	1.2	7	1.2
unknown	16	4.7	9	2.8	25	3.8	36	6.0
Total	342	100.0	324	100.0	666	100.0	597	100.0

Table 3.6. Alcohol and drug impairment

Physiological impairment and Stress. In 24 cases (3.6%) the PTW rider declared to have been tired at time of accident, more frequent in moped than in motorcycle riders (4.1% vs. 3.1%). The other vehicle driver’s fatigue was counted in 1.8% of urban accident.

Physiological impairment, transient condition	L1		L3		PTW		OV	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
None	261	76.3	259	79.9	520	78.1	414	69.3
Fatigue	14	4.1	10	3.1	24	3.6	11	1.8
Hunger	2	0.6	3	0.9	5	0.8	7	1.2
Elimination urgency	0	0.0	1	0.3	1	0.2	0	0.0
muscle spasm	2	0.6	0	0.0	2	0.3	0	0.0
Headache, fever	0	0.0	1	0.3	1	0.2	0	0.0
other	2	0.6	1	0.3	3	0.5	0	0.0
unknown	61	17.8	49	15.1	110	16.5	165	27.6
Total	342	100.0	324	100.0	666	100.0	597	100.0

Table 3.7. Physiological impairment, transient condition

PTW rider declared to be stressed in 8.8% of the cases, mostly related to work problems or conflict with friends or relatives. Moped riders were found to be more stressed than motorcycle riders and other vehicle drivers (9.4% L1 vs. 8% L3 and 7.5% OV).

Stress experienced that day	L1		L3		PTW		OV	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
none observed	249	72.8	247	76.2	496	74.5	385	64.5
conflict with friends/relatives	8	2.3	4	1.2	12	1.8	9	1.5
work problems	8	2.3	10	3.1	18	2.7	13	2.2
financial distress	1	0.3	0	0.0	1	0.2	1	0.2
school problems	2	0.6	0	0.0	2	0.3	2	0.3
legal problems	2	0.6	2	0.6	4	0.6	0	0.0
reward stress	6	1.8	2	0.6	8	1.2	2	0.3
traffic conflict	0	0.0	1	0.3	1	0.2	8	1.3
other	5	1.5	7	2.2	12	1.8	10	1.7
unknown	61	17.8	51	15.7	112	16.8	167	28.0
Total	342	100.0	324	100.0	666	100.0	597	100.0

Table 3.8. Stress experienced that day

Attention. PTW riders were found to have an attention problem at time of accident in 34.8% of the cases. The most frequent reasons of inattention were looking at other traffic (18.5%) and daydreaming (10.8%). Motorcycle riders were found to have more attention problems than moped riders (39.8% vs. 30.4%). L3 riders were more prone to divert their attention to surrounding traffic and on motorcycle controls, while L1 riders were more prone to daydream. Other vehicle driver was found to be inattentive in 32.8% of cases and they were mostly distracted by other traffic or by daydreaming.

Attention to passenger tasks	L1		L3		PTW		OV	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
attention to driving/passenger tasks not a factor	192	56.1	156	48.1	348	52.3	253	42.4
inattentive mode, daydreaming, no attention to driving tasks	48	14.0	24	7.4	72	10.8	49	8.2
attention diverted to surrounding traffic	35	10.2	88	27.2	123	18.5	117	19.6
attention diverted to motorcycle normal operation	3	0.9	11	3.4	14	2.1	4	0.7
attention diverted to motorcycle operating problem	1	0.3	3	0.9	4	0.6	5	0.8
attention diverted to non-traffic item	10	2.9	1	0.3	11	1.7	8	1.3
attention diverted to passenger activities (rider, only)	2	0.6	1	0.3	3	0.5	6	1.0
attention diverted to use of mobile phone	1	0.3	0	0.0	1	0.2	1	0.2
attention diverted to radio, tape, VCR, CD, PC, etc.	1	0.3	0	0.0	1	0.2	1	0.2
other	3	0.9	1	0.3	4	0.6	5	0.8
unknown	46	13.5	39	12.0	85	12.8	148	24.8
Total	342	100	324	100	666	100	597	100.0

Table 3.9. Attention to passenger tasks

Riding skills. In 9.2% of urban cases the PTW rider was found to have some kind of control unfamiliarity on their PTW and this was more frequent in motorcycle riders than on moped riders (13.9% vs. 4.7%). This control unfamiliarity was reported to contribute to accident more for L3 than for L1 riders (5.2% vs. 1.5%).

PTW rider control unfamiliarity	L1		L3		PTW	
	N	*%*	*N*	*%*	*N*	*%*
not applicable, no OV or no control unfamiliarity	317	92.7	276	85.2	593	89.0
control unfamiliarity was not a contributing factor	11	3.2	28	8.6	39	5.9
control unfamiliarity was a contributing factor	5	1.5	17	5.2	22	3.3
unknown	9	2.6	3	0.9	12	1.8
Total	342	100.0	324	100.0	666	100.0

Table 3.10. PTW rider control unfamiliarity

Skills deficiency was present in 14.4% of cases and contributed to accident causation in 9% of cases. L3 riders were found to have more skills deficiencies than L1 riders (16.3% vs. 12.5%), but this contributed more in mopeds than motorcycle accidents.

PTW rider skill deficiency	L1		L3		PTW	
	N	*%*	*N*	*%*	*N*	*%*
not applicable, no OV or no evidence of skills deficiency	290	84.8	266	82.1	556	83.5
skills deficiency present, but not a contributing factor	10	2.9	26	8.0	36	5.4
skills deficiency present as a contributing factor	33	9.6	27	8.3	60	9.0
unknown	9	2.6	5	1.5	14	2.1
Total	342	100.0	324	100.0	666	100.0

Table 3.11. PTW rider skill deficiency

Eleven percent of riders had some kind of unfamiliarity on their vehicles (7.9% L1 and 13.9% L3) and this contributed to accident causation in 4.4% of cases (4.1% for L1 and 4.6% for L3).

PTW rider vehicle unfamiliarity	L1		L3		PTW	
	N	*%*	*N*	*%*	*N*	*%*
not applicable, no OV or no vehicle unfamiliarity	308	90.1	273	84.3	581	87.2
vehicle unfamiliarity present, but not a contributing factor	13	3.8	30	9.3	43	6.5
vehicle unfamiliarity present as a contributing factor	14	4.1	15	4.6	29	4.4
unknown	7	2.0	6	1.9	13	2.0
Total	342	100.0	324	100.0	666	100.0

Table 3.12. PTW rider vehicle unfamiliarity

Speed. In 22% of cases the PTW rider was travelling at a speed exceeding more than 10 km/h the speed limit. Comparing PTW legal categories, motorcycle riders were found to speed more than moped riders (29.6% vs. 15.5%). When fatal cases are analyzed separately, the percentage of PTW riders speeding increases to 46%, with 53.1% of cases related to L3 riders and 33.3% to L1 riders. The other vehicle was found to speed in 6.4% of urban cases and in 20.5% of fatal accidents.

Speeding over 10 km/h over posted speed limit	L1		L3		PTW		OV	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Not speeding	289	84.5	228	70.4	517	77.6	547	91.6
Speeding	53	15.5	96	29.6	149	22.4	38	6.4
Unknown	0	0.0	0	0.0	0	0.0	12	2.0
Total	342	100.0	324	100.0	666	100.0	597	100.0

Table 3.13. Speeding

In 25.3% of cases the PTW speed was either above or below the surrounding traffic and this speed difference was considered to be a contributing factor in 17% of cases. An unusual speed compared to the other traffic was contributing more frequently in motorcycle accidents (19.4% vs. 14.6%). The other vehicle was found to have an unusual speed in 12.4% cases and this to contribute in 4.4% of accidents.

Speed compared to surrounding traffic	L1		L3		PTW		OV	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
no OV or no unusual speed or no other traffic	260	76.0	237	73.1	497	74.6	511	85.6
speed was unusual but did not contribute to accident	31	9.1	24	7.4	55	8.3	48	8.0
unusual speed difference caused or contrib. to accident	50	14.6	63	19.4	113	17.0	26	4.4
unknown	1	0.3	0	0.0	1	0.2	12	2.0
Total	342	100.0	324	100.0	666	100.0	597	100.0

Table 3.14. Speed compared to surrounding traffic

Traffic strategy. It was found that in 65.3% of cases the PTW rider committed a faulty traffic strategy and in 33% this failure contributed to accident causation. A faulty traffic strategy was considered to be present whenever the PTW rider or the OV driver made a poor decision to perform a maneuver or movement. The assessment of the decision was made by investigators who were experienced PTW riders or OV drivers and based upon the general driving situations in the sampling area. When legal categories are compared, moped riders were found to commit more wrong traffic strategies that led to the accident (36.3% vs. 30.9%). OV driver made a faulty traffic strategy in 73.8% of cases and this contributed in 39.7% of the accidents.

Faulty traffic strategy	L1		L3		PTW		OV	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
not applicable, no OV or no other traffic present	110	32.2	119	36.7	229	34.4	182	30.5
traffic strategy made no contribution to accident causation	107	31.3	104	32.1	211	31.7	166	27.8
traffic strategy contributed to accident causation	124	36.3	100	30.9	224	33.6	237	39.7
unknown	1	0.3	1	0.3	2	0.3	12	2.0
Total	342	100.0	324	100.0	666	100.0	597	100.0

Table 3.15 Faulty traffic strategy

Position relative to the other traffic. The position of PTW in traffic was considered not safe and to contribute to accident causation in 21.6% of cases. Moped riders were found to locate themselves on traffic more unsafely than motorcycle riders, representing a major contributing factor (24% vs. 19.1%). The other vehicle position contributed to accident causation in 21.6% of cases.

Safe position relative to other traffic	L1		L3		PTW		OV	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
not applicable no OV or no other traffic	59	17.3	85	26.2	144	21.6	120	20.1
position relative to traffic made no contrib. to accident	197	57.6	176	54.3	373	56.0	339	56.8
position relative to traffic contrib. to accident causation	82	24.0	62	19.1	144	21.6	129	21.6
unknown	4	1.2	1	0.3	5	0.8	9	1.5
Total	342	100.0	324	100.0	666	100.0	597	100.0

Table 3.16. Safe position relative to other traffic

3.3 Additional Environmental contributing factors

Roadway design. A roadway design defect was reported in 7.5% along the path of the PTW rider and in 3.6% these problems were considered a contributing factor. Mopeds were found to be more affected by a road design defect than motorcycles (4.4% vs. 2.5%). Roadway design defect along the other vehicle path was found to contribute to 5.3% of accidents.

Roadway design defect	L1		L3		PTW		OV	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
not applicable, no OV, or no roadway design defect present	310	90.6	308	95.1	618	92.8	537	89.9
roadway design defect present but not a contributing factor	17	5.0	8	2.5	25	3.8	20	3.4
roadway design defect was the precipitating event	1	0.3	2	0.6	3	0.5	8	1.3
roadway design defect was the primary contributing factor	2	0.6	3	0.9	5	0.8	3	0.5
roadway design defect was a contributing factor	12	3.5	3	0.9	15	2.3	21	3.5
unknown	0	0.0	0	0.0	0	0.0	8	1.3
Total	342	100	324	100	666	100	597	100.0

Table 3.17. Roadway design defects

Traffic controls. In 4.1% of urban cases the traffic controls were reported to be malfunctioning and in 2.1% these defects contributed to the accident. Traffic controls defects were more frequently found on motorcycle paths. Considering the other vehicle driver path, defects were found in 3.3% of roads and to contribute to 1.8% of the accidents.

Traffic control defect	L1		L3		PTW		OV	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
not applicable, no OV, or no tr. controls, or tr. contr. ok	325	95.0	314	96.9	639	95.9	570	95.5
traffic controls defect present, but not a contributing. factor	8	2.3	5	1.5	13	2.0	9	1.5
traffic controls defect was the precipitating event	0	0.0	1	0.3	1	0.2	0	0.0
traffic controls defect was the primary contributing factor	2	0.6	3	0.9	5	0.8	2	0.3
traffic controls defect was a contributing factor	6	1.8	1	0.3	7	1.1	9	1.5
unknown	1	0.3	0	0.0	1	0.2	7	1.2
Total	342	100.0	324	100.0	666	100.0	597	100.0

Table 3.18. Traffic control defects

Traffic hazard. Traffic hazards were present in 6.9% of urban cases and contributed to 4.2% of accidents. Mopeds were found to be more affected by traffic hazards, since this was contributing to 2.9% of the accidents (1.5% for motorcycle and 1.8% for other vehicle driver). (Tab 31)

Traffic hazard	L1		L3		PTW		OV	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
not applicable, no OV, or no temporary traffic obstruction	317	92.7	304	93.8	621	93.2	550	92.1
temporary obstruction present but not a contributing factor	10	2.9	8	2.5	18	2.7	21	3.5
temporary obstruction was the precipitating event	2	0.6	5	1.5	7	1.1	3	0.5
temporary obstruction was the primary contributing factor	3	0.9	2	0.6	5	0.8	5	0.8
temporary obstruction was a contributing factor	10	2.9	5	1.5	15	2.3	11	1.8
unknown	0	0.0	0	0.0	0	0.0	7	1.2
Total	342	100.0	324	100.0	666	100.0	597	100.0

Table 3.19. Traffic hazard

Weather. Weather condition had a negative effect on 6.6% of the accidents. Motorcycles were more affected by weather, since this was a contributing factor in 9.3% of cases (vs. 4.1% of moped accidents).

Weather related problems	L1		L3		PTW		OV	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
weather made no contribution to accident	328	95.9	294	90.7	622	93.4	536	89.8
weather related problem was the precipitating event	0	0.0	2	0.6	2	0.3	1	0.2
weather related problem was the primary contributing factor	6	1.8	4	1.2	10	1.5	4	0.7
weather related problem was a contributing factor	8	2.3	24	7.4	32	4.8	18	3.0
unknown	0	0.0	0	0.0	0	0.0	38	6.4
Total	342	100.0	324	100.0	666	100.0	597	100.0

Table 3.20. Traffic hazard

Visual background. Conspicuity was found to be more a problem affecting PTW vehicles than the opposing vehicles. In fact in 13.6% of cases the other vehicle driver was not able to perceive well the upcoming PTW vehicle due to a negative effect of the background. For the same reason, 5.7% of PTW riders were not able to detect the arrival of the other vehicle.

Visual background	L1		L3		PTW		OV	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
not applicable, view obstructed by foreground, no OV	94	27.5	98	30.2	192	28.8	138	23.1
visual background of OV made no contrib. to conspicuity	209	61.1	184	56.8	393	59.0	325	54.4
visual background had a positive effect	14	4.1	21	6.5	35	5.3	39	6.5
visual background had a negative effect	20	5.8	18	5.6	38	5.7	81	13.6
unknown	5	1.5	3	0.9	8	1.2	14	2.3
Total	342	100.0	324	100.0	666	100.0	597	100.0

Table 3.21. Visual background

Findings on urban accident causation

- 51.7% of primary contributing factors were related to OV driver: 75.6% of these related to a perception failure and 19.8% of decision failures
- 32.3% of primary contributing factors were related to PTW rider: 37.9% of these were related to perception failures, 32.3% of decision failures and 14% of reaction failures
- 12.8% of primary contributing factors were due to environment: 29.4% of these were due to obstacles, 10.6% due to roadside environment and 5.9% due to roadway design defect, lack of road surface maintenance and traffic control signs defects
- 15.5% of L1 riders and 29.6% of L3 riders were speeding of more than 10 km/h above the posted speed limit. 6.4% of OV drivers were found to speeding.

