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Analysis of Police collision files for motorcyclist fatalities in London, 2006-09

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Disclaimer

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Contents

Executive summary

Transport for London (TfL) is committed to improving road safety in London by reducing the number of road traffic casualties in London. Despite a fall in the number of casualties from road traffic collisions in recent years, there is still an unacceptable number of casualties each year. In 2011, 159 people were killed and a further 2,646 people were seriously injured on London's roads. Of these, 30 fatalities and 569 seriously injured casualties were motorcyclists, accounting for 21% of the killed and seriously injured (KSI) casualties in London.

This study analysed 93 police fatal files where a motorcyclist was killed in London in the period 2006-2009 with the overall aim of providing a better understanding of how fatal motorcycle collisions in London occur and how they could be prevented in the future.

The fatal files were coded using a Haddon's Matrix approach, which included items related to the environment, the motorcycle, the motorcyclist, other vehicle(s) and their driver(s)/rider(s) in the pre-event, event and post-event stages of the collision. The collisions were analysed in terms of who was involved, the contributory factors, injuries sustained and possible countermeasures.

The project identified the factors or primary interventions, which if they had been in place, may have prevented the collision occurring (primary prevention). Further, the study identified the secondary interventions, which if they had been in place, may have reduced the type and/or severity of the injuries; this was based on an assessment of their causes.

In total 94 fatalities from 93 motorcyclist collisions were coded. Several groups of fatalities were identified as accounting for a substantial proportion of fatalities. Each group shared a common characteristic or feature of the collision and therefore some fatalities are present in more than one group. The groups with the largest numbers of fatalities were:

- Motorcyclist exceeding speed limit (45, 48%)
- Motorcyclist loss of control (42, 45%);
- Only a motorcycle involved collisions (30, 32%);
- Another vehicle turning across motorcycle path (21, 22%);

Other groups of interest included motorcyclists who were:

- undertaking 'stunts' prior to the collision (5, 5%);
- unlicensed motorcyclists and motorcyclists whose motorcycles were defective (12, 13% in each group);
- impaired by alcohol or drugs at the time for the collision (15, 16%); and
- had previous convictions (17, 18%) and inexperienced motorcyclists (18, 19%).

The key characteristics from the analysis following the Haddon's Matrix are listed below by the three phases: pre-event, event (the actual collision) and post event;

For the pre-event:

- The majority of motorcyclist fatalities were male;
- All but three riders were wearing a motorcycle helmet;
- Where known, the majority of riders were familiar with their route;
- Where known, the majority of motorcycle journeys were leisure journeys;
- 77 (82%) of the riders killed were from London;
- 62 (66%) occurred on a major (M or A) road;
- 55 (59%) were at a junction;
- Half were aged 30 and under;
- 45 (48%) of the motorcycles had 'exceeding the speed limit' recorded as a contributory factor in the stats19 record;
- Where the speeds of motorcyclists were estimated by Police Officers at the collision scene 64% of motorcycles were travelling at speeds above the speed limit (45 above the limit, 25 below the limit and 24 where no speed was estimated);
- The most commonly involved other vehicles were cars (44, 47%) and HGVs (12, 13%);
- 30 (32%) collisions involved no other vehicle;
- The most common bike type was sports bikes over 500cc;
- 18 (19%) of the riders had less than one year of riding experience;
- 17 (34%) of the riders had previous convictions (of 50 where this was known);
- 15 (16%) of the riders were impaired by alcohol or drugs; and
- 11 (12%) motorcycles had at least one vehicle defect prior to the collision, most notably defective tyres;

For the event:

- The most common conflict types were those involving loss of control (42, 45%) or another vehicle turning across the motorcycle's path (21, 22%);
- The most common trajectory for the motorcycle was to roll or skid from the point of impact to a point of rest or second impact;

Contributory factors:

- In two-vehicle collisions (57, 61%), the motorcyclist alone was attributed contributory factors in 20 (21%) collisions, the other driver/rider alone in 9 (10%) collisions, and both parties in 28 (30%) collisions;
- In two-vehicle collisions, the most common contributory factor assigned to the motorcyclist was 'exceeding speed limit' (29, 31%); and
- In single vehicle collisions (30, 32%), the most common contributory factors were 'loss of control' (21, 22%) and 'exceeding speed limit' (18, 19%).

For the post event:

- The majority (80, 85%) of motorcyclists died on the same day as the collision;
- The most common body regions with life-threatening injuries were the thorax (78%) or the head (63%);
- Although there were cases with life-threatening injuries to limbs, in all cases other life-threatening injuries were also present;
- There were 17 (18%) fatalities whose helmets were displaced by the collision;
- 17 (18%) drivers of other vehicles in the collision were convicted for an offence following the collision, most commonly 'careless driving'; and
- 13 (14%) fatalities had injury levels that were classed as 'untreatable'.

Using this information the most common countermeasures recorded were primary countermeasures. The most commonly occurring countermeasures that could have prevented the fatal collision occurring were educational and enforcement (see table below). Examples of these countermeasures include:-

- Speed warning systems
- Speed enforcement to increase speed limit compliance
- Additional motorcyclist training to improve riding skill
- Improved braking systems for motorcycles
- Additional training to improve drivers' awareness of motorcycles.

Table 1: Number of fatalities in collisions with each proposed countermeasure type

Countermeasure type		Number	% of fatalities
Primary	Engineering - environment	9	10%
	Engineering - vehicle	46	49%
	Education - motorcyclist	63	67%
	Education - drivers	18	19%
	Enforcement	48	51%
Secondary	Engineering - environment	1	1%
	Engineering - vehicle	11	12%
	Education - motorcyclist	9	10%
	Enforcement	9	10%

1 Introduction

In 2010 the Mayor of London published the Mayor's Transport Strategy which included policies and proposals to improve safety and security of all Londoners (Greater London Authority, 2010). Transport for London (TfL) is committed to improving road safety in London by reducing the number of road traffic casualties in London. Despite a fall in the number of casualties from road traffic collisions in recent years (TfL, 2011), there is still an unacceptable number of casualties each year. In 2011, 159 people were killed and a further 2,646 people were seriously injured on London's roads. Of these casualties, 30 motorcyclists were killed and 569 were seriously injured.

Despite considerable increases in ownership and use of motorcycles, they still only account for about 3% of travel in terms of vehicle-miles (TfL, 2007) and 1% of daily journey stages (TfL, 2011). According to the Department for Transport, motorcycle ownership in the London region increased by 50% between 1997 and 2007. In 2010, motorcyclists accounted for 21% of KSI casualties in London (TfL, 2011).

Police fatal road traffic collision reports provide a unique insight into the causes and consequences of fatal collisions and what may have prevented the collision or reduced its severity. Through understanding the nature and causes of the collisions it is then possible to investigate how they could have been prevented. This study analysed 93 police fatal files where a motorcyclist was killed in London in the period 2006-2009 with the overall aim of providing a better understanding of how fatal motorcycle collisions in London occur and could be prevented.

Using a Haddon's Matrix approach the project identified the factors or primary interventions which if they had been in place may have prevented the collision occurring (primary prevention). Further, the project considered the causes of the injuries and where practical identified the secondary interventions which if they had been in place may have reduced their severity (Secondary and tertiary prevention).

2 Research Methods

A principal aim of the research was to identify the characteristics of collisions that result in fatality injured motorcyclists; and to subsequently identify the relevant risk factors and to propose potential prevention strategies.

The research involved several stages:

- an overview analysis of the STATS19 (ACCSTATS) data for 2006-2010;
- a small targeted literature review;
- a detailed content analysis of 93 police fatal files.

These stages are described below.

2.1 Overview of STATS19 data

STATS19 is the national database of all reported injury accidents on public roads. About 50 variables are recorded for each collision, including details of the collision circumstances, the vehicles involved and the resulting casualties. TfL maintain a database of collisions based on the STATS19 data, named ACCSTATS, and this was investigated for 2006-2010. A brief overview of these data was used to set the context of the findings from the detailed analysis, the results of which are detailed in Section 1. STATS19 data was also used as a reference source to identify collisions in London where a motorcyclist had been killed from 2006 to 2008, and the Metropolitan Police fatal files for a sample of these cases were obtained.

2.2 Police Fatal Road Traffic Collision Files

The Police Fatal Road Traffic Collision Files provide a unique insight into how and why fatal collisions occur on our roads.

The police fatal files include:

- Accident investigators' reports;
- Witness statements;
- Police summaries;
- Vehicle examiners' reports;
- Post-mortem reports;
- Scene photographs and plans; and
- Other expert evidence.

The files provide information to enable the study of the circumstances and contributory causes as well as potential preventative countermeasures.

The level of detail within the files is high, however, there is no provision for knowing certain details if the information was not pertinent to the collision. For example if the file does not explicitly state whether the motorcyclist was wearing protective clothing or if the clothing or equipment was not photographed then it is recorded as unknown. Thus for some variables there is a high proportion of unknowns. Appendix E details the levels of unknowns for all the variables.

All of the interpretation and coding of the police fatal road traffic collision files followed strict data handling and confidentiality guidelines defined in the Department for Transport protocol for accessing the fatal collision files. No personal information was collected or retained by this project.

2.3 Sampling

The majority of the fatal files for 2006 and 2007 are contained in an archive at TRL. However, many of the 2008 files were not contained in the archive as the police do not release the files for at least one year (and possibly two) to allow for the investigations to be completed. In addition, the archive has not been added to by the Metropolitan police since July 2009.

The number of files in total and in the sample is shown in Table 2-1.

Table 2-1: Location of the motorcyclist fatalities (non-pedestrian) by year

Year	File in TRL archive	File held by Metropolitan Police	Total	Sample achieved
2006	39	3	42	37
2007	27	13	40	25
2008	9	41	50	20
2009	0	39	39	12
Total	**75**	**57**	**132**	**94**

It was the original intention to review 100 files, using a combination of those files held at TRL and those held by the Metropolitan Police. The sample was selected to be representative based on the following criteria (shown in Table 2-2):

- Inner/outer London;
- Size of motorbike (<50cc, 50-125cc, 125-500cc, >500cc);
- Single/multi-vehicle collision.

This gave a matrix of 16 combinations of the criteria, for example ‘motorcycles <50cc in single vehicle collision in inner London’.

Files held at TRL and additional files from the Police were reviewed. Initially, the sample was selected at TRL and the Police were asked to provide details for specific cases. However, due to difficulties in locating some of the files, the Police were supplied with a list of all of the possible files in each of the 16 groups, together with the number of files needed in the sample for that group. Once the files had been located and transferred, the TRL team visited the Metropolitan Police Traffic Criminal Justice Unit, at the North West Traffic Unit, Wembley to carry out the analysis of the 28 files.

Table 2-2 shows the number of fatalities between 2006 and 2010, the intended sample and the sample achieved. In total, 94 fatalities from 93 collisions were included in the database.

Table 2-2: Sample of fatal files for motorcyclists

Group		Total fatalities 2006-10	Intended sample	Sample achieved held at TRL	Sample achieved from Police	Total sample achieved (fatalities)
Collision type	Multi vehicle	144	71	44	22	66
	Single motorcycle	58	29	22	6	28
Motorcycle type	<= 50cc	12	6	1	2	3
	50-125cc	46	19	11	6	17
	125-500cc	32	18	4	1	5
	> 500cc	112	57	47	17	64
	unknown	0	0	3	2	5
Area	Inner	83	35	19	16	35
	Outer	119	65	47	12	59
Total		**202**	**100**	**66**	**28**	**94**

2.4 File content analysis approach

The content analysis was based on a Haddon Matrix approach (Haddon Jr, 1999). This matrix provides a framework for the collection and analysis of the information available in the police fatal collision files. Haddon developed this method to identify interactions between the casualty, the vehicle and the environment through phases of the event: pre-crash, crash and post-crash. The matrix defines countermeasures for each of the three time phases: countermeasures which prevent the crash from occurring, countermeasures which reduce the severity of injury and those providing life-sustaining countermeasures and preventing secondary events from occurring. The Haddon Matrix considers personal factors, vehicle factors, and physical and social environmental factors during each of the three time phases (See Appendix A).

An Access database was developed, in consultation with TfL, to store the information collected from the files. Many of the fields have 'drop-down' menus and check boxes which allow searches and in addition several descriptive text fields have been included to enrich the findings and provide a narrative of the collision.

The database has a hierarchical design with a unique (STATS19) code for each collision. There is a separate record for the environment, a record for the fatality (which includes information about the vehicle as well as the rider and any passengers) and a record for each of the other vehicles involved (vehicle information and driver information). A detailed set of coding instructions was developed and is included in Appendix B. As part of the content analysis the researchers considered the evidence contained in the file and suggested contributory factors (based on the STATS19 system, see Appendix B.8) and potential countermeasures from a list of possible interventions. The list of contributory factors is given in Appendix B.5 and the list of countermeasures is given in Appendix B.8. The researcher could enter as many contributory factors and countermeasures as were applicable to the case, although STATS19 only allows for six factors, assigning them to the motorcyclist rider or other driver or either vehicle, each as possible or maybe.

Three researchers were involved in the content analysis and several files were coded by all three team members to help ensure that the files were coded in a similar and consistent manner. In addition, an experienced senior team member checked all the coding for the files, in particular the assigning of countermeasures and collision types. Meetings were held throughout the file analysis stage to discuss various aspects of the files and the availability of the desired information.

In addition to this database a TRL specialist classified the injuries from the post mortem reports using the Abbreviated Injury Scale (AIS, 2005) which is an internationally recognised method of classifying trauma and measuring injury severity. Each injury description is assigned a unique six digit numerical code in addition to the AIS severity score. The first digit summarises the body region; the second digit identifies the type of anatomical structure; the third and fourth digits identify the specific anatomical structure or, in the case of injuries to the external region, the specific nature of the injury; the fifth and sixth digits identify the level of injury within a specific body region or anatomical structure. Finally, the digit to the right of the decimal point is the AIS severity score.

The AIS code (851812.3) shown in Figure 2-1 represents a fracture of the femur, where the AIS severity score is 3 (serious). This study specifically uses the AIS code for the body region injured and the AIS severity score.

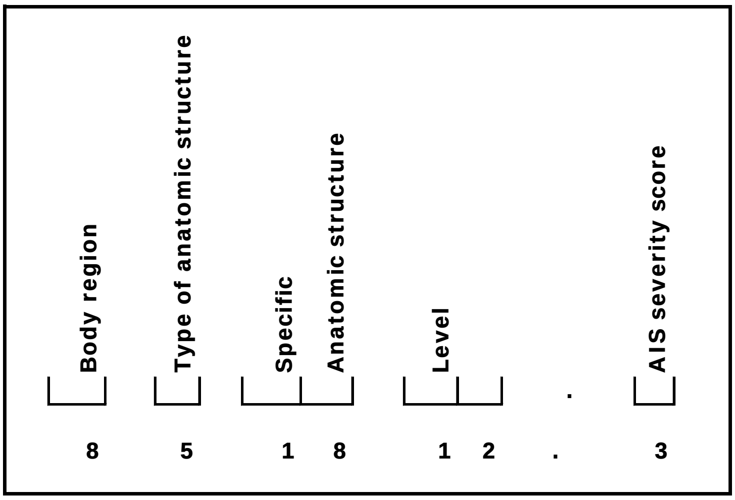


Figure 2-1: Example of an AIS code

The AIS severity score classifies individual injuries by body region on a six point ordinal severity scale ranging from AIS 1 (minor) to AIS 6 (currently untreatable), shown in Table 2-3.

Table 2-3: Description of AIS severity scores

AIS severity score	Description
1	Minor
2	Moderate
3	Serious
4	Severe
5	Critical
6	Maximum

MAIS denotes the Maximum AIS severity score of all injuries sustained by a casualty. It is a single number that attempts to describe the seriousness of the injuries suffered by a casualty. The AIS system therefore allows injuries to be coded by their type and severity in terms of threat to life.

2.4.1 Motorcycle classification

The classifications used cover the main types of motorcycle. When determining which category to allocate, engine capacity was not used as a deciding factor since similarly styled motorcycles are available in a wide range of engine sizes, from mopeds to large capacity motorcycles which may only be ridden by full licence holders.

1. Scooter

Motorcycles classified for the report as ‘scooters’ feature an ‘open’ frame, with a lower section where the rider is able to step through when mounting their machine.

Although traditionally associated with smaller capacity engines, larger-engine scooters are now available.

2. Trail Bike

Motorcycles styled as off-road or ‘trail’ are usually lighter than equivalent motorcycles with similar engine capacity. They feature long travel suspension and ‘knobbly’ tyres designed to provide grip on loose surfaces.

3. Cruiser/tourer

These motorcycles typically have a low seating position and high handlebars, and are styled for the ‘easy rider’/’chopper’ image.

4. Sports

Sports motorcycles feature lower, narrow, handlebars and fairings replicating those used on track racing motorcycles.

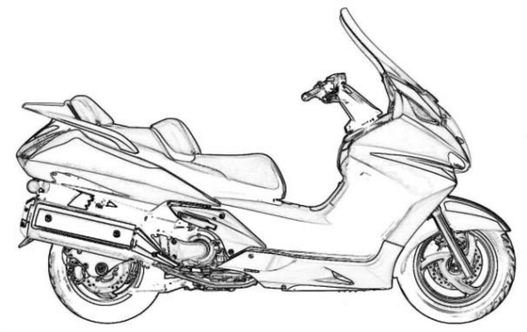
5. Retro

These motorcycles are classified from the design of a ‘basic’ motorcycle; the term ‘retro’ is often used to describe motorcycles which do not feature fairings or more extreme riding positions.

6. Tourer

Touring motorcycles typically feature large, high, fairings and screens, with higher handlebars to aid rider comfort. They usually have luggage equipment such as rear panniers and top cases.

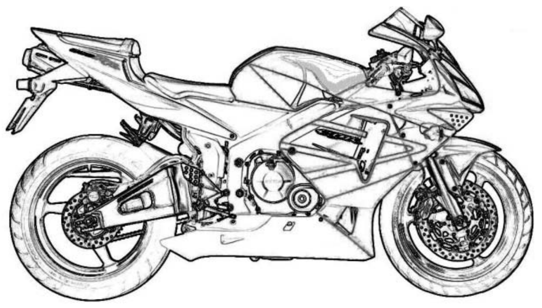
Figure 2-2: Motorcycle classification



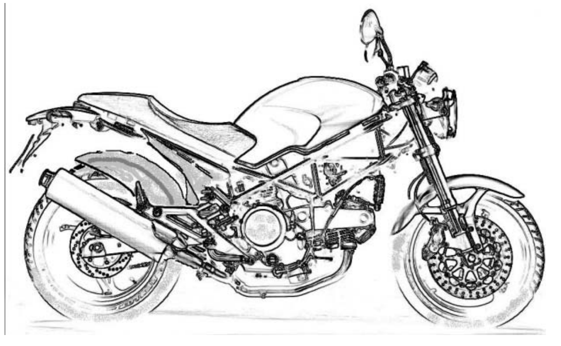
1. Scooter
Rider able to 'step through' centre of bike

2. Trail Bike
Lighter weight, high suspension, 'knobbly' tyres

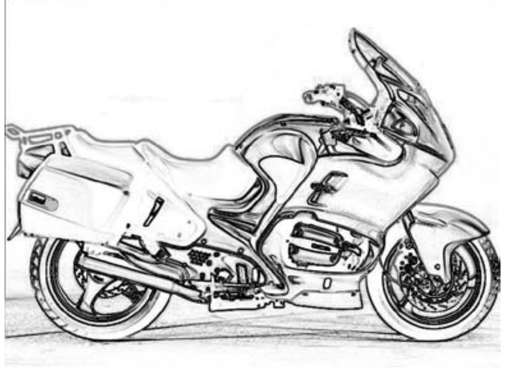
3. Cruiser / tourer
Low seating position, high handlebars



4. Sports
Low handlebars, narrow 'racy' fairing



5. Retro
No fairing



6. Tourer
Large high fairing, higher handlebars, may have panniers

3 STATS19 overview (2006-2010)

3.1 Comparison with GB

In the last five years (2006-2010) there were 201 motorcyclists killed in London, accounting for 8% of all motorcyclists killed in Great Britain over this period. Table 3-1 shows the number of motorcyclists killed in London and Great Britain by year. Over the five year period about one-fifth of fatalities in London and in Great Britain were motorcyclists.

In London and Great Britain the number of motorcyclist fatalities has reduced over the last five years, although other fatalities have shown larger reductions, meaning that the percentage of fatalities who were motorcyclists has increased slightly throughout the period.

Table 3-1: Motorcyclist fatalities in London and Great Britain, 2006-10

	London[1]			Great Britain[2]		
Year	Motorcyclist fatalities	All fatalities	% motorcyclists	Motorcyclist fatalities	All fatalities	% motorcyclists
2006	43	231	18.6%	599	3,172	18.9%
2007	41	222	18.5%	588	2,946	20.0%
2008	50	204	24.5%	493	2,538	19.4%
2009	39	184	21.2%	472	2,222	21.2%
2010	28	126	22.2%	403	1,857	21.7%
Total	**201**	**967**	**20.8%**	**2,555**	**12,735**	**20.1%**

[1] Reproduced from Casualties in Greater London (2007-2010): (TfL, 2008), (TfL, 2009), (TfL, 2010), (TfL, 2011)

[2] Reproduced from Reported Road Casualties Great Britain (DfT, 2011)

In London 7.4% of KSI motorcyclists were killed compared with 11.7% in Great Britain. This difference is likely to reflect different road conditions and riding speeds.

Table 3-2 shows the number of motorcyclist fatalities in London and Great Britain by collision type. London shows a similar pattern to urban areas in Great Britain, with 27% of motorcyclist fatalities in single vehicle collisions.

