CHARACTERISTICS OF FATAL MOTORCYCLE CRASHES INVOLVING EXCESSIVE AND/OR INAPPROPRIATE SPEED

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While previous research has determined that speed is a contributory factor in traffic crashes and that there is a relationship between speed and injury severity few studies have investigated the proportion of crashes that involve the contribution of excessive (defined as travelling over the speed limit) and inappropriate (for the conditions) speed. The current study aimed to: develop a method for determining the involvement of excessive and inappropriate speed from the information available in coroners records of fatal motorcycle crashes; apply this method to determine the proportion of motorcycle fatalities that involved excessive and/or inappropriate speed; and apply the Safe System framework to investigate the contribution of the road-user, the motorcycle and the environment to the crash, and how these factors related to excessive and inappropriate speed involvement. The National Coroners Information System (NCIS) and the VicRoads Road Crash Information System (RCIS) were linked and used to identify 200 motorcycle crashes which occurred during the period from July 2000 to December 2005. The frequency and proportion of motorcycle crashes which involved excessive and/or inappropriate speed were determined and the rider, vehicle and environment factors characteristic of speed-related crashes were ascertained. Potential countermeasures and avenues for further research are discussed.

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Preface

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Contents

Figures

Tables

EXECUTIVE SUMMARY

BACKGROUND

The Monash University Accident Research Centre (MUARC) was awarded a tender by VicRoads to investigate the role of speed and speeding in motorcycle crashes. Travel speed is acknowledged as a road safety risk factor – an increase in speed generally increases the likelihood of a crash due to a reduction in the time available to spot, interpret and react to a hazard. A crash at a higher speed is also likely to result in more injuries as well as an increased severity of any injury that does occur. In that sense, speed can be considered a contributory factor and the absolute travel speed at the time of the crash is the primary variable of interest.

While they are often used interchangeably in the literature, the term “excess speed” is generally used to denote travelling at a speed in excess of the prevailing speed limit and the term “inappropriate speed” indicates travelling at a speed unsuitable (or unsafe) for the prevailing conditions and road environment, or exceeding the capabilities of the driver, or exceeding the tolerances of the vehicle and its equipment. It is possible to exceed the speed limit but not be travelling at an unsafe speed on a well-engineered road, and it is possible to travel at an inappropriate speed within the speed limit. However, in many road environments, both rural and urban, a driver travelling in excess of the speed limit is also likely to be travelling at an inappropriate speed.

Speed as a crash risk factor is particularly pertinent for motorcycles and motorcycle riders. In many instances the quick acceleration and manoeuvrability, if not high speed, are features that attract many to motorcycling, especially leisure riders. But those very same features result in a smaller margin for error than might apply to most other vehicles, and the relative lack of protection offered when a crash does occur means that crash outcome is likely to be more severe for a motorcyclist involved in a crash.

Exceeding the speed limit and travelling at a speed inappropriate for the prevailing conditions can coincide or occur independently. Both increase the likelihood of being involved in a crash and increase the severity of a crash that does occur, for motorcycle riders and drivers. However, it is difficult to reliably separate these factors in crash investigations with certainty.

While previous research has determined that speed is a contributory factor in traffic crashes and that there is a relationship between speed and injury severity, few studies have investigated the proportion of crashes that involve the contribution of excessive (defined as travelling over the speed limit) and inappropriate (for the conditions) speed. The current research has addressed this question.

AIMS

The aims and objectives of the study were:

1. To develop a method for determining the involvement of excessive and inappropriate speed from the information available in coroners records of fatal motorcycle crashes.

2. To apply this method to determine the proportion of motorcycle fatalities that involved excessive and/or inappropriate speed.

3. To apply the Safe System framework[1] to investigate the contribution of the road-user, the motorcycle and the environment to the crash, and how these factors related to excessive and inappropriate speed involvement.

METHOD

Two existing data sources, the National Coroners Information System (NCIS) and the VicRoads Road Crash Information System (RCIS), were linked and used to identify 200 fatal motorcycle crashes which occurred during the period from July 2000 to December 2005. The frequency and proportion of motorcycle crashes which involved excessive and/or inappropriate speed were determined by reviewing the records for each crash. Initially, the involvement of excessive and inappropriate speed in each crash was judged from the coroner's comments in the findings. In cases where there was no strong statement in the NCIS documents regarding the involvement of excessive or inappropriate speed, a member of the research team with experience in crash investigation judged the involvement of speed from evidence available in the crash reports, such as the length of brake marks, slide marks, ejection distance, the geometry of the crash site, reported weather conditions, knowledge of the vehicles involved, and other crash circumstances. Following this, analytical comparisons were made to determine if crashes involving excessive speed differed from crashes not involving excessive speed in terms of the rider, vehicle and environment factors noted. The same comparisons were made for crashes involving inappropriate speed.

