Northern Ireland Motorcycle Fatality Report 2012

Indepth Study Of 39 Motorcycle Collisions In Northern Ireland Between 2004 And 2010 In Which 41 Motorcyclists Were Fatally Injured

RIGHT TO RIDE LTD

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This study is supported by the British Motorcyclists Federation Foundation

Executive Summary

The n.39 case studies analysed in this report are a representative sample of motorcycle fatalities in Northern Ireland between 2004 and 2010. The report contains an analysis of the collisions investigated and includes information relating to vehicle data, the collision scene and the environment as well as human factors. Overall, n.41 motorcyclists were fatality injured.

The evidence provided in this report indicates that each road traffic collision is unique but that in all cases the time frame from the perceived hazard to the conclusion of the impact either with another vehicle or with road infrastructure was typically between 2 and 3 seconds.

Information from the case studies indicates that the conditions for riding were generally optimal and during daylight.

In 63.4% of cases, (n.26/n.41) motorcyclists applied their brakes prior to the collision and n.18 (43.9%) applied their brakes severely. Of the n.17 (41.4%) motorcycles that slid after falling, n.10 (24.4%) fell onto their right side and the remaining n.7 (17.1%) fell onto their left side. There were two cases identified where Anti-Lock Braking Systems (ABS) may have made a difference to the outcome of the collision, both were on a straight section of road. At this point in time, the application of ABS on motorcycles is limited to straight sections of the road.

Of the n.39 cases analysed, there were n.17 cases (43.6%) in which another vehicle was considered the primary cause of the collision. In thirteen of these cases (76.5%), the evidence highlighted that the motorcycle's lights were switched on and therefore the other vehicle driver was in a position to see them. However, there appears to be a problem of looking but not seeing which may be due to the size of the motorcycle or simply because the car/van driver is expecting to see another car or van and has difficulty coping with the unexpected. There also appears to be an issue with the visibility from the cab of trucks to see the dipped beam of the motorcycle, which appears to be limited due to the height of the truck, this may have an effect on the perception of the oncoming motorcycle.

There were four cases (10.3%) of speeding, but in all cases, the actions of the other vehicle driver precipitated the collision. Equally there were four known cases (10.3%) in which the rider had levels of alcohol over the legal limit and or drugs in their blood. Three of these collisions were single vehicle (no other vehicle involved) and the fourth ran a red light through an intersection with no headlights on and impacted a car crossing the intersection.

There were n.9 cases (23%) in which the motorcyclists involved in a collision were either riding in a group or with another motorcyclist. In all these cases the total number of motorcyclists killed was n.11/n.41 (26.8%).

A focus group discussed the relevance of technology on vehicles as a deterrent to collisions as well as the advantages of teaching hazard perception and anticipation in initial and advanced training as a defence against potential collisions. The consensus was that while technology may in some cases be beneficial, good training was more important. However, the availability, image and cost of advanced training seemed to be a barrier to getting more riders involved.

Awareness campaigns were considered useful, but there is no method to measure their efficacy. However the consensus was that different avenues should be used to get the safety message out to the target audience, such as using the internet, social media, race meetings and specific road signage.

According to the participants of the focus group, the best solution to avoid road traffic collisions is anticipation and hazard awareness. The consensus was that the only reliable way to prevent motorcyclist injuries and deaths is to prevent the collision in the first place, which means the rider needs to get his/her eyes up and scanning ahead, taking evasive action when a potential collision is still several seconds from happening.

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Acronyms

ABS: Anti-lock braking system also Advanced braking system

AT: Advanced Training

CBS: Combined braking system

CBT: Compulsory Basic Training

DOE: Department of the Environment Northern Ireland

DRD: Department of Regional Development (Roads Service)

DVA: Driver and Vehicle Agency Northern Ireland

FSNI: Forensic Science Northern Ireland

MC: Motorcycle

OV: Other Vehicle

PSNI: Police Service Northern Ireland

SCRIM: Sideways Force Coefficient Routine Investigation Machine

VRU: Vulnerable Road Users

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1. Introduction

This study is an examination of 39 collision scene reports from Senior Scientific Officers, Damian Coll, Emerson Callender and Lindsay McCormick of the Road Traffic Collision Investigation Unit, Forensic Science, Northern Ireland. The findings of these reports are supported by the Coroners' Verdicts, where available. The study and analysis of the reports was carried out by Elaine Hardy PhD, Research Director of Right To Ride Ltd, Elaine is an analyst with considerable experience in motorcycle safety research.

The three investigators are motorcyclists. Emerson Callender has a PhD in Mechanical Engineering while Lindsay McCormick has a B.Eng. in Mechanical Engineering and Damian Coll has a BSc BA Chartered Engineers and is a Member of the Institution of Mechanical Engineers; Member of the Institute of Traffic Accident Investigators. In the Road Traffic Collision Investigation Unit there are six investigators who attend vehicle fatalities in Northern Ireland.

2. Background

During 2004 to 2010 the Road Traffic Collision investigators attended road traffic collision scenes in which motorcyclists were fatally injured. This document analyses No. 39 cases (41 motorcyclists) from their investigations which is equal to 36% of the total motorcycle fatalities in Northern Ireland between 2004 and 2010 (there were 114 fatalities during this period). The cases reported in this study represent the investigations carried out by Damian Coll (n.21 reports), Dr Emerson Callender (n.16 reports) and Lindsay McCormick (n.2 reports) between April 2004 and June 2010.

The collision scenes were attended by an investigator, a PSNI photographer and mapper. The files that the investigators prepare include photographs of the collision scene, witness statements, as well as maps, diagrams, laboratory examinations and their findings which are compiled in a report from each collision investigation. Typically, the investigator arrives at the collision scene within 2 to 4 hours following the collision. Each accident investigation takes approximately six months to complete. The case studies from which this report is based, contain information from the Investigators' reports including their findings and comments.

There were 23 inquests held in relation to the collisions reported in this study, resulting in a Coroner's verdict. In the cases where there was no Coroner's verdict there may have been a prosecution; the person charged with an offence may have pleaded guilty or the family may have indicated that they did not want a public enquiry.

3. Data Collected On-Scene:

Vehicle data

- Vehicle registration number, manufacturer, model
- Mechanical factors data, motorcycle and other vehicles
- Contribution of design or maintenance defects to collision or injury causation
- Collision or injury related cause factors
- Motorcycle pre-crash motions
- Other vehicle pre-crash motions
- Motorcycle collision motions
- Other vehicle collision motions
- Motorcycle post-collision motions
- Associate vehicle injury sources
- Vehicle speed for motorcycle and other vehicle
- Motorcycle lighting: headlamps, brake lights, etc.

Collision scene, environment

- Collision scene data
- Road motorcycle was travelling

- Road other vehicle was travelling
- Traffic and controls
- Verify collision configuration
- Preview collision cause factors
- Collision contribution of weather, view obstructions
- Collision contribution of road conditions and defects

Human factors

- Collision avoidance performance
- Helmet analysis

4. Aims and Objectives

The aim of this study is to analyse each case study presented from the findings of the FSNI investigators and where available, the Coroner's verdict.

The objective is to identify the primary cause of the collisions as well as the contributory factors and from that information, to understand collision causation and ultimately endeavour to draw conclusions from a focus group of trainers and police.

5. Vehicle factors

Details of all vehicles involved in the n.39 cases reported were recorded which included the vehicle registration, make and model. There were n.41 motorcycles involved in these collisions.

With regards to style, there were n.21 (51.2%) super sports motorcycles (in two cases there were two super sports involved respectively), five (12.2%) tourers (including one super sports tourer and two sports tourers), three cruisers, three scooters, three naked/semi-naked, two sports, two mopeds, one adventure traillie and one trail bike.

Of the n.41 motorcycles (including scooters and mopeds) n.31 (75.5%) had engine sizes between 600cc and 1300cc, there were two between 350cc and 400cc, six (14.6%) with an engine size of 125cc and two mopeds with an engine size of 50cc.

Mechanical factors and contribution of design or maintenance defects to collision or injury causation are recorded. n.36/n.41 (87.8%) motorcycles did not have any mechanical, design or maintenance defects which may have contributed to the collision or injury causation. In Northern Ireland all vehicles are subject to a regular annual technical inspection called MoT which covers lights, brakes, tyres, steering and general maintenance.

However in n.3/n.41 (7.3%) motorcycles, under-inflated tyres were identified as the cause or a contributory factor in the collision. In one case the front tyre was recorded as not for highway use. One motorcycle was recorded as having the steering damper missing which may have contributed to the loss of control. One motorcycle was burnt, so no information is available.

Of the cases where another vehicle was involved, in one case where the car driver performed a U turn in front of the motorcycle, the investigator noted that the C and D pillars may have restricted the view of the driver. In a case there a truck pulled out in front of the motorcycle, there was a problem with the visibility of the driver from the cab of the truck to see the light of the motorcycle which may have had an effect on his perception of the distance of the oncoming motorcycle. No other cases reported mechanical factors or design issues which may have contributed to the collision.

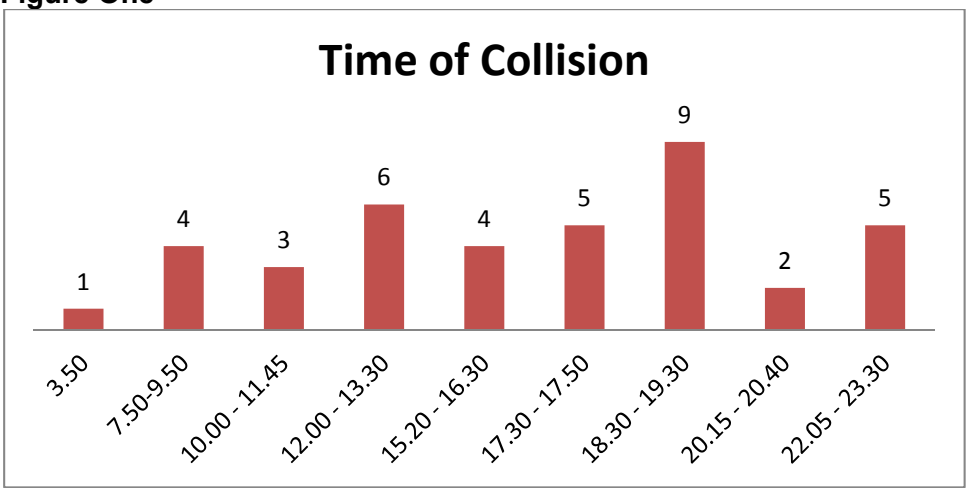
5.1 Tyre Pressure

The measured tyre pressure of the motorcycles indicates that in n.28/n.41 motorcycles recorded, n.13/n.28 (46%) of these motorcycles had under-inflated tyres of between -8 psi up to -25 psi. In two further cases, investigation indicated that there was a probability that the deflated tyres were under-inflated and were a contributory cause of the collision. Overall, evidence that under-inflated tyres contributed to the collision, was found in one case, while in two cases, the under-inflated tyres were the primary cause of the collision. Although the tyre pressure was below the recommended level as indicated by tyre manufacturers in the n.13 cases mentioned above, according to the investigators there was no evidence (apart from the three cases highlighted) that under-inflated tyres had an influence to the outcome of the collision.