Table 3-2: Number of motorcyclist fatalities in London and Great Britain, 2006-10 [1 2]

	Single vehicle, no pedestrian		Single vehicle with pedestrian		Multiple vehicles		All (100%)
	No.	%	No.	%	No.	%	
GB urban	205	26%	5	1%	567	73%	777
GB rural	642	22%	0	0%	2,271	78%	2,907
London	55	27%	2	1%	144	72%	201

[1] GB figures from Reported Road Casualties Great Britain, 2006-2010: (DfT, 2007), (DfT, 2008), (DfT, 2009), (DfT, 2010) and (DfT, 2011).

[2] London data from TfL ACCSTATS data, 2006-2010.

3.2 Motorcyclist fatalities in London

Over the five-year period, 78 of the motorcyclist fatalities occurred in inner London (39%), shown by year in Table 3-3.

Table 3-3: Number of motorcyclist fatalities in inner and outer London by year (2006-2010)

Year	Inner London	Outer London	Total
2006	11	32	43
2007	14	27	41
2008	25	25	50
2009	14	25	39
2010	14	14	28
Total	**78**	**123**	**201**

Table 3-4 shows the number of motorcyclist fatalities in each borough over the five-year period. The highest number of fatalities occurred in Enfield (14), Barnet (13) and Westminster (12)

Table 3-4: Number of motorcyclists killed by borough (2006-2010 totals)

Classification of borough	London Borough	Number of motorcyclists killed in sample
Inner London	Camden	5
	City of London	0
	Greenwich	10
	Hackney	4
	Hammersmith and Fulham	5
	Islington	4
	Kensington and Chelsea	7
	Lambeth	3
	Lewisham	6
	Southwark	6
	Wandsworth	7
	Westminster	12
Outer London	Barking and Dagenham	7
	Barnet	13
	Bexley	3
	Brent	7
	Bromley	10
	Croydon	5
	Ealing	7
	Enfield	14
	Haringey	7
	Harrow	3
	Havering	4
	Hillingdon	11
	Hounslow	5
	Kingston upon Thames	4
	Merton	4
	Newham	3
	Redbridge	6
	Richmond upon Thames	0
	Sutton	5
	Tower Hamlets	9
	Waltham Forest	14

Over half (55%) of motorcyclists fatalities were riders or passengers of motorcycles over 500cc as seen in Table 3-5.

Table 3-5: Number of motorcyclist fatalities London by motorcycle type and year (2006-2010)

Vehicle Type	2006	2007	2008	2009	2010	Total
Motorcycle 50cc and under	2	4	3	2	1	12
Motorcycle 50cc-125cc	7	7	11	9	12	46
Motorcycle 125-500cc	7	8	12	2	3	32
Motorcycle over 500cc	27	22	24	26	12	111
Total	**43**	**41**	**50**	**39**	**28**	**201**

3.3 Motorcyclist fatalities in London in collisions with pedestrians

Collisions where the motorcyclist was killed after colliding with a pedestrian were not included in the review of fatal files since they were small in number. The following information is taken directly from the ACCSTATS database.

Over the five-year period 2006-2010 there were four motorcyclists killed in collisions which involved a pedestrian. The details were as follows:

1. Motorcycle rider was in a collision with a pedestrian; both were killed.
2. Motorcycle rider was killed in a collision with a pedestrian and a car. The pedestrian was seriously injured, no car occupants were injured.
3. Motorcycle rider was killed in a collision with a pedestrian. The pedestrian was slightly injured.
4. Motorcycle passenger killed in a collision with a taxi, a car and 2 pedestrians. The two pedestrians were slightly injured and the taxi passenger was seriously injured.

Three of the collisions were on an A-road and the pedestrian crossed the road into the path of the motorcyclist. The fourth collision was on a minor road; the motorcycle lost control and then hit two other vehicles and the pedestrian. Three of the four collisions occurred between midnight and 2am.

4 Literature review

4.1 Introduction

The aim of the literature review was to summarise key pieces of literature relating to the causes of motorcycle collisions and countermeasures which could help to prevent collisions or reduce injury. The review was conducted using literature provided by TfL as well as key pieces of literature acquired from a brief and targeted literature search. Eleven papers were reviewed.

4.2 Causes

In their in-depth study of motorcycle collisions, Clarke, Ward, Bartle, & Truman, 2004 used police road accident files involving motorcyclists to construct a database containing the facts related to each case, prose accounts, sketch plans and possible explanatory factors for each incident. The following causes of collisions were identified:

- Right of way violations (ROWVs) - these occurred mainly at T-junctions, and usually the motorcyclist was not at fault but rather the collision results from the car (or other vehicle) driver failing to see the motorcyclist.
- Losing control on bends - This was usually attributed to the motorcyclist, and mainly occurred when inexperienced riders were riding their motorcycle for pleasure on rural roads.
- The high power-to-weight ratio of motorcycles and associated manoeuvrability may have been a contributory factor. Riders often ‘filtered’ through slow or stationary traffic and this may have had the effect of ‘subverting’ the expectations of other drivers regarding how traffic behaves.
- Rear end shunts, whereby the motorcyclist collided with the rear of another vehicle. These tended to involve young male riders and may result from riders finding it difficult to brake soon enough, particularly in wet or slippery road conditions.

The authors also found that motorcycles with an engine capacity of 50-125cc were over-represented in collisions. Bikes of this capacity are used most often by young, inexperienced riders. The primary cause of this type of collision tended to lie with the driver of the other vehicle (57% excluding single-vehicle collisions), while in 22% of cases it lay with the motorcyclist.

Huang and Preston (2004) conducted a literature review on motorcycle collisions and described additional factors contributing to collisions:

- Motorcycles are physically smaller than other motor vehicles. Their face-on silhouette area is 30-40% that of a car, and they are more likely to be obscured by traffic. Horswill & Helman, 2001 found that people about to pull out from a junction tend to judge that an oncoming motorbike will reach them later than a car travelling at the same speed.
- There is a lower frequency of motorcycles on the road and so drivers do not expect to encounter them.
- Drivers have visual limitations such as in-vehicle obstructions (e.g. door pillars, passengers) and blind spots.
- Motorcyclists may display aggressive or risk-taking behaviour, for example Horswill & Helman, 2001 found that motorcyclists tended to choose faster speeds,

overtook more and pulled into smaller gaps in traffic compared to car drivers. Young male riders are particularly likely to display risky behaviour.

Elliot, et al., 2003 undertook a scoping study into motorcycle safety. This involved a review of literature and research as well as national accident figures. In addition to points mentioned above, the authors noted that:

- Motorcycles are 'single track' vehicles and therefore at risk of becoming unstable and 'capsizing' if a wheel loses adhesion to the road surface, particularly if the vehicle is taking a bend.
- Motorcycles are particularly vulnerable to the design and condition of roads, with hazards such as pot holes, drain covers and uneven surfaces posing a potential danger to motorcyclists.
- Crash barriers are designed to reduce crash severity for other types of vehicles, but motorcyclists are vulnerable in impacts with crash barriers.

The Motorcycle Accidents In-depth Study (MAIDS) (ACEM, 2004) consisted of an extensive in-depth study of 921 accidents involving a motorcycle or moped in 1999-2000 in sampling areas in France, Germany, Netherlands, Spain and Italy. The investigation of each accident included an accident reconstruction, vehicle inspections, witness interviews and medical record collection (where possible). The study was case-controlled, with comparative information collected on a further 923 non-accident involved powered two wheelers. It was found that:

- Impact speed of motorcyclists was usually below 30mph; excess speed was rarely a contributory factor.
- Human error was the cause of the majority of incidents involving powered two wheelers, with 50% attributed to an error made by the driver of the other vehicle, and 37% by the powered two wheeler driver.
- The primary contributing factor in 37% of cases was a perception failure by the other driver.
- The majority of collisions were with a passenger car (60%) or the roadway (9%).
- Just over 15% of collisions did not involve another vehicle.
- Over half of collisions (54%) took place at an intersection.
- Road surface defects were present in 30% of cases.
- For L1 vehicles (two-wheeled vehicles with an engine cylinder capacity not exceeding 50cc and a maximum design speed not exceeding 50 km/h) some sort of tampering with the engine or driveline was detected in 17.8% of collisions.
- Helmets were effective at preventing or reducing head injury severity in 69% of cases.

4.3 Countermeasures

Interventions and countermeasures aim to prevent a collision occurring in the first place (primary prevention) or may aim to reduce the severity of injury to the rider once a collision has occurred, thus reducing the risk of fatality (secondary prevention).

4.3.1 Preventing collisions – primary countermeasures

The prevention of collisions may be aided by educational, enforcement or engineering interventions.

4.3.1.1 A literature review on motorcycle collisions (Huang & Preston, 2004)

Huang & Preston, 2004 suggested the following primary countermeasures:

- **Graduated driver licensing**, whereby beginners gain experience under less risky conditions and on-road riding is phased in gradually, typically comprises of an 'extended learners stage' (supervised riding only) and a stage of restricted but unsupervised riding (e.g. no night-time riding or riding with a pillion).
- Improved **conspicuity** measures to improve the visibility of motorcyclists both at day and night can reduce collisions. Methods of improving conspicuity include the use of daytime running lights, bright motorcycle colours, and modified rider clothing.
- Improved **rider education** and training may help to reduce the motorcycle collision rate. However, any interventions which aim to enhance the skills of motorcyclists have the potential side effect of motorcyclists becoming over-confident in their riding ability.
- **Assessed rides** (e.g. the five-year initiative launched in Scotland in 2000), involving an assessment by a trained police motorcyclist of on-the-road skills alongside advice and guidance, may also improve biker skills and reduce collisions.
- **Law enforcement** is necessary to ensure that laws and regulations relating to motorcycle safety are complied with, particularly regarding excessive speed which is a contributory factor in many collisions.

4.3.1.2 Motorcycle safety: A scoping study (Elliot, et al., 2003)

The motorcycle safety scoping recommended that the following primary countermeasures relating to the road environment could contribute to a reduction in collision rates for motorcyclists:

- The use of **daytime running lamps** and **fluorescent clothing** improve motorcyclist conspicuity during daylight hours, while night-time conspicuity can be enhanced by bright headlamps, strip-lights and leg shields.
- Certain **road surface** conditions can contribute to motorcyclist collisions, particularly the use of bitumen which is frequently employed in road repair. It has a much lower friction value when wet compared to tarmac (μ=0.25 and 0.8 respectively) resulting in an emergency stop (from 30mph) requiring twice the distance. Therefore the use of bitumen should be avoided whenever possible.
- **Signs** warning of poor road surface or changes in road surface would better enable motorcyclists to prepare for potential instability.
- **Road markings** can also cause instability and may also retain surface water, resulting in loss of adhesion. By imposing a maximum height for profiled markings and ensuring that they are skid-resistant, the risk posed by road markings can be minimised.

Factors relating to rider behaviour include:

- **Speed**, which is a major factor in motorcycle collisions, should be controlled for example through increased use of speed cameras, enhanced enforcement of speeding laws, or cruise control.
- Research has found that motorcyclists are more likely to make errors in **close following** compared to car drivers (Thomson, 1982).
- There is a greater proportion of collisions involving **overtaking manoeuvres** for motorcyclists than car drivers.

- **Conspicuity**, including bright or reflective clothing and helmets, and daytime running lights.
- The risk of accident involvement for motorcyclists may vary at different types of **junction**. For example there is a higher accident rate for roundabouts than at T-junctions.
- Riders' safety can become impaired though stress, fatigue and alcohol.
  - **Stress** may be reduced by addressing road-environment stressors, for example by designing road systems which reduce perceived demands, or training riders to cope with the perceived demands of on-road situations.
  - **Fatigue** may be exacerbated by wearing heavy helmets and by long journeys; and so lightweight helmets and frequent rest breaks are recommended.
  - Motorcyclists are less likely than other drivers to die in drink-drive collisions; however riders are more vulnerable to the effects of **alcohol**.
- **Training and education** of riders, which is associated with increasing the risk of overconfidence in riders. Drivers of other vehicles could also be trained in understanding motorcyclist vulnerability.

4.3.1.3 Powered two wheeler integrated safety (Pisa) Final report (McCarthy, Hulshof, & Robinson, 2010)

McCarthy, Hulshof, & Robinson, 2010 conducted an investigation into Power Integrated Two-Wheeler Safety (as part of the 'PISa project') which aimed to identify and develop an effected integrated safety system for powered two wheelers, focusing principally on primary countermeasures. In addition to measures mentioned above, some more recent technology was considered, including:

- **Autonomous braking** to automatically slow or stop the vehicle without input from the rider.
- **Enhanced braking**, whereby the braking force is amplified in an emergency.
- **Dynamic suspension** to reduce 'front end dive' of the motorcycle under heavy braking conditions.

4.3.2 Preventing fatalities – secondary countermeasures

Secondary countermeasures aim to reduce the injury severity (or to prevent a fatality).

4.3.2.1 A literature review on motorcycle collisions (Huang & Preston, 2004)

- Skidding is a common feature of motorcycle crashes in wet weather. **Braking systems** such as anti-lock brakes should encourage motorcyclists to feel confident to make maximum use of their brakes. ABS is not currently a standard feature on motorcycles.
- **Alternative design** of motorcycles can be used to offer greater protection to riders. For example the BMW C1 and the recently-designed C1-E (an electric motorcycle) have safety features including a 'roof' over the rider's head as well as a seat belt and roll-over bar.

4.3.2.2 Motorcycle safety: A scoping study (Elliot, et al., 2003)

- **Crash barriers** and fences have been designed to protect most road users, but may be hazardous to motorcyclists. The removal of unnecessary crash barriers is recommended, as is using an energy-absorbing protector to cover barrier supports.

- **Helmets** have been proven to reduce the risk of head injury. Open and full face helmets are available, with the latter being associated with a greater reduction in facial injury but also with the disadvantage of being heavier and having a greater tendency to mist over. However helmets are an effective and generally well-used countermeasure.
- Motorcycle **airbags** (either chest airbags or airbag jackets) are rarely available on the current market, but are potentially an effective secondary countermeasure, particularly in reducing head and chest injuries.
- **Leg protection** systems can protect the rider's legs during a collision, although motorcyclists tend to have a negative attitude towards them. Some riders may be under-informed and therefore not realise the safety benefits. Further information should be made available regarding the purpose and effectiveness of leg protection systems to encourage their use.
- **Protective clothing** can include leather gloves, jackets and trousers designed to reduce injury to the soft tissue. Improved design (including aesthetics, to overcome any 'self-image' issues) and wider use could contribute to a reduction in the severity of casualties, but is unlikely to reduce fatalities.

5 Results

The final sample consisted of 94 motorcyclist fatalities, 93 riders and 1 passenger from 93 collisions. Six riders were carrying a passenger of which 1 died in the collision. Thirty collisions involved a single motorcycle (32%), 57 were two-vehicle collisions (61%) and 7 involved three vehicles (8%).

This section shows the results related to Haddon's matrix: Pre-event, event and post event factors for the environment, the motorcycle and rider and other vehicles and drivers involved. Further tables can be found in Appendix E.

5.1 Pre-event

This section describes the pre-event, namely the personal characteristics of the motorcyclist, the type of motorcycle and its pre-event condition, the other vehicles and participants involved and the road environment.

5.1.1 *The motorcyclist fatality and motorcycle*

5.1.1.1 *The motorcyclist*

The majority of the motorcyclists were male (91) and only three of the fatalities were female. The motorcyclists' age distribution is shown in Figure 5-1, which shows that half of the fatalities were aged 30 and under, with the highest number of these being aged between 21 and 25 years (18). Fewest fatalities occurred in the under 16 years (the age at which teenager can take a motorcycle licence test) and over 51 years age groups (2 and 3 respectively).

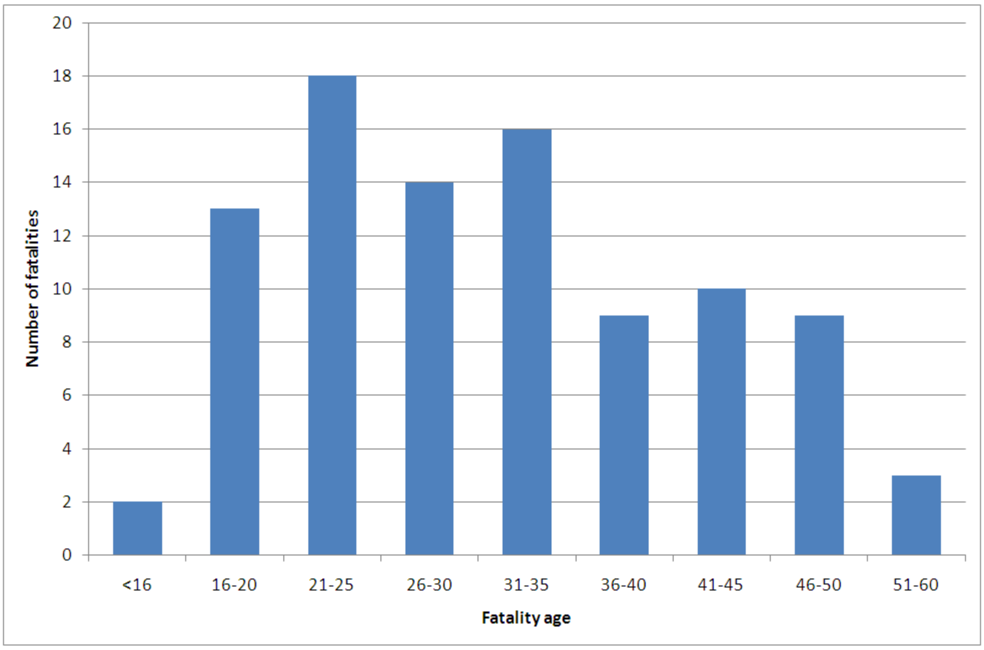


Figure 5-1: Age distribution of the motorcyclists

The ethnicity has been determined using a variety of information from the police reports for 54 of the motorcyclists. Table 5-1 shows this information grouped using the major categories from the ethnic classification system as used in the 2001 census for England and Wales. The majority of the fatalities, where ethnicity was known, were white.

Table 5-1: Fatal file description of the ethnicity of the motorcyclist fatalities

Motorcyclist ethnicity	Total
White	48
Mixed	1
Asian or Asian British	3
Black or Black British	2
Chinese or other ethnic groups	0
Unknown	40
Total	**94**

The area of residence was known for all the motorcyclists, 77 (82%) were from London, 31 from inner London (33%), 46 from outer London (49%), 14 were from other UK regions (15%) and 3 were from abroad (3%). The journey purpose was known for 50 riders; 27 were leisure journeys (54%), 17 were travelling to and from work (34%), 2 were shopping (4%), and 2 were travelling as part of their job (4%). It was known that 37 of the motorcyclists were very familiar with their route (74%) and only 1 was unfamiliar. The journey start point was known for 25 cases; there were 10 with a generic description, for example, 'college' or 'pub' and in 59 cases it was unknown.

There was some evidence as to the level of motorcycling experience of the riders in 41 files. Twenty-three were thought to have had more than 1 year 'on the road' experience (including 14 (34%) with more than 5 years experience) and 18 were thought to be inexperienced (44%). The inexperienced riders were defined to be those that were known to have passed their test less than 1 year before the collision, although this category included a 17 year old male with a provisional licence who is described as 'having ridden since the age of 3'. Section 6.2.5 looks at the collision circumstances of the inexperienced riders in more detail.

Further motorcycling training after passing their licence test was also of interest and this was recorded in 22 of the files. It should be remembered that this information may have only been noted in the file if it were thought to be relevant to the investigation, which is likely to contribute to a recording bias. It was known that 14 of the motorcyclists had had some additional formal training while 8 riders had undertaken no additional training (Table 5-2). The level of training is linked to the type of licence held and it could be assumed that the 46 riders holding a full licence had undertaken some form of training. Of the 8 riders with no training, 2 held a provisional licence while 6 had no valid licence. Section 6.2.6 looks at unlicensed riders in more detail.

Table 5-2: Motorcycle training undertaken

Type of training undertaken:	Type of licence:				Total
	Full	Provisional	None	Unknown	
CBT (Compulsory Basic Training)	5	4	0	0	9
DAS (Direct Access Scheme)	2	0	0	0	2
Other – advanced training	3	0	0	0	3
None	0	2	6	0	8
Unknown	36	12	6	18	72
Total	**46**	**18**	**12**	**18**	**94**

Six riders were carrying a passenger of which 1 died in the collision. Information as to whether the motorcyclist was carrying a load was recorded for half the fatalities. Ten riders and 2 passengers were known to be carrying bags (of which 8 were rucksacks). Two riders were known to have been following another motorcycle.

Insurance information was known for 35 motorcyclists and of these 13 did not have the appropriate insurance. One motorcycle was stolen, and another was described as having been taken without the owner's permission.

Information was collected from the police files regarding the conviction history of the motorcyclist. It should be noted that this information is only likely to be recorded if it is relevant to the police investigation of the fatality. The conviction history was known for over half of the fatalities (50) and of these 17 had had a previous conviction (34%). Table 5-3 presents the category of conviction for which the history was known; 8 motorcyclists had a criminal record, 7 had previous driving/riding convictions and 2 were youth offenders. Collisions involving riders with previous convictions are looked at in more detail in Section 6.2.7

Table 5-3: Conviction history of the motorcyclist

Conviction history	Total
Criminal record - court conviction(s)	8
DVLA offences only	7
Youth offender (warning/reprimand)	2
No previous convictions	32
Unknown	45
Total	**94**

5.1.1.2 Motorcyclist impairment

Information was collected from the files regarding impairment of the motorcyclist by alcohol, drugs, fatigue, defective eyesight and illness or incapacity. The impairment could have influenced the behaviour of the rider before and during the event and their reaction to the event. However, it should be noted that it is not possible to determine whether an alcohol impaired rider exceeding the speed limit would have still exceeded the speed limit even if they had not been drinking.