- 1.2% riders were significantly impaired
- 34.8% of PTW riders and 32.8% of OV drivers had an attention problem during the accident
- 9.2% of PTW riders had PTW control unfamiliarity, 14.4% had skill deficiency and 10.8% had vehicle unfamiliarity
- 65.5% of PTW riders and 73.8% of OV drivers committed a faulty traffic strategy
- 21.6% of PTWs' and OVs' position was not safe in traffic
- In 3.4% of cases a roadway design defect contributed to the accident
- In 2% in PTW path and 4.5% of OV path the traffic controls were defected
- In 4.1% of cases a traffic hazard contributed to the accident
- In 4.8% of the cases weather conditions were a contributing factor
- In 5.7% of cases the background had a negative effect on OV conspicuity and in 13.6% in PTW conspicuity

4.0 Time of urban accidents

Time of accident. The analysis of urban accidents showed three main peaks in the distribution of the time of day: the first peak was found to occur early in the morning between 7:00 and 9:00, the second around lunchtime between 12:00 and 15:00, with high frequency between 14:00 and 15:00, and the third - and also the highest - between 17:00 and 19:00. The overall highest peak was between 17:00 and 18:00. The distribution among PTW legal categories was found to be rather balanced, with the exception of the period between 12:00 and 18:00, when there is a higher percentage of moped accidents (44.1% vs. 38.6%). This pattern may be associated to a possible use of the PTW vehicle for commuting purposes. The highest peak between 17:00 and 18:00 could be explained by a decrease of attention after the working hours and the increase of vehicles circulating in traffic.

Time of accident	L1		L3		Total	
	N	*%*	*N*	*%*	*N*	*%*
0:01-6:00	14	4.1	16	4.9	30	4.5
6:01-12:00	94	27.5	98	30.3	192	28.8
12:01-18:00	151	44.1	125	38.6	276	41.5
18:01-24:00	83	24.3	85	26.2	168	25.2
Total	342	100	324	100	666	100

Table 4.1. Time of accident

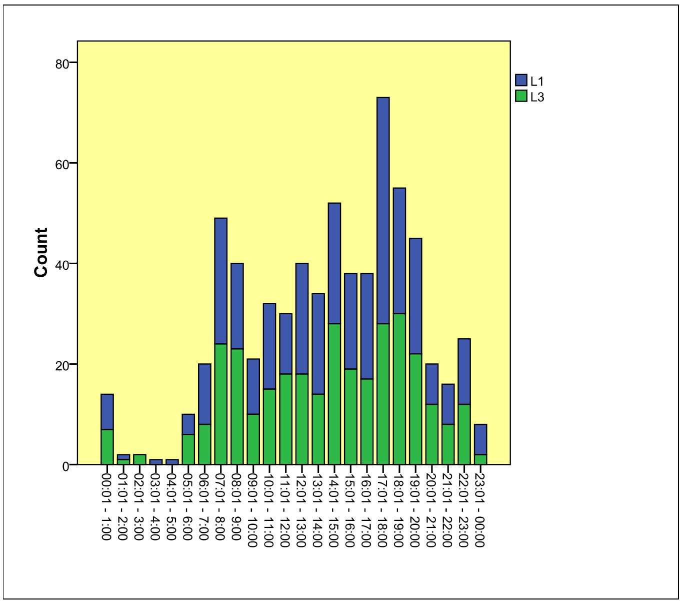

Figure 4.1. Time of accident

Day of week. Urban accidents were equally distributed among the days of the week, although a drop of frequency was found to occur during the weekends. No major differences were found between mopeds and motorcycles.

Day of week	L1		L3		Total	
	N	*%*	*N*	*%*	*N*	*%*
Monday	63	18.4	55	17.0	118	17.7
Tuesday	65	19.0	52	16.1	117	17.6
Wednesday	59	17.3	50	15.4	109	16.4
Thursday	51	14.9	52	16	103	15.5
Friday	56	16.4	53	16.4	109	16.3
Saturday	15	4.4	25	7.7	40	6.0
Sunday	33	9.6	37	11.4	70	10.5
Total	342	100	324	100	666	100

Table 4.2. Day of week

Illumination. In 71.7% of cases the accident occurred at daylight, followed by 20% at night and 8.2% at dusk or dawn. No major differences were found between L1 and L3 accidents.

Illumination	L1		L3		Total	
	N	*%*	*N*	*%*	*N*	*%*
daylight, bright	178	52.0	188	58.0	366	55.0
daylight, not bright	61	17.8	51	15.7	112	16.8
dusk, sundown	18	5.3	15	4.6	33	5.0
night, lighted	68	19.9	55	17	123	18.4
night, not lighted	4	1.2	6	1.9	10	1.5
dawn, sunup	13	3.8	9	2.8	22	3.3
Total	342	100	324	100	666	100

Table 4.3. Illumination

Traffic density. Urban accident occurred in light traffic for the 38% of cases, followed by moderate traffic (32.1%) and heavy traffic (13.7%). In 13.1% of cases the accident occurred with no other traffic. Mopeds were found to have more accidents in light traffic than motorcycles, which on the other hand, had more accidents in moderate traffic.

Traffic density at time of accident	L1		L3		Total	
	N	*%*	*N*	*%*	*N*	*%*
no other traffic	47	13.7	40	12.3	87	13.1
light traffic	134	39.2	119	36.7	253	38.0
moderate traffic	101	29.5	113	34.9	214	32.1
heavy traffic, traffic moving	48	14.0	43	13.3	91	13.7
heavy traffic, congested traffic	6	1.8	7	2.2	13	2.0
unknown	6	1.8	2	0.6	8	1.2
Total	342	100.0	324	100.0	666	100.0

Table 4.4. Traffic density

Origin and destination of the trip. In 35.4% of moped accidents, the trip was originated from home: among these, 38% of riders were going to work and 15.7% to school/university. The second most common origin was work, present in 16.4% of cases: among these 67.9% of riders were going home and 26.8% were travelling to another work related destination. The 93.3% of moped riders that left from school were going home. In motorcycle accidents, the 41.4% of riders were originating their trip from home: among these 52.2% were going to work and 18.7% were travelling towards a recreational location. The second most frequent origin was work present in 22.5% of accidents: among these, 58.9% of L3 riders were going home and 28.8% to another work related destination. (Annex I – Tables 1 to 3)

Frequency of road use. In 49.8% of cases the road where accident occurred was travelled everyday by the PTW rider and in 18.3% it was used every week. Only 4.6% of riders had never ridden that road before. No particular differences were found between moped and motorcycle's distribution. The same pattern was found in the road usage of the driver of the other vehicle.

Frequency of this road use	L1		L3		PTW		OV	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
never used before	14	4.1	15	4.6	29	4.4	23	3.9
daily use	171	50.0	161	49.7	332	49.8	204	34.2
weekly use	64	18.7	58	17.9	122	18.3	119	19.9
monthly use	20	5.8	18	5.6	38	5.7	34	5.7
quarterly	3	0.9	12	3.7	15	2.3	15	2.5
annually	6	1.8	6	1.9	12	1.8	12	2.0
less than annually	4	1.2	0	0.0	4	0.6	5	0.8
unknown	60	17.5	54	16.7	114	17.1	185	31.0
Total	342	100.0	324	100.0	666	100.0	597	100.0

Table 4.5.Frequency of road use

Time since departure. The 72.5% of urban PTW accidents occurred within 20 minutes from departure: 26.3% happened between 3 and 8 minutes, and 23.3% between 9 and 14 minutes (which is logical since the duration of the commuting trips in a city environment usually do not exceed an hour). No major differences were found between L1 and L3 cases, making the exception of a higher frequency of mopeds accidents occurred between 15 and 20 minutes from departure. The same pattern was found for the other vehicle driver: 51.8% of cases occurred within the first 20 minutes of the trip.

Length of time since departure	L1		L3		PTW		OV	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
0 to 2 min	28	8.2	27	8.3	55	8.3	49	8.2
3 to 8 min	93	27.2	82	25.3	175	26.3	133	22.3
9 to 14 min	68	19.9	87	26.9	155	23.3	77	12.9
15 to 20 min	61	17.8	36	11.1	97	14.6	50	8.4
21 to 26 min	7	2.0	7	2.2	14	2.1	10	1.7
27 to 32 min	19	5.6	16	4.9	35	5.3	26	4.4
33 to 38 min	0	0.0	1	0.3	1	0.2	3	0.5
39 to 48 min	4	1.2	2	0.6	6	0.9	3	0.5
45 to 50 min	4	1.2	4	1.2	8	1.2	5	0.8
51 to 56 min	0	0.0	1	0.3	1	0.2	1	0.2
57 to 62 min	9	2.6	4	1.2	13	2.0	11	1.8
more than 62 min	6	1.8	3	0.9	9	1.4	18	3.0
unknown	43	12.6	54	16.7	97	14.6	211	35.3
Total	342	100.0	324	100.0	666	100.0	597	100.0

Table 4.6. Length of time since departure

Findings on time urban accident occurred

- 41.5% of urban accidents and 48% of fatal urban accidents occurred between 12.00 and 18.00
- There are three main time peaks: morning, lunchtime and late afternoon, suggesting a commuting attitude of riders. The highest peak was between 17.00 and 18.00
- Urban accidents are more or less well distributed during the week, although the trend decreases during the weekend
- 71.7% of urban accidents occurred at daylight
- 38% of urban accidents occurred in light traffic and 13.1% with no traffic at all
- Most of the accidents occurred during the trip from home to work or from work to home.

5.0 Location of urban accidents

Roadway type. Half of urban accidents occurred in minor arterials or local streets (50.5%). The second most common type of roadway was found to be major arterial (19.5%) followed by non-arterial sub-arterial roads (14.9%). In 6.8% of cases the accident occurred on moped dedicated paths. When PTW legal categories are compared, motorcycle accidents were found to happen more in major arterials while moped accidents more in non-arterial roads.

Roadway Type	L1		L3		Total	
	N	*%*	*N*	*%*	*N*	*%*
Motorway	3	0.9	18	5.6	21	3.2
Major arterial	46	13.5	84	25.9	130	19.5
Minor arterial	174	50.9	162	50.0	336	50.5
non-arterial, sub-arterial	55	16.1	44	13.6	99	14.9
Parking lot, parking area	2	0.6	2	0.6	4	0.6
driveway	2	0.6	1	0.3	3	0.5
round about or traffic circle	1	0.3	5	1.5	6	0.9
overpass	0	0.0	1	0.3	1	0.2
underpass	0	0.0	5	1.5	5	0.8
moped path separated from traffic roadway	45	13.2	0	0.0	45	6.8
moped path not separated from roadway	2	0.6	0	0.0	2	0.3
Other	11	3.2	2	0.6	13	2.0
unknown	1	0.3	0	0.0	1	0.2
Total	342	100.0	324	100.0	666	100.0

Table 5.1 Roadway type

Road alignment. The majority of urban accidents occurred on level roads (77.6%), followed by slope of the hill upgrade (10.8%) and slope of the hill downgrade (8.6%). Mopeds were found to have more accidents than motorcycles on slope of the hill downgrade.

Vertical road alignment	L1		L3		Total	
	N	*%*	*N*	*%*	*N*	*%*
level	257	75.1	260	80.2	517	77.6
slope of hill, upgrade	38	11.1	34	10.5	72	10.8
crest of hill, loft	6	1.8	5	1.5	11	1.7
slope of hill, downgrade	36	10.5	21	6.5	57	8.6
bottom of hill	3	0.9	1	0.3	4	0.6
dip or low depression	1	0.3	0	0.0	1	0.2

banked curve	0	0.0	3	0.9	3	0.5
other	1	0.3	0	0.0	1	0.2
Total	342	100.0	324	100.0	666	100.0

Table 5.2. Vertical road alignment

Most of urban cases occurred on straight roads (77.5%), while 10.7% of roads were curving left and 9.6% were turning right. Motorcycle riders were found to have more accidents on left curves (14.2% vs. 7.3%).

Horizontal road alignment	L1		L3		Total	
	N	*%*	*N*	*%*	*N*	*%*
straight	276	80.7	240	74.1	516	77.5
curve right	32	9.4	32	9.9	64	9.6
curve left	25	7.3	46	14.2	71	10.7
corner right	1	0.3	1	0.3	2	0.3
corner left	1	0.3	1	0.3	2	0.3
jog right: turn to right, then left, resuming original direction	4	1.2	2	0.6	6	0.9
jog left: turn to left, then right, resuming original direction	3	0.9	1	0.3	4	0.6
other	0	0.0	1	0.3	1	0.2
Total	342	100.0	324	100.0	666	100.0

Table 5.3. Horizontal road alignment

Intersection Type. In 68.2% of cases, the urban accidents occurred at an intersection. The most frequent was cross intersection (29.6%) followed by T-intersections (23.9%). Mopeds were found to have more accidents at intersections than motorcycles (70.2% vs. 66%). Moped accidents were found to occur more often at cross and angle intersections, while motorcycles were more involved in roundabout accidents (4.9% vs. 2%).

Intersection type	L1		L3		Total	
	N	*%*	*N*	*%*	*N*	*%*
non-intersection	102	29.8	110	34.0	212	31.8
T-intersection	84	24.6	75	23.1	159	23.9
cross intersection	105	30.7	92	28.4	197	29.6
angle intersection	24	7.0	14	4.3	38	5.7
alley, driveway	7	2.0	2	0.6	9	1.4
offset intersection	10	2.9	7	2.2	17	2.6
round about or traffic circle	7	2.0	16	4.9	23	3.5
over or under cross-over	2	0.6	5	1.5	7	1.1
other	1	0.3	3	0.9	4	0.6
Total	342	100.0	324	100.0	666	100.0

Table 5.4. Intersection Type

Roadway surface. The 29.3% of roads had some kind of surface defects, present in 31.3% of moped cases and 27.2% of motorcycle cases. Among the surface defects, the most frequent ones were bitumen repair (9.8%), cracking (5.1%) and spalling (3.5%).

Roadway Surface condition and defects	L1		L3		Total	
	N	*%*	*N*	*%*	*N*	*%*
None	235	68.7	236	72.8	471	70.7
Surface cracking	19	5.6	15	4.6	34	5.1
spalling, braking up,	11	3.2	12	3.7	23	3.5
holes	7	2.0	1	0.3	8	1.2
ruts	8	2.3	11	3.4	19	2.9
bump	4	1.2	9	2.8	13	2.0
ripples, ridges	2	0.6	2	0.6	4	0.6
pavement edge	4	1.2	1	0.3	5	0.8
bitumen repair	34	9.9	31	9.6	65	9.8
tram/train rails	6	1.8	2	0.6	8	1.2
other	12	3.5	3	0.9	15	2.3
unknown	0	0.0	1	0.3	1	0.2
Total	342	100.0	324	100.0	666	100.0

Table 5.5. Roadway surface condition

It was found that roadway defects contributed to 11.4% of moped cases and 36.1% of motorcycle cases. In 2.3% of accidents the maintenance defect was considered the primary contributing factor (1.5% in mopeds and 3.1% in motorcycles).

Roadway Maintenance defect as contributing factor	L1		L3		Total	
	N	*%*	*N*	*%*	*N*	*%*
not applicable, no OV, or no roadway maintenance defect	263	76.9	288	88.9	551	82.7
roadway maintenance defect present but not a contrib. factor	70	20.5	23	7.1	93	14.0
roadway maintenance defect was the precipitating event	2	0.6	2	0.6	4	0.6
roadway maintenance defect was a contributing factor	2	0.6	1	0.3	3	0.5
roadway maintenance defect was the primary contributing factor	5	1.5	10	3.1	15	2.3
Total	342	100.0	324	100.0	666	100.0

Table 5.6. Roadway maintenance defect as contributing factor

Traffic control signs. Traffic control signs were present in 44.4% of moped cases and in 38% of motorcycle cases. The most common traffic control sign was the traffic light (25.3%), followed by yield signs and pedestrian crossing (4.8%). In 4.3% of cases the traffic control sign was not properly functioning and in 1.5% they were not visible to the PTW rider. When considering the other vehicle driver's path, in 1.6% of cases the control sign was not functioning well and in 2.3% they were not visible to the OV driver.

Traffic controls	L1		L3		Total		OV	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
none	190	55.6	201	62.0	391	58.7	291	48.7
Yield sign	11	3.2	21	6.5	32	4.8	66	11.1
Stop sign	5	1.5	3	0.9	8	1.2	36	6.0
traffic control signal	92	26.9	77	23.8	169	25.3	154	25.8
traffic officer	0	0	2	0.6	2	0.3	2	0.3
construction personnel	1	0.3	0	0	1	0.2	1	0.2
Gate, toll gate	1	0.3	0	0	1	0.2	0	0.0
pedestrian crossing	22	6.4	10	3.1	32	4.8	15	2.5
speed bumps	5	1.5	2	0.6	7	1	5	0.8
traffic advisory signage	8	2.3	4	1.3	12	1.8	7	1.2
other	7	2	3	0.9	10	1.5	12	2.0
unknown	0	0	1	0.3	1	0.2	8	1.3
Total	342	100	324	100	666	100	597	100.0

Table 5.7. Traffic controls

Traffic control signs were violated in 25% of cases by the moped rider and in 17.9% of cases by the motorcycle rider. The most violated sign were the traffic light – 55.3% by moped riders and 45.5% by motorcycle riders – and yield signs – 15.8% by moped riders and 27.3% by motorcycle riders. The 31.6% of motorcycle riders violated a stop sign at time of accident. The other vehicle driver violated a traffic sign in 37.3% of cases, mostly yield signs (38.6%), traffic lights (31.6%) and stop signs (17.5%).