RESULTS

There were 115 (57.2%) crashes in which the riders' speed relative to the speed limit could be confidently judged. Of these 115 crashes, almost half (56; 48.7%) involved excessive speed, that is, the rider was travelling faster than the speed limit. Whether or not the rider's speed was inappropriate for the conditions was confidently judged for 135 (67.2%) crashes. Of these 135 crashes, more than two-thirds involved inappropriate speed for the conditions (95; 70.4%). The number of cases where excessive or inappropriate speed could and could not be judged is shown in Table 1.

Table 1. Binary classification of the involvement of excessive or inappropriate speed

		Excessive speed Frequency	Excessive speed Percent (% of known)	Inappropriate speed Frequency	Inappropriate speed Percent (% of known)
	Speed involved	56	27.9 (48.7)	95	47.3 (70.4)
	Speed not involved	59	29.4 (51.3)	40	19.9 (29.6)
	Total	115	57.2	135	67.2
Missing	not enough info	86	42.8	66	32.8
Total		201	100.0	201	

[1] The Safe System framework adopted for road transport in Australia notes the contribution of the road user, vehicle, and road environment and infrastructure on the occurrence of errors and the severity of the outcomes, and that effective countermeasures for road safety need to take these factors, and their interactions, into account.

Several individual rider, motorcycle, environment and crash characteristics were found to be related to excessive and/or inappropriate speed involvement. The magnitude of the association between these factors and speed involvement was determined using univariate logistic regression models. One of the limitations of univariate analyses is that the influence of each factor on excessive speed involvement is considered in isolation from each other. As some of the factors were correlated (e.g., marital status and age), multivariate logistic regression was conducted to simultaneously examine the relationship between a number of the potentially confounding characteristics. Of the rider characteristics, gender, marital status and rider experience were thought to be potentially correlated with age. There is also some mention in the literature that older riders are more likely to ride more powerful motorcycles, so the relationship between motorcycle engine capacity and speed involvement might also be confounded by age. As such, even though some of the univariate comparisons did not show a significant association between motorcycle engine capacity and speed involvement, this association was assessed, adjusting for age. Of the environment characteristics, there is likely to be some confounding between speed zone and location.

The association of various rider, motorcycle, environment and crash characteristics with excessive speed involvement is shown in Table 2, and for inappropriate speed involvement, in Table 3. Where necessary, potential confounders have been adjusted for.

Table 2. Factors associated with excessive speed involvement in a sample of fatal motorcycle crashes.

Risk Factor	**Excessive speed involved n [%]**	**Excessive speed not involved n [%]**	**Odds Ratio [95% CI]** ***Adjusted odds ratio***	**p-value**
RIDER				
Age - median [inter-quartile range]	27.5 [11]	39 [16]	**0.93 [0.90, 0.97]**	**<0.001**
Licence status				
Valid motorcycle licence held No valid motorcycle licence	22 [42.3] 15 [75]	30 [57.7] 5 [25]	1 **4.09 [1.29. 12.95]**	 **0.02**
Rider experience				
Experienced Inexperienced	1 [8.3] 5 [45.5]	11 [91.7] 6 [54.5]	1 9.17 [0.86, 97.7] *Adjusted for age* *4.97 [0.33, 74.7]*	 0.07 *0.25*
Marital status				
Married incl. de facto Not married	12 [27.9] 12 [54.6]	31 [72.1] 10 [45.5]	1 **3.10 [1.06, 9.05]** *Adjusted for age* *1.17 [0.29, 4.61]*	 **0.04** *0.83*
Alcohol				
Absent Present	34 [41.0] 18 [69.2]	49 [59.0] 8 [30.8]	1 **3.24 [1.27, 8.31]**	 **0.01**
BAC = 0 BAC > 0 and <0.05 BAC> 0.05 and <0.15 BAC>0.15	34 [41.0] 4 [66.7] 11 [84.6] 3 [42.9]	49 [59.0] 2 [33.3] 2 [15.4] 4 [57.1]	1 2.88 [0.50, 16.63] **7.93 [1.65, 38.07]** 1.08 [0.23, 5.14]	 0.24 **0.01** 0.92
MOTORCYCLE				
Engine capacity				
<=250 cc	7 [43.8]	9 [56.3]	1	