Table 5-4 shows that 15 motorcyclists were impaired by alcohol and/or drugs (16%). The collisions involving these fatalities are studied in more detail in Section 6.2.4.

Table 5-4: Motorcyclist impairment

Impairment	Total
Alcohol	9
Drugs	5
Alcohol & drugs	1
Fatigue	1
Defective eyesight	0
Illness or incapacity	0
No impairment	70
Unknown	8
Total	**94**

5.1.1.3 Motorcyclist clothing, PPE and visibility

There is one legally-required item which must be worn by all motorcyclists in the UK: a helmet which meets the appropriate legislation. All other items of clothing such as boots and gloves are used at the rider's discretion and are often not manufactured specifically for motorcycling. Protective clothing specially designed to offer protection is labelled CE if it meets European Union standards.

Of items specifically designed for riding, eye protection (whether by goggles, visors or other equipment) has a legal requirement to meet the appropriate standard – although there is no requirement for riders to wear any type of eye protection. Often the clothing worn by motorcyclists has not been tested and approved to the available standards and therefore does not qualify as 'protective'. However, while tested and approved 'protective' clothing does offer protection, other clothing, that may not have been tested, may still offer riders some degree of protection in the event of a collision. More detail regarding the type of protective clothing available can be found in Appendix F.

Of the 94 fatalities, it was known that 3 riders wore no helmet and 2 riders wore a helmet which was not fastened. In 17 of the cases the helmet was displaced during the collision (18%). As part of the content analysis, information was collected on what protective clothing the motorcyclist was wearing. This information was collected from one of two sources, either from photographs taken at the collision scene or from police or witness statements which specifically mentioned clothing. In many cases this was unknown as shown in Table 5-5. When it was known what the motorcyclists were wearing, protective jackets and gloves were more often worn than not, while the reverse was true for protective trousers, boots, knee and elbow pads.

Table 5-5: Motorcyclist's protective clothing and visibility

Protective clothing worn:	Yes	No	Unknown	Total
Protective clothing:				
• Helmet	84	3	7	94
• Jacket	35	23	36	94
• Trousers	18	40	36	94
• Gloves	24	16	54	94
• Knee pads	2	19	73	94
• Elbow pads	2	16	76	94
• Boots	17	29	48	94
Visibility:				
• High Viz clothing	5	45	44	94
• Headlights on	25	7	62	94

5.1.1.4 The motorcycle

The make and model of the motorcycle was known for all 93 bikes and the engine size for 88 bikes. A TRL motorcycling expert was able to classify the bikes to a 'bike type' based on the style of the bike using the make and model information. The engine capacity was not used as a deciding factor since similarly styled motorcycles are available in a wide range of engine sizes, from mopeds to large capacity motorcycles which may only be ridden by full licence holders. A picture and description of each bike type is given in Section 2.4.1 (Figure 2-2). Table 5-6 shows the type of bikes involved in the collisions; almost half the sample were large engine sports bikes (43) and of these ten had an engine size of 1,000cc or greater, 15 were retro bikes with an engine size >500cc.

Table 5-6: Types of motorcycle by engine size in single vehicle collisions

Bike type	Engine size:				unknown	Total	%
	≤50cc	51-125cc	126-500cc	>500cc			
Scooter	3	12	2	0	2	19	20
Cruiser	0	1	0	0	0	1	1
Retro	0	2	2	15	1	20	22
Sports	0	0	1	43	1	45	48
Tourer	0	0	0	2	0	2	2
Trail	0	1	0	2	0	3	3
Unknown	0	1	0	1	1	3	3
Total	**3**	**17**	**5**	**63**	**5**	**93**	

The year of registration from the number plate for 89 of the motorcycles was used to estimate the age of the motorcycle (in years) at the date of the collision. From Figure 5-2 it can be seen that the majority of the scooters were 5 years or less while more than half of the sports and retro bikes were over 5 years old.

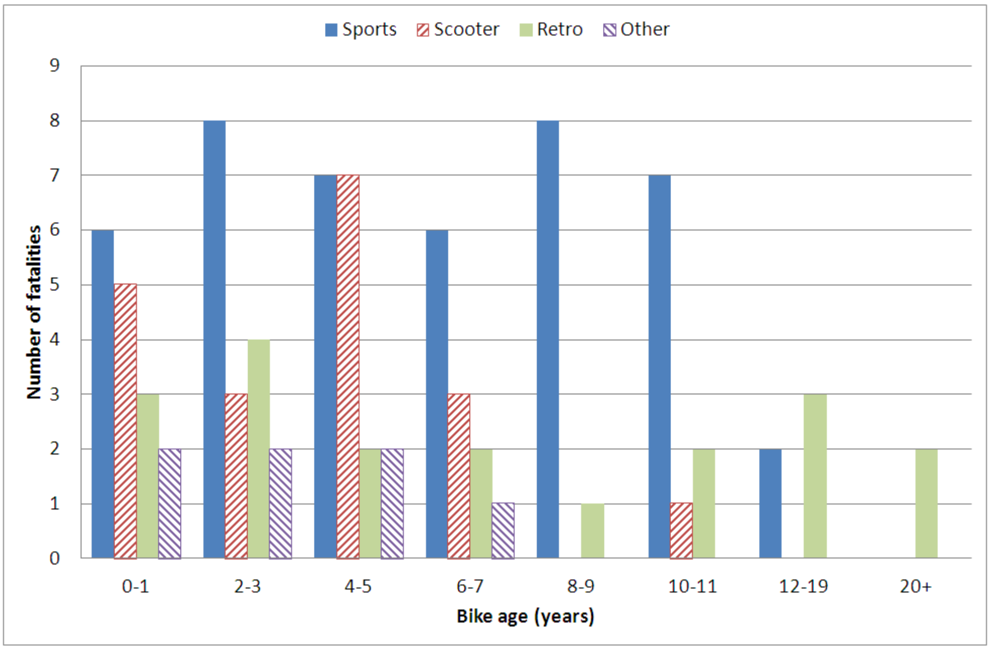


Figure 5-2: Age of motorcycle in years by bike type

Eleven motorcycles (12 fatalities) had at least one defect prior to the collision, 8 of which had defective tyres. The collision event is described in more details for this group of bikes in Section 6.2.9. The pre-event condition was described as good for 75 motorcycles.

5.1.2 Other vehicles and participants in the collision

5.1.2.1 The other vehicles involved

Twenty-nine of the collisions involved a single motorcycle (involving 30 motorcyclist fatalities), 64 were multi-vehicle collisions involving 71 other vehicles; 57 were two-vehicle collisions and 7 involved three vehicles. The vehicle types are shown in Table 5-7.

Table 5-7: Other vehicles involved in the collision

Other vehicle type	Number of other vehicles involved in the collision:		
	1	2	All
Car/taxi	39	5	44
Minibus	1	0	1
LGV	6	3	9
HGV	7	5	12
Coach/bus	2	0	2
Motorcycle	1	0	1
Mobile crane	0	1	1
Skip lorry	1	0	1
Total	**57**	**14**	**71**

The pre-event condition of the other vehicle involved was known for 64 vehicles and was described as ‘good’ in 60 cases. Four cars were recorded as having defects prior to the collision, the details of which can be seen in Table 5-8. Although one car had no defects, the MOT was out of date. It was known that 2 vehicles were not taxed out of the 40 for which information was given.

Table 5-8: The pre-event condition of the other vehicles involved in the collision

Pre-event condition of the other vehicle	Total
No defects – ‘good condition’	60
Defective brakes, & poorly inflated tyres (not thought to have contributed to the collision)	1
Front brakes showed an excessive imbalance (may have contributed to the collision)	1
Poorly inflated tyres	1
Tread on front tyre below legal limit, both dipped beams inoperative, handbrake poorly adjusted and ineffective, driver's seat belt not bolted to seat. (Driver received fines for these, but none of these contributed to accident)	1
Unknown	7
Total	**71**

5.1.2.2 The drivers of the other vehicles

There were 71 drivers of which 54 were male and 13 were female.

Table 5-9 presents the age distribution and Table 5-10 shows the ethnicity of these drivers.

Table 5-9: Driver age and gender distribution for the other vehicle

Age group of driver of other vehicle	Female	Male	Total
19-24	2	6	8
25-34	7	11	18
35-44	1	13	14
45-54	2	12	14
55-64	0	8	8
65+	0	4	4
Unknown	1	0	5[1]
Total	**13**	**54**	**71**

[1]Includes 4 unknown gender & age

Table 5-10: Ethnicity of the drivers of the other vehicles

Driver ethnicity	Total
White	27
Mixed	1
Asian or Asian British	6
Black or Black British	4
Chinese or other ethnic groups	0
Unknown	33
Total	**71**

Almost two-thirds (63%) of the drivers of the other vehicles involved in the collision lived in London, 15 were from inner London (21%) and 30 were from outer London (42%), 14 lived in other UK regions (20%) and 1 lived abroad. This is shown in Table 5-11 by vehicle type.

Table 5-11: Area of residence of the other drivers involved by vehicle type

Area of residence	Car / taxi[1]	LGV	HGV	Other	Total
Inner London	11	1	3	0	15
Outer London	21	3	3	3	30
UK – outside London	6	3	3	2	14
Non-UK	0	0	1	0	1
Unknown	7	2	2	0	11
Total	**45**	**9**	**12**	**5**	**71**

[1]Includes 1 minibus.

See table Table 3-3 for definitions of inner and outer London

Insurance information was known for 39 of the 71 other drivers and of these drivers, one did not have the appropriate insurance. Information on whether the driving licence was appropriate was found in the police reports for 56 drivers and of these 3 did not have the correct driving licence.

Table 5-12 shows the drivers' journey purpose by vehicle type. As would be expected, the drivers of the HGVs, LGVs and the other vehicles (consisting of buses/coaches, a skip lorry and a crane) were driving as part of their job. For the car drivers around a third of the known journeys were to and from work and a third were for leisure purposes. In total 19 of the drivers were regular commuters and 33 drivers were either familiar or very familiar with the route. Two drivers were unfamiliar with the route (17 unknown).

Table 5-12: Journey purpose by vehicle type

Journey purpose	Car/taxi[1]	LGV	HGV	Other	Total
Journey to/from work	11	0	0	0	11
Part of job	6	6	12	4	14
Leisure	13	0	0	1	28
Shopping	4	0	0	0	4
Other	1	0	0	0	1
Unknown	10	3	0	0	13
Total	**45**	**9**	**12**	**5**	**71**

[1]Includes 1 minibus

There was no evidence of alcohol or drug impairment in the police files of the other drivers. It was recorded that one car driver driving to work was impaired with fatigue and one with an illness or disability (their licence had been revoked due to memory loss). Evidence of driver distraction was also looked for and one driver was possibly distracted by their mobile phone and one driver had a distraction in their vehicle. However the majority, 53 drivers, were not distracted (distractions were not known for 16 drivers).

In a similar way to the motorcyclists, evidence was gathered from the police files regarding the conviction history of the other driver. Table 5-13 shows that 4 of the other drivers had previous convictions, 3 with previous driving offences and 1 with a criminal record.

Table 5-13: Conviction history of the other drivers

Conviction history	Total
Criminal record - court conviction(s)	1
DVLA offences only	3
No previous convictions	38
Unknown	29
Total	**71**

5.1.3 *The road environment*

5.1.3.1 *Infrastructure*

Road class, road type and speed limit at the location of the collision are presented in Table . Twenty-nine collisions were on a single A-road predominately with a 30mph speed limit (25), 22 collisions were on an A-road dual carriageway and 18 collisions were on minor C & unclassified roads with a 30 mph speed limit (2 collisions occurred in a 20mph speed limit). Traffic conditions were described as light to moderate in 52 locations and heavy in 18 locations (free flowing in 9 and stop-start in 9).

Table : Number of collisions by road class by speed limit

Road Class	Road Type	Speed limit					Total
		20mph & 30mph	40mph	50mph	60mph & 70mph	unknown	
Motorways (M & A(M))		0	2	3	2	0	7
A-roads	Dual	7	8	5	2	0	22
	Single	25	2	0	2	0	29
	One way	2	0	1	0	0	3
	Unknown	0	1	0	0	0	1
B-roads		7	0	0	0	0	7
C-roads & unclassified		18	0	0	0	0	18
Unknown		4	0	0	0	2	6
Total		**63**	**13**	**9**	**6**	**2**	**93**

The presence of other motor vehicles increases the risk of collisions especially when negotiating a junction. Over half of the collisions (55) were at a junction, 31 at a T/staggered junction, 8 at a crossroads and 6 on a slip road. However, given London's numerous junctions, it may be surprising to find that 37 collisions were not at a junction (almost 50% of these involved a single motorcycle).

Table 5-14: Junctions at the collision locations

Junction Detail	Total	%
Not at a junction (or within 20m)	37	40
T or staggered junction	31	33
Crossroads	8	9
Slip road	6	6
Mini roundabout	2	2
Private drive or entrance	2	2
Other junction	6	6
Unknown	1	1
Total	**93**	

5.1.3.2 Time, lighting weather and road surface

The distribution of fatalities by the month of the collision is shown in Figure 5-3. The number of fatalities per month varies from a low of 5 in November to 12 in July. However the marked summer peak and winter lows seen in the national figures are not seen as clearly in the London data, possibly because of the higher numbers of commuters using motorcycles to get to and from work throughout the year and lower levels of leisure riding (Jamson & Chorlton, 2004).

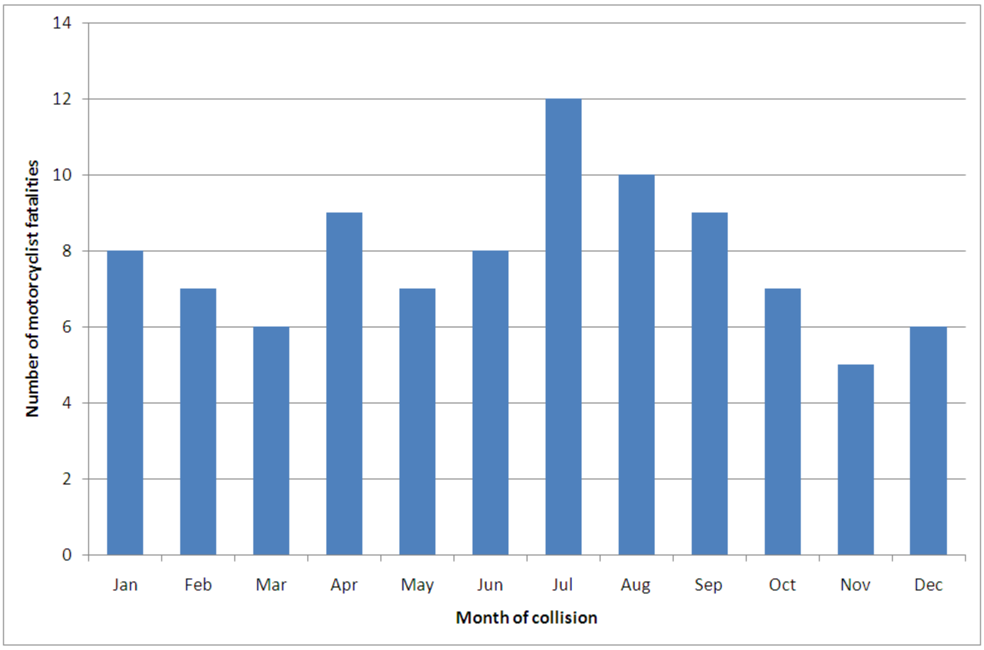


Figure 5-3: The number of motorcyclists killed by month

Figure 5-4 and Figure 5-5 show the number of motorcyclists killed by day of week and hour respectively. Thirty-three motorcyclists were killed at the weekend and 61 during the working week. On average there were more deaths at the weekend per day compared with a weekday (16.5 deaths per weekend day compared to 12.2 deaths per weekday). The number of fatalities peaked during the early evening (5pm-7pm) and was lowest in the early hours of the morning, when the level of motorcycle traffic is likely to be lower.

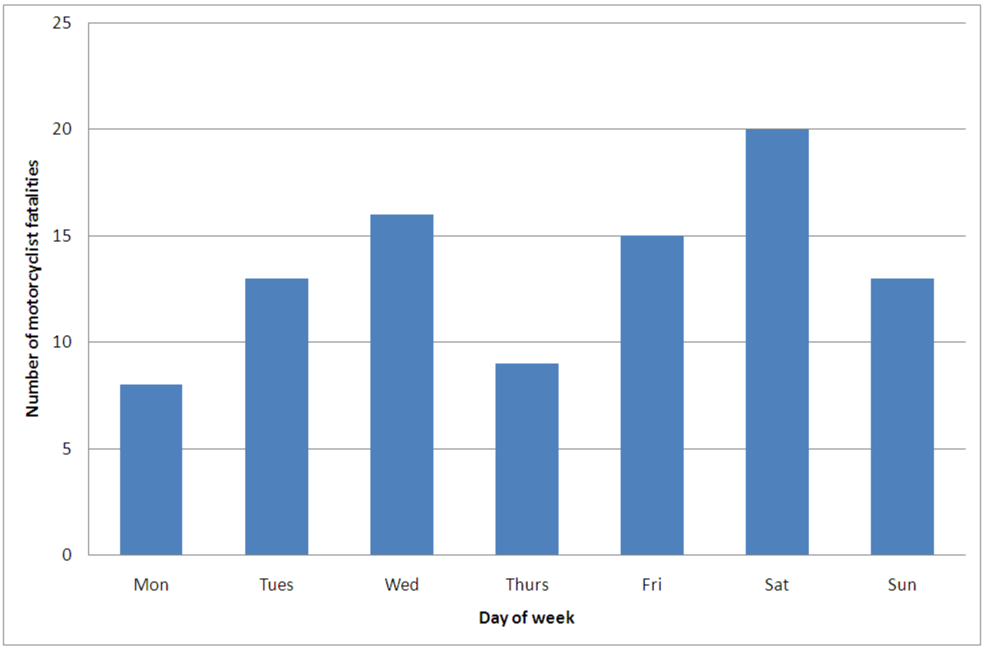


Figure 5-4: The number of motorcyclists killed by day of week

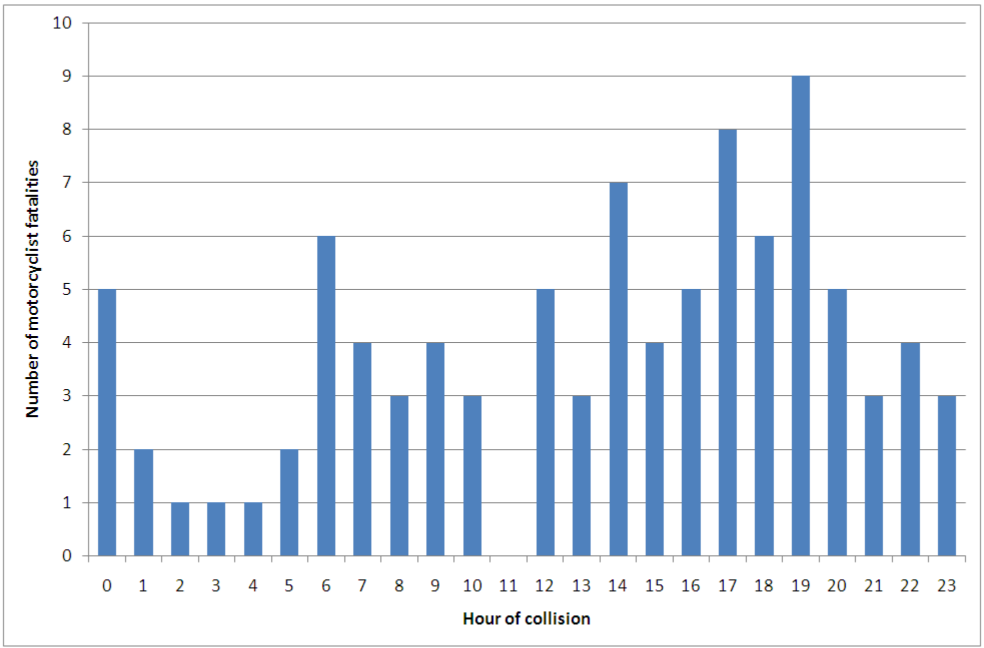


Figure 5-5: The number of motorcyclists killed by hour of collision

The light conditions were known for all the collisions; 52 (56%) were in the daylight and 35 were in darkness (38%). Of the 35 collisions in the dark 16 were known to have their headlight on and only 1 was recorded as not displaying a headlight (Table 5-15). In addition to the lighting, the weather conditions were also recorded. The majority of collisions were in dry conditions (84), 6 were in rain, 1 in snow and 1 in 'hazardous fog'.

Table 5-15: Light conditions at the time of the collision

Light conditions	Headlight on	Headlight off	Unknown	Total
Daylight	6	6	40	52
Dark	16	1	18	35
Dusk/dawn	3	0	3	6
Total	**25**	**7**	**61**	**93**

Motorcycles are particularly vulnerable to the design and condition of roads, with hazards such as pot holes, drain covers, uneven surfaces and poor resurfacing after road-works posing a potential danger to motorcyclists. Motorcycles are 'single track' vehicles and therefore at risk of becoming unstable and falling onto their side if a wheel loses adhesion to the road surface, particularly if the vehicle is taking a bend. Road markings generally have lower friction coefficients than asphalt, particularly when wet and if they also retain surface water. This can also increase stopping distances or cause instability. Oil and diesel spills on the road are also a hazard for motorcyclists. However, there was little evidence that these factors were present in many of the fatal collisions.