Traffic controls violated	L1		L3		Total		OV	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
yield sign	6	15.8	6	27.3	12	20.0	44	38.6
stop sign	2	5.3	3	13.6	5	8.3	20	17.5
traffic control signal	21	55.3	10	45.5	31	51.7	36	31.6
traffic officer	0	0.0	0	0.0	0	0.0	1	0.9
construction personnel	0	0.0	0	0.0	0	0.0	1	0.9
gate, toll gate	1	2.6	0	0.0	1	1.7	0	0.0
pedestrian crossing	1	2.6	0	0.0	1	1.7	1	0.9
traffic calming/speed bumps	0	0.0	2	9.1	2	3.3	0	0.0
traffic advisory signage	3	7.9	0	0.0	3	5.0	2	1.8
Other	4	10.5	0	0.0	4	6.7	8	7.0

unknown	0	0.0	1	4.5	1	1.7	1	0.9
Total sign violated	38	100.0	22	100.0	60	100.0	114	100.0
Total sign violates/ Total signs		25.0		17.9		21.8		37.3
Total signs	152	44.4	123	38	275	41.3	306	51.3

Table 5.8. Traffic controls violated

View obstructions. Stationary view obstructions were present in 20.3% of cases along PTW rider line-of-sight and in 23.4% of cases along the other vehicle driver line-of-sight. The most frequent stationary view obstructions were parked vehicles (7.5% for PTW and 6.7% for OV) and vegetation (6.6% for PTW and 6.7% for OV). Mobile view obstacles were obstructing the view of a PTW rider in 9.9% of cases and of the other vehicle driver in 10.7% of cases. These mobile obstacles were mainly automobiles.

Stationary view obstructions	L1		L3		Total		OV	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
none	256	74.9	274	84.6	530	79.6	449	75.2
buildings	14	4.1	5	1.5	19	2.9	20	3.4
signs	1	0.3	3	0.9	4	0.6	8	1.3
vegetation, trees, bushes, walls,	25	7.3	19	5.9	44	6.6	40	6.7
Hill	1	0.3	1	0.3	2	0.3	2	0.3
blind curve	3	0.9	1	0.3	4	0.6	4	0.7
stationary or parked vehicles	32	9.4	18	5.6	50	7.5	52	8.7
barricades	2	0.6	1	0.3	3	0.5	4	0.7
other	7	2.0	2	0.6	9	1.4	9	1.5
unknown	1	0.3	0	0.0	1	0.2	9	1.5
total	342	100.0	324	100.0	666	100.0	597	100.0

Table 5.9. Stationary view obstructions

Mobile view obstructions	L1		L3		PTW		OV	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
none	302	88.3	292	90.1	594	89.2	516	86.4
vehicles: automobiles	24	7.0	19	5.9	43	6.5	41	6.9
vehicles: light trucks and vans	6	1.8	6	1.9	12	1.8	12	2.0
trucks and busses	5	1.5	2	0.6	7	1.1	7	1.2
people, pedestrians	1	0.3	1	0.3	2	0.3	0	0.0
other	1	0.3	1	0.3	2	0.3	4	0.7
unknown	3	0.9	3	0.9	6	0.9	17	2.8
Total	342	100.0	324	100.0	666	100.0	597	100.0

Table 5.10. Mobile view obstructions

Visual obstructions were neglected by PTW rider in 27.7% of cases and in 19.2% this unsafe behavior contributed to the accident causation. Moped riders were found to neglect more view obstacles than motorcycle riders (23.7% vs. 14.5%). The other vehicle driver neglected a view obstacle in 30% of cases and in 23.6% this action contributed to cause the accident.

Visual obstructions neglected	L1		L3		PTW		OV	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
no OV, no view obstructions	226	66.1	252	77.8	478	71.8	402	67.3
view obstructions but not a factor	33	9.6	24	7.4	57	8.6	40	6.7
view obstructions contributed to accident	81	23.7	47	14.5	128	19.2	141	23.6
unknown	2	0.6	1	0.3	3	0.5	14	2.3
Total	342	100.0	324	100.0	666	100.0	597	100.0

Table 5.11. Visual obstructions neglected

Findings on where urban accident occurred

- 50.5% of urban accidents occurred in a minor arterial or local street
- 68.2% of cases happened at intersection
- The majority of accidents occurred on straight and level roads
- In 49.8% of cases the road where accident occurred was ridden daily by the PTW rider
- In 29.3% of cases there was a roadway maintenance problem and this contributed for the 3.4% of times.
- In 50% of accidents there was a traffic sign along PTW path, which was violated by riders in 21.8% of cases (37.3% by OV driver)
- Most violated signs from PTW riders were traffic lights, stop signs and yield signs, while OV driver mostly violated yield signs
- Stationary view obstructions were present in front of 20.3% of riders and 23.4% of OV drivers, mainly represented by vegetation and parked cars.
- 27.7% of rider neglected the obstacle and this contributed in 19.4% of accident. OV driver neglected the obstacle in 30% of cases and this caused the accident in 23.6% of accidents

6.0 People involved in urban accidents

Age. The 26.6% of moped riders were between 18 and 21 year of age, followed by 16-17 (24.9%) and 26-40 (17.5%) of age. When moped cases where compared to controls, the age category 18-21 year-old were found to be over represented in accidents (26.9% vs. 18.3%). This difference though was found to be not significant. The majority of motorcycle riders were between 26 and 40 year of age (49.4%), followed by 41-55 (19.8%) and 22-25 (17.6%) of age. Comparing motorcycle accidents with controls, the category 22-25 year-old was found to be over-represented in motorcycle urban accidents (17.6% vs. 9.9%). This difference was found to be significant. The majority of other vehicle drivers were older than 26 year old: 35.7% were between 26 and 40 year of age, 26.3% between 41 and 55 and 16.9% were over 56 years.

Age	L1				L3				PTW				OV	
	Cases		Controls		Cases		Controls		Cases		Controls		Cases	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
14-15	24	7.0	18	6.5	1	0.3	0	0.0	25	3.8	18	2.9	2	0.3
16-17	85	24.9	84	30.1	16	4.9	7	2.1	101	15.2	91	14.9	6	1.0
18-21	92	26.9	51	18.3	17	5.2	18	5.4	109	16.4	69	11.3	49	8.2
22-25	34	9.9	22	7.9	57	17.6	33	9.9	91	13.7	55	9.0	69	11.6
26-40	60	17.5	57	20.4	160	49.4	170	51.1	220	33.0	227	37.1	213	35.7
41-55	37	10.8	31	11.1	64	19.8	94	28.2	101	15.2	125	20.4	157	26.3
over 56	10	2.9	16	5.7	9	2.8	11	3.3	19	2.9	27	4.4	101	16.9
Total	342	100.0	279	100.0	324	100.0	333	100.0	666	100.0	612	100.0	597	100.0

Table 6.1. Age

Gender. In 83.5% of cases the PTW rider was a male. Female riders were more frequent in moped than in motorcycle accidents (23.7% vs. 6.5%).

PTW rider gender	L1				L3				PTW			
	Cases		Controls		Cases		Controls		Cases		Controls	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Male	265	77.5	213	76.3	303	93.5	298	89.5	568	85.3	511	83.5
Female	77	23.7	66	23.7	21	6.5	35	10.5	98	14.7	101	16.5
Total	342	100.0	279	100.0	324	100.0	333	100.0	666	100.0	612	100.0

Table 6.2. Gender

License held. More than half (56.7%) of the PTW riders involved in urban accidents had a valid motorcycle license: in 22.8% of cases this was the only license held and in 33.9% the rider was also holding another vehicle license. When PTW legal categories were compared, it was found that L3 riders had a higher frequency of motorcycle licenses (76.2% vs. 37.7%), while L1 riders had the highest number of no license held (37.1%). Among moped riders without a license, 27.2% were not required to have a license and 9.9% were riding illegally (vs. 1.2% of L3 riders). When comparing cases and controls, both L1 and L3 riders without a license were found to be over-represented in accidents. This difference was found to be significant. The majority of other vehicle drivers had only an automobile license, and 17.8% had also a PTW license.

License	L1				L3				PTW				OV	
	Cases		Controls		Cases		Controls		Cases		Controls		Cases	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%
no license held	34	9.9	8	2.9	4	1.2	0	0.0	38	5.7	8	1.3	4	0.7
learner's permit, only	2	0.6	1	0.4	2	0.6	0	0.0	4	0.6	1	0.2	0	0.0
motorcycle license	112	32.7	148	53.0	40	12.3	11	3.3	152	22.8	159	26.0	23	3.9
automobile license	55	16.1	50	17.9	37	11.4	18	5.4	92	13.8	68	11.1	410	68.7
commercial license	1	0.3	0	0.0	0	0.0	1	0.3	1	0.2	1	0.2	3	0.5
no license required	93	27.2	42	15.1	1	0.3	0	0.0	94	14.1	42	6.9	7	1.2
motorcycle and automobile license	17	5.0	21	7.5	207	63.9	257	77.2	224	33.6	278	45.4	62	10.4
Automobile and other license	4	1.2	5	1.8	1	0.3	2	0.6	5	0.8	7	1.1	34	5.7
Motorcycle, car and other license	0	0.0	3	1.1	2	0.6	0	0.0	2	0.3	3	0.5	21	3.5
Other	1	0.3	0	0.0	28	8.6	44	13.2	29	4.4	44	7.2	5	0.8
Unknown	23	6.7	1	0.4	2	0.6	0	0.0	25	3.8	1	0.2	28	4.7
Total	342	100.0	279	100.0	324	100.0	333	100.0	666	100.0	612	100.0	597	100.0

Table 6.3. License held

PTW training. The majority of PTW riders either were self taught (39.5%) or had a compulsory motorcycle training (44.1%). In most of the cases moped riders had no formal riding training, since 48% were self taught, 10.2% were taught by friends and family, and 12.9% had no training at all. Moped riders with no training were found to be over-represented in accidents. The difference between cases and controls was found to be significant. The majority of motorcycle riders had a special compulsory training (72.8%). L3 riders with no license were found to be over-represented in accidents and the difference between cases and controls was found to be significant.

PTW rider Training	L1				L3				PTW			
	Cases		Controls		Cases		Controls		Cases		Controls	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
no training	44	12.9	2	0.7	11	3.4	1	0.3	55	8.3	3	0.5
self taught	164	48.0	189	67.7	38	11.7	53	15.9	202	30.3	242	39.5
taught by friends or family	35	10.2	57	20.4	6	1.9	18	5.4	41	6.2	75	12.3
special voluntary mc training	7	2.0	2	0.7	6	1.9	5	1.5	13	2.0	7	1.1
special compulsory mc training	24	7.0	16	5.7	236	72.8	254	76.3	260	39.0	270	44.1
no training needed	18	5.3	10	3.6	0	0.0	0	0.0	18	2.7	10	1.6
Other	0	0.0	1	0.4	1	0.3	1	0.3	1	0.2	2	0.4
Unknown	50	14.6	2	0.7	26	8.0	1	0.3	76	11.4	3	0.5
Total	342	100.0	279	100.0	324	100.0	333	100.0	666	100.0	612	100.0

Table 6.4. PTW rider training

PTW experience. In 23.4% of cases the PTW rider had more than 98 months of experience on any PTW vehicles, followed by 20% between 13 and 36 months. Moped riders were found to have more experience of 13-36 months (24.3%), followed by 37-60 months (12.9%). The 19.6% of moped riders had less than 1 year of experience (vs. 12.7% of L3 rider). In 31.8% of cases the motorcycle rider had more than 98 months of experience on any PTW vehicle. When cases and controls were compared, L3 riders with less than 6 months of experience were found to be over-represented in accidents (7.1% vs. 2.1%).

PTW rider experience on any PTW (months)	L1				L3				PTW			
	Cases		Controls		Cases		Controls		Cases		Controls	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*	*N*	*%*
up to 6	25	7.3	29	10.4	23	7.1	7	2.1	48	7.2	36	5.9
7 to 12	42	12.3	40	14.3	18	5.6	16	4.8	60	9.0	56	9.2
13 to 36	83	24.3	77	27.6	50	15.4	44	13.2	133	20.0	121	19.8
37 to 60	44	12.9	33	11.8	30	9.3	19	5.7	74	11.1	52	8.5
61 to 97	19	5.6	9	3.2	33	10.2	37	11.1	52	7.8	46	7.5
> 98	53	15.5	91	32.6	103	31.8	202	60.7	156	23.4	293	47.9
unknown	76	22.2	0	0.0	67	20.7	8	2.4	143	21.5	8	1.3
Total	342	100.0	279	100.0	324	100.0	333	100.0	666	100.0	612	100.0

Table 6.5. PTW rider experience on any PTW

Findings on people involved in urban accidents

- L1 riders of 18-21 yr old and L3 riders of 22-25 yr old were found to be over represented in urban accidents
- 56.7% of riders had a motorcycle license
- Riders without a license were found to be over represented in accidents
- Riders with no training were found to be over represented in accidents
- L3 riders with experience up to 6 months were found to be more involved in accidents

7.0 Vehicles involved in urban accidents

PTW style. The most frequent PTW style involved in urban accidents was the scooter (41.5%) and conventional street motorcycle without modifications (12.6%). Moped accidents involved 74.9% of scooters and 12.6% of step-through vehicles. When compared to the controls, it was found that moped scooters were over-represented in accident, but the difference was not considered significant. Although there were no predominant PTW styles in motorcycle accidents, the most frequent style was sport replica (22.2%) and conventional street style without modifications (20.4%). The sport race replica style was found to be over-represented in motorcycle accidents and the difference between cases and controls was found to be significant. For definitions of the different PTW styles, please refer to the MAIDS Report 1.3 pages 16-20.

PTW style	L1				L3				PTW			
	Cases		Controls		Cases		Controls		Cases		Controls	
	N	%	N	%	N	%	N	%	N	%	N	%
Conventional street	20	5.8	11	3.9	66	20.4	66	19.8	86	12.9	77	12.6
Conventional street modified	4	1.2	0	0.0	12	3.7	7	2.1	16	2.4	7	1.1
Sport, race replica	8	2.3	6	2.2	72	22.2	45	13.5	80	12.0	51	8.3
Cruiser	0	0.0	0	0.0	22	6.8	19	5.7	22	3.3	19	3.1
Chopper	0	0.0	1	0.4	23	7.1	26	7.8	23	3.5	27	4.4
Touring	0	0.0	0	0.0	17	5.2	39	11.7	17	2.6	39	6.4
Scooter	256	74.9	193	69.2	51	15.7	61	18.3	307	46.1	254	41.5
Step-through	43	12.6	60	21.5	0	0.0	1	0.3	43	6.5	61	10.0
Sport touring	0	0.0	2	0.7	21	6.5	39	11.7	21	3.2	41	6.7
Other	9	2.6	5	1.8	37	11.4	30	9.0	46	6.9	35	5.7
unknown	2	0.6	1	0.4	3	0.9	0	0.0	5	0.8	1	0.2
Total	342	100.0	279	100.0	324	100.0	333	100.0	666	100.0	612	100.0

Table 7.1. PTW style

PTW engine capacity. In 3 cases and 3 controls the moped rider tampered the L1 vehicle with an engine capacity increment. Among L3 vehicle accidents, the most frequent engine capacity was 501-750 cc, present in 39.5% of cases. This category was also found to be over-represented in motorcycle accidents (39.5% vs. 34.5%) when compared to controls. The difference was found not significant.