>250 cc	22 [71.0]	9 [29.0]	**3.14 [0.90, 11.03]** ***Adjusted for age*** ***7.37 [1.48, 36.66]***	**0.07** **0.02**
<=500 cc >500 cc	7 [41.2] 22 [73.3]	10 [58.8] 8 [26.7]	**1** **3.93 [1.11, 13.85]** ***Adjusted for age*** ***10.69 [1.96, 58.37]***	 **0.03** ***0.006***
Riding own bike				
No Yes	7 [100] 35 [44.9]	0 43 [55.1]	Cannot be computed	
ENVIRONMENT				
Speed zone				
<=70 km/h > 70 km/h	33 [75] 22 [31.4]	11 [25] 48 [68.8]	1 **0.15 [0.07, 0.36]** *Adjusted for location* ***0.31 [0.11, 0.90]***	 **<0.001** ***0.03***
Location				
City (incl. large town) Rural	41 [69.5] 15 [26.8]	18 [30.5] 41 [73.2]	1 **0.16 [0.07, 0.36]** *Adjusted for speed zone* ***0.33 [0.12, 0.93]***	 **<0.001** ***0.04***
CRASH				
No. of other vehicles involved				
0 1 2+	24 [63.2] 31 [44.9] 1 [12.5]	14 [36.8] 38 [55.1] 7 [87.5]	1 0.48 [0.21, 1.07] **0.08 [0.01, 0.75]**	 0.07 **0.03**
Fault of rider				
Not at fault Partially at fault Fully at fault	4 [16.7] 10 [71.4] 31 [51.7]	20 [83.3] 4 [28.6] 29 [48.3]	1 **12.50 [2.57, 60.7]** **5.34 [1.63, 17.51]**	 **0.002** **0.006**

Results in bold are those that met the conventional level for statistical significance (<0.05). Other results, where the p-value lies between 0.05 and 0.10 are also of interest).

Amongst the sample of fatally injured motorcycle riders, the following factors were significantly associated with being involved in a collision involving excessive speed:

- Age: On average, as rider age increased by one year, the odds of the fatal crash involving excessive speed decreased by 7%.
- Licence status: The odds of the crash involving excessive speed were increased by over three times if the rider did not have a valid motorcycle licence.
- Marital status: The odds of the crash involving excessive speed were increased by over two times if the rider was not married, however, once the confounding effect of age was taken into account, this association disappeared. That is, for fatally crashed riders of a given age, marital status is not related to excessive speed involvement.
- Use of alcohol: The odds of the crash involving excessive speed were increased by 224% if the rider had a positive alcohol reading. Looking at this in more depth, compared to those riders with a zero BAC, those with a BAC of between 0.05 and 0.15 were more likely to be involved in a crash involving excessive speed. However, riders with alcohol detected at levels less than the legal threshold (i.e. <0.05), and riders with very high BAC (over 0.15) did not differ from those with no alcohol detected in terms of the odds of the crash involving excessive speed.

- Motorcycle engine capacity: The odds of the crash involving excessive speed were increased if the engine capacity of the motorcycle was over 250 cubic centimetres (cc), although the univariate association was not significant. However, older riders were more likely to ride more powerful motorcycles, and so a multivariate model was used, adjusting for age. For riders of a comparable age, the odds of the crash involving excessive speed were over six times higher when the motorcycle was over 250cc. Likewise, for riders of a comparable age, the odds of the crash involving excessive speed were almost ten times higher when the motorcycle was over 500cc.
- Speed zone: The odds of the crash involving excessive speed were decreased in speed zones >70 km/h, compared to speed zones of 70 km/h or less. The effect of speed zone remained, even when the location (a potential confounder) was adjusted for. For a given location (i.e. urban or rural) the odds of the crash involving excessive speed decreased by 69% in speed zones >70 km/h, compared to speed zones of 70km/h or less.
- Location: The odds of the crash involving excessive speed were decreased in rural areas, compared to city areas (including large country towns), even when the speed zone (a potential confounder) was adjusted for. For a given speed zone, the odds of the crash involving excessive speed decreased by 67% in rural areas compared to city areas.
- Number of other vehicles involved: The odds of the crash involving excessive speed were decreased by 92% if there were two or more other vehicles involved, compared to when it was a single-vehicle collision.
- Fault: The odds of the crash involving excessive speed were increased if the rider was partially (odds 11.5 times higher) or fully (odds over 4 times higher) at fault, compared to when they were not at fault.