Table 5-16 shows that in 14 collisions the road surface was wet or damp, debris was present in 1 collision, oil/diesel was on the road in 1 collision, ironworks at 1 collision site and potholes were at 1 collision site. High friction surfacing was also present at 4 collision sites.

Table 5-16: Road surface conditions at the time of the collision

Road surface condition & site maintenance	Total
Road surface conditions	
• Dry	77
• Wet/Damp	14
• Unknown	2
Site maintenance	
• Debris	1
• Ironwork	1
• Oil or diesel	1
• Potholes	1
• None	81
• Unknown	8
High friction surfacing	
• yes	4
• no	35
• unknown	54
Total	**93**

5.2 The event

This section describes the types of conflicts and the main factors that were thought to have contributed to the collision. Section 6.2 presents an in-depth analysis of the main fatality groups identified in this section.

5.2.1 Conflict types

Each of the 93 motorcyclist collisions was classified into a conflict type. There were 12 possible types (labelled A-M) and within these up to 7 detailed conflict types (labelled 1-7). Table 5-17 shows the type of collisions that resulted in a motorcyclist fatality in London. See Appendix B.7 for detailed descriptions of the conflicts within each collision type group.

Table 5-17: Conflict types

	Collision type	Single vehicle collisions	Multi-vehicle collisions[1] involving a motorcycle and…				Total
			Car/taxi	LGV	HGV	Other	
A	Overtaking and lane change	4	6	1	3	2	16
B	Head on	0	4	0	0	0	4
C	Lost control or off road (straight roads)	16	4	0	0	0	20
D	Cornering (bends)	9	1	0	0	0	10
E	Collision with obstruction	0	2		1	0	3
F	Rear end	0	3			2	5
G	Turning versus same direction	0	1	1	3	0	5
H	Crossing (no turns)	0	1	1	0	0	2
J	Crossing (vehicle turning)	0	6	1	0	0	7
K	Merging	0	3	1	0	0	4
L	Right turn against	0	9	0	1	0	10
M	Manoeuvring	0	4	2	1	0	7
Total		**29**	**44**	**7**	**9**	**4**	**93**

[1]This category includes 7 three vehicle collisions which have been grouped according to the first 'other' vehicle hit.

The most common collision type involving a single motorcyclist was loss of control on straight roads, whilst for motorcycle collisions involving another vehicle the most common collision types involved a right turn (L2 'right turn against' and J1 'right turn right side' in Table 5-17). Table 5-18 presents the ten most frequent conflict types for collisions involving a motorcyclist and at least one other vehicle. Loss of control (A4, B5, C1, C2, C3, D1 D2) and right turn conflicts (L2, J1, K2) are discussed in more detail in Sections 6.2.2 and 6.2.8 respectively.

Table 5-18: The ten most frequent conflict types for multi-vehicle collisions

	Conflict type	Multi-vehicle collisions involving a motorcycle and…				
		Car/taxi	LGV	HGV	Other	Total
	L2 - Right turn against	9	0	1	0	10
	J1 - Right turn right side	6	1	0	0	7
	A4 - Lost control overtaking	2	1	1	1	5
	C1 - Out of control on roadway	4	0	0	0	4
	F1 - Rear end -slow vehicle	3	0	0	1	4
	K2 - Merging – right turn in	3	1	0	0	4
	M1 - Parking or leaving	3	0	1	0	4
	B5 - Head on – lost control on straight	3	0	0	0	3
	A7 - Weaving in heavy traffic	0	0	2	0	2
	A2 - Head on - overtaking	1	0	0	1	2

5.2.2 *Motorcyclist trajectory*

Table 5-19 shows the trajectory of the motorcyclist following the collision. The most common trajectories were that the motorcyclist rolled or skidded from the point of impact to the point of rest or second impact or that the motorcyclist stopped within 2 metres of the point of impact. Eighteen motorcyclists were thrown from their bikes on impact and 6 were run over by another vehicle.

Table 5-19: Motorcyclist fatalities by motorcyclist trajectory

Motorcyclist trajectory	Total
Stopped at or within 2m of point of impact	14
Rolled/skidded from point of impact to point of rest/2nd impact	21
Vaulted above ride height to point of rest/2nd impact	6
Knocked to ground - not run over	4
Not thrown but run over	1
Thrown forwards - then run over	1
Thrown over top of vehicle	7
Thrown to side of vehicle	3
Thrown/knocked forwards - then run over	1
Thrown/knocked to side of vehicle	6
Run over but throw not known	3
Other	1
Unknown	26
Total	**94**

5.2.3 Contributory factors

The contributory factors in a road collision are the key actions and failures that may have led to the collision. As part of the content analysis the researchers considered the evidence contained in the files and assigned up to six contributory factors to any of the vehicles or casualties involved, based on the STATS19 system. It is important to note that the contributory factors assigned are based on the researcher's opinion after a detailed examination of the police file and this does not necessarily mean that the motorcyclist or other road user was responsible or to blame for the collision.

The following analyses are based on 57 two-vehicle collisions, involving one motorcycle and one other vehicle. There are three possible outcomes:

- At least one Contributory Factor was attributed to the motorcyclist and none were attributed to the driver/rider of the other vehicle; this accounted for 20 collisions.
- At least one Contributory Factor was attributed to the driver/rider of the other vehicle and none were attributed to the motorcyclist; this accounted for 9 collisions.
- At least one Contributory Factor was attributed to the motorcyclist and to the driver/rider of the other vehicle driver/rider; this accounted for 28 collisions.

Table 5-20: Attribution of contributory factors in two vehicle collisions by vehicle type

Factors attributed to:	Other vehicle involved				All
	Car / taxi[1]	LGV	HGV	Other[2]	
Motorcyclist	13	3	1	3	20
Other driver	7	1	1	0	9
Both	20	2	5	1	28
Total	**40**	**6**	**7**	**4**	**57**

[1] Includes 1 minibus

[2] Other includes 2 buses/coaches, 1 motorcycle, 1 skip lorry

It was of interest to investigate which Contributory Factors were attributed to the motorcyclists and also to the other people involved in these collisions. The coding system used includes 76 Contributory Factors. Table 5-21 shows the ten contributory factors most frequently attributed to the motorcyclists. 'Exceeding the speed limit' was the most commonly attributed factor for the motorcyclists riding bikes with an engine size over 500cc, reported in 29 out of 39 collisions. The motorcyclists riding the smaller bikes (engine size ≤ 500cc) had a combination of commonly reported factors: 'exceeding the speed limit', 'careless, reckless or in a hurry' and 'learner or inexperienced rider'.

Table 5-21: The ten most frequently recorded contributory factors attributed to the motorcyclist in two vehicle collisions by motorcycle engine size

Frequency of contributory factors	Engine size ≤500cc	Engine size >500cc	All engine sizes[1]
Exceeding speed limit	4	23	29
Careless, reckless or in a hurry	4	4	8
Learner or inexperienced rider	4	4	8
Poor turn or manoeuvre	1	5	6
Loss of control	1	5	6
Sudden braking	0	5	6
Failed to judge other person's path or speed	0	6	6
Failed to look properly	2	3	5
Travelling too fast for conditions	0	4	4
Unfamiliar with model of vehicle	1	3	4
Number of collisions	***16***	***39***	***57***
Number of riders with CFs	**10**	**36**	**48**
Average number of CFs per rider	***2.2***	***2.4***	***2.4***

[1] Includes 2 cases where the engine size was unknown.

Table 5-22 shows the ten contributory factors most frequently attributed to the other driver. ‘Failed to look properly’ and ‘poor turn or manoeuvre’ were the most frequently recorded factors closely followed by ‘failed to judge the other person’s path or speed’. These three factors appeared in the same order for drivers of cars, LGVs and HGVs. Eight of each of the collisions with ‘failed to look properly’ or ‘failed to judge other person’s path or speed’ as a factor for the other vehicle also had ‘exceeding speed limit as a contributory factor for the motorcyclist. Another person’s path or speed may be easy to misjudge, when that other person is exceeding the speed limit.

Table 5-22: The ten most frequently recorded contributory factors attributed to the other driver / rider in two vehicle collisions by other vehicle type

Frequency of contributory factors	Car / taxi[1]	LGV	HGV	Other	All
Failed to look properly	16	2	4	0	22
Poor turn or manoeuvre	16	1	2	0	19
Failed to judge other person's path or speed	12	1	0	0	13
Exceeding speed limit	2	0	0	1	3
Sudden braking	2	0	0	1	3
Careless, reckless or in a hurry	3	0	0	0	3
Road layout (e.g. bend, hill, narrow carriageway)	2	0	0	0	2
Junction restart (moving off at junction)	1	0	1	0	2
Vehicle blind spot	1	0	1	0	2
Defective brakes	1	0	0	0	1
Number of collisions	***40***	***6***	***7***	***4***	***57***
Number of drivers with CFs	***27***	***3***	***6***	***1***	***37***
Average number of CFs per driver	***2.3***	***1.3***	***1.8***	***2.0***	***2.1***

[1]Includes 1 minibus

Whilst the presence of other motor vehicles certainly increases the risk of collisions, it should be noted that almost a third of the fatalities occurred when there was no involvement of another vehicle (30 fatalities including 1 passenger). Table 5-23 lists the ten factors recorded most frequently in single motorcycle collisions by the age of the motorcyclist.

Table 5-23: The ten most frequently recorded contributory factors attributed to the motorcyclist in single vehicle collisions by age of the motorcyclist

Frequency of contributory factors	Aged <25	Aged 25-34	Aged 35+	All ages
Loss of control	4	11	6	21
Exceeding speed limit	4	11	3	18
Impaired by alcohol	2	4	2	8
Learner or inexperienced driver/rider	4	1	1	6
Poor turn or manoeuvre	2	2	1	5
Tyres illegal, defective or under inflated	0	2	2	4
Sudden braking	1	3	0	4
Careless, reckless or in a hurry	3	1	0	4
Poor or defective road surface	0	2	1	3
Travelling too fast for conditions	1	1	1	3
Number of riders with CFs	**8**	**13**	**8**	**29**
Average number of CFs per rider	***3.6***	***3.3***	***2.9***	***3.3***

The reported contributory factors for single motorcyclist collisions differed from collisions with another vehicle with the most frequently recorded factor being 'loss of control', recorded in 21 of the 29 collisions. Similar to the two-vehicle collisions 'exceeding the speed limit' frequently contributed to the collisions (contributing to 18 of the 29 collisions). There were 18 collisions with factors 'exceeding the speed limit' and 'loss of control'. 'Impaired by alcohol' is a factor that affects single motorcyclist collisions (contributing to 8 of the 29 collisions) and yet did not appear in the top 10 factors for two-vehicle collisions.

5.3 Post event

This section describes the post-event, namely the injuries to the motorcyclist, the post event condition of the vehicles and whether there were any convictions of the other participants involved.

5.3.1 The motorcyclists' injuries

The majority (80) of the motorcyclists died on the same day as the collision, 9 died 1-3 days later and 5 died more than 6 days later.

The injuries of each motorcyclist were coded based on the post mortems, where available, using the Abbreviated Injury Scale (AIS). The AIS scale uses a scoring system for each body region, where 0 is uninjured and 6 is the maximum severity score. Scores of 3 or above are described as 'life threatening'.

Post mortems were available and coded for 86 motorcyclist fatalities. In total 1,240 injuries were coded, of which 339 were 'life threatening' (AIS >=3). Figure 5-6 shows the percentage of motorcyclists with life threatening injuries for each body region. 'Head' includes neck and face.

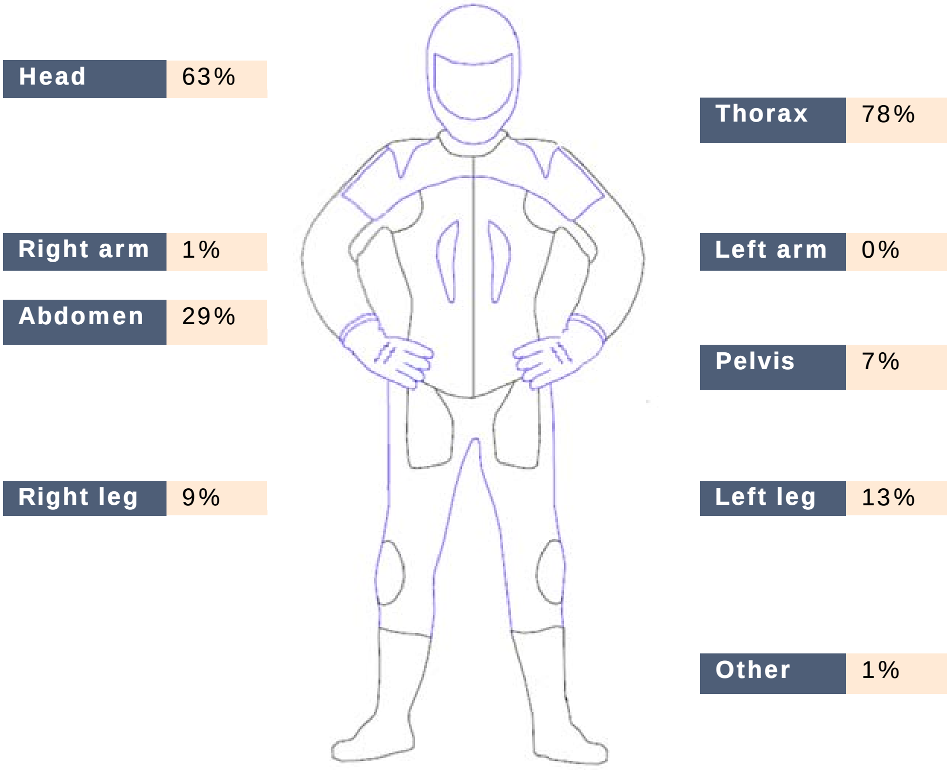


Figure 5-6: Motorcyclist body regions with AIS >=3

The most common body region with life threatening injuries was the thorax (chest), with over three-quarters (78%) of motorcyclists having a life threatening injury to this area. The second most common was head injuries (63%). Forty-four motorcyclists (51%) had life threatening injuries to both the head and thorax. The number of fatalities with life threatening injuries to different combinations of body regions is shown below.

Table 5-24: Motorcyclist AIS>=3 combinations

Injury pattern	Head	Thorax	Abdomen	Pelvis	Limbs	Other	Total
Head, Thorax	27	27					27
Thorax		10					10
Head, Thorax, Abdomen	9	9	9				9
None							5
Thorax, Abdomen		4	4				4
Head	5						5
Abdomen			3				3
Head, Thorax, Limb	3	3			3		3
Thorax, Limb		3			3		3
Head, Thorax, Abdomen, Limb	4	4	4		4		4
Head, Limb	3				3		3
Thorax, Abdomen, Limb		2	2		2		2
Thorax, Pelvis, Limb		2		2	2		2
Head, Thorax, Abdomen, Other	1	1	1			1	1
Thorax, Pelvis		1		1			1
Pelvis, Limb				1	1		1
Head, Pelvis, Limb	1			1	1		1
Head, Abdomen	1		1				1
Thorax, Abdomen, Pelvis		1	1	1			1
Total	**54**	**68**	**25**	**6**	**19**	**1**	**86**

Although there were cases with life-threatening injuries to arms or legs, all of these cases also involved other life-threatening injuries, often to the head or thorax.

The Injury Severity Score (ISS) is based on the AIS coding and is used to assess trauma severity. The score is calculated as the sum of the squares of the highest three AIS scores by body region, except where a body region scores has an AIS of 6, in which case, the ISS is the maximum of 75. The maximum score of 75 (AIS 6 for at least one body region or three AIS 5 scores) is often classed as ‘untreatable’ or ‘un-survivable’. A score of 15 and above is sometimes used to define ‘major trauma’. Table 5-25 shows the injury severity scores for the motorcyclists. Seventy-five motorcyclists had injuries that could be described as ‘major trauma’ (87%) (ISS>=15), of which 13 (14%) had injuries that were ‘untreatable’ (ISS=75).

Table 5-25: Injury severity scores

Injury severity score	Total	%
4-14	10	12%
15-29	32	37%
30-66	30	35%
75	13	15%
unknown	1	1%
Total	**86**	

5.3.1.1 Collisions resulting in untreatable injuries

There were 13 motorcyclists with an ISS of 75. In all of these cases one body region had an AIS score of 6. Ten cases had an AIS score of 6 for head injuries, 4 cases had an AIS score of 6 for thorax injuries (including two which had AIS 6 for both head and thorax injuries).

Analysis of the conflict types for the motorcyclists with an ISS score of 75 showed that 4 of the collisions involved loss of control and 5 involved another vehicle turning across the motorcyclist's path.

Seven of the 13 motorcyclists with these injuries were speeding.

Twelve of the motorcyclists were wearing helmets (1 was unknown) and three of the helmets were displaced in the course of the collision.

5.3.1.2 Injuries by conflict type

Table 5-26 shows the number of motorcyclists with life-threatening injuries to each body region for each conflict type. Thorax injuries were the most common injury for all collision types except manoeuvring conflicts where the head was more commonly injured. Life-threatening injuries to the head were less common in head-on and merging conflicts. Life-threatening leg injuries were more common in head-on and rear-end collisions.

Table 5-26: Number of motorcyclists with AIS>=3 by conflict type

Conflict type		Fatalities with post mortem data	Head	Thorax	Abdomen	Pelvis	Right arm	Left arm	Right Leg	Left leg	Other
A	Overtaking and lane change	12	8	9	3	2	0	0	1	1	0
B	Head on	8	3	7	2	1	0	0	3	1	0
C	Lost control	19	14	16	6	0	1	0	1	2	0
D	Cornering	6	4	5	1	0	0	0	0	0	0
E	Collision with obstruction	3	2	3	0	0	0	0	0	0	0
F	Rear end	6	4	4	2	0	0	0	0	2	0
G	Turning versus same direction	5	2	5	3	2	0	0	0	1	0
H	Crossing (no turns)	1	1	0	0	0	0	0	0	0	0
J	Crossing (vehicle turning)	4	3	3	1	0	0	0	0	0	1
K	Merging	3	1	3	1	0	0	0	0	0	0
L	Right turn against	14	9	11	5	1	0	0	3	3	0
M	Manoeuvring	4	3	1	1	0	0	0	0	1	0
Q	Miscellaneous	1	0	0	0	0	0	0	0	0	0
Total		**86**	**54**	**67**	**25**	**6**	**1**	**0**	**8**	**11**	**1**
Loss of Control		**32**	**22**	**26**	**9**	**2**	**1**	**0**	**3**	**3**	**0**
Turning across path		**17**	**11**	**13**	**6**	**1**	**0**	**0**	**3**	**3**	**1**

5.3.1.3 Helmets displaced in collision

There were 17 casualties whose helmets were displaced during the collision. There were no discernible differences between these casualties and those whose helmets stayed on, with respect to rider age, type of motorcycle, licence type, experience of riding, impairment or compliance with the speed limit.

The mechanisms which caused the helmets to be displaced in the collisions are not well understood. We hypothesise that the helmets came off because:

- they were not a good fit for the rider, they were loose or too big for the rider; or
- the strap was not fastened or was not tightened enough; or
- the impact forces were so severe they forced the helmet off either by distorting the helmet or the head or both.

It was not known from this dataset whether certain types of riders are more prone to have poor fitting helmets or to not fasten straps. Equally, the pre-impact condition of the helmets was unknown, either for those which that stayed on or that came off and this could have been an important factor for a number of riders. Helmets vary significantly in their protective performance, which often deteriorates as they age. For the riders whose helmets were displaced, 16 cases had post mortem data available for analysis.

Table 5-27: Injury severity scores for fatalities whose helmet was displaced

Injury severity score	Total
4-14	1
15-29	5
30-66	7
75	3
Total	**16**

Table 5-28: Body regions with life-threatening injuries (AIS $\geq$ 3) for fatalities whose helmet was displaced

Body region	Total
Head	10
Thorax	14
Abdomen	4
Pelvis	1
Right arm	0
Left arm	0
Right leg	2
Left leg	1
Other	0

All 10 of the fatalities with life-threatening head injuries also had life-threatening thorax injuries. There were five riders whose head injuries were the most severe or were equal to the most severe AIS injury.

- One of these riders lost his helmet due to massive crushing injuries under the wheels of a large vehicle and no helmet improvement or intervention would have prevented the fatal outcome in this case.
- The remaining four casualties could have benefitted from better helmets. However, because the helmet displacement mechanisms were not understood and the subsequent timing and magnitude of the head impacts with and without the helmet in place were not known. Therefore it is not possible to say any more than that these riders 'may' have benefitted from a better helmet.

The fact that 17 helmets came off during the collisions (18% of the collisions in this study) is enough evidence to start to investigate further how riders acquire their helmets and maintain them. Are riders aware of the importance of helmet selection and to ensure a correct fit, both for comfort (a tight helmet can cause considerable discomfort) and safety (a loose helmet may leave the rider's head during a crash)?

5.3.1.4 Personal Protective Equipment

There is just one legally-required item which must be worn by all motorcyclists: a helmet meeting the appropriate legislation. All other items are used at the rider's discretion;

often, items of clothing used by motorcyclists will not be manufactured specifically for motorcycling.