PTW engine capacity	L1				L3				PTW			
	Cases		Controls		Cases		Controls		Cases		Controls	
	N	%	*N*	%	*N*	%	*N*	%	*N*	%	*N*	%
up to 50	339	99.1	276	98.9	0	0.0	0	0.0	339	50.9	276	45.1
51-125	3	0.9	3	1.1	62	19.1	57	17.1	65	9.8	60	9.8
126-250	0	0.0	0	0.0	29	9.0	23	6.9	29	4.4	23	3.8
251-500	0	0.0	0	0.0	33	10.2	35	10.5	33	5.0	35	5.7
501-750	0	0.0	0	0.0	128	39.5	115	34.5	128	19.2	115	18.8
751-1000	0	0.0	0	0.0	42	13.0	60	18.0	42	6.3	60	9.8
> 1001	0	0.0	0	0.0	30	9.3	43	12.9	30	4.5	43	7.0
Total	342	100.0	279	100.0	324	100.0	333	100.0	666	100.0	612	100.0

Table 7.2. PTW style

Other vehicle classification. The majority of opposing vehicles were passenger cars with a mass between 800 kg and 2 t (65%), followed by passenger cars with mass below 800 kg (10.6%). In 7.2% of cases the PTW rider was involved in the accident with another PTW vehicle: 4% were mopeds and 3.2% were motorcycle.

OV vehicle classification	*N*	%
passenger car with a maximum mass less than 800 kg (M1)	63	10.6
passenger car with a max. between 800 kg and 2 t (M1)	388	65.0
passenger car with a maximum mass greater than 2 t (M1)	6	1.0
Bicycles	8	1.3
minibuses, buses and vans with a max. mass less than 5 t	18	3.0
buses with a maximum mass greater than 5 t (M3)	2	0.3
moped, mofas	24	4.0
Motorcycles	19	3.2
sport utility vehicle (SUVs) with a max. mass less than 5 t	5	0.8
mini trucks with a maximum mass of less than 1.5 t	7	1.2
light trucks with a mass between 1.5 t and 3.5 t	17	2.8
trucks and heavy goods vehicle with a max. mass > 3.5 t	18	3.0
Other	6	1.0
Unknown	16	2.7
Total	597	100.0

Table 7.3. Other vehicle classification

Findings on people involved in urban accidents

- Sport replica style was found to be over represented in accidents
- The engine capacity more involved in accidents was the one up to 50cc, followed by 501-750cc.
- 65% of OVs were passenger cars between 800kg and 2t

8.0 PTW rider injuries

As part of the accident investigation, teams were required to collect data on all riders and passengers injuries. Injuries were categorized according to one of nine separate body regions and all injuries were coded using the 1998 AIS coding scheme (AAAM, 1990[3]). In addition to the AIS code, a specific code was introduced to indicate the side of the injury as well as the specific anatomical location of the injury. For each case and each body region it was possible to identify the most severe AIS injury for that body region. This injury was considered to be the MAIS for that particular region.

The most frequent injured body parts were the lower and upper extremities, present respectively in 31.2% and 24.7% of urban accidents. When injuries were compared in their severity, it was found that serious injuries were mostly at lower extremities (47%), severe and critical injuries at head and thorax (54.8% and 25.8%) and maximum injuries at the spine (44.4%).

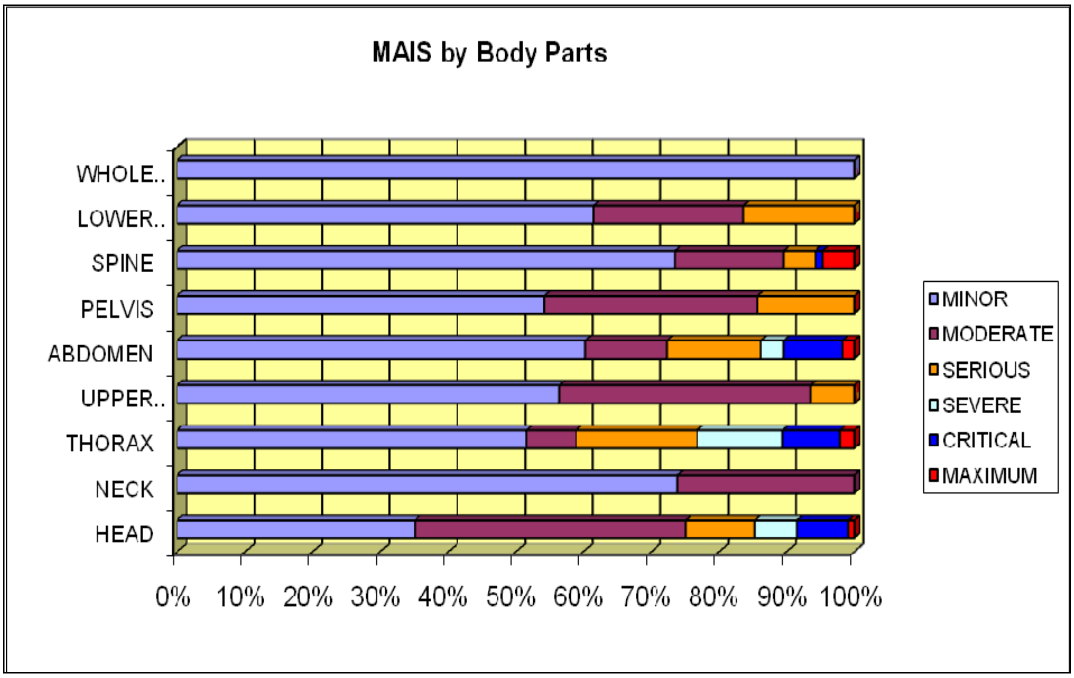

Figure 8.1. Urban accident injuries by severity and body part

In addition to collecting data on all injuries, investigators had to indentify two unique collision contact codes for each reported injury. Injuries were either due to direct trauma

---

[3] Association for the Advancement of Automotive Medicine (AAAM). *The abbreviated injury scale.* 1990 revision, 1998 update. Des Plaines (IL, U.S.A.).

(i.e. direct contact with a surface of object) or indirect trauma (i.e. result of a remote contact with a surface, object or another part of the body).
The graph below indicates the distribution of MAIDS injuries and their collision contact codes. The contact with the road surface or a road element was producing 46.8% of injuries, while the other vehicle caused 23.4% of injuries. Among all possible contact surfaces, the impact with another vehicle was found to produce more severe, serious and maximum level injuries.

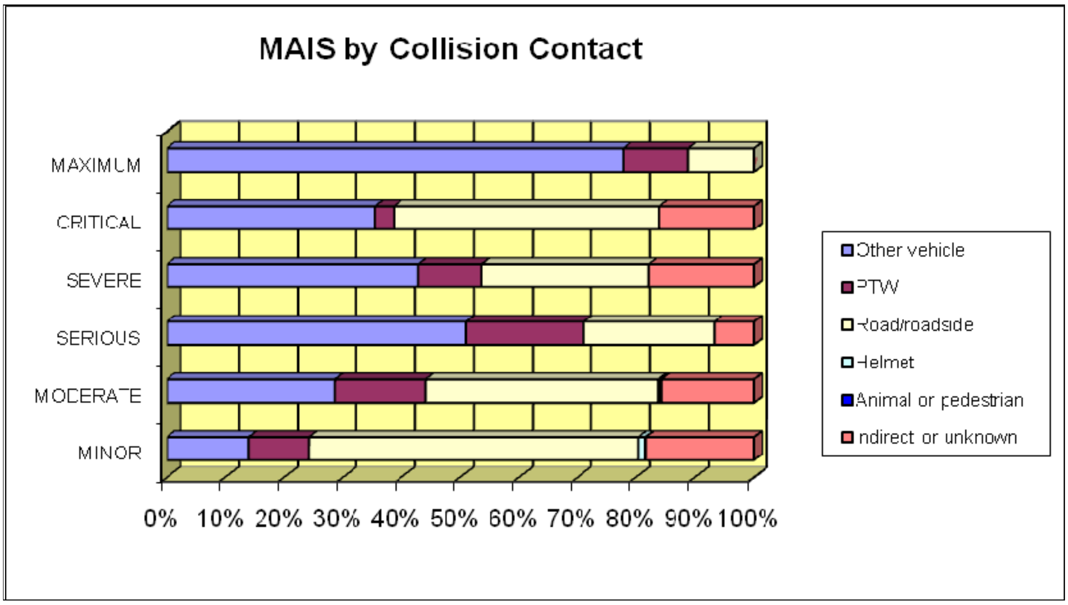

Figure 8.2. Injuries collision contact codes

9.0 Single vehicle urban accidents

On 921 cases present in the MAIDS database, 143 (16%) were accidents where the power two wheeler was the only vehicle involved. Analyzing the area where single vehicle accident occurred, it was found an equal distribution among urban and rural locations (48.3%). When compared to controls, single accidents were found to be under-represented in urban areas and over-represented in rural areas. This difference was found to be significant. (Annex II– Table 1)

Motorcycles were more involved in single accidents than mopeds (55.1% vs. 44.9%). (Annex II – Table 2)

Single accidents were found to have a higher frequency of fatal outcome than multi-vehicle accidents (15.9% vs. 6.5%). (Annex II – Table 3)

PTW passengers were found to be more frequent in single than in multi vehicle accidents (20.3% vs. 8.7%). Passengers were also found to be over-represented in single accidents when these were compared to controls (20.3% vs. 3.8%). This difference was found to be significant. (Annex II – Table 4)

All urban cases with the involvement of a pedestrian were single vehicle accidents. (Annex II – Table 5)

While multi-vehicle accidents occurred more during the day, single vehicle accidents were found to happen more during the evening and night: 33.3% occurred between 18:00 and midnight and 17.4% between midnight and 6:00. (Annex II – Table 6)

Mondays and Fridays were the week days when single vehicle accidents mostly occurred (24.6% and 23.2%). (Annex II – Table 7)

The 40.5% of single vehicle accidents occurred at night (vs. 17.6% of multi-vehicle accidents). (Annex II – Table 8)

PTW riders tend to have more single accidents when they travel on straight roads (59.5% vs. 29%) and at round-about (10.1% vs. 2.7%). (Annex II – Table 9)

Although roads were slightly less defected in single than in multi-vehicle accidents, defects were found to contribute more when the PTW rider was the only party involved in the accident. In fact in 13% of single vehicle cases the roadway maintenance was contributing or causing the accident. (Annex II – Table 10 and Table 11)

In 43.4% of single cases, the PTW rider was riding in a curve: 24.6% in left curves and 18.8% in right curves. This kind of accidents was more frequent in single than multi-vehicle accidents (43.4% vs. 20.3%). (Annex II – Table 13)

PTW riders travelling to and from a recreational location were more likely to be involved in a single accident. Riders were found to use less the roads where single accidents occurred: 20.5% of them were travelling it weekly and 14.5% monthly (vs. 18.1% and 4.7% of multi-vehicle accidents). (Annex II – Table 14, Table 15 and Table 16)

Single vehicle accident riders were found to have more experience on a PTW vehicle and more compulsory training. On the other hand, they were also found to have more problems in managing their PTW vehicle when compared to multi-vehicle accident riders. In fact, these riders had control unfamiliarity in 14.5% (vs. 8.6%) of cases, and contributing in 8.7% of accidents; they had skill deficiency in 23.4% (vs. 13.4%) of cases, contributing to 17.4% of accidents. These riders were also found to have vehicle unfamiliarity in 15.9% (vs. 10.3%) of cases, contributing in 8.7% of accidents. (Annex II – Table 17 to Table 20)

Riders in single vehicle accidents had a higher percentage of no license held compared to multi-vehicle accident riders (7.2% vs. 5.5%). When these riders were compared to control cases, they were found to be over-represented in single accidents. This difference was found to be significant. (Annex II – Table 21)

These riders were also found to have a more risky behavior: 40.6% of them were speeding over 10 km/h the posted speed limit (vs. 19.8%) and, 18.7% had done use of alcohol or drug before the accident and 7.2% were significantly impaired. They were also found to pay less attention and be more distracted by the surrounding traffic or by daydreaming. (Annex II – Table 22 to Table 25)

In 66% of single vehicle cases, riders lost control of their bikes, compared to 19.9% of multi-vehicle accident riders. (Annex II – Table 26)

Since no other vehicle was involved in the accident, the major cause factors were related to the PTW rider (66.7%) and to the environment (24.6%). A PTW vehicle failure caused 2.9% of single accidents. (Annex II – Table 27)

Riders were found to make more perception (47.8%) and reaction (21.7%) failures. Roadside maintenance defects (23.5%) and roadside elements (47.1%) were the most frequent environmental factors to cause the accident. In 17.6% of cases the major cause of accident was the adverse weather. (Annex II – Table 28 to Table 30)

Findings on single urban accidents

- Single accidents were found to be underrepresented in urban areas

- 66.7% of single accidents were caused by a PTW rider's failure: 47.8% of perception and 21.7% of reaction failures
- 24.6% of single accidents had the environment as primary contributing factor: road environment, roadway maintenance defect and adverse weather
- L3 vehicles were more involved in urban single accidents than L1 vehicles
- Single accidents had a higher percentage of fatal outcomes (15.6% vs. 6.5%)
- Riders were found to wear helmets less and to adjust them less properly
- Single accidents occur more during evening and night hours
- 43.4% of single accidents occurred in curves: more left than right curves
- Home and recreation/free time locations were the most common origins and destinations
- Riders with no training and no license were found to be over represented
- 40.6% of single accident riders were speeding over 10 km/h the speed limit vs. 19.8% of multi vehicle accident riders
- 14.5% of single accident riders drunk alcohol before departure and 7.2% of these were significantly impaired
- 14.5% of single accident riders had control unfamiliarity, 23.4% had skill deficiency and 15.9% were unfamiliar with their PTW

10.0 Fatal Urban Accidents

Fatalities were counted in 11.2% of the MAIDS urban database. No major differences were noted regarding type of area, since the distribution of fatalities among urban and rural locations were rather balanced (48.5%). When comparing fatal cases with non fatal cases, it was found that accidents in rural areas had more frequently a fatal outcome (51.5% vs. 21.5%). (Annex III – Table 1)

In half of the urban fatal accidents the primary contributing factor was attributed to the PTW rider and in 36% to the other vehicle driver. PTW riders were also found to be more at fault when compared to non fatal accidents (50.0% vs. 34.1%). The most frequent causes of accidents were decision (44.0% vs. 31.0% of non fatal accidents) and perception failures (32.0%). These types of failures were also found to be the most frequent mistakes of the other vehicle driver. The environment contributed in 10.0% of fatal accidents, mainly due to presence of a roadside element, an animal or a pedestrian. (Annex III – Table 2 to Table 6)

Analyzing the MAIDS urban database, mopeds were found to be over-represented in accidents. The analysis of fatal cases showed instead that motorcycles were more involved (64% vs. 36% of L1). (Annex III – Table 7)

Single vehicle accidents were found to be more frequent in fatal accidents, representing the 22% of the fatal urban database (vs. 9.4% of non fatal accidents). (Annex III – Table 8)

The PTW rider was carrying a passenger at time of accidents in 20% of cases, a higher percentage compared to 9.1% of non fatal accidents. Pedestrians were involved in 4% of cases. (Annex III – Table 9&10)

Although helmet wearing rate was high, the riders who lost their lives in the accidents were found to have had an unsafe attitude when compared to other riders. In fact, 96.0% of these riders were wearing a helmet, but in 12.0% of cases it was not properly adjusted on head, and in 20.0% it was not securely fastened (vs. 3.1% and 6.6% of non fatal riders). (Annex III – Table 11 to Table 13)

Fatal accidents were found to occur less in the morning and more in the afternoon and evening: 48.0% occurred between 12:00 and 18:00 and 38.0% between 18:00 and 6:00. When compared to less severe accidents, the night hours were found to be more dangerous (8% vs. 4.2%). (Annex III – Table 14)

Friday was found to be the week day with the highest number of fatalities (20.0% vs. 16.1% of non fatal accidents), though the distribution was rather balanced among the other days of the week. (Annex III – Table 15)

Although more than half of fatal accidents occurred at intersections, it was found that riders travelling on straight roads were more at risk of being involved in a fatal accident (48.0% vs. 30.5% of non fatal accidents). (Annex III – Table 17)

Major arterial roadways were found to be the most frequent setting of fatal accidents. Data showed that PTW riders travelling on left curves were more at risk (22.0% vs. 9.7% of non fatal accidents). (Annex III – Table 18 and Table 20)