6. Collision scene and environment factors of n.39 collisions

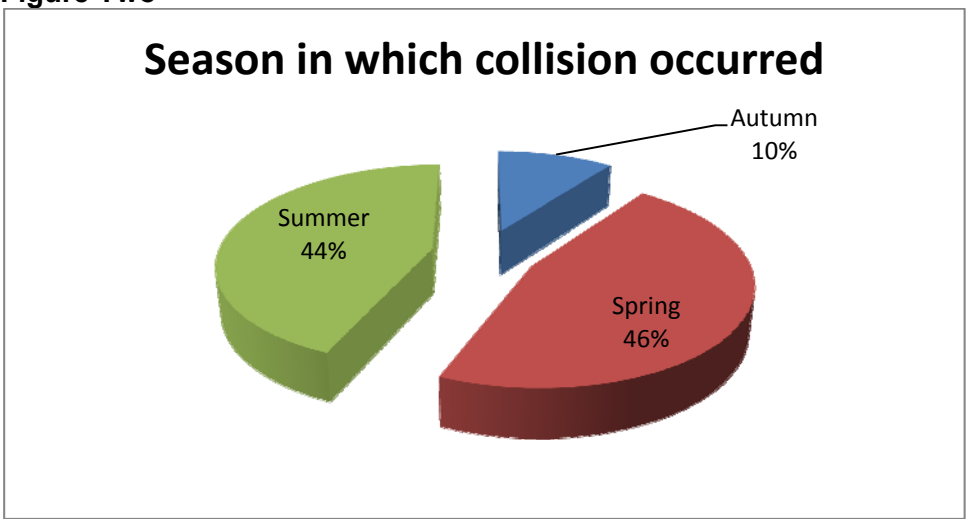
The time of day of the collisions highlights that 46.2% (n.18) occurred between afternoon and early evening. 17.9% (n.7) occurred in the evening and 33.3% (n.13) occurred between morning and early afternoon. One collision (2.6%) occurred in the early morning. The highest proportion of fatalities: 23%, (n.9) occurred between 18.30 and 19.30.

Figure One



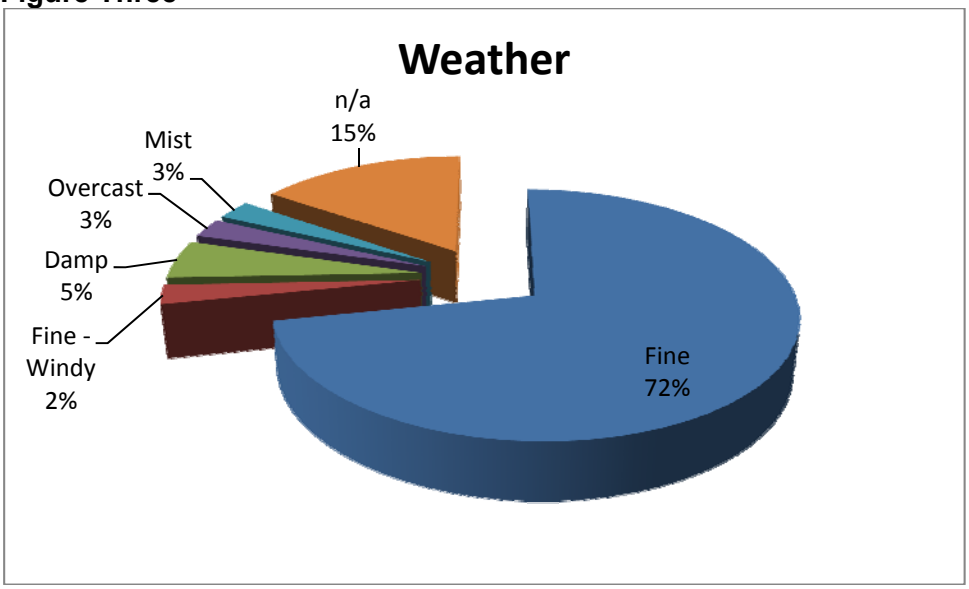
The proportion of collisions occurring in Spring were 46.2% (n.18), Summer 43.6% (n.17) and autumn 10.3% (n.4).

Figure Two



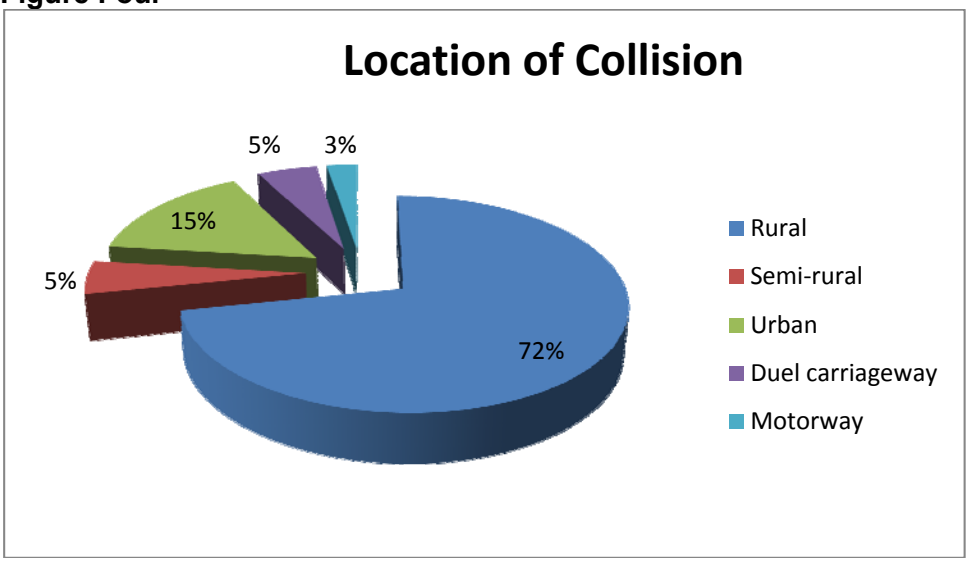
In 72% (n.28) of cases, the weather was fine; in n.4 cases the weather was either overcast or damp. In six cases the weather was not mentioned.

Figure Three



Twenty eight collisions occurred in rural locations (71.8%) while n.6 (15.4%) occurred in urban locations, the remainder occurred in a semi-rural location (n.2), on a duel carriageway (n.2) and one occurred on a motorway.

Figure Four



6.1 Road Conditions

The investigators examine the road where the collisions occur looking for contaminants, surface irregularities, quality and markings.

If the investigators suspect that there is an issue with the road surface, or to attempt to estimate the speed from the tyre marks, they would carry out a skid test, using a skid mark device to measure the coefficient of friction between the tyres and the road surface. Generally this would be applied more for cars, because the friction coefficient might be slightly higher for motorcycle tyres than what there would be in a test for a car. But if the investigators suspected that there was an

issue with the traction of the road surface, or if they are to perform calculations based on the length of the tyre marks, then the investigators would conduct skid tests.

Typically there is a road test conducted at the scene while the road is still closed or at a later stage when the road is open, whereby the investigators will drive or ride through the collision scene or get another expert police motorcyclist to ride through the scene to comment on and/or determine whether it is possible to negotiate part of the road through the collision scene at a specific speed. The investigators need to be satisfied that the motorcyclist was not travelling in excess of that speed to eliminate this as a factor in the collision and demonstrate that there was no issue with the road surface.

In all cases, the condition of the roads was reported as "good". In one case there were no road markings. In n.29/n.39 cases (74.3%), the surface of the road was "dry". In three cases the surface of the road was "damp" and in one case there were loose stones on part of the road.

6.2 Road Layout[1]

In the approach to the collision scene, there were n.13 cases (31.7%) in which the approach was a right hand bend and in eight (19.5%) cases, the approach was a left hand bend. In the remaining n.18 (43.9%) cases, the approach was a straight section of road.

6.3 Action taken by Motorcyclist

63.4% (n.26/n.41) motorcyclists applied their brakes prior to the collision and n.18 (43.9%) applied their brakes severely. Of the n.17 (41.4%) motorcycles that slid after falling, ten (24.4%) fell onto their right side and the remaining seven (17.1%) fell onto their left side.

Table one highlights the actions of seven motorcyclists who approached the collision scene on a left hand bend. In five cases, the motorcyclist applied the brakes. Three motorcycles fell on the left hand side and two fell on the right side.

Table One: Left hand bend approach prior to collision and subsequent action taken

Style of MC	Approach to collision scene by MC	Position of MC prior to collision	Action taken by Motorcyclist	Side that MC slides after falling
Sports 750cc	Downhill left hand bend	Travelling on main road	Leans MC and applies front brake severely (locking wheel)	Left side
Super Sport 1100cc	Gentle left hand bend	Centre of lane	Applies brakes severely locking rear wheel	Motorcycle "high sides" then falls on right side
Moped 50cc	Gentle left hand bend	Approaches junction	Applies brakes severely	Right side
Trail 125cc	Left hand bend	Veers slowly towards kerbstone	Puts left foot down on raised verge	Left side
Super Sport 750cc	Sharp left hand bend	Attempts to overtake van and leans MC into the corner	Applies brakes to front wheel (locking wheel) changes down gears and leans MC left at same time	Left side
Super Sport 900cc	Uphill left hand bend	Centre of lane	Applies brake	N/a (Impacts car)
Tourer 1300cc	Uphill left hand bend	Travelling on duel carriageway	Moves left to avoid van	N/a (Impacts van)

N/a = Did not slide

[1] In Northern Ireland (as with the rest of the United Kingdom), vehicles drive/ride on the left hand side of the road.