The severe and life threatening injuries sustained by the motorcyclists in this study were predominantly a result of blunt impact trauma. It was not possible to assess whether better PPE would have mitigated or even prevented the thoracic injuries within the scope of this study. Indeed, to begin to address these questions would require a case-by-case forensic biomechanical reconstruction of the impacts and forces for each casualty to begin to outline where PPE equipment may have been beneficial. There are many unknowns, not least a lack of knowledge of the precise impact forces and the effectiveness of commercially available PPE in real world impacts that would need to be overcome before this work could be taken forward.

Although there were some friction related injuries caused by the rider sliding along the road surface, where better or improved clothing and/or protective devices could have prevented skin to road surface contact, it is unlikely that these measures would have had a significant effect on the injury outcome of these casualties.

In summary, the potential for PPE to have provided additional protection and mitigated injury for these casualties is believed to be low, principally because of the high severity of the collision forces. However, that is not to say that PPE would not offer significant benefits for motorcyclists involved in non-fatal accidents, where the forces are lower and the potential to prevent impact and friction related trauma is greater.

5.3.2 *The condition of the vehicles following the collision*

Information, where available, on the condition of the vehicles after the collision was collected from the files. In 14 collisions the motorcycle was known to be not useable following the collision and usable in 9 cases (unknown for 70). Sixty-four collisions were multi-vehicle collisions involving 71 other vehicles. Of the 71 other vehicles only 1 car was known to be not usable following the collision (Table 5-29).

Table 5-29: Post event condition of the other vehicles involved in the collision, by vehicle type

Was the vehicle drivable following the collision?	Car/taxi	LGV	HGV	Other	Total
Yes	26	5	7	2	40
No	1	0	0	0	1
Unknown	18	4	5	3	30
Total	**45**	**9**	**12**	**5**	**71**

5.3.3 *The environment following the collision*

In 70 cases the road was closed following the collision contributing to additional congestion and delay, in three cases the road was not closed.

5.3.4 Convictions of the other drivers as a result of the collision

Almost a quarter of the drivers of other vehicles involved (17 of 71) were convicted of driving offences following the collision. The majority of these drivers were convicted of one offence (14). Table 5-30 shows the most frequently recorded type of offence was careless driving.

Table 5-30: Type of conviction of the other drivers following the collision

Convictions	Car / taxi	LGV	HGV	Other	Total
Careless driving	9	0	0	0	9
Dangerous driving	0	1	0	1	2
Other motoring offences	2	0	1	0	3
Dangerous & other motoring offences	1	0	0	0	1
Careless driving , dangerous driving & other motoring offences	1	0	0	0	1
Multiple offences (including careless and dangerous driving, drink driving and speeding)	1	0	0	0	1
Total	**14**	**1**	**1**	**1**	**17**

6 Interventions for motorcyclist safety

The overall aim of this study is to provide a better understanding of how fatal motorcycle collisions in London occur and could be prevented. Two approaches have been taken to describe the interventions identified:

- **Countermeasures:** A 'top-down' summary of the overall countermeasures for all the collisions investigated by the study (Section 6.1); and
- **In-depth analysis of fatality groups:** A breakdown of the different collision types or themes that were identified as being relatively common for the motorcyclist fatalities (Section 6.2).

The 'top-down' approach provides a broad overview of the common countermeasures identified, which by their nature are intrinsically linked to the contributory factors.

Because the collisions are complex events, the in-depth analysis of fatality groups provides more contextual descriptions of their characteristics. The groups described **are not** mutually exclusive, and the overlaps are explicitly summarised in Section 6.2, Table 6-5.

6.1 Countermeasures

Countermeasures aimed at preventing the collision from occurring (primary countermeasures) and aimed at reducing the severity of the collision (secondary countermeasures) were proposed for each collision based on evidence contained in the fatal files. Because the amount of evidence in each file varied an indication of whether the countermeasure would have prevented the collision or fatal injury was also given, described as 'likely', 'probably' or 'maybe'. The interventions have been grouped into three categories; those related to engineering, education (including training and publicity) and enforcement.

It should be remembered that collisions and their outcomes are determined by multiple factors. The proposed countermeasures may address one of these factors but may not always be effective in preventing the collision. The effectiveness of each countermeasure has not been assessed. Those riders that were breaking the law or not following The Highway Code may not be affected by some of the countermeasures, for example, speed warning system or improved training.

Table 6-1 shows the number of fatalities with each type of countermeasure. The countermeasures are grouped by type; for example if a collision had two countermeasures that were motorcyclist education, this is only counted once in the table below.

Overall, primary countermeasures were coded more frequently than secondary measures. The most frequent types of factors were educational measures aimed at the motorcyclist, enforcement and vehicle engineering measures.

Table 6-1: Number of fatalities by proposed countermeasure types

Countermeasure type		Number	% of fatalities
Primary	Engineering - environment	9	10%
	Engineering - vehicle	46	49%
	Education - motorcyclist	63	67%
	Education - drivers	18	19%
	Enforcement	48	51%
Secondary	Engineering - environment	1	1%
	Engineering - vehicle	11	12%
	Education - motorcyclist	9	10%
	Enforcement	9	10%

The link between what is readily available now (i.e. enforcement), albeit may require additional resourcing, and what would have to be technically developed (i.e. Intelligent Speed Assistance, ITS etc.) needs to be considered. Therefore, the countermeasures could be further classified as short, medium and long term. Equally the overall effectiveness of any given countermeasure needs to be evaluated before its potential can be quantified.

Table 6-2 shows the number of fatalities in collisions with individual primary countermeasures in each category, by whether they were coded as 'likely', 'probably' or 'maybe'. For each countermeasure type these are likely to sum to greater than the totals given in the above table since some collisions had multiple countermeasures of the same type.

Table 6-2: Number of fatalities in collisions with each primary countermeasure

	Code	Countermeasure	'Likely'	'Probably'	'Maybe'	Total
Engineering - environment	111	Proposed changes to junction layout	2	2	3	7
	112	Improve the condition of the road surface	0	0	1	1
	114	Introduce warning signs of poor/changes in road surface	0	0	1	1
Engineering - vehicle	121	Improve visibility of motorbike (e.g. high-vis/bright colours, headlamps, striplights)	0	0	5	5
	122	Intelligent Speed Assistance - Advice or warning systems	1	14	17	32
	123	Improved braking systems for motorcycles (e.g. ABS, enhanced braking, autonomous braking)	1	6	14	21
	124	Other veh driver's view of road (inc. obscuration due to width of A-pillar	0	0	3	3
	125	External mirror placement to ensure driver's vision is not obscured	0	1	1	2
	126	ITS (such as radar)		5	2	7
Education - motorcyclist	131	Additional motorcyclist training to improve riding skill	1	6	25	32
	132	Improved motorcyclist conspicuity (high-vis/fluorescent clothing)	0	1	8	9
	133	Riding whist fatigued	0	0	3	3
	134	Riding whist impaired	3	2	10	15
	135	Roadworthiness of motorcycle	1	2	5	8
	136	Dangers of tampering	0	1	1	2
	137	Work related road safety training	0	1	1	2
	138	Greater motorcyclist awareness of other vehicles	1	3	9	13
	139	Changing driving/riding behaviour that affect motorcyclists safety	0	0	3	3
Education - drivers	141	Improved driver awareness of motorcyclists	1	4	11	16
	142	Driving whilst impaired	0	0	1	1
	143	Roadworthiness of vehicle		1	1	2
Enforcement	152	Speed enforcement to increase speed limit compliance	1	10	17	28
	153	Drinking and driving/riding	6	2	2	10
	154	Driving/riding without a licence/uninsured	3	6	11	20
	155	General traffic law enforcement	0	0	4	4

The most common vehicle engineering primary countermeasures were Intelligent Speed Assistance and improved braking systems. However, it must be borne in mind that this is directly related to the high frequency of speed as a contributory factor (Section 5.2.3); and when interpreting these findings, the speed systems were defined as generic functions as opposed to specific ones with performance criteria, and therefore the specific effectiveness is unknown.

The most commonly occurring countermeasures that could have prevented the fatal collision occurring were educational and enforcement (see table below). Examples of these countermeasures include:-

- Speed warning systems
- Speed enforcement to increase speed limit compliance
- Additional motorcyclist training to improve riding skill
- Improved braking systems for motorcycles

The secondary countermeasures were recorded less frequently than the primary measures, in part because of the nature of these collisions, which often involved high speeds and therefore were often beyond the scope of the effectiveness of most secondary safety measures, for example personal protective equipment (PPE). This was evidenced in Section 5.3.1, 'The motorcyclists' injuries'. Those that were recorded are shown in Table 6-3. The most commonly recorded were 'introduce air bags for motorcycles' and 'speed enforcement', recorded in 9 and 8 cases respectively.

Table 6-3: Number of fatalities in collisions with secondary countermeasures

		Countermeasure	'Likely'	'Probably'	'Maybe'	Total
Engineering - environment	211	Removal of unnecessary crash barriers	0	1	0	1
Engineering - vehicle	221	Alternative design of motorcycle (e.g. roll-over bars, roofs)	0	0	1	1
	222	Dynamic suspension to reduce 'front end dive' of the motorcycle under heavy braking conditions	1	0	0	1
	223	Introduce airbags for motorcycles	0	2	7	9
Education - motorcyclist	231	Use of helmets	0	2	1	3
	232	fit side-guards to HGV	0	1	1	2
	233	Use of protective clothing (jackets, trousers, gloves etc.)	0	1	3	4
	234	PPE - back protector	0	0	1	1
Enforcement	251	Helmet use	0	0	1	1
	252	Speed enforcement	0	4	4	8

The countermeasures recorded for various groups of fatalities are considered in the next section.

6.2 In-depth analysis of fatality groups

The sections that follow identify the interactions between the casualty, the vehicle and the environment for subsets of the sample along with the appropriate countermeasures. These subsets were identified by experts as part of the analysis as being common groups, or groups that are of special interest.

Table 6-4 gives a summary of the collision types considered, the definitions used and the number of motorcyclist fatalities in each type.

Table 6-4: Collision types, definitions and number of casualties

Collision type	Definition	Number of motorcyclist fatalities	%
Exceeding speed limit	Based on estimated travelling speed	45	48%
Loss of control*	Conflict types A4, A6, B5, B6, C1, C2, C3, D1, D2	42	45%
Single vehicle	Number of vehicles = 1	30	32%
Turning across motorcycle path*	Conflict types J1, K2, L2	21	22%
Inexperienced	Less than 1 year riding experience	18	19%
Previous convictions	Criminal record, DVLA offences, youth offender	17	18%
Involving alcohol or drugs	Based on whether there was evidence in the file to suggest that the motorcyclist was impaired	15	16%
ISS 75	Those fatalities with a Injury Severity Score of 75 (untreatable)	13	14%
Unlicensed	No licence	12	13%
Motorcycle defects	Pre-event defects present	12	13%
Stunts	Wheelies	5	5%

Note:* See Table 5-17 for explanation of conflict types.

The subsets of the sample overlap and an individual collision may be included in more than one section. For example a single vehicle collision involving an inexperienced rider who lost control would appear in Section 6.2.1 (single vehicle collisions), Section 6.2.2 (loss of control collisions) as well as Section 6.2.5 (inexperienced riders).

Table 6-5 gives the number of motorcyclist fatalities by combination of collision type. For example, there were 28 fatalities in single vehicle collisions; 13 of these involved exceeding the speed limit and 27 involved a loss of control conflict. Note that some of these 'loss of control' collisions may have also involved exceeding the speed limit, but this is not shown in the table.

Table 6-5: Number of motorcyclist fatalities by combination of collision type

	Total	Single vehicle	Exceeding speed limit	Loss of control conflict	Turning across motorcycle path conflict	Inexperienced	Unlicensed	Involving alcohol or drugs	Motorcycle defects	Stunts	Previous convictions	ISS 75
Single vehicle	**28**	**28**	13	27	0	6	3	9	8	2	4	2
Exceeding speed limit	**45**	15	**45**	22	13	10	7	7	2	3	8	7
Loss of control	**42**	29	22	**42**	0	8	4	11	8	3	7	5
Turning across motorcycle path	**21**	0	13	0	**21**	4	5	1	4	1	5	5
Inexperienced	**18**	6	10	8	4	**18**	1	4	1	1	1	3
Unlicensed	**12**	4	7	4	5	1	**12**	3	2	0	6	1
Involving alcohol or drugs	**15**	9	7	11	1	4	3	**15**	2	0	4	1
Motorcycle defects	**12**	7	2	8	4	1	2	2	**12**	1	2	1
Stunts	**5**	2	3	3	1	1	0	0	1	**5**	2	1
Previous convictions	**17**	5	8	7	5	1	6	4	2	2	**17**	0
ISS 75	**13**	2	7	5	5	3	1	1	1	1	0	**13**
Total	**94**	**30**	**45**	**42**	**21**	**18**	**12**	**15**	**12**	**5**	**17**	**13**

6.2.1 Single vehicle collisions

There were 30 motorcyclist fatalities from 29 collisions that did not involve another vehicle; 29 were male and one was female (it was not known whether the female was a passenger or the driver). Over half (57%) of the single motorcycle collisions were aged between 21 and 35, compared to 48% of motorcyclist fatalities in multi-vehicle collisions, as shown in Table 6-6.

Table 6-6: Age distribution of motorcyclist fatalities in collisions by number of vehicles involved

Fatality age	Single vehicle	Multi vehicle	Total	
<16	1	1	2	50%
16-20	4	9	13	31%
21-25	5	13	18	28%
26-30	6	8	14	43%
31-35	6	10	16	38%
36-40	2	7	9	22%
41-45	3	7	10	30%
46-50	1	8	9	11%
51-55	0	1	1	0%
56-60	2	0	2	100%
Total	**30**	**64**	**94**	**32%**

The most common type of bikes involved in single motorcyclist collisions were the powerful bikes with an engine size greater than 600cc, these were predominately sports bikes (Table 6-7). These bikes are able to be ridden at high speeds and ‘exceeding the speed limit’ was a contributory factor in 18 of the 29 collisions (see Table 5-23)

Table 6-7: Types of Motorcycle by engine size in single vehicle collisions

Bike type	Engine size:				unknown	Total
	125cc	172cc	600-955cc	1000cc and over		
Retro	1	0	3	1	0	5
Scooter	3	1	0	0	1	5
Sports	0	0	10	4	0	14
Tourer	0	0	1	1	0	2
Trail	1	0	0	0	0	1
Unknown	0	0	0	1	1	2
Total	**5**	**1**	**14**	**7**	**2**	**29**

The level of experience was known for half of the single vehicle collisions, and 6 were described as having less than one year of experience on the road. Table 6-8 shows the type of licences held by the motorcyclists, 4 had no licence and 5 held a provisional licence. The motorcyclists' inexperience was recorded as being a contributory factor in 6 of the single vehicle collisions (see Table 5-23).

Table 6-8: The type of licence held by the motorcycle rider in the single vehicle collisions

Type of licence held	Frequency
Full motorcycle licence	16
Provisional motorcycle licence	5
No licence	4
Unknown	5
Total	**30***

Note: *This total of 30 includes both the rider and passenger from one collision; it was unknown which fatality was the rider and which was the passenger.

Almost two thirds of these collisions were not at a junction (19), and in light traffic (17). The journey purpose was known for 17 of the riders, of which 12 were riding for pleasure and one was riding for shopping. Four were on their journey to and from work and it follows that half were at the weekend (15). Just over half of the single motorcycle collisions were in the dark (16) and 11 were between 10pm-6am. It was known that 8 of the riders were impaired with drink or drugs (19 were not, and how many unknown) and this impairment contributed to the collision.

It is clear from Table 6-9 that the single motorcycle collisions involved some form of loss of control. This loss of control was a contributory factor in 21 of the 29 collisions.

Table 6-9: The single motorcyclist collisions

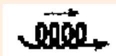
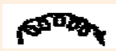
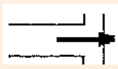
Code	Conflict		Frequency
A4	Lost control (overtaking vehicle)		4
C1	Out of control on roadway		6
C2	Out of control - off roadway to left		7
C3	Out of control - off roadway to right		3
D1	Lost control turning right		5
D2	Lost control turning left		3
D3	Missed intersection or end of road		1
Total			**29**

Table 6-10 shows the most commonly recorded contributory factors for single motorcyclist collisions. The most common contributory factor was 'loss of control', reported in 21 collisions. Exceeding the speed limit was recorded in 18 collisions.

Table 6-10: Most commonly recorded single motorcyclist contributory factors

Factor	Description	Total
410	Loss of control	21
306	Exceeding speed limit	18
501	Impaired by alcohol	8
605	Learner or inexperienced driver/rider	6
403	Poor turn or manoeuvre	5
201	Tyres illegal, defective or under inflated	4
602	careless, reckless or in a hurry	4
408	sudden braking	4
307	travelling too fast for conditions	3
101	poor or defective road surface	3
503	Fatigue	3

Twenty-seven fatalities in this group had post mortem data available. In terms of life-threatening injuries (AIS at least 3), the thorax was most commonly injured (24), followed by the head (20). Nineteen fatalities had life-threatening injuries to both their head and thorax.

Table 6-11: Body regions with life-threatening injuries for single motorcyclist collisions

Body region	Total
Head	20
Thorax	24
Abdomen	9
Pelvis	0
Left arm	0
Right arm	1
Right leg	2
Left leg	2
Other	0

Twenty-four fatalities had 'major trauma' injuries (injury severity score of at least 15), including 2 with the maximum ISS score of 75 (untreatable).

Table 6-12: Injury severity score of motorcyclists in single vehicle collisions

Injury severity score	Total
4-14	3
15-29	10
30-66	12
75	2
Total	**27**

Table 6-13 shows the most frequently associated countermeasures for single motorcyclist collisions. Two engineering interventions may have prevented the collisions in 7 cases if the rider had a Intelligent Speed Assistance system and in 5 collisions if the motorcycles had improved braking systems. The motorcyclists' injuries may have been less if the speed limit had been enforced (4), helmet had been worn or used effectively (3), and/or if protective clothing had been worn (2).

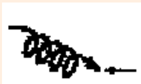
Table 6-13: The most frequently recorded countermeasures for single motorcycle collisions

Counter measure		'Likely'	'Probably'	'Maybe'	Total
134	Riding whist impaired	2	5	2	9
152	Speed enforcement	0	6	3	9
153	Drinking and driving/riding	4	2	2	8
122	Intelligent Speed Assistance - Advice or warning systems	0	3	4	7
154	Driving/riding without a licence/uninsured	2	4	1	7
131	Improved motorcyclist training	0	6	0	6
123	Improved braking systems for motorcycles (e.g. ABS, enhanced braking, autonomous braking)	1	3	1	5
135	Roadworthiness of motorcycle	0	2	2	4
252	Speed enforcement	0	3	1	4
231	Use of helmets	0	1	2	3
111	Proposed changes to junction layout	0	1	1	2
133	Riding whist fatigued	0	2	0	2
136	Dangers of tampering	0	1	1	2
233	Use of protective clothing (jackets, trousers, gloves etc.)	0	1	1	2
222	Dynamic suspension to reduce 'front end dive' of the motorcycle under heavy braking conditions	1	0	0	1

6.2.2 Loss of control collisions

In total there were 42 motorcyclist fatalities from 41 collisions which involved loss of control, as shown in Table 6-14. The definition of 'loss of control' is where a road user lost control of the vehicle (including direction and/or orientation) which caused or contributed to the collision.

Table 6-14: Number of motorcyclist collisions involving the motorcyclist losing control

	Conflict		Total
A4	Lost control (overtaking vehicle)		9
A6	Lost control (overtaken vehicle)		0
B5	Head on – lost control on straight		3
B6	Head on – lost control on bend		0
C1	Lost control on roadway		10
C2	Lost control off roadway to left		7
C3	Lost control off roadway to right		3
D1	Lost control turning right		5
D2	Lost control turning left		4
Total			**41**

As with all motorcyclist fatalities in the sample, there were more loss of control collisions in outer London (27) compared with inner London (14). More than half were on major roads (1 on a motorway and 28 on A-roads), as shown in Table 6-15.

Table 6-15: Loss of control collisions by road class

Road Class	Road Type	Total
Motorway		1
A-road	Dual	19
	Single	8
	unknown	1
A-road total		28
B-road		4
C and unclassified		8
Total		**41**

The majority of the loss of control collisions (24) occurred away from a junction. The road surface was most commonly dry (35) and the traffic level was mostly light (35).

6.2.2.1 When loss of control collisions occurred

The figure below shows the number of loss of control fatalities by day of the week. Whereas other motorcycle collisions in the sample were more common on Mondays to Fridays, 'loss of control' collisions were more common at the weekend (18).