In 26.0% of fatal cases, the PTW rider trip was originating from home and in 18.0% from work. A recreational destination was found to be more frequent in fatal than non fatal accidents (14.0% vs. 11.2%). The 36.0% of PTW riders was riding on that road every day. (Annex III – Table 21 to Table 23)

The majority of fatalities occurred within 15 minutes from departure, but a higher percentage was noted of trips longer than 45 minutes (12% vs. 5.1 of non fatal accidents). Trips longer than 45 minutes were found to be more frequent in fatal than in non fatal accidents. (Annex III – Table 24)

Riders from 16 to 17 of age, from 22 to 25 and over 41 year of age were found to be more involved in fatal accidents. (Annex III – Table 25)

Scooter (34.0%) was the most involved PTW style in fatal accident, but when compared to non fatal accidents, conventional street motorcycles, sport race replica and sport touring style were found to be more at risk. These PTW styles were also found to be over-represented in fatal accidents when compared to the controls. Riders of motorcycles from 51 to 125 cc and over 501cc were more likely to be involved in fatal accidents than other riders. (Annex III – Table 26 and Table 27)

The cinematic reconstruction of the accidents showed that travelling speed was higher in fatal than non fatal cases. In fact 60.0% of riders who died in the crash were travelling at a speed higher than 60 km/h, and 46.0% were speeding over 10 km/h the speed limit (vs. 20% of non fatal accidents). An unusual speed compared to surrounding traffic was a contributing factor in 28.0% of cases with fatal outcome (vs. 16.1% of non fatal cases). (Annex III – Table 28 to Table 30)

Although 48.0% of riders attended special compulsory motorcycle training and 68% had a motorcycle license, riders in fatal accidents were more likely to have skill problems. In fact control unfamiliarity contributed to accident causation in 10% of cases (vs. 2.8%), skills deficiency in 12.0% of cases (vs. 8.8%), and vehicle unfamiliarity in 14.0% of cases (vs. 3.6%). (Annex III – Table 31 to Table 35)

This lack of skills prevented riders from reacting properly to the upcoming danger: 29.4% of them did not apply any avoidance action before the impact, mostly due to a strategic detection failure. Although 48% of riders made the right evasive maneuver choice, 32% of these avoiding actions were not properly executed. Fatal cases also counted a higher number of losses of control (34.0% vs. 24.1%): 16.0% of braking slide-out low side (vs. 9.4%) and 4% of runoff road (vs. 1.1%). (Annex III – Table 37 to Table 40)

In 18.0% of fatal urban accidents the other vehicle driver turned in front of the PTW vehicle, while travelling in opposite directions (vs. 7.0% of non fatal accidents). Falling on roadway and impacting a pedestrian, animal or environmental object were found to be configurations more common in fatal than non fatal accidents. (Annex III – Table 41)

Findings on fatal urban accidents

- Fatal accidents are more common in rural than urban areas
- L3 vehicles are more involved in fatal accidents (64.0% vs. 47.4%)
- 50% of fatal accidents were caused by the PTW rider (vs. 34% non fatal)
- PTW riders failures are found to contribute more in fatal than in non fatal accidents (50 vs. 34.1%)
- Single accidents are more likely to have a fatal outcome (22% vs. 9.4%)
- Fatal accidents are more likely to occur during evening and night time and less likely during the morning
- In fatal accidents home and work are the most common origins and destinations
- Trips longer than 45 minutes were found to be more frequent in fatal than in non fatal accidents
- Accidents in a non intersection road are more likely to have a fatal outcome (48.0% vs. 30.5%)
- Accidents in major arterials are more likely to be fatal (48.0% vs. 17.2%)
- Accidents on left curve are more likely to have a fatal outcome (22.0% vs. 9.7%)
- Riders of 16-17, 22-25 and over 41 were found to be more involved in a fatal accidents
- Conventional street motorcycles, sport replica and sport touring were the styles more involved in fatal accidents
- Motorcycles over 501cc were more frequent in fatal accidents
- Among all accidents, fatal accidents were found to have higher travelling speeds
- 10.0% of control unfamiliarity, 12.0% of skill deficiency and 14.0% of vehicle unfamiliarity of the rider was contributing to the fatal accidents causation
- In 29.4% the rider did not attempt any evasive action, mostly due to a strategic detection failure. 8.0% of riders made the wrong choice of evasive action, 32.0% of evasive actions were not properly executed

11.0 Conclusions

Although the analysis of the MAIDS urban sub-database confirmed the major findings described in the MAIDS Report, it was possible to underline some traits typical of the urban context.

While in the total database the distribution of PTW legal category was more shifted towards motorcycles (56.8%), in urban settings mopeds were found to be more involved in accidents (51.4%). The distribution of the time of accident occurred, of the week days and of the trip origin and destination suggests that nowadays power two wheelers are more frequently used for commuting purposes.

Urban accidents are more concentrated towards the end of a working day, when higher frequencies of vehicles are travelling on roads and the concentration level of people involved may be decreased. In fact a lower attention was noted in 35% of riders – contributing to 11.3% of accidents – and in 32.8% of other vehicle drivers – contributing to 15.5% of accidents. The MAIDS Report showed that 10.6% of rider attention failure and 18.4% of other vehicle driver attention failure had a contribution in accident causation.

A failure by the other vehicle driver is still the most frequent reason for urban accidents, mostly due to a perception or decision failure. Comparing results with the major MAIDS finding, it was found that environmental factors played a more important role in urban context. In fact 9.6% of urban cases were caused by an element of the environment (vs. 7.7%), mainly a temporary traffic obstruction or a stationary or mobile view obstacle. Roadway design defects and roadway maintenance were found to contribute to 6.3% of accidents. Whenever an obstacle was present, both riders and other vehicle riders were found to underestimate the possible danger of having their view obstructed, and this contributed to cause the accident in 19.2% (riders) and 23.6% (driver) of cases.

Riders involved in urban accidents were also found to be less trained and less skilled than the total number of MAIDS riders. In fact, 47.6% of urban riders did not have an official training (vs. 40.1%) and 9.2% were found to have control unfamiliarity (vs. 3.7%) on their vehicles and 14.4% to have some skill deficiency (vs. 10%).

When single vehicle urban accidents and fatal urban accidents are analyzed separately, different characteristics were found. Both fatal and single accidents have a less commuting pattern, occur more during the evening and night hours and are most likely caused by a PTW rider failure. Riders of these two accident typologies are more prone to take risks, such as speeding over the posted speed limit, wearing helmets improperly, and alcohol impairment. These riders were also found to have less riding skills and to lose control of their vehicles, especially when negotiating a bend.

In conclusion, an increased awareness of possible urban dangers, better maintenance of roads and roadside environment, more severe traffic law enforcements, together with better PTW training programs could be considered valuable countermeasures for reducing accidents within urban areas.

GLOSSARY

The failures were defined using the following definitions (OECD, 2001):

Perception failure: The investigator determines through reconstruction analysis or contributory factor analysis that the PTW rider or the OV driver failed to detect the dangerous condition based upon the strategy that he was using to detect dangerous conditions. For example; the OV driver fails to check his side view mirrors and moves into adjacent lane, striking the PTW that was in the adjacent lane.

Comprehension failure: The investigator determines through reconstruction analysis or contributory factor analysis that the PTW rider or OV driver perceived a dangerous situation; however, they failed to comprehend the danger associated with that situation. An example of a comprehension failure would be a rider who observes flashing police lights travelling towards him; but fails to comprehend that the police official is going to turn immediately in front of him.

Decision failure: The investigator determines through reconstruction analysis or contributory factor analysis that the PTW rider or the OV driver failed to make the correct decision to avoid the dangerous condition based upon his strategy. For example; the PTW rider observes yellow caution lights and continues on same path of travel at same speed based on the PTW rider's decision to continue through the intersection. The PTW rider hits the side of a passenger car moving perpendicular to direction of the PTW.

Reaction failure: The investigator determines through reconstruction analysis or contributory factor analysis that the PTW rider or the OV driver had failed to react to the dangerous condition, resulting in a continuation or faulty collision avoidance. For example; the PTW rider observes small objects on the roadway and decides to continue on the same path of travel. An accumulation of these small objects in the tyre of the PTW causes the PTW rider to lose control of the PTW and crash.

Abbreviated injury scale (AIS) - The categorization of injury severity which ranks injury severity from 0 to 6; 0 being no injury to 6 being currently unsurvivable/untreatable, representing a subjective medical consensus measure of the probability of dying (AIS 90).

Accident - Any collision of a motor vehicle on a public roadway which results in property damage and/or personal injury to the motorcycle rider or passenger.

Accident data sample – The accidents which have been collected within a given sample region according to part 2 of the OECD Common Methodology.

Accident investigation – The collection, synthesis, and analysis of data on human, vehicle, and environmental factors to identify accident and injury causation and countermeasures.

Contact injury - An injury which is due to contact with the environment, a vehicle or a vehicle component or another person or animal involved in the accident.

Contributing factors - Any human, vehicle or environmental factor which the investigator considers to have contributed to the overall outcome of the accident. The precipitating event may or may not be considered to be a contributing factor.

Database variable – A coded variable in the database

Environmental factor - Any factor, other than the vehicle factors or human factors, which has any effect on the accident or injury causation during the pre-crash, crash, or post-crash time periods.

Factor – An independent variable

Fatal injuries - One or more injuries which result in death within 30 days.

First collision contact - The portion or area of a vehicle where the earliest, main collision force, is applied during an accident.

Hazard – A temporary traffic obstruction.

High-side - A motorcycle sideward's upset involving an extreme rolling and capsizing motion, where the upper part of the vehicle rolls towards the direction of travel.

Impact speed - The magnitude of the velocity relative to the ground, immediately prior to impact.

Intersection - Any level crossroad, junction or fork, including the open areas formed by such crossroads, junctions or forks.

Low side (Slide-out) - A vehicle upset involving an extreme rolling and capsizing motion, where the upper part of the vehicle rolls away from the direction of travel, e.g., a lay down.

Over represented value – a value which occurs with a statistically significant greater frequency than would be expected, assuming there were no differences associated with that value (i.e., the difference in frequencies cannot be explained by random variation).

Point of impact (POI) - A vertical projection of a point to the ground representing the location of impact in a given accident.

Precipitating event - The failure or manoeuvre that immediately led to the accident.

EXAMPLE: An automobile turns into the path of an oncoming motorcycle. The automobile turning is the action of the precipitating event.

EXAMPLE: A motorcycle rider is alcohol-involved and runs off the road. The motorcycle running off the road is the precipitating event, which may be followed by loss of control, collision with a fixed object, etc. The time when the rider began consuming alcohol is interesting in the accident causation, but is totally unrelated to the crash events.

EXAMPLE: Motorcycle is travelling through an intersection. The motorcycle rider observes that the light has changed to red; however, the MC rider feels that he cannot stop safely and proceeds to accelerate and travel through the intersection at a high rate of speed. A large truck is travelling in a direction normal to the path of travel of the motorcycle and observes a green light and proceeds to enter the intersection. As a result of both vehicles actions, a collision occurs. The precipitating event is the failure of the motorcycle to stop. If the motorcycle rider had acted properly (i.e., stopped at the red light), the accident would not have occurred.

Primary contributing factor - The contributing factor which the investigator considers to have contributed the most to the overall outcome of the accident.

Risk factor – A hypothetical causal factor for accidents or injuries

Roadway design defect - Any deviation from applicable national or local highway design standards for any cause

EXAMPLE: Unmarked sharp curve

Roadway maintenance defect - Any deviation from applicable roadway maintenance standards.

EXAMPLE: Construction debris, large hole in pavement

Single vehicle accident - A motorcycle accident in which no other vehicle is involved in either causation or collision.

Slide-out (Low side) **-** A vehicle upset involving an extreme rolling and capsizing motion, where the upper part of the vehicle rolls away from the direction of travel, e.g., a lay down.

Statistically significant – A situation in which the observed differences in frequencies is great enough that it is improbable (i.e., the probability is less than 0.05) that this difference in frequencies is only due to random variation.

Swerve - A sudden deviation in the path of the motorcycle as a result of turning actions.

Traffic hazard - A danger or risk present on a roadway excluding roadway design or maintenance defects.

EXAMPLE: Dead animal, dropped box, inoperable vehicle.

Traffic control defect or malfunction – Any traffic control that does not perform as intended.

EXAMPLE: Inoperable traffic control signals, damaged stop sign.

Under represented value – A value which occurs with a statistically significant lesser frequency than would be expected, assuming there were no differences associated with that value (i.e., the difference in frequencies cannot be explained by random variation).

Variable – A specific piece of information that can have different values or categories in a range or set (e.g., helmet colour).

Wheelie - A large amplitude pitch-up condition where the front wheel lifts off the ground for a period of time; usually caused by a combination of rider throttle control and body movement fore and aft.

Annex I – Additional urban accident Tables

L1 Trip origin	L1 Trip Destination									
	home	work, business	recreation	school, university	errand, shopping	friends, relatives	bar, pub, restaurant, café	other	unknown	Total
home	2	46	22	19	7	19	1	3	2	121
	1.7	38.0%	18.2%	15.7%	5.8%	15.7%	.8%	2.5%	1.7%	100.0%
	1.9	73.0%	64.7%	82.6%	43.8%	51.4%	20.0%	42.9%	3.8%	35.4%
work, business	38	15	0	0	2	0	0	1	0	56
	67.9	26.8%	.0%	.0%	3.6%	.0%	.0%	1.8%	.0%	100.0%
	36.2	23.8%	.0%	.0%	12.5%	.0%	.0%	14.3%	.0%	16.4%
recreation	24	0	10	1	0	4	1	0	1	41
	58.5%	.0%	24.4%	2.4%	.0%	9.8%	2.4%	.0%	2.4%	100.0%
	22.9%	.0%	29.4%	4.3%	.0%	10.8%	20.0%	.0%	1.9%	12.0%
school, university	14	0	0	0	0	1	0	0	0	15
	93.3%	.0%	.0%	.0%	.0%	6.7%	.0%	.0%	.0%	100.0%
	13.3%	.0%	.0%	.0%	.0%	2.7%	.0%	.0%	.0%	4.4%
errand, shopping	5	0	0	0	5	1	0	0	0	11
	45.5%	.0%	.0%	.0%	45.5%	9.1%	.0%	.0%	.0%	100.0%
	4.8%	.0%	.0%	.0%	31.3%	2.7%	.0%	.0%	.0%	3.2%
friends, relatives	12	1	2	2	2	10	3	0	1	33
	36.4%	3.0%	6.1%	6.1%	6.1%	30.3%	9.1%	.0%	3.0%	100.0%
	11.4%	1.6%	5.9%	8.7%	12.5%	27.0%	60.0%	.0%	1.9%	9.6%
bar, pub, restaurant, café	5	0	0	0	0	1	0	1	0	7
	71.4%	.0%	.0%	.0%	.0%	14.3%	.0%	14.3%	.0%	100.0%
	4.8%	.0%	.0%	.0%	.0%	2.7%	.0%	14.3%	.0%	2.0%
other	4	1	0	0	0	1	0	2	0	8
	50.0%	12.5%	.0%	.0%	.0%	12.5%	.0%	25.0%	.0%	100.0%
	3.8%	1.6%	.0%	.0%	.0%	2.7%	.0%	28.6%	.0%	2.3%
unknown	1	0	0	1	0	0	0	0	48	50
	2.0%	.0%	.0%	2.0%	.0%	.0%	.0%	.0%	96.0%	100.0%
	1.0%	.0%	.0%	4.3%	.0%	.0%	.0%	.0%	92.3%	14.6%
Total	105	63	34	23	16	37	5	7	52	342
	30.7%	18.4%	9.9%	6.7%	4.7%	10.8%	1.5%	2.0%	15.2%	100.0%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 1. Trip origin and destination – L1 vehicles