Table two identifies n.14 motorcyclists that approached the collision scene on a right hand bend, in five cases, the motorcycle fell to the right, three fell to the left, two motorcyclists impacted the other vehicle.

Table Two: Right hand approach prior to collision and subsequent action taken

Style of MC	Approach to collision scene by MC	Position of MC prior to collision	Action taken by Motorcyclist	Side that MC slides after falling
Naked 600cc	Downhill right hand bend	Not recorded	Applies braking severely and almost locks front wheel	Right side
Tourer 1100cc	Downhill right hand bend	Travelling on main road	Veers suddenly to left and hits kerbstones deflecting MC	Right side
Scooter 125cc	Downhill Right hand bend	Veers to left to avoid metal covers on road	Applies brakes	N/a (impacts wall)
Sports 400cc	Gentle right hand bend	Close to left hand side	Applies brakes	Left side
Super sport (2) 1000cc and 1200cc	Gradual right hand bend	Centre of lane Two MCs speeding at >130 mph (1000cc behind and slightly to the right of 1200cc)	1200cc applies brake severely to both front and rear wheel; 1000cc applies brake	N/a (Impacts truck)
Cruiser 650 cc	Long sweeping right hand bend	Travelling on main road	No Action	N/a (impacts car)
Super Sport 600cc	Right hand bend	Motorcyclist leans to left and loses grip	No action	Left side (into oncoming car)
Super Sport 1000cc	Right hand bend	Overtakes bus, perceives hazard (oncoming vehicle)	Manoeuvres severely to left and applies brakes severely, locking front wheel	Right side
Super Sport 1000cc	Right hand bend	Travelling on main road	Applies brakes severely	Right side
Super Sport 1000cc	Right hand bend	Travelling on main road	Applies brakes severely, locking front wheel	Right side
Super Sport 600cc	Right hand bend	Travelling on Motorway, goes wide and moves left onto hard shoulder then top of Armco Barrier	No action	Flies over Armco barrier to construction site (impacts ground)
Sports Tourer 750cc	Right hand bend	Overtakes cars and follows wide path	Leans MC severely to the right and falls	Left side
Classic 350cc	Right hand bend	Travelling on main road into bend, loses control	Applies rear brake severely (locking wheel)	N/a (Impacts raised bank)
Super Sport 750cc	Uphill right hand bend	Overtakes three cars, centre line	MC goes out of control, motorcyclist applies rear brake severely and rotates left	N/a

N/a = Did not slide

The following table (three) indicates that there were n.18 motorcycles that approached the collision scene on a straight stretch of road. Of these, n.12 impacted another vehicle. In seven cases the investigators provided evidence that no action was taken (i.e. the motorcyclist did not apply the brakes). Three motorcycles fell on their right side and one on the left side.

Table Three: Straight approach prior to collision and subsequent action taken

Style of MC	Approach to collision scene by MC	Position of MC prior to collision	Action taken by Motorcyclist	Side that MC slides after falling
Sports Tourer 800cc	Straight (junction)	Manoeuvres to right of lane	Applies brakes	N/a (Impacts car)
Super sport 1000cc	Straight	Manoeuvres over centre line to opposite lane	Applies brakes	N/a (impacts car)
Advent. Traillie 1150cc	Straight	Attempts to overtake car and car applies brakes	Applies brakes (ABS) but too close to car in front	N/a (Impacts oncoming car)
Semi-naked 650cc	Straight	Travelling on minor road emerges from junction without stopping	Applies brakes severely	N/a (Impacts car)
Super Sport 1000cc	Straight	Approaches junction	Applies brakes severely front and rear wheel	N/a (Impacts truck)
Super Sport 600cc	Straight	Centre of lane	Applies brakes severely locking brake, causing rear wheel to lift	N/a (impacts car)
Super Sport 600cc	Straight	Travelling on main road	Applies brakes severely locking brake, reduces braking or transfers weight forward, causing MC to pivot on front wheel, lifting rear wheel	N/a (Impacts car)
Super Sport 600cc	Straight downhill	Crosses centre line	Applies brakes severely locking front wheel	N/a (Impacts oncoming MC)
Super Sports 1100cc	Straight	Travelling in group of Motorcycles	Applies front brake severely (locking wheel)	Right side
Super Sport Tourer 1100cc	Straight	Travelling on duel carriageway	Applies rear brake severely	Right side
Super sport 125cc	Straight at junction	Attempts to overtake truck while truck steers to the right	Impacts truck and slides towards oncoming car	Right side
Cruiser 125cc	Straight, crest then decline	Emerging from junction without stopping	No action	N/a (Impacts car)
Cruiser c.900cc	Straight	Overtakes bus and runs into car at junction	No action	N/a (impacts car)
Sports 1000cc	Straight	Manoeuvres to right of lane	No action	N/a (Impacts car)
Scooter 125cc	Straight	Travels across junction running red light	No action	N/a (impacts car)
Scooter 125cc	Straight	Moves gradually to left towards kerbstone	No action	Left side
Moped 50cc	Straight	Travelling on main road impacts friend's moped, loses control	No action	N/a (Impacts wall)
Super Sport 600cc	Straight (dip in the road)	Travelling along main road	No action	N/a (impacts van)

N/a = Did not slide

6.4 Road Infrastructure

Of the n.39 cases, there were n.12 cases (30.8%) in which the motorcyclist impacted against road infrastructure. In five of these cases the motorcyclist either impacted a fence or wall. In one of these cases, the wall had "dragon teeth" which caused the injuries to the motorcyclist. In four cases the motorcyclist impacted a pole – in one case, the pole had a traffic monitoring box attached which caused the injuries of the motorcyclist. In two cases the motorcyclist impacted the bank or kerbstones on the side of the road and one motorcyclist impacted rocks in a construction area after "flying" over an Armco barrier. Of the n.12 cases, in five (12.8%), the collision involved another vehicle while in seven cases (17.9%) there was no other vehicle involved.

Table Four: Road Infrastructure

Involvement of OV in the collision	
1	Motorcyclist impacts a concrete post and wooden fence
2	Motorcyclist impacts traffic monitoring box on pole
3	First motorcyclist is projected onto road and second motorcyclist hits wooden fence
4	Motorcyclist impacts wall (and is projected back under a bus)
5	Moped rider impacts "dragon tooth" wall
No involvement of OV in the collision	
6	Motorcyclist impacts lower part of telegraph pole
7	Motorcyclist impacts poles of a warning sign
8	Motorcyclist impacts outer support pole for a speed limit sign
9	Motorcyclist impacts rocks in a construction area (after passing over Armco barrier)
10	Motorcyclist impacts kerbstones
11	Motorcyclist impacts bank
12	Motorcyclist impacts wall

6.5 Other Vehicle Involvement

There were seventeen cases (43.6%) in which another vehicle was considered the primary cause of the collision. As highlighted in table five, four of the other vehicle drivers performed a U turn in front of the motorcycle. One driver was a hit and run (i.e. after the collision the car driver left the scene of the collision). The remaining vehicles exited from a side road or private entrance in front of the motorcycle or turned across the road in front of motorcycle from the opposite lane. Of the seventeen cases, eight (47%) were cars, five (29.4%) were vans, two were trucks and one was a tractor.

Table Five: Type of Collision involving OV that pulls out or performs U turn

	Style of MC	**Type of Collision**
1	Sports 400cc	Van pulls out in front of MC
2	Super sport 1000cc	Car performs U turn in front of MC
3	Cruiser 650cc	(Hit and run) Car driver pulls out in front of the MC
4	Super sport 1100cc	Van performs U turn in front of MC
5	Sports Tourer 800cc	Car pulls out in front of the MC
6	Super sport 600cc	Car performs U turn in front of MC
7	Super sport 600cc	Car pulls out in front of the MC
8	Super sport 900cc	Car pulls out in front of the MC
9	Super sport 1200cc;Super sport 1000cc	Tipper truck pulls out from entrance to quarry
10	Naked 600cc	Car pulls out in front of the MC
11	Super sports tourer 1100cc	Car pulls out in front of the MC
12	Sports 1000cc	Car turning right in front of MC
13	Tourer 1300cc	Van performs U turn in front of MC
14	Super sport 1000cc	Truck pulls out in front of MC
15	Super sport 1000cc	Tractor pulls out in front of MC
16	Super sport 1000cc	Van driver cuts the corner in front of the MC's path
17	Super sport 600cc	Van driver pulls out in front of MC

7. Human factors
7.1 Helmets

Of the twenty eight cases where information about helmets is recorded, twenty six were full face and one was a flip face. In six cases, the helmet was recorded as not being secured. The type of closure was recorded for eight of the helmets: six had a “Double D” closure and two had a “locking tongue” closure. In two cases the visor was tinted, sixteen of the visors were clear and there was no information about visors for the remaining nine helmets.

7.2 Alcohol/drugs

There are four recorded cases in which the motorcyclists had levels of alcohol over the legal limit and or drugs in their blood. In Northern Ireland the maximum legal alcohol limit for driving is 80 mg per 100 mls. In three cases the alcohol content was more than two times over the legal limit. In one case the motorcyclist had also taken nerve suppressant drugs and possibly cannabis. In another case the motorcyclist also had ecstasy in his blood. Three of these collisions were single vehicle (no other vehicle involved) and the fourth ran a red light through an intersection with no headlights on and impacted a car crossing the intersection. The information on alcohol and drugs is only available from the Coroner’s Verdicts.

7.3 Experience

The information available from the Coroner’s Verdicts regarding the experience of the motorcyclists is limited (only six cases are reported). Based on the reference numbers of case studies in table ten (annex one), in case n.24, the rider was experienced, but was more than twice over the legal drink limit and had traces of ecstasy and cannabis in his blood. In case n.26 the rider was “very experienced” but veered suddenly and lost control; in case n.27 the rider had insufficient experience (he had returned to riding three years previously and had owned his motorcycle for one year). In case n.30 the rider had only one year’s experience. In case n.32 the rider had only passed his test eleven months previous to the collision and owned his motorcycle for two months, he was almost twice over the legal drink limit. In case n.34, the rider was experienced, but was more than twice over the legal drink limit.