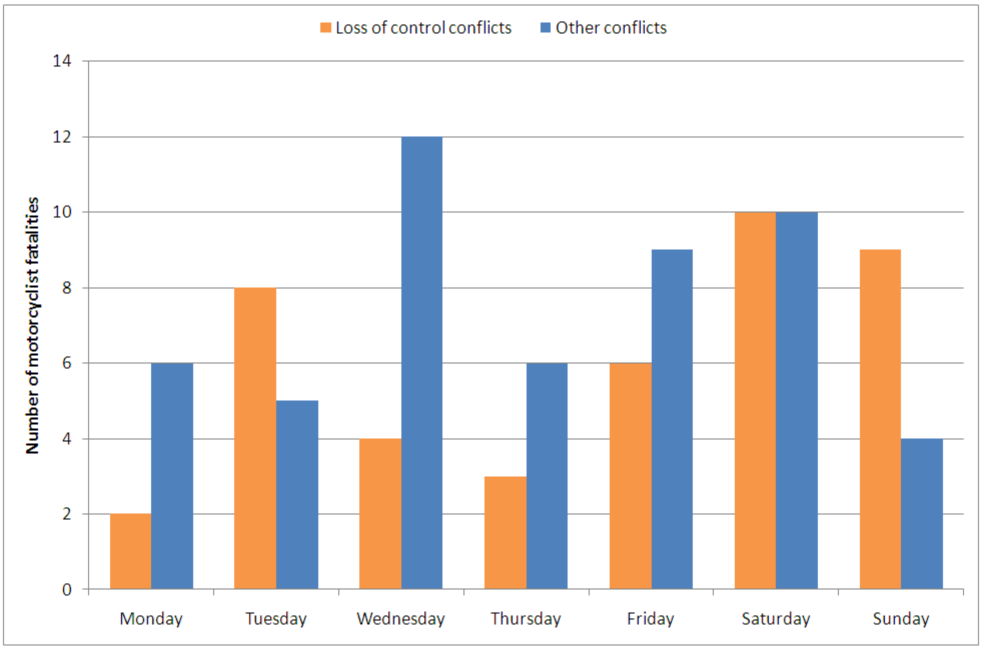


Figure 6-1: Distribution of motorcyclist fatalities involving loss of control conflicts by day of week

As with other motorcyclist fatalities, those involving a loss of control conflict were most common in the afternoon and evening; 7 out of the 8 motorcyclists killed between midnight and 4am involved a loss of control conflict (Table 6-16).

Table 6-16: Loss of control fatalities by time of day

Time	Loss of control conflicts	Other conflicts	Total
midnight-4am	7	1	8
4am-8am	6	7	13
8am-noon	3	7	10
noon-4pm	9	10	20
4pm-8pm	10	18	28
8pm-midnight	6	9	15
Total	**41**	**52**	**93**

6.2.2.2 Motorcycle and rider

All of the fatalities in loss of control conflicts were male riders except for one female, aged 55-59. In this case, there was also a male killed in the same age group. It could not be determined which of the fatalities was the rider and which was the passenger. Three other motorcyclists were carrying a passenger who was not killed.

The figure below shows the age distribution of fatalities in loss of control collision compared with other fatalities. The most commonly killed age group for loss of control collision was ages 20-24, whereas for other collision older ages were more common.

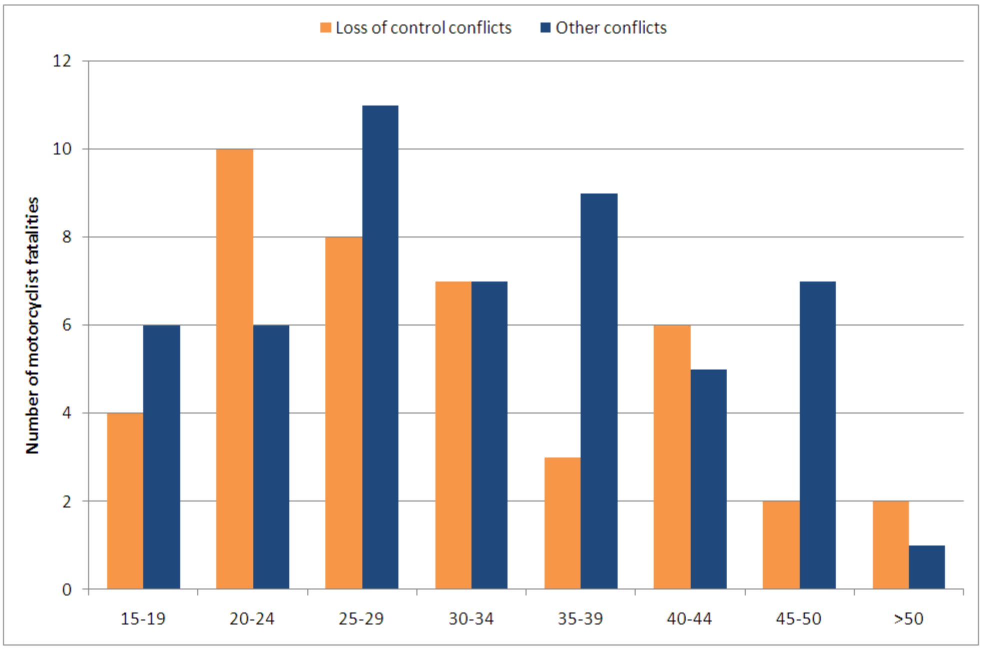


Figure 6-2: Distribution of motorcyclist fatalities involving loss of control collision by fatality age

The journey purpose was known in 22 cases; 15 of these were classed as leisure journeys. The 42 fatalities in these collisions included:

- 20 fatalities with a full licence, 10 fatalities with a provisional licence and 4 with no licence (and 8 unknown)
- With respect to training:
    - o 5 fatalities had had no training;
    - o 2 had completed CBT;
    - o 3 had undertaken other training; and
    - o in 32 cases, the level of training was unknown.
- 6 fatalities who had been riding for less than one year

The majority of the riders were not impaired by drugs, alcohol or fatigue; however, 8 were impaired by alcohol, 2 by drugs, 1 by alcohol and drugs and 1 by fatigue. The conviction history was known for 18 cases; 7 of these had a court conviction, DVLA offences or a youth offender.

Table 6-17 shows the types of motorcycles involved in loss of control collisions. The most commonly involved type was ‘sports’, with 22 bikes in this category. There were also 8 ‘retro’ bikes and 7 scooters (including 1 moped). 31 of the motorcycles were in good condition and 8 had defects recorded, mostly tyre defects.

Table 6-17: Loss of control fatalities by bike type and size

Bike type	Engine size	Total
Scooter	50cc	1
	125cc	3
	172cc	1
	unknown	2
Retro		8
Sports		22
Tourer		3
Trail		1
Unknown		1
Total		**42**

6.2.2.3 *Circumstances of the collisions*

Twenty-nine of the 42 loss of control collisions involved no other vehicles (69%). The most common first points of impacts for these motorcycles were impacts with the kerb (11, 26%) or crash barrier (6, 14%). There were 13 multi-vehicle collisions involving loss of control. These motorcyclists most commonly hit other vehicles (5, 38%) or nothing further (5, 38%) (see Table 6-18).

Table 6-18: Loss of control collisions by motorcycle impact with objects

Impact with objects	Single vehicle	Multi vehicle	Total
Kerb	11	1	12
Crash barrier	5	0	5
Further vehicle(s)	1	5	6
Nothing further	1	5	6
Road sign / Lamp/Electricity pole	3	1	4
Tree	3	0	3
Guard railing	1	1	2
Bollard/refuge	1	0	1
Bus stop/shelter	1	0	1
Wall	1	0	1
Total	**28**	**13**	**41**

6.2.2.4 *Injuries*

There were 32 motorcyclist fatalities in loss of control collisions for which post mortem data were available. As with all fatalities in the sample, head or thorax injuries were most common (Table 6-19). Twenty motorcyclists had both head and thorax life-threatening injuries. Four motorcyclists had the maximum injury severity score of 75 (untreatable) as shown in Table 6-20.

Table 6-19: Body regions with life-threatening injuries for motorcyclists in loss of control collisions

Body region	Number
Head	22
Thorax	26
Abdomen	9
Pelvis	2
Right arm	1
Right Leg	3
Left leg	3

Table 6-20: Injury Severity Score for motorcyclists in loss of control collisions

Injury Severity Score	Total
4-14	5
15-29	10
30-66	13
75	4
Total	**32**

6.2.2.5 Contributory factors

Contributory factors were assigned to the motorcyclist in 38 of the 41 loss of control collisions and to both the motorcyclist and the other driver in 3 collisions. Table 6-21 shows the ten most common contributory factors assigned to the riders in loss of control collisions.

Table 6-21: The ten most frequently recorded contributory factors attributed to the motorcyclist in loss of control collisions

Frequency of contributory factors	Frequency
Loss of control	26
Exceeding speed limit	24
Poor turn or manoeuvre	10
Impaired by alcohol	9
Careless, reckless or in a hurry	6
Learner or inexperienced driver/rider	7
Sudden braking	5
Travelling too fast for conditions	5
Tyres illegal, defective or under inflated	4
Fatigue	3
Number of riders with CFs	41
Average number of CFs per rider	***3.1***

6.2.2.6 Countermeasures

Table 6-22 lists the ten most frequently recorded countermeasures for loss of control collisions. The most common countermeasure was 'improved motorcycle training', recorded in 15 collisions. Excessive speed and/or poor turn or manoeuvres and impairments were often contributory to these collisions and this may be an area where training would help. Countermeasures aimed at reducing travelling speed, through enforcement or advice or warning systems featured in the most common countermeasures, as does improved braking systems. Improved braking systems have the potential to help the rider remain in control of the motorcycle and to avoid collisions, they also may reduce the impact speed of the collision or change the collision circumstances. Countermeasures aimed at reducing motorcyclists' impairment, through education or enforcement were also commonly recorded.

Table 6-22: The ten most frequently recorded countermeasures for loss of control motorcycle collisions

Counter measure		'Likely'	'Probably'	'Maybe'	Total
131	Improved motorcyclist training	0	13	2	15
152	Speed enforcement	0	8	4	12
134	Riding whist impaired	3	6	2	11
122	Intelligent Speed Assistance - Advice or warning systems	0	6	4	10
123	Improved braking systems for motorcycles (e.g. ABS, enhanced braking, autonomous braking)	1	7	1	9
153	Drinking and driving/riding	5	2	2	9
154	Driving/riding without a licence/uninsured	1	6	1	8
135	Roadworthiness of motorcycle	0	3	2	5
252	Speed enforcement	0	3	2	5
231	Use of helmets	0	1	2	3

6.2.3 The role of speed in the collision

6.2.3.1 Speed contributory factors for motorcycles

There are two contributory factors relating to speed: exceeding the speed limit and travelling too fast for conditions. Exceeding the speed limit was recorded when there was evidence that the motorcyclist was exceeding the posted speed limit at the time of the collision. Travelling too fast for conditions was recorded when there was evidence that certain conditions (for example, weather) had made riding more dangerous and should have been taken into consideration by the motorcyclist. 'Exceeding speed limit' was recorded for 48 motorcyclists and travelling too fast for conditions was recorded for one motorcyclist. When both factors applied to a collision, only exceeding the speed limit was recorded, following the guidance given for completing STATS19 contributory factor data.

In 8 of the collisions with a speed-related contributory factor assigned to the motorcyclist there were no other contributory factors assigned to the motorcyclist. Where there were other contributory factors recorded for the motorcyclist, the most common were:

- Loss of control (16)
- Careless, reckless, or in a hurry (8)
- Sudden braking (8)
- Impaired by alcohol (6)

6.2.3.2 Speeds of other vehicles

There were three collisions where another vehicle in the collision was recorded as ‘exceeding speed limit’. This is a much smaller group than the motorcycles that were exceeding the speed limit, suggesting that speed-related collisions are mainly due to the speed of the motorcycle rather than the other vehicle.

6.2.3.3 Estimated speeds of motorcycles

Information on the estimated speed of the vehicles involved in a collision was often included in the fatal file and is a key piece of information that the STATS19 data does not provide. Vehicle speeds at time of collision are estimated by the Police and may be based on measurements, expert opinion or on witness evidence.

The fatal file analysis included estimated ranges for the travelling speed and impact speed of the motorcycle. Figure 6-3 shows the estimated speeds of each motorcycle, where known, compared with the speed limit of the road. Each bar represents one motorcycle and shows the range of the estimate, with each speed limit shown as a different colour. The very small bars are those where only a single figure of speed was given, rather than a range. These generally would be a minimum speed.

This shows that on 30mph, a large number of motorcyclists were exceeding the speed limit, some by a large margin. On 40mph roads there was also a large proportion of ‘speeders’, with one motorcycle estimated to be travelling between 111mph and 127mph.

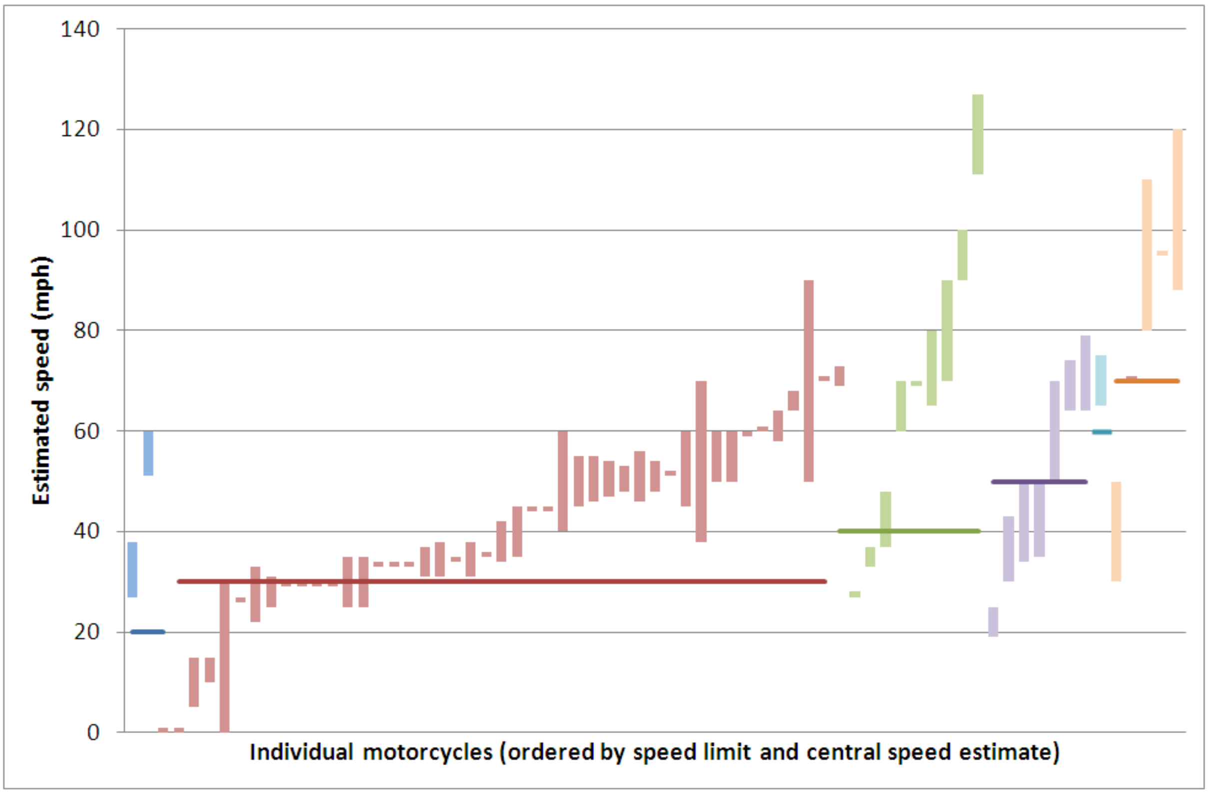


Figure 6-3: Estimated speeds of motorcycles

A summary of the speed data is given in Table 6-23. Overall, where the speed of the motorcycle was calculated, 64% of motorcycles were travelling over the speed limit, and many were exceeding the speed limit by a large margin.

Table 6-23: Speeding motorcycles by speed limit

Speed limit	Below speed limit	Above speed limit	Unknown	Total
20mph	0	2	1	3
30mph	14	31	15	60
40mph	4	6	3	13
50mph	6	2	2	10
60mph	0	1	0	1
70mph	1	3	1	5
unknown	0	0	2	2
Total	**25**	**45**	**24**	**94**

6.2.3.4 Characteristics of motorcyclists travelling over the speed limit

Figure 6-4 shows the age group distribution of speeders. Eighty per cent of motorcyclist fatalities in the 20-39 year age group were riding over the speed limit (where the travelling speed was known).

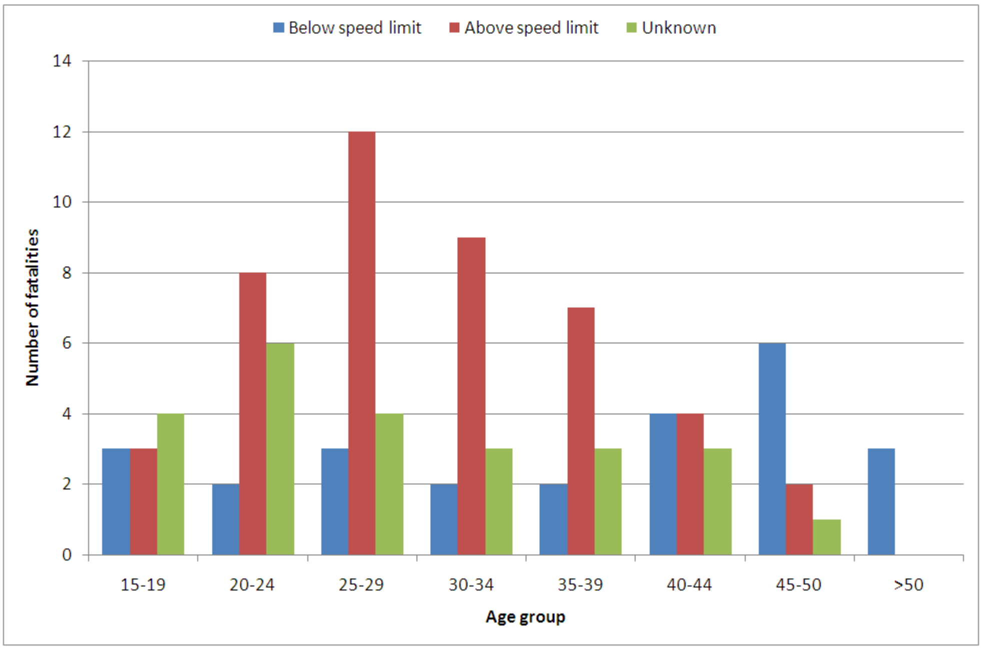


Figure 6-4: Estimated speeds of motorcycles

The majority of the motorcyclists travelling above the speed limit were riding sports bikes (31), and the majority had a full licence (25), although there were 7 riders with a provisional licence and 7 with no licence. In addition:

- 6 of the speeding motorcyclists were impaired by alcohol;
- 2 were not wearing a helmet;
- 2 were carrying a passenger.

6.2.3.5 Conflicts

Table 6-24 shows the number of motorcyclists who were speeding by conflict type. Almost half (22) of the motorcyclists that were travelling above the speed limit were in loss of control conflicts. Thirteen had a turning across path conflict, which accounted for over 80% of this conflict type where the speed was known.

Table 6-24: Speeding motorcycles by speed limit

Conflict type	Below speed limit	Above speed limit	Unknown	Total
A – overtaking and lane change	4	6	6	16
B – head on	1	2	1	4
C – lost control or off road	7	10	4	21
D – cornering	2	5	3	10
E – collision with obstruction	2	1	0	3
F – rear end	2	1	2	5
G – turning versus same direction	3	2	0	5
H – crossing (no turns)	2	0	0	2
J – Crossing (vehicle turning)	0	4	3	7
K – merging	0	3	1	4
L – right turn against	2	6	2	10
M - manoeuvring	0	5	2	7
Total	**25**	**45**	**24**	**94**
All loss of control	**11**	**22**	**9**	**42**
All turning across path	**2**	**13**	**6**	**21**

6.2.3.6 Contributory factors

Table 6-25 shows the most commonly recorded contributory factors for motorcycles travelling above the speed limit to be ‘exceeding speed limit’ (39) and ‘loss of control’ (16).

Table 6-25: Top ten contributory factors assigned to speeding motorcycles

Contributory factor		Very likely	Possible	Total
306	Exceeding speed limit	35	4	39
410	Loss of control	11	5	16
602	Careless, reckless or in a hurry	5	2	7
408	Sudden braking	4	3	7
605	Learner or inexperienced driver or rider	4	2	6
403	Poor turn or manoeuvre	4	2	6
501	Impaired by alcohol	5	1	6
307	Travelling too fast for conditions	4	1	5
406	Failed to judge other person’s path or speed	2	3	5
405	Failed to look properly	2	2	4

6.2.3.7 Injuries

Post mortem data were available for 41 motorcyclists who were travelling over the speed limit. Table 6-26 shows the number of motorcyclists with life-threatening injuries for each body region. Injuries to the head (28) and thorax (31) were most common; 22 riders had life-threatening injuries to both their head and thorax.

Table 6-26: Body regions with life-threatening injuries for speeding motorcyclists

Body region	Below speed limit	Above speed limit	Unknown	Total
Head	16	28	10	54
Thorax	20	31	16	67
Abdomen	7	12	6	25
Pelvis	2	3	1	6
Left arm	0	0	0	0
Right arm	0	0	1	1
Right leg	2	4	2	8
Left leg	1	7	3	11
Other	0	1	0	1
Total cases with post mortems	**24**	**41**	**21**	**86**

The injury Severity Scores (ISS) for speeding motorcyclists are shown in the Table below. 37 of the motorcyclists had injuries which could be described as 'major trauma' (ISS of at least 15), including 7 which had the maximum ISS of 75 (untreatable).

Table 6-27: Injury Severity Scores for speeding motorcyclists

Injury Severity Score	Below speed limit	Above speed limit	Unknown	Total
4-14	3	4	3	10
15-29	9	15	8	32
30-66	8	15	7	30
75	4	7	2	13
unknown	0	0	1	1
Total	**24**	**41**	**21**	**86**

6.2.3.8 Countermeasures

Table 6-28 shows the countermeasures recorded for motorcyclists travelling above the speed limit. The most commonly recorded seven countermeasures were primary safety measures, the most common being Intelligent Speed Assistance systems and speed enforcement. There were some cases where neither of these countermeasures applied, for example, collisions where the action of the other vehicle contributed to the collision or those where the collision would have occurred even if the motorcycle had been travelling within the speed limit. In some cases Intelligent Speed Assistance systems were listed as a countermeasure, but speed enforcement was not, for example, riders who were not complying with other aspects of the law may not be deterred by increased enforcement levels. This highlights the difficulty associated with assigning countermeasures and predicting their likely effects; and emphasises their importance as part of the overall list (Table 6-28) rather than necessarily their absolute ranking order based on frequency.