L3 Rider Trip Origin	L3 Rider Trip Destination									
	home	work, business	recreation	school, university	errand, shopping	friends, relatives	bar, pub, restaurant, café	other	unknown	Total
home	3	70	25	4	12	11	3	4	2	134
	2.2%	52.2%	18.7%	3.0%	9.0%	8.2%	2.2%	3.0%	1.5%	100.0%
	3.2%	72.9%	59.5%	80.0%	66.7%	73.3%	75.0%	40.0%	4.9%	41.4%
work, business	43	21	3	1	2	0	1	1	1	73
	58.9%	28.8%	4.1%	1.4%	2.7%	.0%	1.4%	1.4%	1.4%	100.0%
	46.2%	21.9%	7.1%	20.0%	11.1%	.0%	25.0%	10.0%	2.4%	22.5%
recreation	23	3	7	0	1	1	0	0	0	35
	65.7%	8.6%	20.0%	.0%	2.9%	2.9%	.0%	.0%	.0%	100.0%
	24.7%	3.1%	16.7%	.0%	5.6%	6.7%	.0%	.0%	.0%	10.8%
school, university	2	0	0	0	0	0	0	0	0	2
	100.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	100.0%
	2.2%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.6%
errand, shopping	6	0	0	0	1	0	0	0	0	7
	85.7%	.0%	.0%	.0%	14.3%	.0%	.0%	.0%	.0%	100.0%
	6.5%	.0%	.0%	.0%	5.6%	.0%	.0%	.0%	.0%	2.2%
friends, relatives	14	0	5	0	1	3	0	2	0	25
	56.0%	.0%	20.0%	.0%	4.0%	12.0%	.0%	8.0%	.0%	100.0%
	15.1%	.0%	11.9%	.0%	5.6%	20.0%	.0%	20.0%	.0%	7.7%
bar, pub, restaurant, café	2	0	0	0	0	0	0	0	0	2
	100.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	100.0%
	2.2%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.6%
other	0	0	1	0	1	0	0	3	0	5
	.0%	.0%	20.0%	.0%	20.0%	.0%	.0%	60.0%	.0%	100.0%
	.0%	.0%	2.4%	.0%	5.6%	.0%	.0%	30.0%	.0%	1.5%
unknown	0	2	1	0	0	0	0	0	38	41
	.0%	4.9%	2.4%	.0%	.0%	.0%	.0%	.0%	92.7%	100.0%
	.0%	2.1%	2.4%	.0%	.0%	.0%	.0%	.0%	92.7%	12.7%
Total	93	96	42	5	18	15	4	10	41	324
	28.7%	29.6%	13.0%	1.5%	5.6%	4.6%	1.2%	3.1%	12.7%	100.0%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 2. Trip origin and destination – L3 vehicles

OV driver Trip Origin	OV Driver Trip Destination										
	not applicable	home	work, business	recreation	school, university	errand, shopping	friends, relatives	bar, pub, restaurant, café	other	unknown	Total
not applicable	1	0	0	0	0	0	0	0	0	0	1
	100.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	100.0%
	100.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.0%	.2%
home	0	7	70	24	8	32	17	2	3	4	167
	.0%	4.2%	41.9%	14.4%	4.8%	19.2%	10.2%	1.2%	1.8%	2.4%	100.0%
	.0%	4.7%	47.9%	55.8%	72.7%	82.1%	50.0%	33.3%	37.5%	2.5%	28.0%
work, business	0	56	63	2	1	2	4	3	1	2	134
	.0%	41.8%	47.0%	1.5%	.7%	1.5%	3.0%	2.2%	.7%	1.5%	100.0%
	.0%	37.6%	43.2%	4.7%	9.1%	5.1%	11.8%	50.0%	12.5%	1.3%	22.4%
recreation	0	20	1	11	1	0	0	0	0	0	33
	.0%	60.6%	3.0%	33.3%	3.0%	.0%	.0%	.0%	.0%	.0%	100.0%
	.0%	13.4%	.7%	25.6%	9.1%	.0%	.0%	.0%	.0%	.0%	5.5%
school, university	0	2	2	0	1	0	0	0	0	0	5
	.0%	40.0%	40.0%	.0%	20.0%	.0%	.0%	.0%	.0%	.0%	100.0%
	.0%	1.3%	1.4%	.0%	9.1%	.0%	.0%	.0%	.0%	.0%	.8%
errand, shopping	0	28	3	0	0	1	0	0	0	0	32
	.0%	87.5%	9.4%	.0%	.0%	3.1%	.0%	.0%	.0%	.0%	100.0%
	.0%	18.8%	2.1%	.0%	.0%	2.6%	.0%	.0%	.0%	.0%	5.4%
friends, relatives	0	24	3	5	0	2	6	1	1	2	44
	.0%	54.5%	6.8%	11.4%	.0%	4.5%	13.6%	2.3%	2.3%	4.5%	100.0%
	.0%	16.1%	2.1%	11.6%	.0%	5.1%	17.6%	16.7%	12.5%	1.3%	7.4%
bar, pub, restaurant, café	0	5	0	0	0	0	2	0	1	0	8
	.0%	62.5%	.0%	.0%	.0%	.0%	25.0%	.0%	12.5%	.0%	100.0%
	.0%	3.4%	.0%	.0%	.0%	.0%	5.9%	.0%	12.5%	.0%	1.3%
other	0	4	4	1	0	2	3	0	1	2	17
	.0%	23.5%	23.5%	5.9%	.0%	11.8%	17.6%	.0%	5.9%	11.8%	100.0%
	.0%	2.7%	2.7%	2.3%	.0%	5.1%	8.8%	.0%	12.5%	1.3%	2.8%
unknown	0	3	0	0	0	0	2	0	1	150	156
	.0%	1.9%	.0%	.0%	.0%	.0%	1.3%	.0%	.6%	96.2%	100.0%
	.0%	2.0%	.0%	.0%	.0%	.0%	5.9%	.0%	12.5%	93.8%	26.1%
Total	1	149	146	43	11	39	34	6	8	160	597
	.2%	25.0%	24.5%	7.2%	1.8%	6.5%	5.7%	1.0%	1.3%	26.8%	100.0%

	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 3. Trip origin and destination – Other vehicles

Annex II – Single urban accident Tables

Type of Area	Single		Multi vehicle		Total		Controls	
	N	*48.3*	*N*	*%*	*N*	*%*	*N*	*%*
Urban	69	48.3	597	76.7	666	72.3	612	66.3
Rural	69	48.3	160	20.6	229	24.9	182	19.7
Other	5	3.5	21	2.7	26	2.8	0	0
unknown	0	0.0	0	0.0	0	0.0	129	14
Total	143	100	778	100	921	100	923	100

Table 1. Type of area

PTW legal category	Single		Multi vehicle		Total		Controls	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
L1	31	44.9	311	52.1	342	51.4	279	45.6
L3	38	55.1	286	47.9	324	48.6	333	54.4
Total	69	100.0	597	100.0	666	100.0	612	100

Table 2. PTW legal category

PTW fatalities	Single		Multi vehicle		Total	
	N	*%*	*N*	*%*	*N*	*%*
No	57	82.6	554	92.8	611	91.7
Yes	11	15.9	39	6.5	50	7.5
Unknown	1	1.4	4	0.7	5	0.8
Total	69	100	597	100	666	100

Table 3. Number of fatalities

Number of passenger	Single		Multi vehicle		Total		Controls	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Zero	55	79.7	545	91.3	600	90.1	589	96.2
One	14	20.3	52	8.7	66	9.9	23	3.8
Total	69	100.0	597	100.0	666	100.0	612	100.0

Table 4. Number of PTW passengers

Number of pedestrians	Single		Multi vehicle		Total	
	N	%	*N*	%	*N*	%
Zero	60	87.0	596	99.8	656	98.5
One	9	13.0	0	0.0	9	1.4
Three	0	0.0	1	0.2	1	0.2
Total	96	100.0	597	100.0	666	100.0

Table 5. Number of pedestrians

Time of accident	Single		Multi vehicle		Total	
	N	%	*N*	%	*N*	%
0:01-6:00	12	17.4	18	3.0	30	4.5
6:01-12:00	11	15.9	181	30.3	192	28.8
12:01-18:00	23	33.3	253	42.4	276	41.4
18:01-24:00	23	33.3	145	24.3	168	25.2
Total	69	100	597	100	666	100

Table 6. Time of accident

Day of week	Single		Multi vehicle		Total	
	N	%	*N*	%	*N*	%
Monday	17	24.6	101	16.9	118	17.7
Tuesday	5	7.2	112	18.8	117	17.6
Wednesday	9	13.0	100	16.8	109	16.4
Thursday	10	14.5	93	15.6	103	15.5
Friday	16	23.2	93	15.6	109	16.4
Saturday	4	5.8	36	6	40	6
Sunday	8	11.6	62	10.4	70	10.5
Total	69	100	597	100	666	100

Table 7. Day of week

Illumination	Single		Multi vehicle		Total	
	N	%	*N*	%	*N*	%
daylight, bright	26	37.7	340	57.0	366	55.0
daylight, not bright	12	17.4	100	16.8	112	16.8
dusk, sundown	3	4.3	30	5.0	33	5.0
night, lighted	27	39.1	96	16.1	123	18.5
night, not lighted	1	1.4	9	1.5	10	1.5
dawn, sunup	0	0	22	3.7	22	3.3
Total	69	100	597	100	666	100

Table 8. Illumination

Intersection type	Single		Multi vehicle		Total	
	N	*%*	*N*	*%*	*N*	*%*
non-intersection	39	56.5	173	29.0	212	31.8
T-intersection	9	13.0	150	25.1	159	23.9
cross intersection	8	11.6	197	31.7	197	29.6
angle intersection	2	2.9	38	6.0	38	5.7
alley, driveway	0	0.0	9	1.5	9	1.4
offset intersection	3	4.3	17	2.3	17	2.6
round about or traffic circle	7	10.1	23	2.7	23	3.5
over or under cross-over, with feeders or transitions	1	1.4	7	1.0	7	1.1
other	0	0.0	4	0.7	4	0.6
Total	69	100.0	666	100.0	666	100.0

Table 9 Intersection type

Roadway Surface condition and defects	Single		Multi vehicle		Total	
	N	*%*	*N*	*%*	*N*	*%*
None	49	71.0	422	70.7	471	70.7
Surface cracking	1	1.4	33	5.5	34	5.1
spalling, braking up, splintering	5	7.2	18	3.0	23	3.5
holes	1	1.4	7	1.2	8	1.2
ruts	3	4.3	16	2.7	19	2.9
bump	1	1.4	12	2.0	13	2.0
ripples, ridges	1	1.4	3	0.5	4	0.5
pavement edge	0	0.0	5	0.8	5	0.8
bitumen repair	4	5.8	61	10.2	65	9.8
tram/train rails	0	0.0	8	1.3	8	1.2
other	3	4.3	12	2.0	15	2.3
unknown	1	1.4	0	0.0	1	0.2
Total	69	100.0	597	100.0	666	100.0

Table 10. Roadway surface condition and defects

Roadway Maintenance defect as contributing factor	Single		Multi vehicle		Total	
	N	*%*	*N*	*%*	*N*	*%*
not applicable, no OV, or no roadway maintenance defect	54	78.3	497	83.2	551	82.7
roadway maintenance defect present but not a contrib. factor	6	8.7	87	14.6	93	14.0
roadway maintenance defect was the precipitating event	4	5.8	0	0.0	4	0.6
roadway maintenance defect was a contributing factor	3	4.3	0	0.0	3	0.5
roadway maintenance defect was the primary contributing. factor	2	2.9	13	2.2	15	2.3
Total	69	100.0	597	100.0	666	100.0

Table 11. Roadway maintenance defect as contributing factor

Vertical road alignment	Single		Multi vehicle		Total	
	N	*%*	*N*	*%*	*N*	*%*
level	55	79.7	462	77.4	517	77.6
slope of hill, upgrade	7	10.1	65	10.9	72	10.8
crest of hill, loft	3	4.3	8	1.3	11	1.7
slope of hill, downgrade	3	4.3	54	9.0	57	8.6
bottom of hill	0	0.0	4	0.7	4	0.6
dip or low lying depression	0	0.0	1	0.2	1	0.2
banked curve	1	1.4	2	0.3	3	0.5
other	0	0.0	1	0.2	1	0.2
Total	69	100.0	597	100.0	666	100.0

Table 12. Vertical road alignment

Horizontal road alignment	Single		Multi vehicle		Total	
	N	*%*	*N*	*%*	*N*	*%*
straight	37	53.6	479	80.2	516	77.5
curve right	13	18.8	51	8.5	64	9.6
curve left	17	24.6	54	9.0	71	10.7
corner right	0	0.0	2	0.3	2	0.3
corner left	1	1.4	1	0.2	2	0.3
jog right: turn to right, then left, resuming original direct.	0	0.0	6	1.0	6	0.9
jog left: turn to left, then right, resuming original direct.	1	1.4	3	0.5	4	0.6
other	0	0.0	1	0.2	1	0.2
Total	69	100.0	597	100.0	666	100.0

Table 13. Horizontal road alignment

Trip Origin	Single		Multi vehicle		Total	
	N	*%*	*N*	*%*	*N*	*%*
home	29	42.0	226	37.9	255	38.3
work, business	8	11.6	121	20.3	129	19.4
recreation	8	11.6	68	11.4	76	11.4
school, university	1	1.4	16	2.7	17	2.6
errand, shopping	3	4.3	15	2.5	18	2.7
friends, relatives	8	11.6	50	8.4	58	8.7
bar, pub, restaurant, café	4	5.8	5	0.8	9	1.4
other	1	1.4	12	2.0	13	2.0
unknown	7	10.1	84	14.1	91	13.7
Total	69	100	597	100	666	100

Table 14. Trip origin

Trip Destination	Single		Multi vehicle		Total	
	N	*%*	*N*	*%*	*N*	*%*
home	25	36.2	173	29.0	198	29.7
work, business	14	20.3	145	24.3	159	23.9
recreation	14	20.3	62	10.4	76	11.4
school, university	1	1.4	27	4.5	28	4.2
errand, shopping	3	4.3	31	5.2	34	5.1
friends, relatives	1	1.4	51	8.5	52	7.8
bar, pub, restaurant, café	3	4.3	6	1.0	9	1.4
other	1	1.4	16	2.7	17	2.6
unknown	7	10.1	86	14.4	93	14.0
Total	69	100.0	597	100.0	666	100.0

Table 15. Trip destination

Frequency of this road use	Single		Multi vehicle		Total	
	N	*%*	*N*	*%*	*N*	*%*
never used this roadway before	3	4.3	26	4.4	29	4.4
daily use, i.e., once per day	27	39.1	305	51.1	332	49.8
weekly use, i.e., once per week	14	20.3	108	18.1	122	18.3
monthly use, i.e., once per month	10	14.5	28	4.7	38	5.7
quarterly, i.e., once per quarter	2	2.9	13	2.2	15	2.3
annually, i.e., once per year	2	2.9	10	1.7	12	1.8
less than annually	0	0.0	4	0.7	4	0.6
unknown	11	15.9	103	17.3	114	17.1
Total	69	100.0	597	100.0	666	100.0

Table 16. Frequency of this road use

PTW rider experience on any PTW (months)	Single		Multi vehicle		Total		Controls	
	N	*%*	*N*	*%*	*N*	*%*	N	%
up to 6	5	7.2	43	7.2	48	7.2	36	5.9
7 to 12	2	2.9	58	9.7	60	9.0	56	9.2
13 to 36	13	18.8	120	20.1	133	20.0	121	19.8
37 to 60	11	15.9	63	10.6	74	11.1	52	8.5
61 to 97	8	11.6	44	7.4	52	7.8	46	7.5
more than 98	13	18.8	143	24.0	156	23.4	293	47.9
unknown	17	24.6	126	21.1	143	21.5	8	1.3
Total	69	100.0	597	100.0	666	100.0	612	100.0

Table 17. PTW rider experience on any PTW

PTW rider control unfamiliarity	Single		Multi vehicle		Total	
	N	*%*	*N*	*%*	*N*	*%*
not applicable, no OV or no control unfamiliarity	58	84.1	535	89.6	593	89.0
control unfamiliarity was not a contributing factor	4	5.8	35	5.9	39	5.9
control unfamiliarity was a contributing factor	6	8.7	16	2.7	22	3.3
unknown	1	1.4	11	1.8	12	1.8
Total	69	100.0	597	100.0	666	100.0

Table 18. PTW rider control unfamiliarity

PTW rider skill deficiency	Single		Multi vehicle		Total	
	N	*%*	*N*	*%*	*N*	*%*
not applicable, no OV or no evidence of skills deficiency	51	73.9	505	84.6	556	83.5
skills deficiency present, but not a contributing factor	4	5.8	32	5.4	36	5.4
skills deficiency present as a contributing factor	12	17.4	48	8.0	60	9.0
unknown	2	2.9	12	2.0	14	2.1
Total	69	100.0	597	100.0	666	100.0