7.4 Riding in Groups

There were n.9/n.39 (23%) cases in which the motorcyclists involved in collisions were either riding in a group or with another motorcyclist. Based on the reference numbers of case studies in table ten (annex one), in two cases (n.5 and n.35) the collision occurred between two or more motorcycles. In two other cases (n.15 and n.19), the motorcyclists were accompanied by another motorcyclist and were speeding above the national limit. In both cases, the catalyst for the collision was another vehicle pulling out in front of the motorcycles. In another case (n.21) the motorcyclist was accompanied by a second motorcycle, but the catalyst of the collision was a van performing a U turn in front of the lead motorcyclist. In one case (n.30) two mopeds were involved, although the evidence is unable to determine with absolute certainty, one of the mopeds may have collided with the other and caused the moped and rider to deflect and hit a nearby wall. In cases n.5 and n.15, two motorcyclists were killed respectively. Finally there were three cases (n.10, n.20, n.27) in which the second rider (who was following a lead rider) was involved in a collision with another vehicle and/or road infrastructure. In all these cases the total number of motorcyclists killed was n.11/n.41 (26.8%).

8. Other Influencing Factors
8.1 Speed

Of the 39 cases, there were four in which evidence of speed above the national legal limit was recorded. In one case the speed of two motorcycles involved was above the national legal speed limit (>130 mph) and the motorcyclists were unable to stop in time when a truck exited from a quarry. According to the investigator, had the motorcycles been travelling at the national speed limit and had they begun braking at the location of the start of the long tyre mark, the collision

would have been avoided. Furthermore travelling at a constant speed of 60 mph, it would have taken approx. 5.2 seconds for the motorcycles to travel from the start of the tyre mark to the impact area (139 metres). This would have given sufficient time for the truck to move away from the quarry entrance and clear the west bound lane. In this scenario, the collision could have been avoided without any brake application by the motorcyclists.

In the three remaining cases, the speed was higher than the national legal limit and in each case a vehicle pulled out from a minor road in front of the motorcycles. However, the actions of the other vehicle driver pulling out in front of the motorcycles were the primary cause of the collision, not the speed of the motorcycle. With regards to the actions of the motorcyclist, due to the speed of the motorcycle, the rider was restricted in his ability to brake sufficiently in time prior to impact.

Table Six: Lighting (Other Vehicle involvement)

Style of MC	Type of Collision	Lights on	Brake light used
Sports 400cc	Van pulls out in front of MC	Yes	Yes
Super sports 1000cc	Car performs U turn in front of MC	Yes	Yes
Cruiser 650cc	Car driver pulls out in front of the MC	Yes	Yes
Super sport 1100cc	Van performs U turn in front of MC	n/a	Yes
Sports Tourer 800cc	Car pulls out in front of the MC	Yes	Yes (CBS)
Super sport 600cc	Car performs U turn in front of MC	No	Yes
Super sport 600cc	Car pulls out in front of the MC	Yes	Yes
Super sport 900cc	Car pulls out in front of the MC	n/a	Yes
Super sport 1200cc	Tipper truck pulls out from entrance to quarry	Yes	Yes
Naked 600cc	Car pulls out in front of the MC	Yes	Yes
Super Sports tourer 1100cc	Car pulls out in front of the MC	n/a	n/a
Sports 1000cc	Car turns right in front of MC	Yes	n/a
Tourer 1300cc	Van performs U turn in front of MC	Yes	n/a (ABS)
Super sport 1000cc	Truck pulls out in front of MC	Yes	Yes
Super sport 1000cc	Tractor pulls out in front of MC	Yes	Yes
Super sport 1000cc	Van driver cuts the corner in front of the MC's path	Yes	Yes
Super sport 600cc	Van driver pulls out in front of MC	Yes	n/a (LED)

N/a – information not available

8.2 Lights

Of the 39 cases reported seventeen (43.6%) were collisions between a motorcycle and another vehicle that had either pulled out from a private entrance, another road (typically at a junction) or performed a U turn in front of the motorcycle. In these cases, the other vehicle was considered the primary cause of the collision. The investigators were unable to determine whether the motorcycle had its dipped beam or headlights on in three cases, while in a fourth case the dipped beam lights were not switched on, however in that specific collision, the car driver performed a U turn in front of the motorcycle which was coloured bright yellow and was being followed by a white car, which the car driver also failed to see. In the remaining thirteen cases, the motorcycles had their lights switched on and in one case the motorcyclist was wearing a high visibility jacket.

8.3 Conspicuity

For the purpose of conspicuity, 79.5% (n.31) of all the collisions occurred during daylight hours.
In one of these cases where the collision involved another vehicle, (case n.22) there was a problem with the visibility of the driver from the cab of the truck to see the light of the motorcycle which may have had an effect on his perception of the distance of the oncoming motorcycle.

Below are photographs of the view at 231, 153 and 109 metres. The first indicates the position of the motorcycle when the truck commences to manoeuvre (8 seconds to complete) with the motorcycle at a speed of 80 mph, the second indicates the position of the motorcycle when the truck commences to manoeuvre (8 seconds to complete) with the motorcycle at a speed of 68 mph, the third indicates the position of the motorcycle when the motorcyclist perceived a hazard with the motorcycle at a speed of 80 mph.

Photograph One: (Speed of 80 mph)

Photograph Two: (Speed of 68 mph)

Photograph Three: (perceived a hazard with the motorcycle at a speed of 80 mph)

The speed at the location of the collision was 40 mph, however according to the investigator the motorcycle had been travelling at a speed of at least 68 to 80 mph at the start of the tyre mark. The Highway Code states that the braking distance at 40 mph is 24 metres. Therefore if braking had been applied at the start of the tyre mark at 40 mph, it should have been possible to stop the motorcycle approx. 31 metres prior to the centre of the junction or 37 metres prior to the collision area.

According to the investigator, the motorcycle was being ridden on dipped beam illumination at the time of the collision, however as shown in the photographs above, the illuminated dipped beam headlight on a similar motorcycle does not significantly alter the visibility of the motorcycle in daylight when viewed from the inside of the truck at the end of the minor road. The illuminated headlight is much more apparent when viewed from a lower angle and when more closely aligned with the direction of travel of the motorcycle (see photograph four below).

Photograph Four: Collision scene

9. Sequence of events

The following tables, seven, eight and nine set out the sequence of events leading to each of the fatalities in the n.39 collisions. The sequences are structured from the first event which indicates the movement of the motorcycle and its direction of travel and whether the motorcycles had lights on.

The second event indicates the beginning of the actions which lead to a collision, including the underlying reason for the action and also indicates in the second and third actions the movement of a second vehicle and the commencement of the actions if any, of the motorcyclist.

The fourth and fifth sequence of events highlights the actions or reactions of the motorcyclist on perceiving the hazard or in the case where there was no action, the continuation of the progress of the events.

The sixth event identifies the circumstances which led to the primary cause of the fatalities.

The following table (seven) highlights the sequence of events where the actions of the other vehicle driver are the primary cause of the collision. The actions of the other vehicles do not imply that the other vehicle driver was necessarily responsible for the collision but that their actions precipitated the sequence of events which led to the collision.

Table Seven

Sequence of events where the primary cause is the action of the OV driver

	1 →	2 →	3 →	4 →	5 →	6
1	MC travelling south on main road with lights on	Van emerges from entrance to turn right, view unobstructed	Motorcyclist brakes prior to impact	MC impacts van and slides into stationary car	MC rebounds before coming to rest	Motorcyclist continues forward and impacts a concrete post and wooden fence
2	MC travelling south on main road with lights on	MC positioned onto North bound lane to overtake car which had right indicator on (possibly out of line of sight of car driver)	Car performs U turn in front of MC	MC brakes prior to impact	MC and motorcyclist impacts car	Motorcyclist is projected forwards and travels through air before landing on grass verge
3	MC travelling south on main road with lights on	Hit and run car emerges from minor road on left of MC (staggered cross junction)	Car pulls out in front of MC and leaves scene	MC impacts car	MC then slides across the road onto the minor road	Motorcyclist and pillion are thrown from MC. Motorcyclist suffers fatal injuries.
4	MC travelling north on main road with lights on	MC's position prior to left hand bend is not on the centre line, thus unable to see van about to turn right	Van performs U turn in front of MC Van driver's view restricted by hedge	MC brakes severely prior to impact	MC high-sides and falls on its right side, sliding into van	Motorcyclist travels through air and impacts van
5	MC travelling north-west on main road with lights on at night time	Car emerges from a minor road (at T junction) with clear give way markings, no visual impediments, from the left of the MC and crosses in front of MC	MC positioned to right of north-west bound lane in response to car's position	MC applies brakes prior to impact (link brakes)	MC impacts front of car	Motorcyclist is projected off his MC and travels through air landing on the ground
6	MC travelling towards exit of industrial estate, no lights (followed by white car)	Car performs U turn (turning right) in front of MC	MC applies severe front brake and attempts to steer left	MC pivots with rear wheel lifting off the ground	Motorcyclist is thrown from MC against car	MC impacts car Motorcyclist is hit from behind by MC
7	MC travelling east on main road with lights on	Car pulls out in front of MC, intending to turn right at a junction with clear give way markings	MC applies severe front brake	MC pivots with rear wheel lifting off the ground	MC impacts car	Motorcyclist impacts car head on and comes to rest in an area near the impact
8	MC travelling west on main road travelling at speed poss. higher than legal limit	MC out of view when car driver commences manoeuvre to turn right across main road	Car pulls out in front of MC from minor road	MC applies brakes	MC unable to stop in time and impacts car	Motorcyclist impacts car