The most common secondary safety countermeasure was 'introduce air bags for motorcyclists', which was recorded in 7 cases.

Table 6-28: Countermeasures for speeding motorcycles

Counter measure	Name	'Likely'	'Probably'	'Maybe'	Total
122	Intelligent Speed Assistance - Advice or warning systems	1	13	15	29
152	Speed enforcement	0	9	13	22
131	Improved motorcyclist training	0	0	19	19
123	Improved braking systems for motorcycles (e.g. ABS, enhanced braking, autonomous braking)	1	3	9	13
154	Driving/riding without a licence/uninsured	2	1	8	11
141	Improved driver awareness of motorcyclists	1	2	4	7
153	Drinking and driving/riding	3	1	2	6
223	Introduce airbags for motorcycles	0	2	4	6
134	Riding whist impaired	3	0	3	6
138	Greater motorcyclist awareness of other vehicles	0	1	5	6
252	Speed enforcement	0	2	3	5
132	Improved motorcyclist conspicuity (high-vis/fluorescent clothing)	0	0	4	4
111	Proposed changes to junction layout	2	1	0	3
233	Use of protective clothing (jackets, trousers, gloves etc.)	0	1	2	3
126	ITS (such as radar)	0	1	2	3
155	General traffic law enforcement	0	0	3	3
133	Riding whist fatigued	0	0	2	2
231	Use of helmets	0	2		2
139	Changing driving/riding behaviour that affect motorcyclists safety	0	0	2	2
112	Improve the condition of the road surface	0	0	1	1
121	Improve visibility of motorbike (e.g. high-vis/bright colours, headlamps, striplights)	0	0	1	1
232	Fit sideguards to HGV	0	1	0	1
222	Dynamic suspension to reduce 'front end dive' of the motorcycle under heavy braking conditions	1	0	0	1
251	Helmet use	0	0	1	1
135	Roadworthiness of motorcycle	0	1	0	1
211	Removal of unnecessary crash barriers	0	1	0	1
114	Introduce warning signs of poor/changes in road surface	0	0	1	1

6.2.4 Fatal collisions involving alcohol and drugs

There were 15 motorcyclists that were impaired by alcohol or drugs (9 with alcohol, 5 with drugs and 1 with both) recorded in the database from the fatal files.

The Blood Alcohol Concentration (BAC) levels were available for 7 of these riders from the post mortems and all 7 had a BAC level well over the legal alcohol limit of 80mg/100ml, the lowest being 133mg/100ml and the highest of 217 mg/100ml.

Drug details were available from the post mortems for 3 of the 5 fatalities reported as being impaired by drugs. In addition, one of the riders who was classed as impaired by alcohol also tested positive for drugs in their blood. The drugs recorded included benzoylecgonie (the main ingredient in prescription drugs – used to treat muscle pain), cannabinoids and cannabis metabolites (a group of compounds present in Cannabis), cocaine, and morphine. The presence of cannabinoids indicates the deceased had recently been exposed passively or actively to marijuana smoke.

All of the 15 motorcyclists that were impaired by alcohol or drugs were male aged between 17 and 46 shown in Table 6-29, this is a similar distribution to the non-impaired fatalities.

Table 6-29: Age distribution of motorcyclist fatalities impaired with alcohol or drugs

Age range	Frequency
17-24	3
25-34	6
35-44	5
45+	1
Total	**15**

The majority of these collisions were in the dark (11) at night between 6pm and 6am (10). The majority of collisions that occurred during the night were at weekends (6), slightly fewer collisions occurred during the week nights (4).

Over half of the impaired motorcyclists were riding scooters (8) with an engine size of 125cc or less, 5 were riding sports bikes 1 retro and 1 tourer bike (all of which had an engine size >500cc). Two were riding stolen bikes.

The level of experience was known for 9 of the impaired riders, and 4 were described as having less than 1 year of experience on the road. The motorcyclists' inexperience was recorded as being a contributory factor in these collisions for 3 cases (see Table 6-32).

Table 6-30 shows the type of licences held by the motorcyclists, 4 had no licence and 3 held a provisional licence.

Table 6-30: The type of licence held by the impaired motorcyclists

Type of licence held	Frequency
Full motorcycle licence	7
Provisional motorcycle licence	3
No licence	4
Unknown	1
Total	**15**

Of this group of motorcyclists 3 had previous DVLA offences and 1 had a previous criminal conviction.

The majority of the impaired motorcyclists were killed in single vehicle collisions (9) and all of these were loss of control conflicts (5 on a straight road, 4 on a bend). There were a further 2 loss of control conflicts were the motorcyclist lost control and collided with another vehicle (Table 6-31).

Table 6-31: Conflicts involving alcohol and drug impaired riders

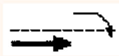
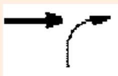
Code	Conflict		Single vehicle	Two vehicle
A2	Head on		0	1
C1	Out of control on roadway		2	2
C2	Out of control - off roadway to left		1	0
C3	Out of control - off roadway to right		2	0
D1	Lost control turning right		3	0
D2	Lost control turning left		1	0
F4	Queue		0	1
G5	Overtaking vehicle		0	1
K2	Right turn in		0	1
Total			**9**	**6**

Table 6-32 presents the most common contributory factors attributed to the motorcyclists impaired by alcohol or drugs. Not surprisingly 'impaired by alcohol' was one of the most common causes of the collision (10 collisions), closely followed by 'exceeding the speed limit' and 'loss of control'. It is not known however, whether or not the motorcyclist was exceeding the speed limit because they were impaired. It should be noted that the impairment was not thought to be a cause of two collisions, and the actions of the other driver led to the collision.

Table 6-32: The most common contributory factors attributed to motorcyclists impaired by alcohol or drugs

Contributory factors	Frequency
Impaired by alcohol	10
Exceeding speed limit	9
Loss of control	8
Impaired by drugs (illicit or medicinal)	3
Learner or inexperienced driver/rider	3
Failed to judge other person's path or speed	2
Fatigue	2
Stolen vehicle	2
Number of collisions	15
Number of riders with CFs	13
Average number of CFs per rider	**3.4**

Post mortem data were available for 14 motorcyclists in this group. As with other fatalities, the most common body regions with life threatening injuries were the head or thorax (see Table 6-33). One rider had the maximum injury severity score of 75 (untreatable).

Table 6-33: Body regions with life-threatening injuries to motorcyclists impaired by alcohol or drugs

Body region	Single vehicle	multi-vehicle	Total
Head	4	4	8
Thorax	8	6	14
Abdomen	1	0	1
Right leg	1	0	1
Left leg	1	2	3

Table 6-34: Injury severity score for motorcyclists impaired by alcohol or drugs

Injury Severity Score	Single vehicle	multi-vehicle	Total
4-14	1	0	1
15-29	3	4	7
30-66	4	1	5
75	0	1	1
Total	**8**	**6**	**14**

Table 6-35 lists the ten most frequently recorded countermeasures for collisions involving motorcyclists' impaired by alcohol and/or drugs.

Table 6-35: The ten most frequently recorded countermeasures for collisions involving motorcyclists impaired by alcohol and/or drugs

Counter measure	Name	'Likely'	'Probably'	'Maybe'	Total
134	Riding whist impaired	3	9	3	15
153	Drinking and driving/riding	6	2	2	10
154	Driving/riding without a licence/uninsured	1	2	3	6
152	Speed enforcement	1	3	1	5
122	Intelligent Speed Assistance - Advice or warning systems	0	1	1	2
123	Improved braking systems for motorcycles (e.g. ABS, enhanced braking, autonomous braking)	0	2	0	2
131	Improved motorcyclist training	0	1	1	2
143	Roadworthiness of vehicle	0	1	1	2
252	Speed enforcement	0	1	1	2
121	Improve visibility of motorbike (e.g. high-vis/bright colours, headlamps, striplights)	0	1	0	1

6.2.5 Fatal collisions involving inexperienced motorcyclists

There was some evidence as to the level of motorcycling experience of the riders in 41 files and 18 were thought to be inexperienced. All of the motorcyclists in this category were aged 36 and under, 12 of which were aged less than 25 years. 17 were males and 1 was a female.

Ten of the inexperienced riders held only a provisional licence and 7 held a full licence (but had passed their test less than 1 year before the collision). It was known that 7 of the inexperienced riders had undertaken some form of formal training, the details of which are shown in Table 6-36.

Table 6-36: The type of licence held and training undertaken of the inexperienced motorcyclists

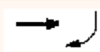
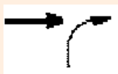
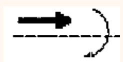
Type of training undertaken:	Type of licence:			
	Full	Provisional	No licence	Total
CBT	2	2	0	4
DAS	2	0	0	2
Other – advanced training	1	0	0	1
None	0	2	1	3
Unknown	2	6	0	8
Total	**7**	**10**	**1**	**18**

Seventeen of the 18 inexperienced riders were not complying with the law at the time of the collision. These were as follows:

- Speeding (8)
- Licence was for a smaller bike than the one they were riding (2)
- Impaired by alcohol, speeding, unlicensed and not wearing a helmet (1)
- Impaired by drugs (1)
- Impaired by alcohol and drugs and uninsured (1)
- Impaired by alcohol and speeding (1)
- Travelling wrong way in a bus lane (1)
- Uninsured and speeding (1)
- Wore a helmet which was not fastened (1)

The majority of the inexperienced riders were killed in collisions involving two vehicles (12). Table 6-31 shows the conflicts of the inexperienced riders, 8 conflicts involved a loss of control. 15 riders were going ahead and 3 were overtaking. 1 rider was doing a 'wheelie'.

Table 6-37: Conflicts involving inexperienced riders

Code	Conflict		Frequency
A2	Head on - overtaking		2
B5	Head on – lost control		2
C1	Out of control on roadway		2
C2	Out of control - off roadway to left		1
C3	Out of control - off roadway to right		2
D2	Lost control turning right		1
E4	Collision with workman vehicle		1
J1	Crossing vehicle turning right		2
K2	Right turn in		1
L2	Right turn against		1
M1	Parking or leaving		2
M3	'U' turn		1
Total			**18**

Contributory factors were assigned only to the motorcyclist in 12 of the 18 collisions. Factors were assigned to both the motorcyclist and the other driver in 5 collisions and to the other driver in 1 collision. The most common contributory factors assigned to the inexperienced riders were:

- 'Exceeding the speed limit' (11 riders),
- 'Learner/inexperienced' (10 riders),
- 'Careless, reckless in a hurry' (6 riders).

The most common contributory factors assigned to the other drivers were:

- 'Failed to judge other person's path or speed' (4),
- 'Failed to look properly' (3),
- 'Poor turn or manoeuvre' (3),
- 'Careless, reckless and in a hurry' (2).

Post mortem data were available for 16 motorcyclists in this group. The most common body regions with life-threatening injuries were head (11) or thorax (12) (8 had both head and thorax). Three of the fatalities had an injury severity score of 75 (untreatable).

The most common countermeasures for this group were:

- Speed enforcement (8)
- Enforcement – riding without a licence/uninsured (7)
- Engineering – Intelligent Speed Assistance advice or warning systems (7)
- Education – motorcyclist training (7)
- Education - riding whilst impaired (4)
- Engineering – improved braking systems (4)

6.2.6 Fatal collisions involving unlicensed motorcyclists

There were 12 motorcyclists who died that did not have a valid licence. They were all male ranging from age 15 years to age 50 years.

Table 6-38: Age distribution of unlicensed motorcyclist fatalities

Age range	Number of casualties
15-24	4
25-34	6
35-44	1
45+	1
Total	**12**

It may be assumed that people that break the law by riding a motorcycle without a licence may also break other laws. Six of the 12 unlicensed riders had previous convictions, as shown in Table 6-39. In addition, two of the unlicensed motorcyclists were impaired with alcohol and 1 with drugs. 1 of the motorcyclists did not wear a helmet and 1 wore an unfastened helmet.

Table 6-39: Conviction history of the unlicensed motorcyclist

Conviction history	Number of casualties
Criminal record - court conviction(s)	4
DVLA offences only	1
Youth offender only (warning/reprimand)	1
Unknown	6
Total	**12**

Table 6-40 shows the type of bikes ridden by the unlicensed riders. The majority were large bikes with an engine size between 600-900cc. Two of the motorcyclists were carrying passengers.

Table 6-40: Types of Motorcycle by engine size ridden by the unlicensed riders

Bike type	Engine size 107- 250cc	Engine size over 600cc	Unknown engine size	Total
Retro	1	1	0	2
Scooter	2	0	0	2
Sports	0	6	0	6
Unknown	1	0	1	2
Total	**4**	**7**	**1**	**12**

The most common contributory factors assigned to the non-licensed riders were:

- 'Exceeding the speed limit' (7 riders),
- 'Learner/inexperienced' (3 riders),
- 'Impaired by alcohol' (2 riders),
- 'Loss of control' (2 riders),
- 'Sudden braking' (2 riders).

The most common contributory factors assigned to the other drivers were:

- 'Poor turn or manoeuvre' (5),
- 'Failed to judge other person's path or speed' (3),
- 'Failed to look properly' (2).

There were 11 motorcyclists in the unlicensed group for which post mortem data were available. As with all motorcyclists, the most common body regions with life-threatening injuries were head (6) and thorax (6). One motorcyclist has an Injury Severity Score

(ISS) of 75 (untreatable), although the most common score was between 15 and 29 (5 motorcyclists).

The most common countermeasures for this group were:

- Enforcement – riding without a licence/uninsured (11)
- Engineering – Intelligent Speed Assistance advice or warning systems (4)
- Education - riding whilst impaired (3)
- Speed enforcement (3)

6.2.7 *Fatal collisions involving motorcyclists with previous convictions or offences*

There were 17 motorcyclists who were reported as having previous convictions or offences. This included 8 criminal convictions and 7 with DVLA offences. The exact details of the offence were not recorded, though it was noted in four cases that the rider had previously been disqualified from driving.

Table 6-41: Conviction history of motorcyclist

Conviction history	Number of casualties
No conviction history	32
Criminal record - court conviction(s)	8
DVLA offences only	7
Youth offender only (warning/reprimand)	2
Unknown	45
Total	**94**

Five of the 17 riders with previous convictions were in collisions which occurred between midnight and 2am. This time period could be target for enforcement activities.

The age of the motorcyclists with previous convictions ranged from 15 to 50, shown in Table 6-42.

Table 6-42: Ages of fatalities with conviction history

Fatality age group	Criminal record - court conviction(s)	DVLA offences only	Youth offender only (warning/reprimand)	Total
15-19	1	0	2	3
20-24	1	0	0	1
25-29	3	1	0	4
30-34	2	1	0	3
35-39	0	1	0	1
40-44	0	2	0	2
45-50	1	2	0	3
Total	**8**	**7**	**2**	**17**

Table 6-43 shows the licence status and speeding of the 17 riders with these convictions. Eight were travelling over the speed limit and 6 had no licence. Six of the riders were in loss of control conflicts. Two of the riders were performing ‘wheelies’.

Table 6-43: Licence status and speeding of riders with previous convictions

Type of licence held	Below speed limit	Above speed limit	Unknown	Total
Full PTW	2	5	0	7
No licence	0	2	4	6
Provisional PTW	1	1	1	3
Unknown	0	0	1	1
Total	**3**	**8**	**6**	**17**

Contributory factors were assigned to the motorcyclist only in 9 of the 17 collisions, to both the motorcyclist and the other driver in 7 collisions and only to the other driver in 1 collision. The most common contributory factors assigned to the riders with previous convictions were:

- ‘Exceeding the speed limit’ (7 riders),
- ‘Loss of control’ (6 riders),
- ‘Sudden braking’ (4 riders),
- ‘Impaired by alcohol’ (3 riders).

The most common contributory factors assigned to the other drivers were:

- ‘Poor turn or manoeuvre’ (6),
- ‘Failed to judge other person's path or speed’ (4).

Post mortem data were available for 16 of the fatalities in this group. Twelve had life-threatening thorax injuries and 8 had head injuries (6 had both). The maximum Injury severity score was 50, although the majority of the scores were between 15 and 29.

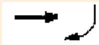
The most common countermeasures for this group were:

- Enforcement – riding without a licence/uninsured (8)
- Engineering – Intelligent Speed Assistance advice or warning systems (6)
- Engineering – improved braking systems for motorcycles (5)
- Education - riding whilst impaired (4)
- Enforcement - speed (4)

6.2.8 Other vehicle turning across the path of the motorcyclist

There were 21 fatalities in the sample where another vehicle turned across the path of the motorcycle, as shown in the table below.

Table 6-44: Turning across path conflicts

Conflict		Total
J1 – right turn right side		7
K2 – right turn in		4
L2 – making turn		10
Total		**21**

6.2.8.1 When and where?

These collisions tended to occur most frequently when traffic levels are high; 17 of the 21 motorcyclists killed in these collisions were in collisions between noon and midnight and 16 occurred between Monday and Friday.

6.2.8.2 Motorcyclist

The motorcyclists in these collisions were aged between 15 and 48. Sixteen were unimpaired, 1 was impaired by drugs and the remaining 4 had unknown impairments.

The majority of the motorcyclists were fully licensed (Table 6-45), although 5 had no licence.

Table 6-45: Turning across path conflicts by licence held

Type of licence held	J1	K2	L2	Total
Full PTW	3	2	5	10
Provisional PTW	1	0	1	2
No licence	2	2	1	5
Unknown	1	0	3	4
Total	**7**	**4**	**10**	**21**

Thirteen of the riders were travelling above the speed limit (Table 6-46).

Table 6-46: Turning across path conflicts by speeding

Speeding	J1	K2	L2	Total
Below speed limit	0	0	2	2
Above speed limit	4	3	6	13
Unknown	3	1	2	6
Total	**7**	**4**	**10**	**21**

6.2.8.3 Other driver

Each of these collisions involved one other vehicle. These vehicles were 8 cars, 2 goods vehicles, a taxi and a minibus. The age of the other driver ranged from 22 to 68, and none of the other drivers were impaired, distracted or had their vision affected

Eight of the other drivers (38%) were convicted of an offence following the collision, as shown in Table 6-47. The most common offence was careless driving.

Table 6-47: Convictions of other drivers in turning collisions

Convictions following collision	Number
Drink driving	1
Speeding	1
Careless	6
Dangerous driving	2
Construction and use	1
Other motoring offences	2
None	13
Total	**21**

6.2.8.4 Contributory factors

Contributory factors were assigned to both the motorcyclist and the other driver in two-thirds of the collisions (14). The motorcyclist was thought to be solely responsible in 4 collisions and the other driver solely responsible in 3 collisions. ‘Exceeding the speed limit’ was the most frequently recorded contributory factor for the motorcyclists (13, 80% of the sample) and was not assigned to any of the drivers of the other vehicles. Other factors assigned to the motorcyclist include: ‘careless, reckless and in a hurry’ (3), ‘sudden braking’ (3) and ‘slippery road due to weather’ (2). ‘Failed to look properly’ (11), ‘failed to judge other person’s path or speed’ (11) and ‘poor turn or manoeuvre’ (9) were assigned to the driver of the other vehicle.

6.2.8.5 Countermeasures

Table 6-48 lists the ten most frequently recorded countermeasures for conflict involving the other vehicle turning across the path of the motorcyclist.

Table 6-48: The ten most frequently recorded countermeasures in 'turning' collisions

Counter measure	Name	'Likely'	'Probably'	'Maybe'	Total
122	Intelligent Speed Assistance - Advice or warning systems	0	5	7	12
141	Improved driver awareness of motorcyclists	1	5	2	8
152	Speed enforcement	0	3	4	7
123	Improved braking systems for motorcycles (e.g. ABS, enhanced braking, autonomous braking)	0	2	3	5
154	Driving/riding without a licence/uninsured	0	3	2	5
131	Improved motorcyclist training	0	3	1	4
132	Improved motorcyclist conspicuity (high-vis/fluorescent clothing)	0	4	0	4
223	Introduce airbags for motorcycles	0	3	1	4
111	Proposed changes to junction layout	2	1	0	3
121	Improve visibility of motorbike (e.g. high-vis/bright colours, headlamps, striplights)	0	3	0	3

6.2.8.6 Injuries

Post mortem data were available for 17 of the motorcyclist fatalities in this group. The most common life-threatening injuries were head (11) or thorax (13). Seven fatalities had both head and thorax injuries.

Table 6-49: Number of motorcyclist fatalities with life-threatening injuries by body region turning conflict

Body region	J1	K2	L2	Total
Head	2	1	8	11
Thorax	1	3	9	13
Abdomen	1	1	4	6
Pelvis	0	0	1	1
Right arm	0	0	0	0
Left arm	0	0	0	0
Right leg	0	0	3	3
Left leg	0	0	3	3
Other	1	0	0	1

Sixteen of the 17 fatalities had injuries that could be described as 'major trauma', including 5 which had an injury severity score (ISS) or 75 (untreatable) (see Table 6-50).