Table 19. PTW rider skill deficiency

PTW rider vehicle unfamiliarity	Single		Multi vehicle		Total	
	N	*%*	*N*	*%*	*N*	*%*
not applicable, no OV or no vehicle unfamiliarity	58	84.1	523	87.6	581	87.2
vehicle unfamiliarity present, but not a contributing factor	5	7.2	38	6.4	43	6.5
vehicle unfamiliarity present as a contributing factor	6	8.7	23	3.9	29	4.4
unknown	0	0.0	13	2.2	13	2.0
Total	69	100.0	597	100.0	666	100.0

Table 20. PTW rider vehicle unfamiliarity

PTW Rider license	Single		Multi vehicle		Total		Controls	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
no license held	5	7.2	33	5.5	38	5.7	8	1.3
learner's permit, only	0	0	4	0.7	4	0.6	1	0.2
motorcycle license	20	29	132	22.1	152	22.8	159	26.0
automobile license	8	11.6	84	14.1	92	13.8	68	11.1
commercial license	0	0	1	0.2	1	0.2	1	0.2
no license required	5	7.2	88	14.7	93	14	42	6.9
motorcycle and automobile license	27	39.1	197	33	224	33.6	278	45.4
Automobile and other license	1	1.4	4	0.7	5	0.8	7	1.1
Motorcycle, car and other license	0	0	28	4.7	28	4.2	3	0.5
other	0	0	4	0.6	4	0.5	44	7.2
unknown	3	4.3	22	3.7	25	3.8	1	0.2
Total	69	100	597	100	666	100	612	100.0

Table 21. PTW rider license

Speeding over 10 km/h over posted speed limit	Single		Multi vehicle		Total	
	N	%	*N*	%	*N*	%
Not speeding	39	56.5%	478	80.1%	517	77.6%
Speeding	28	40.6%	118	19.8%	146	21.9%
Unknown	2	2.9%	1	0.2%	3	0.5%
Total	69	100.0%	597	100.0%	666	100.0%

Table 22. Speeding over 10 km/h over posted speed limit

Speed compared to surrounding traffic	Single		Multi vehicle		Total	
	N	%	*N*	%	*N*	%
no OV or no unusual speed or no surrounding traffic	54	78.3	443	74.2	497	74.6
speed was unusual but made no contribution to accident	3	4.3	52	8.7	55	8.3
unusual speed difference caused or contrib. to accident	11	15.9	102	17.1	113	17.0
unknown	1	1.4	0	0.0	1	0.2
Total	69	100.0	597	100.0	666	100.0

Table 23. Speed compared to surrounding traffic

Alcohol involvement	Single		Multi vehicle		Total	
	N	%	*N*	%	*N*	%
None	56	81.2	564	94.5	620	93.1
Alcohol use, only	10	14.5	12	2.0	22	3.3
Drug use, only	1	1.4	3	0.5	4	0.6
combined alcohol and drug use	1	1.4	1	0.2	2	0.3
unknown	1	1.4	17	2.8	18	2.7
Total	69	100.0	597	100.0	666	100.0
Alcohol or drug impairment	*N*	%	*N*	%	*N*	%
Not applicable	56	81.2	564	94.5	620	93.1
No impairment	1	1.4	4	0.7	5	0.8
not significantly impaired	1	1.4	7	1.2	8	1.2
significantly impaired	5	7.2	3	0.5	8	1.2
unknown	6	8.7	19	3.2	25	3.8
Total	69	100.0	597	100.0	666	100.0

Table 24. Alcohol involvement

Attention to passenger tasks	Single		Multi vehicle		Total	
	N	*%*	*N*	*%*	*N*	*%*
attention to driving/passenger tasks not a factor	32	46.4	316	52.9	348	52.3
inattentive mode, daydreaming, no attention to driving tasks	9	13.0	63	10.6	72	10.8
attention diverted to surrounding traffic	10	14.5	113	18.9	123	18.5
attention diverted to motorcycle normal operation	2	2.9	12	2.0	14	2.1
attention diverted to motorcycle operating problem	1	1.4	3	0.5	4	0.6
attention diverted to non-traffic item	3	4.3	8	1.3	11	1.7
attention diverted to passenger activities (rider, only)	1	1.4	2	0.3	3	0.5
attention diverted to use of mobile phone	0	0.0	1	0.2	1	0.2
attention diverted to radio, tape, VCR, CD, PC, etc.	0	0.0	1	0.2	1	0.2
other	0	0.0	4	0.7	4	0.6
unknown	11	15.9	74	12.4	85	12.8
Total	69	100	597	100	666	100

Table 25. Attention to passenger tasks

PTW loss of control	Single		Multi vehicle		Total	
	N	*%*	*N*	*%*	*N*	*%*
no loss of control	20	29.0	477	79.9	497	74.6
capsize, or fall over	1	17.4	27	4.5	28	5.9
braking slide-out, low side	14	20.3	52	8.7	66	9.9
braking slide-out, high side	2	2.9	18	3.0	20	3.0
cornering slide out, low side	2	2.9	4	0.7	6	0.9
ran wide on turn, ran off road,	5	7.2	4	0.7	9	1.4
lost wheelie	1	1.4	0	0.0	1	0.2
low speed wobble	1	1.4	2	0.3	3	0.5
high speed wobble	0	0.0	1	0.2	1	0.2
weave, no pitch	1	1.4	0	0.0	1	0.2
pitch weave, low speed	1	1.4	1	0.2	2	0.3
pitch weave, high speed cornering	1	1.4	0	0.0	1	0.2
end-over, endo, reverse wheelie	3	4.3	2	0.3	5	0.8
continuation, no control actions	2	2.9	3	0.5	5	0.8
other	1	1.4	5	0.8	6	0.9
unknown	3	4.3	1	0.2	4	0.6
Total	69	100.0	597	100.0	666	100.0

Table 26. PTW loss of control

Primary contributing factor	Single		Multi vehicle		Total	
	N	*%*	*N*	*%*	*N*	*%*
Human - PTW rider	46	66.7	189	31.7	235	35.3
Human - OV driver	0	0.0	344	57.6	344	51.7
Vehicle - PTW failure	2	2.9	0	0.0	2	0.3
Environment	17	24.6	47	7.9	64	9.6
Other failures	4	5.8	17	2.8	21	3.2
Total	69	100.0	597	100.0	666	100.0

Table 27. Primary contributing factor

Primary contributing factor - Human PTW rider	Single		Multi vehicle		Total	
	N	*%*	*N*	*%*	*N*	*%*
motorcycle rider perception failure	22	47.8	67	35.4	89	37.9
motorcycle rider comprehension failure	4	8.7	21	11.1	25	10.6
motorcycle rider decision failure	4	8.7	72	38.1	76	32.3
motorcycle rider reaction failure	10	21.7	23	12.2	33	14.0
motorcycle avoiding a different collision	0	0.0	4	2.1	4	1.7
motorcycle rider failure, unknown type	6	13.0	2	1.1	8	3.4
Total	46	100.0	189	100.0	235	100.0

Table 28. Primary contributing factor – Human PTW rider

Primary contributing factor - Environmental	Single		Multi vehicle		Total	
	N	*%*	*N*	*%*	*N*	*%*
roadway design defect	1	5.9	4	8.5	5	7.8
roadway maintenance defect	4	23.5	1	2.1	5	7.8
traffic control problem, temporary traffic obstruction	0	0.0	5	10.6	5	7.8
view obstruction, mobile or stationary	0	0.0	25	53.2	25	39.1
roadside environmental factor, incl. animal and pedestrian involvement	8	47.1	1	2.1	9	14.1
adverse weather	3	17.6	0	0.0	3	4.7
some maneuver. of another vehicle, not involved in the collision	1	5.9	11	23.4	12	18.8
Total	17	100.0	47	100.0	64	100.0

Table 29. Primary contributing factor – Environment

Primary contributing factor - PTW vehicle	Single		Multi vehicle		Total	
	N	*%*	*N*	*%*	*N*	*%*
pre-existing motorcycle maintenance related problem	2	100	0	0	2	100
Total	2	100	0	0	2	100

Table 30. Primary contributing factor – PTW vehicle

Annex III – Fatal urban accident Tables

Type of Area	Non Fatal		Fatal		Total		Controls	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
urban	616	75.3	50	48.5	666	72.3	612	66.3
rural	176	21.5	53	51.5	229	24.9	182	19.7
other	26	3.2	0	0.0	26	2.8	0	0
unknown	0	0.0	0	0.0	0	0.0	129	14
Total	818	100.0	103	100.0	921	100.0	923	100.0

Table 1. – Type of area

Primary contributing factor	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
Human - PTW rider	210	34.1	25	50.0	235	35.3
Human - OV driver	326	52.9	18	36.0	344	51.7
Vehicle - PTW failure	2	0.3	0	0.0	2	0.3
Environment	59	9.6	5	10.0	64	9.6
Other failures	19	3.1	2	4.0	21	3.2
Total	616	100.0	50	100.0	666	100.0

Table 2. – Primary contributing factor

Primary contributing factor - Human PTW rider	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
motorcycle rider perception failure	81	38.5	8	32.0	89	37.9
motorcycle rider comprehension failure	23	11.0	2	8.0	25	10.6
motorcycle rider decision failure	65	31.0	11	44.0	76	32.3
motorcycle rider reaction failure	32	15.2	1	4.0	33	14.0
motorcycle avoiding a different collision	4	1.9	0	0.0	4	1.7
motorcycle rider failure, unknown type	5	2.4	3	12.0	8	3.4
Total	210	100.0	25	100.0	235	100.0

Table 3. Primary Contributing factors – Human PTW rider

Primary contributing factor - Human OV driver	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
other vehicle driver perception failure	245	75.2	15	83.3	260	75.6
other vehicle driver comprehension failure	10	3.1	0	0.0	10	2.9
other vehicle driver decision failure	65	19.9	3	16.7	68	19.8
other vehicle driver reaction failure	2	0.6	0	0.0	2	0.6
ov post-crash motions from immediate prior collision	2	0.6	0	0.0	2	0.6
other vehicle avoiding a different collision	1	0.3	0	0.0	1	0.3
other vehicle driver failure, unknown type	1	0.3	0	0.0	1	0.3
Total	326	100.0	18	100.0	344	100.0

Table 4. – Primary contributing factor – Human OV driver

Primary contributing factor - Environmental	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
roadway design defect	5	8.5	0	0.0	5	7.8
roadway maintenance defect	5	8.5	0	0.0	5	7.8
traffic control problem, temporary traffic obstruction	4	6.8	1	20.0	5	7.8
view obstruction, mobile or stationary	25	42.3	0	0.0	25	39.1
roadside environ. factor, incl. animal and pedestrian involvement	6	10.2	3	60.0	9	14.1
adverse weather	3	5.1	0	0.0	3	4.7
some maneuver of another vehicle, not involved in the collision	11	18.6	1	20.0	12	18.8
Total	59	100.0	5	100.0	64	100.0

Table 5. – Primary contributing factor – Environment

Primary contributing factor - PTW vehicle	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
pre-existing motorcycle maintenance related problem	2	100.0	0	0.0	2	100.0
Total	2	100.0	0	0.0	2	100.0

Table 6. – Primary contributing factor – PTW vehicle

PTW legal category	Non Fatal		Fatal		Total		Controls	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
L1	324	52.6	18	36.0	342	51.4	279	45.6
L3	292	47.4	32	64.0	324	48.6	333	54.4
Total	616	100.0	50	100.0	666	100.0	612	100.0

Table 7. – PTW legal category

Number of OV involved	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
Zero	58	9.4	11	22.0	69	10.4
One	534	86.7	34	68.0	568	85.3
Two	24	3.9	4	8.0	28	4.2
Three	0	0.0	1	2.0	1	0.2
Total	616	100.0	50	100.0	666	100.0

Table 8. – Number of Other vehicles involved

Number of passengers	Non Fatal		Fatal		Total		Controls	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
Zero	560	90.9	40	80.0	600	90.1	589	96.2
One	56	9.1	10	20.0	66	9.9	23	3.8
Total	616	100.0	50	100.0	666	100.0	612	100.0

Table 9. – Number of passengers

Number of pedestrians	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
Zero	608	98.7	48	96.0	656	98.5
One	7	1.1	2	4.0	9	1.4
Three	1	0.2	0	0.0	1	0.2
Total	616	100.0	50	100.0	666	100.0

Table 10. – Number of pedestrians

Wearing helmet on head?	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
No	62	10.1	1	2.0	63	9.5
Yes	541	87.8	48	96.0	589	88.4
Unknown	13	2.1	1	2.0	14	2.1
Total	616	100.0	50	100.0	666	100.0

Table 11. – Wearing helmet on head?

Was helmet properly adjusted on head?	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
Not applicable	62	10.1	1	2	63	9.5
No	19	3.1	6	12.0	25	3.8
Yes	482	78.2	33	66.0	515	77.3
Unknown	53	8.6	10	20.0	63	9.5
Total	616	100.0	50	100.0	666	100.0

Table 12. – Was properly adjusted on head?

Was helmet securely fastened?	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
Not applicable	62	10.1	1	2	63	9.5
No	41	6.6	10	20.0	51	7.7
Yes	457	74.2	27	54.0	484	72.7
Unknown	56	9.1	12	24.0	68	10.2
Total	616	100.0	50	100.0	666	100.0

Table 13. – Was helmet securely fastened?

Time of accident	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
0:01-6:00	26	4.2	4	8.0	30	4.5
6:01-12:00	185	30.0	7	14.0	192	28.8
12:01-18:00	252	40.9	24	48.0	276	41.4
18:01-24:00	153	24.8	15	30.0	168	25.2
Total	616	100.0	50	100.0	666	100.0

Table 14. – Time of accident

Day of week	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
Monday	109	17.7	9	18.0	118	17.7
Tuesday	110	17.8	7	14.0	117	17.6
Wednesday	101	16.4	8	16.0	109	16.4
Thursday	94	15.3	9	18.0	103	15.5
Friday	99	16.1	10	20.0	109	16.4
Saturday	37	6.0	3	6.0	40	6.0
Sunday	66	10.7	4	8.0	70	10.5
Total	616	100.0	50	100.0	666	100.0

Table 15. – Day of week

Illumination	Non Fatal		Fatal		Total	
	N	%	*N*	%	*N*	%
daylight, bright	339	55.0	27	54.0	366	55.0
daylight, not bright	106	17.2	6	12.0	112	16.8
dusk, sundown	31	5.0	2	4.0	33	5.0
night, lighted	110	17.9	13	26.0	123	18.5
night, not lighted	9	1.5	1	2.0	10	1.5
dawn, sunup	21	3.4	1	2.0	22	3.3
Total	616	100.0	50	100.0	666	100.0

Table 16. - Illumination

Intersection type	Non Fatal		Fatal		Total	
	N	%	*N*	%	*N*	%
non-intersection	188	30.5	24	48.0	212	31.8
T-intersection	147	23.9	12	24.0	159	23.9
cross intersection	185	30.0	12	24.0	197	29.6
angle intersection	38	6.2	0	0.0	38	5.7
alley, driveway	8	1.3	1	2.0	9	1.4
offset intersection	17	2.8	0	0.0	17	2.6
round about or traffic circle	22	3.6	1	2.0	23	3.5
over or under cross-over, with feeders or transitions	7	1.1	0	0.0	7	1.1
Other	4	0.6	0	0.0	4	0.6
Total	616	100.0	50	100.0	666	100.0

Table 17. – Intersection Type

Roadway Type	Non Fatal		Fatal		Total	
	N	%	*N*	%	*N*	%
Motorway	20	3.2%	1	2.0%	21	3.2%
Major arterial	106	17.2%	24	48.0%	130	19.5%
Minor arterial	319	51.8%	17	34.0%	336	50.5%
non-arterial, sub-arterial	96	15.6%	3	6.0%	99	14.9%
parking lot, parking area	4	0.6%	0	0.0%	4	0.6%
Driveway	3	0.5%	0	0.0%	3	0.5%
round about or traffic circle	5	0.8%	1	2.0%	6	0.9%
Overpass	1	0.2%	0	0.0%	1	0.2%
Underpass	4	0.6%	1	2.0%	5	0.8%
dedicated bicycle/moped path separated from traffic roadway	43	7.0%	2	4.0%	45	6.8%
dedicated bicycle/moped path not separated from roadway	2	0.3%	0	0.0%	2	0.3%
other	12	2.0%	1	2.0%	13	2.0%
Unknown	1	0.2%	0	0.0%	1	0.2%