9	Two MCs travelling west on main road with lights on, both travelling at >130 mph	Tipper truck exits quarry to turn right	MC applies severe braking	Tipper truck had almost cleared the road when impact occurs	Both MCs impact tipper truck	Both motorcyclists impact tipper truck
10	MC travelling north west on main road with lights on	Car exits from minor road intending to turn right without indicating	Car pulls out in front of MC	MC applies severe braking and falls on right side	MC impacts car	Motorcyclist impacts front of car
11	MC travelling south with lights on	Car exits from private dwelling intending to turn right	Car pulls out in front of MC	MC moves to right to avoid car	MC impacts car	Motorcyclist separates from MC and comes to rest near a sign on the verge next to north bound lane
12	MC travelling north on main road (duel carriageway) travelling at fast speed	Car exists from minor road intending to turn right in front on MC (view possibly obstructed by shrubs and fence)	MC applies severe front braking	MC falls on right side and slides towards car	MC impacts car and both vehicles ignite.	Motorcyclist falls off MC and comes to rest on lane two. Car driver dies as a result of burn injuries
13	MC travelling south on duel motorway with lights on	Van stopped on hard shoulder, driver using mobile phone	Van performs U turn, turning right, across motorway in front of MC	Van crosses into lane two, MC impacts the rear of the van	After impacting van (while upright), MC falls on left side and continues to slide	Motorcyclist impacts van
14	MC travelling east on main road with lights on at higher than legal speed limit	Truck intending to turn right emerges from minor road in front of MC	MC applies brakes	MC impacts truck and continues towards side of road	MC impacts pole on side of road	Motorcyclist impacts traffic monitoring box on pole against which the motorcyclist had come to rest
15	MC travelling west on main road with lights on	Tractor travelling in opposite direction	Tractor turns right in front of MC into field	MC applies severe braking and falls on right side	MC slides along road surface and impacts tractor and trailer.	Motorcyclist impacts trailer
16	MC travelling south on main road with lights on	Van travelling in opposite direction	Van turns right in front of MC cutting the corner thus travelling across wrong side of road	MC applies severe braking and MC falls on right side	MC impacts van	Motorcyclist impacts van
17	MC travelling south-west on main road with lights on	Van travelling north-east on main road	Van turns right into private entrance in front of MC. View restricted due to dip in the road	Motorcyclist's view is obstructed due to dip in the road	MC applies brakes but unable to avoid impact and is upright on impact with van	Motorcyclist impacts van

The following table (eight) highlights the sequence of events where the actions of the motorcyclist are the primary cause of the collision.

The second event indicates the beginning of the actions which lead to a collision, including the underlying reason for the action. The second and third actions also highlight the movement of the motorcycle or another vehicle and the commencement of the actions if any of the motorcyclist.

The fourth and fifth sequence of events highlights the actions or reactions of the motorcyclist on perceiving the hazard or in the case where there was no action, the continuation of the progress of the events.

The sixth event identifies the circumstances which led to the primary cause of the fatalities.

Although there are fifteen cases in which another vehicle was involved in the collision, it was the actions of the motorcyclist that precipitated the sequence of events that caused the collision.

Table Eight
Sequence of events where the primary cause of the collision is the action of the MC but another vehicle is involved

	1 →	2 →	3 →	4 →	5 →	6
1	MC travelling north on minor road with lights on	MC does not stop at junction. Stop sign missing	Car driving along main road	Car possibly hidden from view due to hedge adjacent to exit lane from minor road	MC and motorcyclist impacts car	Motorcyclist is projected forward and left over a fence travelling through air and comes to rest approx. 43 metres from impact area
2	Two MCs travelling in opposite directions, one south one north, both with lights on	Second MC travelling south towards the first MC	First MC (travelling north) brakes severely and crosses over into south bound lane	First MC loses control and side swipes second MC	Both MCs then fall and slide across the road in opposite directions	Both motorcyclists are thrown from their MCs. 1st motorcyclist is projected onto road and 2nd motorcyclist hits wooden fence
3	MC travelling south on main road (side light on)	Car travelling north in opposite lane	MC negotiating RH bend, MC leans to left	MC applies severe front braking and loses control while negotiating bend	MC slides across carriageway in front of car. Car driver attempts to avoid impact by steering to the left.	Motorcyclist separates from MC and passes beneath the car
4	MC travelling north on main road with lights on	Overtakes bus and enters Right Hand bend	MC applies severe front braking and loses control	MC falls on right side and rotates across road	MC impacts wall and is projected back under the bus, bus driver applies severe braking	Motorcyclist impacts wall and is projected back under the bus
5	MC travelling south west on main road with lights on	Car had slowed down to turn right into minor road	MC travelling behind a bus. Bus pulls out from a stop. MC overtakes bus	Bus obscures motorcyclist's view and MC impacts car	MC collides into the back of a car	Motorcyclist is projected forwards and left, passing through the air and lands on the hard shoulder next to SW bound lane
6	Moped travelling west. Front tyre under-inflated	Car travelling in opposite direction towards moped	Moped riders applies severe braking to avoid hazard	Moped loses control	Moped falls on right side	Moped rider separates from moped and slides towards oncoming car
7	MC travelling east in group on main road behind car one with lights on	Car one applies brakes in front of MC	MC applies brakes but impacts car one in front	MC rotates anti-clockwise and slides into path of oncoming car	Car two drives over motorcycle	Motorcyclist impacts car two
8	MC travelling south on main road with lights on	Car travelling in opposite direction	MC negotiates right hand bend	MC swerves towards nearside kerb (possibly due to wind)	MC loses control, goes into spin and crosses over onto opposite lane and collides with car	Motorcyclist impacts car
9	MC travelling north on main road following friend on MC in front	Overtakes van at sharp left hand bend	MC applies severe front braking	MC leans into corner and falls on left side	MC continues into path of oncoming car and impacts car then stone wall	Motorcyclist slides across road and impacts oncoming car
10	MC travelling west at night time, no lights. Alcohol above legal limit and drug found in motorcyclist's blood	Car travelling north across intersection	MC runs red light	MC does not brake and impacts car	MC falls on right side and slides across south bound lane before coming to rest	Motorcyclist impacts car and passes over the roof of the car, then travels through air before coming to rest on the road
11	Two mopeds travelling south. Moped one has lights on	Second moped loses control	Second moped falls on left side	First moped hits second moped or swerves to avoid second moped	First moped impacts stone wall in upright position	Moped rider impacts "dragon tooth" wall
12	MC part of group travelling north on main road	MC negotiates left hand bend	MC applies front and possibly back brake while leaning into bend	MC loses control and falls on left side	MC slides across road into oncoming car	Motorcyclist impacts car and goes underneath car

13	Three MCs travelling east on main road with lights on	First MC approaches a lay-by, the second MC commences to overtake first MC	Third MC travelling faster than second MC impacts first MC	Second MC then rides into path of third MC and falls onto right side	third MC applies severe braking, falls on right side and collides with second MC	Motorcyclist falls off MC and impacts second MC
14	MC travelling south-east on minor road with lights on (Helmet unfastened)	MC enters main road at junction (sign post partially obscured)	SUV travelling north-west on main road	MC applies severe braking	MC impacts SUV	Motorcyclist impacts SUV
15	MC travelling west behind truck with lights on	MC attempts to overtake truck, while truck steers to right (possibly to steer around a parked car on the left)	MC impacts rear of truck	MC falls on right side	MC and motorcyclist move towards east bound lane into the path of an oncoming car	Motorcyclist impacts car

The following table (nine) highlights the sequence of events where the actions of the motorcyclist are the primary cause of the collision and no other vehicle is involved.

Table Nine
Sequence of events where the primary cause of the collision is the action of the MC but no other vehicle is involved

	1 →	**2 →**	**3 →**	**4 →**	**5 →**	**6**
1	MC travelling east on main road. Road conditions wet/damp.	Overtakes cars then when exiting Right Hand bend, loses control	The back wheel slips on white lines as a result of motorcyclist applying throttle: rotates faster than front wheel	MC applies rear brake, MC flips into the air	MC impacts telegraph pole	Motorcyclist is thrown from MC and impacts lower part of telegraph pole
2	MC travelling north on main road early a.m. Alcohol in motorcyclist's blood 2 ¾ over legal limit with presence of ecstasy	MC veers off road into kerb	MC front tyre makes contact with kerb	MC continues along verge unable to turn right	Motorcyclist puts his left foot down on raised grass verge and falls down	Motorcyclist impacts poles of a warning sign
3	MC travelling north on main road	MC approaches change of speed limit and steers left into kerb	MC continues along kerbing and falls on left side	MC slides back out onto the north bound lane	MC slides towards for 45 metres before coming to rest	Motorcyclist falls off MC and slides along verge and impacts outer support pole for a speed limit sign
4	MC travelling north on motorway with lights on. Motorcyclist has alcohol almost twice legal limit in blood and helmet was not secured	MC attempts to negotiate right hand bend	MC loses control and moves left off the main carriageway onto hard shoulder	MC continues in upright position over Armco barrier	MC is airborne and falls onto area of new road construction below Armco barrier	Motorcyclist also airborne, then impacts rocks in the construction area
5	MC travelling along main road. Alcohol is more than twice the legal limit in Motorcyclist's blood.	MC attempts to negotiate right hand bend after overtaking two cars	MC leans severely to the right, rear tyre under-inflated	MC goes wide and rear tyre moves onto loose stones and slips sideways to the left	MC continues forwards to raised footpath and rear wheel strikes the kerbstones of the footpath and is deflected back onto the road	Motorcyclist falls off MC, impacts kerbstones and slides across the road
6	MC travelling east with pillion. Rear tyres under-inflated	MC enters right hand bend	MC loses control	MC applies severe rear braking and rear wheel locks	MC impacts raised bank and falls on side	Motorcyclist impacts bank
7	MC travelling south on main road	MC attempts to negotiate right hand bend	Possibly tries to avoid metal covers on the carriageway	MC travels towards footpath and wall. MC mounts footpath	MC impacts wall	Motorcyclist impacts wall

10. Braking, Deceleration and Perception/Reaction time

The deceleration rate of the motorcycle is dependent on a number of factors, one of which is the braking technique employed by the motorcyclist i.e. the severity of braking applied and the ratio of front/rear brake distribution.

Unlike a car, the front and rear brakes of the motorcycle in question are separate systems and the rider can vary the ratio of braking applied to each wheel. Under severe braking, the minimum deceleration is achieved with rear wheel only braking and a value of approximately 0.4g (3.92 m/s^2)[2] can be considered. A deceleration of 1g (9.81 m/s^2) can be considered representative of strong braking by a skilled motorcyclist on, for example, a 1000cc engine Super Sports motorcycle using both front and rear brakes[3]. Following examination of the motorcycle, considering the nature of the tyre mark and considering the friction surface dressing on the road surface, the investigators are thus able to determine a range of possible deceleration rates.