Table 6-50: Injury severity score by turning conflict

Injury Severity Score	J1	K2	L2	Total
4-14	0	0	1	1
15-29	0	1	3	4
30-66	2	1	4	7
75	0	1	4	5
Total	**2**	**3**	**12**	**17**

6.2.9 *Fatal collisions involving motorcycles with pre-event defects*

Vehicle defects were not identified in the majority of motorcycles considered in this study (75). However, there were 11 motorcycle collisions (involving 12 fatalities) where there was found to be defective prior to the collision. The most common defects were related to tyres, either under-inflation or insufficient tyre tread, recorded for 9 casualties (Table 6-51). There were also defects relating to brakes and suspension.

Table 6-51: Pre-event vehicle condition

Pre event vehicle condition	Number of casualties
No defects – 'good condition'	75
Defective brakes and under-inflated tyres	1
Defective front suspension unit & under-inflated front tyre-may have had an effect on handling & stability	1
Defective rear tyre and low friction material on brakes. These were not contributory factors	1
Front side bulb was defective, front tyre was worn below the legal tread depth, rear tyre had the cords exposed, nearside fork seal badly worn, chain badly adjusted, exhaust not legal for road use.	1
Front tyre pressure lower than recommended and front tyre was subject to uneven tread pattern wear	2
Low tyre pressure in front tyre	1
Not registered for road use & not fitted with lighting, no pillion foot pegs	1
Rear brake defective, not suitable for use on road. Insufficient tyre tread.	1
Rear shock absorbers upside down	1
Rear wheel bearings were badly worn, seat didn't lock in place, front wheel size was changed	1
Under inflated rear tyre	1
Unknown condition	7
Total	**94**

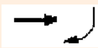
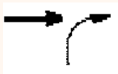
The age of the motorcycle at the time of the collision was known for 10 of the bikes with defects. All were over 3 years old, 6 were 3-5 years old, 3 were 6-10 years and 1 was 11 years old. The majority of the bikes with defects were scooters (5) shown in Table 6-52.

Table 6-52: Types of Motorcycles with defects by engine size

Bike type	Engine size 107, 125 & 172cc	Engine size 650-1200cc	Unknown engine size	Total
Retro	0	2	0	2
Scooter	3	0	2	5
Sports	0	1	0	1
Tourer	0	2	0	2
Unknown	1	1	0	2
Total	**4**	**6**	**2**	**12**

The type of conflicts involving motorcycles with defects are shown Table 6-53. Seven were single vehicle collisions and 5 involved a car. Eight collisions were loss of control conflicts.

Table 6-53: Conflicts involving bikes with defects

Code	Conflict		Single vehicle	Two vehicles	Total
A4	Loss of control – overtaking		1	0	1
C1	Out of control on roadway		1	1	2
C2	Out of control - off roadway to left		3	0	3
D1	Cornering – lost control turning right		2	0	2
J1	Crossing vehicle turning right		0	2	2
K2	Right turn in		0	1	1
L2	Right turn against		0	1	1
Total			**7**	**5**	**12**

Post mortem results were available for 11 of the fatalities where there was a defective bike. As with all fatalities, the most common life-threatening injuries were injuries to the head and/or thorax: 9 had thorax injuries and 8 had head injuries, all of which also had thorax injuries. Three fatalities had life-threatening abdomen injuries. No motorcyclists with defective bikes had life-threatening injuries to any other body regions.

The motorcyclist was thought to be responsible for the collision in 8 cases, both the motorcyclist and the other driver were responsible in 2 collisions and the other driver was thought to be solely responsible in 1 collision. ‘Tyres illegal, defective or under inflated’ (5), ‘loss of control’ (5), and ‘exceeding speed limit’ (5) were the most common contributory factors assigned to the motorcyclist. ‘Defective steering or suspension’ (2) and ‘defective brakes’ (1) were also thought to have contributed to the collisions. ‘Failed to look properly’ (3) and ‘poor turn or manoeuvre’ (2) were assigned to the car drivers.

The suggested countermeasures for this group (those with defective motorcycles) of collisions are mainly education and enforcement interventions. The education interventions include educating the motorcyclist about improving the roadworthiness of the motorcycle (8), the dangers of tampering (2), and riding whist impaired by alcohol and/or drugs (2). The enforcement interventions include speed enforcement (4) and driving/riding without a licence/insurance (3).

6.2.10 Motorcyclist stunts ending in a fatality

There were five fatalities where the description of the collision included that the motorcyclist was performing a 'wheelie'. These five fatalities were aged 17-44 years, 3 had full motorcycle licences and 2 had provisional licences. Four were riding a 1000cc sports bikes and 1 was riding a 172cc scooter.

All fatalities were non-compliant with the law:

- 3 were exceeding the speed limit
- 1 had no tax or insurance
- 1 was not wearing a helmet
- 1 was a provisional licence holder whose licence did not permit them to ride a 172cc motorcycle

In three of these collisions, the motorcycle lost control which resulted in the collision. In two of these cases no other vehicle was involved, but in the third the motorcyclist slid into another vehicle.

In two cases, the motorcyclist was performing a wheelie in dark conditions which both obscured their view of the road ahead and meant that other vehicles could not see the motorcyclist as clearly since the motorcyclist headlight was directed upwards.

Post mortems were available for four of the fatalities; all had life-threatening head injures (AIS >=3), two also had life-threatening thorax and abdomen injures.

The suggested educational countermeasures for this group of collisions include improve motorcyclist training (2) and greater motorcyclist awareness of other vehicles (2). The suggested engineering measure was Intelligent Speed Assistance systems (2) and the enforcement measures include speed enforcement (2) and driving/riding without a licence/uninsured (2). The suggested secondary countermeasures were: introduce airbags for motorcyclists, use of helmets, use of protective clothing and speed enforcement.

7 Conclusions

The fatal files for 94 motorcyclists who died in a road traffic collision were reviewed as part of this project. The sample covered the years 2006-09 and was selected to be broadly representative in terms of inner/outer London, fatality age group and motorcycle type.

A structured database was created, based on Haddon's Matrix (Haddon Jr, 1999), which included items related to the environment, the motorcycle, the motorcyclist, other vehicle(s) and their driver(s)/rider(s) in terms of pre-event, event and post-event.

The analysis did not include other severities of collision or casualty, nor did it consider damage only collisions or account for exposure to risk.

STATS19, or ACCSTATS data, recorded for all reported collisions in Great Britain includes over 50 items of data, although this does not provide detailed information on every element of the collision, vehicle and casualty. The fatal collision files used for this research are a rich source of information and contain much greater detail about the collisions, vehicles and casualties than are routinely available in STATS19. However, this is not an exhaustive collection of data as some data fields are sometimes not completed.

The key characteristics from the analysis following the Haddon's Matrix are listed below by the three phases: pre-event, event (the actual collision) and post event;

For the pre-event:

- The majority of motorcyclist fatalities were male;
- All but three riders were wearing a motorcycle helmet;
- Where known, the majority of riders were familiar with their route;
- Where known, the majority of motorcycle journeys were leisure journeys;
- 77 (82%) of the riders killed were from London;
- 62 (66%) occurred on a major (M or A) road;
- 55 (59%) were at a junction;
- Half were aged 30 and under;
- 45 (48%) of the motorcycles had 'exceeding the speed limit' contributory factor recorded in there stats19 record;
- Where the speeds of motorcyclists were estimated by Police Officers at the collision scene, 64% of motorcycles were travelling at speeds above the speed limit (45 above the limit, 25 below the limit and 24 where no speed was estimated);
- The most commonly involved other vehicles were cars (44, 47%) and HGVs (12, 13%);
- 30 (32%) collisions involved no other vehicle;
- The most common bike type was sports bikes over 500cc;
- 18 (19%) of the riders had less than one year of riding experience;

- 17 (34%) of the riders had previous convictions (of 50 where this was known);
- 15 (16%) of the riders were impaired by alcohol or drugs; and
- 11 (12%) motorcycles had at least one vehicle defect prior to the collision, most notably defective tyres;

For the event:

- The most common conflict types were those involving loss of control (42, 45%) or another vehicle turning across the motorcycle's path (21, 22%);
- The most common trajectory for the motorcycle was to roll or skid from point of impact to a point of rest or second impact;

Contributory factors:

- In two-vehicle collisions (57, 61%), the motorcyclist alone was attributed contributory factors in 20 (21%) collisions, the other driver/rider alone in 9 (10%) collisions, and both parties in 28 (30%) collisions;
- In two-vehicle collisions, the most common contributory factor assigned to the motorcyclist was 'exceeding speed limit' (29, 31%); and
- In single vehicle collisions (30, 32%), the most common contributory factors were 'loss of control' (21, 22%) and 'exceeding speed limit' (18, 19%).

For the post event:

- The majority (80, 85%) of motorcyclists died on the same day as the collision;
- The most common body regions with life-threatening injuries were the thorax (78%) or the head (63%);
- Although there were cases with life-threatening injuries to limbs, in all cases other life-threatening injuries were also present;
- There were 17 (18%) fatalities whose helmets were displaced by the collision;
- 17 (18%) drivers of other vehicles in the collision were convicted for an offence following the collision, most commonly 'careless driving'; and
- 13 (14%) fatalities had injury levels that were classed as 'untreatable'.

Table 7-1: Collision types and number of fatalities in sample

Collision type	Number of motorcyclist fatalities in sample	%
Motorcyclist exceeding speed limit	45	48%
Motorcyclist loss of control	42	45%
Single vehicle	30	32%
Turning across motorcycle path	21	22%
Inexperienced motorcyclists	18	19%
Motorcyclists with previous convictions	17	18%
Motorcyclists impaired by alcohol or drugs	15	16%
Unlicensed motorcyclists	12	13%
Motorcycle defects	12	13%
Motorcycle stunts	5	5%

8 Recommendations

Overall, the most common countermeasures recorded were primary countermeasures, aimed at preventing the collision. Secondary countermeasures, aimed at reducing the severity of the collision were less frequently recorded, because, in our opinion, the injuries sustained would rarely have been prevented by PPE. Potential exceptions to this surround the issues of helmet effectiveness and helmet retention, but there was not enough information held within the files to quantify these.

Fatal collision types

Several groups of fatalities were identified as accounting for a substantial proportion of fatalities. Each group shared a common characteristic or feature of the collision and therefore some fatalities are present in more than one group. The groups with the largest numbers of fatalities were:

- Motorcyclist exceeding speed limit (45, 48%)
- Motorcyclist loss of control (42, 45%);
- Only a motorcycle involved collisions (30, 32%);
- Another vehicle turning across motorcycle path (21, 22%);

The larger fatal collision types should be targeted for action to improve road safety in London

Countermeasures

For primary countermeasures, there was a relatively small number of collisions where improved road engineering was recorded as a countermeasure. In two cases the only countermeasure was 'Proposed changes to junction layout', but in other cases at least one other countermeasure was listed, most notably, 'improved driver training' or 'speed enforcement against motorcycles'.

Table 8-1: Number of fatalities in collisions with each proposed countermeasure types

Countermeasure type		Number	% of fatalities
Primary	Engineering - environment	9	10%
	Engineering - vehicle	46	49%
	Education - motorcyclist	63	67%
	Education - drivers	18	19%
	Enforcement	48	51%
Secondary	Engineering - environment	1	1%
	Engineering - vehicle	11	12%
	Education - motorcyclist	9	10%
	Enforcement	9	10%

This project did not seek to consider the effectiveness of the countermeasures; therefore whilst they could have prevented the incident or reduced the severity of the incident, further work should be undertaken to understand the likely effect of any intervention on fatal collisions, other casualties and any other implications.

Countermeasures may not be immediately applicable and may be developed in the medium to longer term. The following countermeasures should be considered for action or further evaluation.

Countermeasures aimed to reduce the incidence of collisions involving speeding motorcyclists, other vehicles turning across the path of motorcycles, loss of control motorcycle crashes and single vehicle collisions

Motorcyclists who were speeding were also involved in types of collision where other countermeasures may also apply; in particular inexperienced, unlicensed or impaired riders, who may benefit from further training or enforcement. The combinations of factors in these collisions make it difficult to determine whether the rider would have been speeding if they were more experienced, licensed or unimpaired. Speeding motorcycles were often involved in collision involving a vehicle turning across their path. In these cases, improved driver awareness of motorcycles may also help.

Intelligent Speed Assistance – advice or warning systems

This countermeasure was recorded for 32 collisions. This countermeasure was mainly recorded as ‘probably’ or ‘maybe’ since it is unknown whether a rider would be ‘likely’ to heed a voluntary warning. No such system is currently commercially available and would have to be developed in the future.

Speed enforcement to increase speed limit compliance

This countermeasure was recorded for 28 collisions. As with Intelligent Speed Assistance, this countermeasure was generally recorded as ‘probable’ or ‘maybe’. Enforcement may be infrastructure based such as speed cameras operated by the police or through road side traffic police. In either case, speed cannot be enforced for all vehicles at all locations, and therefore would need to be targeted.

Additional motorcyclist training to improve riding skill

This was recorded as a countermeasure in 32 collisions. This countermeasure includes improvements to initial motorcyclist training and further training. This was recorded commonly in single vehicle collisions, loss of control collisions, collisions involving the motorcyclist travelling over the speed limit and collisions involving inexperienced motorcyclists. In each case (although these groups overlap) the sort of training and its effectiveness may be different

Improved braking systems for motorcycles

This countermeasure was recorded for 21 collisions. This vehicle technology means that riders can achieve a higher deceleration level without locking one or both wheels. Some bikes already have Assisted Braking Systems, and the EU commission has announced that ABS should be mandatory on bikes from 2017. How safety systems such as ABS are considered by riders when purchasing a bike is unknown. What is also unknown is whether a rider would ride differently if they know that their bike has better braking capabilities.

Other countermeasures

Improve driver awareness of motorcycles

There were 16 collisions with this countermeasure. These collisions included those where a vehicle turned right across the path of the motorcyclist and also where an HGV turned left into the motorcyclist.

Education about riding whilst impaired by drugs and/or alcohol

This was recorded as a countermeasure in 15 cases. Further consideration needs to be given to the type of education or publicity that would be most effective at reducing the number of riders impaired by alcohol or drugs. Some publicity is carried out by DfT's THINK! campaign, but some additional resources targeted specifically towards motorcyclists in London may be useful.

Enforcement of riding without a licence/uninsured

There were 20 collisions with this countermeasure. As with other enforcement activity, it needs to be targeted. Education, training and publicity addressing unlicensed riding could also be considered.

Enforcement of drinking and riding

This was recorded as a countermeasure in 10 cases. As with enforcement of speed, drink-riding cannot be enforced in all locations and times, and needs to be targeted.

Improved conspicuity

This countermeasure was recorded for 9 collisions, in cases where an alert driver looked, but failed to see the motorcyclist. This was often coded for vehicles which turned across the path of a motorcycle, and in these cases the motorcycle was often speeding.

Education about roadworthiness of motorcycle

There were 8 collisions with this countermeasure. The roadworthiness defects were mainly related to tyres, both under-inflation and poor tread.

Secondary safety improvements

The most commonly reported secondary countermeasures, aimed at reducing the severity of the collision were 'introduce airbags for motorcycles' and 'speed enforcement'.

This research also showed that of the 84 motorcyclists wearing helmets 17 of them came off during the collision (3 motorcyclists were not wearing a helmet and 7 were unknown). Helmet displacement mechanisms are not understood, and it is unknown whether these riders would have benefitted if their helmet had not been displaced. There is enough evidence, however, to investigate further how riders acquire their helmets and maintain them. For example, are riders aware of the importance of helmet selection, in terms of comfort and safety, and do they wear and maintain their helmets correctly?

The potential for PPE to have provided additional protection and mitigated injury for fatalities is believed to be low, principally because of the high severity of the collision forces. However, that is not to say that PPE would not offer significant benefits for motorcyclists involved in non-fatal accidents, where the forces are lower and the potential therefore to prevent impact and friction related trauma is greater.

Summary

This project has used the rich detail contained in Police fatal files. Future projects could seek to complement this information with new sources to resolve gaps in the data. Detailed investigation of serious collisions involving motorcycles could also be undertaken.

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References

ACEM. (2004). *MAIDS. In-depth investigation of accidents involving powered two-wheelers. Final report 1.2.* Retrieved August 30, 2011, from European Comission: http://ec.europa.eu/transport/roadsafety_library/publications/maids_report_1_2_september_2004.pdf

Carsten, Fowkes, Lai, Chorlton, Janson, Tate, et al. (2008). *Intelligent speed adaptaion ISA-UK - Executive summary of project results.* University of Leeds for DfT.

Clarke, D. D., Ward, P., Bartle, C., & Truman, W. (2004). *In depth study of motorcycle accidents.* Retrieved October 2011, from Department for Transport: http://www2.dft.gov.uk/pgr/roadsafety/research/rsrr/theme5/indepthstudyofmotorcycleacc.pdf

DfT. (2004). *Instructions for the completion of road accident reports.* Retrieved October 2011, from http://www.dft.gov.uk/collisionreporting/Stats/stats20.pdf

DfT. (2010). *Reported Road Casualties Great Britain 2009.* London: The Stationery Office.

DfT. (2009). *Reported Road Casualties Great Britain: 2008 - Annual Report.* Retrieved October 2011, from Department for Transport: http://www2.dft.gov.uk/pgr/statistics/datatablespublications/accidents/casualtiesgbar/rrcgb2008.html

DfT. (2011). *Reported road casualties in Great Britain: annual report 2010.* Retrieved October 2011, from Department for Transport: http://www.dft.gov.uk/statistics/releases/road-accidents-and-safety-annual-report-2010

DfT. (2007). *Road Casualties Great Britain: 2006 - Annual Report.* Retrieved October 2011, from Department for Transport: http://webarchive.nationalarchives.gov.uk/+/http://www.dft.gov.uk/pgr/statistics/datatablespublications/accidents/casualtiesgbar/roadcasualtiesgreatbritain2006

DfT. (2008). *Road Casualties Great Britain: 2007 - Annual Report.* Retrieved October 2011, from Department for Transport: http://www2.dft.gov.uk/pgr/statistics/datatablespublications/accidents/casualtiesgbar/roadcasualtiesgreatbritain20071.html

Elliot, M. A., Baughan, C. J., Broughton, J., Chinn, B., Grayson, G. B., Knowles, J., et al. (2003). *Motorcycle safety: A scoping study. TRL report TRL581.* Crowthorne: TRL.

Gorell, R., & Sexton, B. (2004). *Performance of Safety Cameras in London: Final Report. TRL published project report.* Crowthorne: TRL.

Greater London Authority. (2010). *Mayor's Transport Strategy.* London: Greater London Authority.

Greenaway. (2004). *Uninsured Driving in the United Kingdon.* Retrieved October 2011, from DfT: http://www.direct.gov.uk/prod_consum_dg/groups/dg_digitalassets/@dg/@en/@motor/documents/digitalasset/dg_068758.pdf

Haddon Jr, W. (1999). *The changing approach to the epidemiology, prevention, and amelioration of trauma: the transistion approaches etiologically rather than descriptively* *based. Volume 5(3):231-235. Injury Prevention.* Retrieved July 21, 2011, from Pub Med Central: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1730511/pdf/v005p00231.pdf

Horswill, M. S., & Helman, S. (2001). *Motorcycle accident - a summary of EPRSC-funded project, EPSRC Fast Stream Grant (number GR/M94724).* University of Reading: Department of Psychology.

Huang, B., & Preston, J. (2004). *A literature review on motorcycle collisions: Final Report. University of Oxford Transport Studies Unit.* Retrieved October 2011, from Manitoba Public Insurance: http://www.mpi.mb.ca/PDFs/MotorcycleRiskStudy/Appendix%205.2%20Oxford%20Univ.pdf

Jamson, S., & Chorlton, K. (2004). *Differences between London motorcyclists and those from the rest of the UK, Institute for Transport Studies, University of Leeds.* Retrieved October 2011, from TfL: http://www.tfl.gov.uk/assets/downloads/london-motorcyclists-final-version.pdf

Keigan, M., Cuerden, R., & Wheeler, A. (2009). *Analysis of Police Collision files from Pedal Cycle fatalities in London 2001-06. TRL Published Project Repoer PPR438.* Wokingham: TRL.

Labbett, S., & Langahm, M. (2006). *What do drivers do at junctions? Paper given at 71st RoSPA Road Safety Congress, Blackpool.* RoSPA.

McCarthy, M., Hulshof, W., & Robinson, T. (2010). *Powered two wheeler integrated safety (PIsa) Final Report. TRL client report CPR668.* Crowthorne: TRL.

Smith, Gibson, & McCarthy. (2009). *Development of a methodology for the evaulation of safety systems for powered two wheelers: final report. TRL published project report PPR381.* Crowthorne: TRL.

TfL. (2008). *Casualties in Greater London during 2007.* Retrieved October 2011, from TfL: http://www.tfl.gov.uk/assets/downloads/casualties-in-Greater-London-during-2007.pdf

TfL. (2010). *Casualties in Greater London during 2009.* Retrieved October 2011, from http://www.pacts.org.uk/docs/pdf-bank/casualties-in-greater-london-during-2009.pdf

TfL. (2009). *Casualties in Greater London in 2008.* Retrieved October 2011, from TfL: http://www.tfl.gov.uk/assets/downloads/casualties-greater-london-2008.pdf

TfL. (2011a, May). *Casualties in Greater London in 2010.* Retrieved May 15, 2011, from TfL: http://www.tfl.gov.uk/assets/downloads/Cycling/casualties-in-greater-london-2010.pdf

TfL. (2011b). Travel in London. Report 4. Retrieved March 2012, from http://www.tfl.gov.uk/assets/downloads/corporate/travel-in-london-report-4.pdf

TfL. (2007). *Powered two wheeler user casualties in Greater London.* Retrieved 7 22, 2011, from Transport for London: http://www.tfl.gov.uk/assets/downloads/Powered_two_wheeler_casualties.pdf