Total	616	100.0%	50	100.0%	666	100.0%

Table 18. – Roadway type

Vertical road alignment	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
Level	479	77.7	39	78.0	517	77.6
slope of hill, upgrade	65	10.6	6	12.0	72	10.8
crest of hill, loft	11	1.8	0	0.0	11	1.7
slope of hill, downgrade	53	8.6	4	8.0	57	8.6
bottom of hill	4	0.7	0	0.0	4	0.6
dip or low lying depression	1	0.2	0	0.0	1	0.2
banked curve	2	0.3	1	2.0	3	0.5
other	1	0.2	0	0.0	1	0.2
Total	616	100.0	50	100.0	666	100.0

Table 19. – Vertical road alignment

Horizontal road alignment	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
straight	480	77.9	36	72.0	516	77.5
curve right	63	10.2	1	2.0	64	9.6
curve left	60	9.7	11	22.0	71	10.7
corner right	2	0.3	0	0.0	2	0.3
corner left	1	0.2	1	2.0	2	0.3
jog right: turn to right, then left, resum. original direct.	5	0.8	1	2.0	6	0.9
jog left: turn to left, then right, resum. original direct.	4	0.7	0	0.0	4	0.6
other	1	0.2	0	0.0	1	0.2
Total	616	100.0	50	100.0	666	100.0

Table 20. – Horizontal road alignment

Trip Origin	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
home	242	39.3	13	26.0	255	38.3
work, business	120	19.5	9	18.0	129	19.4
recreation	72	11.7	4	8.0	76	11.4
school, university	16	2.6	1	2.0	17	2.6
errand, shopping	17	2.8	1	2.0	18	2.7
friends, relatives	53	8.6	5	10.0	58	8.7
bar, pub, restaurant, café	8	1.3	1	2.0	9	1.4
other	13	2.1	0	0.0	13	2.0
unknown	75	12.2	16	32.0	91	13.7

Total	616	100	50	100	666	100

Table 21. – Trip Origin

Trip Destination	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
home	185	30.0	13	26.0	198	29.7
work, business	150	24.4	9	18.0	159	23.9
recreation	69	11.2	7	14.0	76	11.4
school, university	26	4.2	2	4.0	28	4.2
errand, shopping	33	5.4	1	2.0	34	5.1
friends, relatives	51	8.3	1	2.0	52	7.8
bar, pub, restaurant, café	9	1.5	0	0.0	9	1.4
other	16	2.6	1	2.0	17	2.6
unknown	77	12.5	16	32.0	93	14.0
Total	616	100.0	50	100.0	666	100.0

Table 22. – Trip Destination

Frequency of this road use	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
never used this roadway before	29	4.7	0	0.0	29	4.4
daily use, i.e., once per day	314	51.0	18	36.0	332	49.8
weekly use, i.e., once per week	118	19.2	4	8.0	122	18.3
monthly use, i.e., once per month	36	5.8	2	4.0	38	5.7
quarterly, i.e., once per quarter	15	2.4	0	0.0	15	2.3
annually, i.e., once per year	11	1.8	1	2.0	12	1.8
less than annually	4	0.7	0	0.0	4	0.6
unknown	89	14.5	25	50.0	114	17.1
Total	616	100.0	50	100.0	666	100.0

Table 23. – Frequency of this road use

Length of time since departure	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
0 to 2 min	54	8.8	1	2.0	55	8.3
3 to 8 min	166	26.9	9	18.0	175	26.3
9 to 14 min	141	22.9	14	28.0	155	23.3
15 to 20 min	92	14.9	5	10.0	97	14.6
21 to 26 min	14	2.3	0	0.0	14	2.1
27 to 32 min	30	4.9	5	10.0	35	5.3
33 to 38 min	1	0.2	0	0.0	1	0.2
39 to 48 min	6	1.0	2	0.0	6	0.9

45 to 50 min	6	1.0	0	4.0	8	1.2
51 to 56 min	1	0.2	3	0.0	1	0.2
57 to 62 min	10	1.6	3	6.0	13	2.0
more than 62 min	8	1.3	1	2.0	9	1.4
unknown	87	14.1	20	10.0	97	14.6
Total	616	100.0	50	100.0	666	100.0

Table 24. – Length of time since departure

Age	Non Fatal		Fatal		Total		Controls	
	N	*%*	*N*	*%*	*N*	*%*	*N*	*%*
14-15	24	3.9	1	2.0	25	3.8	18	2.9
16-17	92	14.9	9	18.0	101	15.2	91	14.9
18-21	105	17.0	4	8.0	109	16.4	69	11.3
22-25	81	13.1	10	20.0	91	13.7	55	9
26-40	206	33.4	14	28.0	220	33.0	227	37.1
41-55	92	14.9	10	20.0	102	15.3	125	20.4
over 56	16	2.6	2	4.0	18	2.7	27	4.4
Total	616	100.0	50	100.0	666	100.0	612	100

Table 25. – Age

PTW Style	Non Fatal		Fatal		Total		Controls	
	N	*%*	*N*	*%*	*N*	*%*	N	%
Conventional street	77	12.5	9	18.0	84	12.7	77	12.6
Conventional street modified	16	2.6	0	0.0	16	2.4	7	1.1
Sport, race replica	68	11.0	12	24.0	79	12.0	51	8.3
Cruiser	21	3.4	1	2.0	22	3.3	19	3.1
Chopper, modified chopper	20	3.2	3	6.0	23	3.5	27	4.4
Touring	0	0.0	0	0.0	0	0.0	39	6.4
Scooter	290	47.1	17	34.0	306	46.3	254	41.5
Step-through	42	6.8	1	2.0	43	6.5	61	10.0
Sport touring	33	5.4	5	10.0	38	5.7	41	6.7
other	44	7.1	2	4.0	45	6.8	30	4.9
unknown	5	0.8	0	0.0	5	0.8	1	0.2
Total	616	100.0	50	100.0	661	100.0	612	100.0

Table 26. – PTW Style

PTW Engine Capacity	Non Fatal		Fatal		Total		Controls	
	N	*%*	*N*	*%*	*N*	*%*	N	%
up to 50	322	52.3	17	34.0	339	50.9	276	45.1
51-125	58	9.4	7	14.0	65	9.8	60	9.8
126-250	28	4.5	1	2.0	29	4.4	23	3.8
251-500	30	4.9	3	6.0	33	5	35	5.7
501-750	115	18.7	13	26.0	128	19.2	115	18.8
751-1000	37	6.0	5	10.0	42	6.3	60	9.8
>1001	26	4.2	4	8.0	30	4.5	43	7.0
Total	616	100	50	100.0	666	100	612	100.0

Table 27. – PTW engine capacity

Travelling speed (km/h)	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
0	26	4.2	0	0.0	26	3.9
10	24	3.9	0	0.0	24	3.6
20	57	9.3	1	2.0	58	8.7
30	108	17.5	3	6.0	111	16.7
40	141	22.9	6	12.0	147	22.1
50	126	20.5	10	20.0	136	20.4
60	61	9.9	7	14.0	68	10.2
70	41	6.7	9	18.0	50	7.5
80	11	1.8	9	18.0	20	3.0
90	5	0.8	2	4.0	7	1.1
100 or higher	13	2.1	3	6.0	16	2.3
unknown	3	0.5	0	0.0	3	0.5
Total	615	100.0	50	100.0	666	100.0

Table 28. – Travelling speed

Speeding over 10 km/h over posted speed limit	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
Not speeding	490	79.5	27	54.0	517	77.6
Speeding	123	20.0	23	46.0	146	21.9
Unknown	3	0.5	0	0.0	3	0.5
Total	611	100.0	50	100.0	666	100.0

Table 29. – Speeding

Speed compared to surrounding traffic	Non Fatal		Fatal		Total	
	N	%	N	%	N	%
no OV or no unusual speed or no surrounding traffic	466	75.7	31	62.0	497	74.6
speed was unusual but made no contribution to accident	50	8.1	5	10.0	55	8.3
unusual speed difference caused or contrib. to accident	99	16.1	14	28.0	113	17.0
unknown	1	0.2	0	0.0	1	0.2
Total	616	100.0	50	100.0	666	100.0

Table 30. – Speed compared to surrounding traffic

PTW rider Training	Non Fatal		Fatal		Total		Controls	
	N	%	N	%	N	%	N	%
no training	51	8.3	4	8.0	55	8.3	3	0.5
self taught	197	32.0	5	10.0	202	30.3	242	39.5
taught by friends or family	39	6.3	2	4.0	41	6.2	75	12.3
special voluntary training	11	1.8	2	4.0	13	2.0	7	1.1
special compulsory training	236	38.3	24	48.0	260	39.0	270	44.1
no training needed	17	2.8	1	2.0	18	2.7	10	1.6
other	1	0.2	0	0.0	1	0.2	2	0.4
unknown	64	10.4	12	24.0	76	11.4	3	0.5
Total	616	100.0	50	100.0	666	100.0	612	100.0

Table 31. PTW rider Training

PTW Rider license	Non Fatal		Fatal		Total		Controls	
	N	%	N	%	N	%	N	%
no license held	35	5.7	3	6.0	38	5.7	8	1.3
learner's permit, only	4	0.7	0	0.0	4	0.6	1	0.2
motorcycle license	136	22.0	16	32.0	150	22.8	159	26.0
automobile license	85	13.8	7	14.0	92	13.8	68	11.1
commercial license	1	0.2	0	0.0	1	0.2	1	0.2
no license required	89	14.4	4	8.0	93	14.0	42	6.9
motorcycle + automobile license	206	33.4	18	36.0	223	33.6	278	45.4

Automobile + other license	5	0.8	0	0.0	5	0.8	7	1.1
Motorcycle, car + other license	28	4.6	0	0.0	28	4.2	3	0.5
other	3	0.4	1	2.0	4	0.5	44	7.2
unknown	24	3.9	1	2.0	23	3.8	1	0.2
Total	616	100.0	50	100.0	661	100.0	612	100.0

Table 32. – PTW rider license

PTW rider control unfamiliarity	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
not applicable, no OV or no control unfamiliarity	553	89.8	40	80.0	593	89.0
control unfamiliarity was not a contributing factor	38	6.1	1	2.0	39	5.9
control unfamiliarity was a contributing factor	17	2.8	5	10.0	22	3.3
unknown	8	1.3	4	8.0	12	1.8
Total	611	100.0	50	100.0	666	100.0

Table 33. – PTW rider control unfamiliarity

PTW rider skill deficiency	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
not applicable, no OV or no evidence of skills deficiency	517	83.9	39	78.0	556	83.5
skills deficiency present, but not a contributing factor	34	5.5	2	4.0	36	5.4
skills deficiency present as a contributing factor	54	8.8	6	12.0	60	9.0
unknown	11	1.8	3	6.0	14	2.1
Total	616	100.0	50	100.0	666	100.0

Table 34. – PTW rider skill deficiency

PTW rider vehicle unfamiliarity	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
not applicable, no OV or no vehicle unfamiliarity	540	87.6	41	82.0	581	87.2
vehicle unfamiliarity present, but not a contributing factor	42	6.9	1	2.0	43	6.5
vehicle unfamiliarity present as a contributing factor	22	3.6	7	14.0	29	4.4
unknown	12	1.9	1	2.0	13	2.0
Total	616	100.0	50	100.0	666	100.0

Table 35. – PTW rider vehicle unfamiliarity

PTW rider evasive actions	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
No collision avoidance action	233	25.4	20	29.4	253	25.7
Braking	474	51.6	36	52.9	510	51.8
Swerve	154	16.8	10	14.7	164	16.7
Accelerating	14	1.5	0	0.0	14	1.4
Use of horn, flashing headlamp	7	0.8	0	0.0	7	0.7
Drag feet, jump from PTW	7	0.8	0	0.0	7	0.7
Other	21	2.3	2	2.9	23	2.3
Unknown	9	1.0	0	0.0	6	0.6
Total	919	100.0	68	100.0	984	100.0

Table 36. – PTW rider evasive actions

If continuation, no action due to	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
no continuation, evasive action was taken	373	57.0	29	46.8	402	56.1
strategic detection failure	91	13.9	8	12.9	99	13.8
impairment detection failure	14	2.1	1	1.6	15	2.1
strategic decision failure	47	7.2	3	4.8	50	7.0
impairment decision failure	2	0.3	0	0.0	2	0.3
strategic reaction failure	27	4.1	3	4.8	30	4.2
impairment reaction failure	6	0.9	1	1.6	7	1.0
other	79	12.1	2	3.2	81	11.3
unknown	15	2.3	15	24.2	30	4.2
Total	654	100.0	62	100.0	716	100.0

Table 37. – If continuation, no action due to

Was the evasive action the proper choice for the situation?	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
not applicable, no OV or no evasive action	240	39.0	21	42.0	261	39.2
no	62	10.1	4	8.0	66	9.9
yes	306	49.6	24	48.0	330	49.5
unknown	8	1.3	1	2.0	9	1.4
Total	616	100.0	50	100.0	666	100.0

Table 38. – Was the evasive action the proper choice?

Was the evasive action properly executed?	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
not applicable, no OV or no evasive action taken	239	38.8	21	42.0	260	39.0
no, evasive action was not properly executed	199	32.3	16	32.0	215	32.3
yes, evasive action was properly executed	153	24.8	12	24.0	165	24.8
unknown	25	4.1	1	2.0	26	3.9
Total	616	100.0	50	100.0	666	100.0

Table 39. – Was the evasive action properly executed?

PTW loss of control	Non Fatal		Fatal		Total	
	N	*%*	*N*	*%*	*N*	*%*
no loss of control	465	75.5	32	64.0	497	74.6
capsize, or fall over	37	6.0	2	4.0	39	5.9
braking slide-out, low side	58	9.4	8	16.0	66	9.9
braking slide-out, high side	19	3.1	1	2.0	20	3.0
cornering slide out, low side	6	1.0	0	0.0	6	0.9
ran wide on turn, ran off road, under cornering	7	1.1	2	4.0	9	1.4
lost wheelie	1	0.2	0	0.0	1	0.2
low speed wobble	3	0.5	0	0.0	3	0.5
high speed wobble	0	0.0	1	2.0	1	0.2
weave, no pitch	1	0.2	0	0.0	1	0.2
pitch weave, low speed	2	0.3	0	0.0	2	0.3
pitch weave, high speed cornering	1	0.2	0	0.0	1	0.2
end-over, endo, reverse wheelie	3	0.5	2	4.0	5	0.8
continuation, no control actions	4	0.6	1	2.0	5	0.8
other	6	1.0	0	0.0	6	0.9
unknown	3	0.5	1	2.0	4	0.6
Total	616	100.0	50	100.0	666	100.0

Table 40. – PTW loss of control

Accident configurations	Non fatal		Fatal		Total	
	N	%	N	%	N	%
head-on collision of MC and OV	32	5.2	1	2.0	33	5.0
OV into MC impact at intersection; paths perpendicular	57	9.3	3	6.0	60	9.0
MC into OV impact at intersection; paths perpendicular	67	10.9	2	4.0	69	10.4
OV turning left in front of MC, MC perpendicular to OV path	71	11.5	3	6.0	74	11.1
MC & OV in opp. dir., OV turns in front of MC, MC impacting	43	7.0	9	18.0	52	7.8
MC overtaking OV while OV turning left	39	6.3	4	8.0	43	6.5
MC impacting rear of OV	46	7.4	3	6.0	49	7.4
MC falling on roadway, no OV involvement	30	4.9	3	6.0	33	5.0
MC falling on roadway in collision avoidance with OV	29	4.7	4	8.0	33	5.0
MC impacting pedestrian or animal	8	1.3	3	6.0	11	1.7
MC impacting environmental object	14	2.3	4	8.0	18	2.7
other (includes 13 different categories below 5%)	180	29.2	11	22.0	191	28.7
Total	616	100.0	50	100.0	666	100.0

Table 41. – Accident configuration