Before the motorcyclist applies braking and begins to leave a tyre mark, there is a time period during which the rider perceives there to be a hazard ahead and then, typically reacts to that perceived hazard. The length of this perception/reaction time depends on a number of factors and cannot be known. However, a probable range of perception/reaction times of 0.75 to 1.5 seconds can be assumed.[4] These calculations for braking, deceleration and perception/reactions time are considered by the investigators when preparing the reports of the scientific examination of the material relating to the collision scenes.

11. Summary

With regards to style, there were 21 (51.2%) super sports motorcycles (in two cases there were two super sports involved respectively), five (12.2%) tourers (including one super sports tourer and two sports tourers), three cruisers, three scooters, three naked/semi-naked, two sports, two mopeds, one adventure traillie and one trail bike.

Of the n.41 motorcycles (including scooters and mopeds) n.31 (75.5%) had engine sizes between 600cc and 1300cc, there were two between 350cc and 400cc, six (14.6%) with an engine size of 125cc and two mopeds with an engine size of 50cc.

Mechanical factors and contribution of design or maintenance defects to collision or injury causation are recorded. n.36/n.41 (87.8%) motorcycles did not have any mechanical, design or maintenance defects which may have contributed to the collision or injury causation. Evidence that under-inflated tyres caused or contributed to the collision was found in three cases.

The time of day of the collisions highlights that 46.2% (n.18) occurred between afternoon and early evening. 17.9% (n.7) occurred in the evening and 33.3% (n.13) occurred between morning and early afternoon. One collision (2.6%) occurred in the early morning.

The proportion of collisions occurring in Spring were 46.2% (n.18), Summer 43.6% (n.17) and autumn 10.3% (n.4).

In 74.4% (n.29) of cases, the weather was fine; in four cases the weather was either overcast or damp. In six cases the weather was not mentioned.

Twenty eight collisions occurred in rural locations (71.8%) while n.6 (15.4%) occurred in urban locations, the remainder occurred in a semi-rural location (n.2), on a duel carriageway (n.2) and one occurred on a motorway.

[2] Interpretation of Motorcycle Rear-wheel Skidmarks, W. Bartlett Proceedings, Fourth International Conference on Accident Investigation, Reconstruction, Interpretation and the Law; Vancouver BC, Canada, August 2001. (g = gravity; m/s = miles per second).
[3] Motorcycle Handling and Chassis Design, Tony Foale, April 2002, Tony Foale Designs, ISBN 84-933286-1-8
[4] Forensic Aspects of Driver Perception and Response, Paul L. Olsen, Lawyers and Judges Publishing Company Inc. 1996. ISBN 0-913875-22-8

In all cases, the condition of the roads was reported as “good”. In one case there were no road markings. In n.29/n.39 cases (74.3%), the surface of the road was “dry”. In three cases the surface of the road was “damp” and in one case there were loose stone on part of the road.

Of the n.39 cases, there were 12 (30.8%) in which the motorcyclist impacted against road infrastructure. In five cases (12.8%), the collision also involved another vehicle while in seven cases (17.9%) there was no other vehicle involved.

In the approach to the collision scene, there were n.13 cases out of n.39 (31.7%) in which the approach was a right hand bend and in n.8 (19.5%) cases, the approach was a left hand bend. In the remaining n.18 (43.9%) cases, the approach was a straight section of road.

63.4% (n.26/n.41) motorcyclists applied their brakes prior to the collision and n.18 (43.9%) applied their brakes severely. Of the n.17 (41.4%) motorcycles that slid after falling, n.10 (24.4%) fell onto their right side and the remaining n.7 (17.1%) fell onto their left side.

There were seventeen cases out of n.39 (43.6%) in which another vehicle was considered the primary cause of the collision. Four of the other vehicle drivers performed a U turn in front of the motorcycle. One driver was a hit and run (i.e. after the collision the car driver left the scene of the collision). The remaining vehicles exited from a side road or private entrance in front of the motorcycle or turned across the road in front of motorcycle from the opposite lane.

Where the collision was caused by the action of another vehicle pulling in front of the motorcycle or performing a U turn, the investigators were unable to determine whether the motorcycle had its dipped beam or headlights on in three cases, while in a fourth case the dipped beam lights were not switched on. In the remaining thirteen cases (76.5%), the motorcycles had their lights switched on and in one case the motorcyclist was also wearing a high visibility jacket.

Of the twenty eight cases where information about helmets is recorded, twenty six (92.8%) were full face and one was a flip face. In six cases, the helmet was recorded as not being secured.

There are four recorded cases in which the motorcyclists had levels of alcohol over the legal limit and or drugs in their blood. Three of these collisions were single vehicle (no other vehicle involved) and the fourth ran a red light through an intersection with no headlights on and impacted a car crossing the intersection. This information is only available from the Coroners’ Verdicts.

Of the 39 cases, there were four in which evidence of speed above the national legal limit was recorded. In one case the speed of two motorcycles involved (who were travelling together) was significantly above the national legal speed limit (>130 mph). In all cases, a vehicle pulled out from a minor road or entrance in front of the motorcycles.

There were n.9/n.39 (23%) cases in which the motorcyclists involved in collisions were either riding in a group or with another motorcyclist. In all these cases the total number of motorcyclists killed was n.11/n.41 (26.8%).

12. Focus Group

On March 27th, 2012 a focus group of experienced trainers, police, government agency representatives and one of the investigators from Forensic Science Northern Ireland, was held to discuss the outcome of the study. Four topics were covered in the focus group:

1. Technology e.g. ABS brakes and warning systems - also for cars
2. Initial training both for car drivers and motorcyclists including hazard perception, distance perception, anticipation/prediction
3. Advanced training - how could this be improved
4. Awareness campaigns - what works

The following participants took part in the focus group:

Emerson Callender - FSNI (Road Traffic Collision Investigation Team)
Richard Crawford – Department Of the Environment, Vehicle Policy Branch, Road Safety and Vehicle Regulation Division, Northern Ireland
Stevie Gregson – Supervising Examiner Driver and Vehicle Agency, Northern Ireland
Gary McComb – Police Service Northern Ireland, Road Traffic Policing
David McGuckin - IAM and RoSPA Advanced Instructor and initial rider trainer, Northern Ireland
Marc O'Loideoin - Advanced Trainer - RoADA DIP; Consultant to the RSA (ROI); co-author of the Initial Rider Training Project Manual (EU funded)
Martin Reilly - Chief ROSPA examiner for the ROI and ex Garda Driving School Dublin (ROI)
Victor Rodgers - Approved Motorcycle Instructor(AMI)/Approved Driving Instructor(ADI); Chairman of AMIANI (Approved Motorcycle Instructor's Association Northern Ireland)
Charlie Stewart – Chief Instructor, POADA (Dip.) RoADA (Gold) IAM/RoSPA Advanced Instructor, Northern Ireland.

12.1 Technology

The premise for warning systems with regards to collisions between vehicles is intrinsically linked to the time line for a collision. The collision investigator explained that the time frame, depending on specific cases – but generally - is only a couple of seconds from when the motorcyclist perceives the hazard to when the impact occurs. For example, in the scenario of a car or van pulling out in front of a motorcycle, typically there would be about one second of severe braking, the motorcycle falls over and there is about one second of sliding to impact. Considering a perception/reaction time of about a second before the braking commences, in all, it takes around two to three seconds for the impact in that type of scenario.

In terms of measuring speed at impact, the investigator explained that they do this in part based on the extent of the damage. However, for a motorcycle this is limited since when the front wheel and forks are forced back into contact with the engine, it behaves like a cannon ball, and not much more damage occurs. In certain cases, speed can be estimated by the damage that has been done to the other vehicle or possibly by the distance that the rider has been projected. Then the investigators are working back along the marks, if there are any pre-impact braking marks or sliding marks and really all the investigators can do is comment on the speed from the initial marks. Beyond that, it is an unknown.

The investigator also explained that with regards to OV drivers pulling out in front of the motorcycle, it is the size of the motorcycle that is the difficulty, because it does not change much in size until it is looming near. He said that it happens with trucks as well: they don't change much in size until they get very near and suddenly get a lot bigger. A lot of the right of way violations in these cases, were due to drivers looking but not seeing even though the motorcycle was in a position to be seen. So it is possible to train people to look but more difficult to train them to see. It is not the case that they did not look long enough, though if they had looked longer, they would have seen them. It seems that they are looking for cars or something that is a bigger threat.

The consensus of the group was that technology can be helpful. In the case of the Anti-lock Braking System (ABS), there were two cases in the study in which this braking system may have made a difference. In both cases, the motorcycles were 1100cc engine sizes, one was a Super Sport and the other was a Super Sport Tourer. The riders were on a straight section of the road, one applied the front brake and in doing so, locked the wheel and went down on the right side. The second applied the rear brake severely and also went down on the right side.

According to the investigator, when the motorcycle goes down, there is no control. Anything to keep the bike upright means that potentially that there is a better chance of avoiding an impact or it would be at a lower speed. In that second or two before impact, there are a couple of cases of looking at the line that the motorcycle has taken once it has gone down on its side, which indicates for example if the hazard is coming from the right, the rider might try and steer to the left while braking. But if he/she goes down and slides, they keep going to the left, whereas if they were able to stay up, it is possible that they would be able to go around behind the hazard and the collision would have been avoided. But he said, we would not hear about the cases where ABS has worked – because the accident has been avoided. Technology has a role to play. There is greater scope for the application in cars. Having directional control through braking should help.

The trainers held the view that high quality training is required, accordingly, this means high quality advanced observation. The consensus was that while it is good to build in technology but good quality observation is more important, including far distance, mid distance, back to the bike and mirrors. The rider has to have the information and making accurate judgements about what's going on ahead. Planning ahead and attitude is fundamental, technology is not the first port of call. A situation where a car pulls out across the road will always exist in spite of technology. High quality training and emphasis on this can prevent a lot of accidents.

12.2 Initial Training

One of the trainers pointed out that almost everybody including motorcyclists are also car drivers (possibly with the exception of moped riders). The inexperienced rider is also an inexperienced car driver, so their hazard perception is the same. Training car drivers to be aware when approaching a junction is important, not just one glance and away. Even in the case of lorries, cars will pull out, because they (the car drivers) are looking for the expected, which is another car.

As previously mentioned above, another trainer commented there is a problem of looking but not seeing and there isn't much to do about that with the experienced driver, the same with motorcycles, there are not many people who will do an advanced car test. The problems exist with all drivers, not just motorcyclists. Both need more training. What was highlighted in the report were simple things which are likely to happen passing a test – emergency stops and riding in groups. Nobody is taught how to ride in groups. So the lesson is not to look at the number plate in front but to look for your own road. With emergency stops, riders should go out and practice.

The observation from the Supervising Examiner of the DVA was in relation to training and distance perception. He commented that it can be difficult to train to make the right decision. Car driver trainers use very basic reference points to judge speed and position. So unless they are in the right environment where motorcycles are actually passing, it's hard to transfer those skills.

He said that it is something that should be done, but it should be done for both cars and bikes. Group riding was mentioned, he said that it is not actually mentioned anywhere in Northern Ireland scheme, while the DSA (Driving Standards Agency in Great Britain) mention group riding in their scheme, so maybe something the DVA should look at.

With regards to the car L test, it's hard for an examiner to test someone's knowledge on how to deal with vulnerable road users (VRU) motorcyclists included, unless something actually happens during the test where they are able to measure the response. It's mainly pedestrians and cyclists that would cause an issue for a learner driver and it's quite clear, sometimes they are not capable of dealing with those people. He suggested that if they are trained to deal with those two groups of VRU then they would be able to deal with motorcyclists as well.

He commented that the DVA has modules for cars and bikes for anticipation in the instructor qualification tests and it is a role play situation, unless something actually happens, it's hard to test competence in a practical manner.

He also mentioned hazard perception in the theory test and said that the DVA is moving towards animation which according to the DVA, would make it better to deal with scenarios from a rider's point of view as film clips have limitations. He said that they can build in collision factors into the animation for cars.

One of the trainers mentioned basic techniques like observation, but he commented that what is happening with novice training is that people are trying to get them through as quickly as possible to earn a "quick buck" and move onto the next candidate. There is not enough expertise in novice training. They should be teaching advanced techniques in novice training, because they (the riders) don't come back for advanced training.

However, another commented that the best possible training is based on the Initial Rider Training[5] project where the emphasis is not on machine control, but on hazard management, so that a novice has to think first to build the skill level up on the basis of if in doubt, check it out, so that they can have a second chance to take the bend again. He continued that based on the findings of this report, perhaps one of the manoeuvres that could be improved is the "Brake and Swerve" manoeuvre. These fatalities could have been avoided – perhaps – if there was a higher level of machine control skills in the brake and swerve manoeuvre as well as hazard perception.

According to one of the trainers, in Northern Ireland, there was a big discussion with the DVA when they brought compulsory basic training (CBT) in, such as road positioning, where the examiner would mark them down for taking the advanced line, which he believed is understandable. For example on right hand bends, the DVA would accept moving to the left to get a better view, but on a left hand bend, they are not keen on people moving to right to get a better view, because a novice can run wide. On a right hand bend they'd go into a hedge, on a left hand bend they'd go into oncoming traffic.

One of the trainers commented that while he understood the logic, he said that he taught a beginner where they should be positioned with the understanding that they need to rethink their positioning after they do their test. That's what a good instructor would do, but a poor instructor only follows the book. He concluded that generally that's what people want, to get enough training to get them through the test. Good instructors are using advanced techniques in novice training.

12.3 Advanced Training (AT)

There is a major image issue – one of the trainers felt that the image of AT needed to be sexed up in order to show that there is an improvement in skills. It's the training and it's difficult to get the attention, but if riders can be shown that they can improve their skills and safety – which for young riders is a by product, they want the skills, but their family will want the safety. This can be done through groups and clubs.

AT does suffer from the pipe and slippers image. Different tactics are needed to get riders involved. Access to AT requires the assistance of those with resources, i.e. a county council car park or a piece of land to use at the weekend, which is what happens in mainland Europe in some countries.

Dealers play a big part in this because they are on their hands and knees at the moment and can't sell bikes. So they will jump on any bandwagon to shift bikes out of the shop and they are encouraging these assessments to get cheaper insurance. Another trainer suggested encouraging young rider forums based on training or skills techniques to help disseminate good habits and practice.

[5] http://bookshop.europa.eu/is-bin/INTERSHOP.enfinity/WFS/EU-Bookshop-Site/en_GB/-/EUR/ViewPublication-Start?PublicationKey=MI3110649

AT and advanced techniques, one of the trainers raised the question of who pays for it. He commented that the problem is that here – out on the road, the instructors can only take two students. A track would be a different issue. The professional trainers – some are good and some are bad – so that creates a problem.

Advanced motorcycle training is expensive – same for car drivers – it's difficult to sell it whether there is a track or not. A lot more could perhaps be done by bringing in advanced techniques into novice training. But the best thing that the DVA and other authorities can do is to weed out the bad instructors and using a system to make it more obvious to the public who the good instructors are. However the difficulty is cost, instructors need to be paid too.

12.4 Awareness Campaigns

According to the representative from the Road Safety and Vehicle Regulation Division, one of the problems is to measure the effect of the campaigns. In terms of the message, there is the message, the target audience and the means of getting the message to that audience. TV is one of the most expensive means of targeting an audience. He said that the department is considering social media, which means really cutting edge stuff, trying to get at kids through games. Like a road racing game so the message would be don't speed. It's a really complex area and the most challenging aspect is developing a means of measuring and assessing the effectiveness of such interventions.

With regard to "Shock – Horror" videos and television advertisements, there were mixed views about their efficacy. However the consensus was that different avenues should be used to get the safety message out to the target audience, such as using the internet, social media, campaigns recommending training, race meetings and signage like that used in some English counties (Think Bike). Finally attitude and tackling aggression was also considered an important factor in road safety awareness campaigns.

13. Conclusions

The n.39 case studies analysed in this report are a representative sample of motorcycle fatalities in Northern Ireland between 2004 and 2010. Of the six investigators in Forensic Science Northern Ireland who attend road fatalities, the cases in this report represent the sum of collisions attended by two investigators as well as two sample cases from a third investigator. The total number of motorcyclists who died in these collisions was n.41 (36%) out of a total of n.114 motorcycle fatalities in Northern Ireland during 2004 to 2010.

The report contains an analysis of the collisions investigated and includes information relating to vehicle data, the collision scene and the environment as well as human factors.

Overall 12.2% (n.5) of the vehicles presented defects and of these, 7.3% (n.3) motorcycles had under-inflated tyres, one of the motorcycles had the steering damper missing, while the C and D pillars of one of the other vehicles involved may have restricted the view of the driver.

Information from the case studies indicates that the conditions for riding were generally optimal and during daylight. Eighteen (46.2%) of the collisions occurred mainly between the afternoon and early evening; 90% of the collisions occurred in Summer and Spring and the weather was fine in 72% of cases. 71.8% of the collisions occurred in rural areas with 15.4% in urban settings. The road conditions were good in all cases and in 74.3% of cases the surface was dry.

Before the motorcyclist applies braking and begins to leave a tyre mark, there is a time period during which the rider perceives there to be a hazard ahead and then, typically reacts to that perceived hazard. The length of this perception/reaction time depends on a number of factors and cannot be known. However, a probable range of perception/reaction times of 0.75 to 1.5 seconds can be assumed.

In 63.4% of cased, the motorcyclists applied their brakes 63 prior to the collision and n.18 (43.9%) applied their brakes severely. Of the n.17 (41.4%) motorcycles that slid after falling, n.10 (24.4%) fell onto their right side and the remaining n.7 (17.1%) fell onto their left side. However, there only appears to be two instances whereby anti-lock brakes may have benefitted the rider by keeping the motorcycle upright, in this case the collision occurred on a straight section of road. The one case where the motorcycle had ABS features, the rider was too close to the vehicle in front and was unable to brake in time before impacting the car.

For the purpose of conspicuity, 79.5% (n.31) of all the collisions occurred during daylight hours.
In one of these cases where the collision involved another vehicle, there was a problem with the visibility of the driver from the cab of the truck to see the dipped beam light of the motorcycle which may have an effect on the perception of the distance of the oncoming motorcycle for truck drivers in general.

Out of the n.39 cases, there were seventeen (43.6%) in which another vehicle was considered the primary cause of the collision, in three cases, the investigators were unable to determine whether the lights of the motorcycles were on, in one case the lights were switched off. However, in that case the driver of the car failed to see the bright yellow coloured motorcycle and the white car which was immediately behind it, prior to performing a U turn in front of the motorcycle. In the thirteen remaining cases the motorcycles all had their lights on, but in nine cases the other vehicle driver either pulled out in front of the motorcycles and in four cases, performed a U turn across the path of the motorcycle.

In twenty eight cases, (72%), information is recorded about helmets, in n.6 cases, the helmet was not secured.

There were known four cases (10.3%) of speeding, but in all cases, the actions of the other vehicle driver precipitated the collision. Equally there were four cases (10.3%) in which the rider had levels of alcohol over the legal limit and or drugs in their blood. (In Northern Ireland the maximum legal alcohol limit for driving is 80 mg per 100 mls). Three of these collisions were single vehicle (no other vehicle involved) and the fourth ran a red light through an intersection with no headlights on and impacted a car crossing the intersection.

There were n.9 cases (23%) in which the motorcyclists involved in a collision were either riding in a group or with another motorcyclist. There were three cases in which the second rider (who was following a lead rider) was involved in a collision with another vehicle and/or road infrastructure. In all these cases the total number of motorcyclists killed was n.11/n.41 (26.8%).

The focus group discussed the relevance of technology on vehicles as a deterrent to collisions as well as the advantages of hazard perception in initial rider training and teaching anticipation as a defence against potential collisions. The consensus was that while technology may in some cases be beneficial, good training was more important. However, the availability, image and cost of advanced training seemed to be a barrier to getting more riders involved.

Awareness campaigns were considered useful, but there is no method to measure their efficacy. However the consensus was that different avenues should be used to get the safety message out to the target audience, such as using the internet, social media, race meetings and specific road signage.

14. Recommendations

The information provided in this report indicates that each road traffic collision is unique but that in all cases the time frame from the perceived hazard to the conclusion of the impact either with another vehicle or with road infrastructure is typically between 2 and 3 seconds. Within this time frame, although there is time to react, there may be insufficient time to avoid the collision. This time frame should be considered in any research regarding motorcycle accident causation.

In the seventeen cases (43.6%) the other vehicle driver precipitated the event. In thirteen of these cases (76.5%), the evidence highlighted that the motorcycle's lights were switched on and therefore the other vehicle driver was in a position to see them. However, there appears to be a problem of looking but not seeing which may be due to the size of the motorcycle or simply because the car/van driver is expecting to see another car or van and has difficulty coping with the unexpected.

There also appears to be an issue with the visibility of the driver from the cab of the truck to see the dipped beam light of the motorcycle which appears impaired due to the height of the sitting position in the truck. This may affect the truck driver's perception of the distance of the oncoming motorcycle. Further investigation into the perception of lights on motorcycles by OV drivers would be warranted.

Panic braking by motorcyclists was an important factor in the cause of the fatalities. Anti-lock braking systems (ABS) may become mandatory shortly through proposed legislation from the European Union, however as indicated, this technology is relevant in some circumstances, but not all. At this point in time, the application of ABS is limited to straight sections of the road. It is not (yet) designed to work when the motorcycle is in a lean. The development of braking systems that can function as efficiently when the motorcycle is leaning either left or right, may improve casualty rates. However, care should be taken about too much focus on technology rather than good training and attitude.

Emphasis is needed in car driver training to include more focus on scanning for VRUs. However as mentioned by the representative of the DVA, it is difficult to test awareness out on the road unless the novice driver or rider is presented with a situation which requires them to apply the skills acquired during training. A possible solution could be simulator training whereby situations which include the unexpected (cases of VRUs appearing suddenly, or in the case of novice riders, the sudden appearance of another vehicle at a junction), may help to avoid panic situations, or prepare the novice to take more care and give more attention in specific situations – e.g. at junctions, or exiting onto a road from a private entrance.

According to the participants of the focus group, the best solution to avoid road traffic collisions is anticipation and hazard awareness training. The consensus was that the only reliable way to prevent motorcyclist injuries and deaths is to prevent the collision in the first place, which means the rider needs to get his/her eyes up and scanning ahead, and then taking evasive action when a potential collision is still several seconds from happening.

Annex One: Table Ten: Summary of 39 case studies

Case No.	Style of MC	Principle Cause	Contributory Cause 1	Contributory Cause 2	Primary cause of fatality
1	Sports 400cc	Collision with a van	Van driver pulled out in front of the MC	Panic braking caused MC to slide	Impacted van then concrete post and wooden fence
2	Cruiser 125cc	Stop sign missing on minor road from where MC emerged	MC was impacted by car	MC did not stop at junction and collided with car	Motorcyclist was projected over a fence into a field c.43 metres from impact area
3	Super sport 1000cc	Collision with car	Car performed U turn in front of MC	Motorcyclist misjudged car driver's intentions and MC impacted car	Motorcyclist was projected forwards and onto grass verge
4	Cruiser 650cc	Collision with car at junction	(Hit and run) Car driver pulled out in front of the MC	Car driver ignored give way sign	Motorcyclist thrown from MC and suffered severe head injuries
5a	Super sport 1000cc	Collision with MC	Motorcyclist on 600cc MC braked severely and hit other MC	Impacted with other MC	Motorcyclist projected onto grass verge
5b	Super sport 600cc	Collision with MC	Motorcyclist on 600cc MC braked severely and hit other MC	Veered over onto opposite lane	Helmet not secured, Motorcyclist projected off MC onto road
6	Super sport 1100cc	Collision with a van	Van performed U turn in front of MC	MC high-sided after severe braking, fell on side	Motorcyclists was projected forward and impacted van
7	Sports Tourer 800cc	Collision with car	Car driver pulled out in front of the MC	Motorcyclist misjudged car driver's intentions and MC impacted car	Motorcyclist was projected forwards and onto grass verge
8	Super Sports 600cc	Head on Collision with car	Motorcyclist lost control and MC fell on side	Motorcyclist braked while negotiating corner	Motorcyclist separated from MC and passed under the car
9	Super sports 750cc	Single vehicle	Motorcyclist lost control exiting bend, overtaking two cars	MC back wheel commenced to spin (possibly on white line) No steering damper	MC and Motorcyclist impacted against telegraph pole
10	Super sports 1000cc	Single vehicle	Motorcyclist lost control overtaking a bus on a bend	Motorcyclist braked in bend, lost control and hit a wall	MC and Motorcyclist were projected back onto road and under an oncoming bus
11	Cruiser c.900cc	Rear end collision with car	Collided with rear of car	MC fell on side and slid after braking	Motorcyclist was projected onto the hard shoulder
12	Super sports 600cc	Collision with car	Car performed U turn in front of MC	Severe braking caused MC rear wheel to lift off the ground	Motorcyclist thrown off and landed against the car
13	Super sports 600cc	Collision with car at junction	Car driver pulled out in front of the MC	Severe braking caused MC rear wheel to lift off the ground	Motorcyclist impacted car
14	Super sports 900cc	Collision with car at junction	Car driver pulled out in front of the MC (due to speed of MC, car driver may not have seen MC when exiting minor road)	MC speed probably higher than speed limit, motorcyclist braked but was unable to avoid impact	Motorcyclist impacted car

15a	Super sports 1000cc	Collision with tipper truck	Truck pulled out in front of MC	Excessive speed of >130mph motorcyclist was unable to avoid impact	Motorcyclist impacted tipper truck
15b	Super sports 1200cc	Collision with tipper truck	Truck pulled out in front of MC	Excessive speed of >130mph motorcyclist was unable to avoid impact	Motorcyclist impacted tipper truck
16	Naked 600cc	Collision with car	Car driver pulled out in front of the MC (possible visual impairment due to the position of the sun)	MC fell on side and slid after severe braking	Motorcyclist impacted car
17	Super sports 1000cc	Collision with car	Car driver pulled out in front of MC	Motorcyclist was unable to avoid impact with car	Motorcyclist impacted car
18	Moped 50cc	Collision with car	Moped rider lost control	Rider applied severe braking and lost control (tyres were significantly under-inflated)	Rider slid and hit an oncoming car
19	Super sports tourer 1100cc	Collision with car	Car driver pulled out in front of the MC. Both vehicles ignited.	MC speed probably higher than speed limit, motorcyclist braked but was unable to avoid impact	Motorcyclist impacted car
20	Advent. Traillie 1150cc	Collision with two cars	MC rear ended car one	MC moved onto the opposite lane in the path of car two	Car two impacted motorcyclist
21	Tourer 1300cc	Collision with a van	Van driver performed U turn in front of MC	Van driver possibly talking on mobile phone while performing U turn	Motorcyclist impacted van
22	Super sports 1000cc	Collision with truck	Truck driver pulled out in front of MC	MC speed probably higher than national speed limit, motorcyclist braked but was unable to avoid impact	Motorcyclist impacted truck
23	Super sports 1000cc	Collision with tractor	Tractor driver turned into a field in front of MC	Motorcyclist applied severe braking and MC fell and slid into the tractor	Motorcyclist impacted with tractor
24	Trail 125cc	Single vehicle	MC hit kerb and was unable to counter steer	MC fell on side	Motorcyclist impacted poles of traffic warning sign
25	Super sports 1000cc	Collision with van	Van driver cut the corner in front of the MC's path	Motorcyclist severely braked, MC fell and slid into van	Motorcyclist impacted van
26	Tourer 1100cc	Collided with 4x4	Motorcyclist lost control possibly due to wind	Motorcyclist swerved and hit a nearside kerb, MC went into a spin and crossed over to the opposite lane	Motorcyclist impacted 4x4
27	Super sports 750cc	Collided with car	Motorcyclist overtook van, braked and lost control	MC slid under oncoming car	Motorcyclist was run over by oncoming car
28	Scooter 125cc	Collided with car at junction	Motorcyclist ignored red traffic light	crossed the junction	Motorcyclist impacted car
29	Scooter 125cc	Single vehicle	MC contacted kerbstone and Motorcyclist lost control	MC fell and slid across the road	Motorcyclist slid and hit the support pole for a speed limit sign

30	Moped 50cc	Collision with moped	Moped either contacted with friend's moped or swerved to avoid it and rider lost control	Moped impacted stone wall in upright position	Motorcyclist pivoted forward and hit "dragon tooth" stone wall
31	Sports 750cc	Collision with car	Motorcyclist braked and lost control while negotiating bend	Front wheel locked and MC fell onto its side	Motorcyclist impacted car travelling in the opposite direction
32	Super sport 600cc	Single vehicle	Motorcyclist lost control while negotiating bend	Motorcyclist flew over Armco barrier to new road construction area (112 metres from barrier to rest position)	Hit head on rocks in construction area, suffered severe head injuries
33	Super sport 600cc	Collision with van	Van driver pulled out in front of MC (Dip in the road may have restricted his view)	MC impacted nearside of van	Motorcyclist impacted with van
34	Sports Tourer 750cc	Single vehicle	Motorcyclist lost control (severe right steering) while negotiating a bend	MC fell over and slid into the nearby kerb	Motorcyclist hit kerb
35	Super sports 1100cc	Collision between three MCs	Catalyst was an Advent. Traillie overtaking and rode into the path of MC	Motorcyclist applied severe front braking and MC fell onto its side	Motorcyclist impacted other MC
36	Semi-naked 650cc	Collision with SUV	MC did not stop at junction and collided with SUV	Motorcyclist misjudged speed and distance (Give way sign partially covered)	Motorcyclist impacted SUV
37	Naked 350cc	Single vehicle	Motorcyclist applied severe braking and lost control while negotiating right bend	MC tyres were under-inflated	Motorcyclist impacted with grass verge
38	Scooter 125cc	Single vehicle	Motorcyclist attempted to avoid metal covers on the road	Motorcyclist lost control and mounted footpath	MC and motorcyclist impacted with wall
39	Super sport 125cc	Collision with truck and car	Motorcyclist attempted to overtake truck while truck was moving right	MC impacted with truck then fell on side	MC and motorcyclist fell into the path of oncoming car