Other factors, while not reaching the conventional level of statistical significance, may also be of interest for further research because there are indications that they might increase the likelihood of the crash involving excessive speed.

- Rider inexperience, however, once the confounding effect of age was taken into account, this association disappeared.
- Compared to single-vehicle collisions, the odds of the crash involving excessive speed may be decreased if there is one other vehicle involved.

Riding someone else's motorcycle was also related to excessive speed involvement, however the magnitude of this association could not be computed. Time of day and the Defintion for Classifying Accidents (DCA) were also related. For those crashes where excessive speed could be judged, all crashes occurring between midnight and six am involved excessive speed compared to only 25% that occurred between six and nine am. In terms of DCA, a larger proportion of crashes classified as left off carriageway into object/parked vehicle and off right bend into object/parked vehicle involved excessive speed than for other crash types.

Table 3. Factors associated with inappropriate speed involvement in a sample of fatal motorcycle crashes

Risk Factor	Inappropriate speed involved n [%]	Inappropriate speed not involved n [%]	Odds Ratio [95% CI]	p-value
RIDER				
Gender				
Female Male	1 [25] 94 [71.8]	3 [75] 37 [28.2]	1 7.62 [0.77, 75.63] *Adjusted for age* *9.72 [0.96, 98.59]*	 0.08 *0.05*
Age median [iqr]	29 [16]	40 [15.5]	**0.96 [0.93, 0.99]**	**0.007**
Marital status				
Married incl. de facto Not married	25 [54.4] 23 [74.2]	21 [45.7] 8 [25.8]	1 2.42 [0.90, 6.51] *Adjusted for age* *0.89 [0.25,3.181]*	 0.08 *0.86*
Tetrahydrocannabinol (THC)				
Absent Present	64 [64.7] 19 [86.4]	35 [35.4] 3 [13.6]	1 3.46 [0.96, 12.53]	 0.06
MOTORCYCLE				
Engine capacity				
<=250 cc >250 cc	11 [61.1] 32 [86.5]	7 [38.9] 5 [13.5]	1 **4.07 [1.07, 15.50]**	 **0.04**
<=500 cc >500 cc	13 [65.0] 30 [85.7]	7 [35.0] 5 [14.3]	1 3.23 [0.86, 12.09]	0.08
Motorcycle registered				
Yes No	34 [65.4] 11 [91.7]	18 [34.6] 1 [8.3]	1 5.82 [0.70, 48.78]	 0.10
ENVIRONMENT				
Speed zone				
<=70 km/h > 70 km/h	43 [82.7] 51 [62.2]	9 [17.3] 31 [37.8]	1 **0.34 [0.15, 0.80]** *Adjusted for location* *0.52 [0.17, 1.58]*	 **0.01** *0.25*
Location				
City (incl. large town) Rural	57 [80.3] 38 [59.4]	14 [19.7] 26 [40.6]	1 **0.36 [0.17, 0.77]** *Adjusted for speed zone* *0.54 [0.20, 1.48]*	 **0.009** *0.23*
CRASH				
Cut off				
No Yes	67 [74.4] 26 [60.5]	23 [25.6] 17 [39.5]	1 0.53 [0.24, 1.14]	 0.10
No. of other vehicles involved				

0 1 2+	34 [79.1] 58 [69.9] 3 [33.3]	9 [20.9] 25 [30.1] 6 [66.7]	1 0.61 [0.26, 1.46] **0.13 [0.03, 0.64]**	 0.27 **0.01**
Fault of rider				
Not at fault Partially at fault Fully at fault	7 [28] 12 [92.3] 63 [79.8]	18 [72] 1 [7.7] 16 [20.3]	1 **30.86 [3.35, 283.81]** **10.13 [3.61, 28.39]**	 **0.002** **<0.001**

Results in bold are those that met the conventional level for statistical significance (<0.05). Other results, where the p-value lies between 0.05 and 0.10 are also of interest).

Amongst the sample of fatally injured motorcycle riders, the following factors were associated with being involved in a collision involving inappropriate speed:

- Age: As age increases by one year, the odds of the fatal crash involving inappropriate speed decreased by 4%.
- Motorcycle engine capacity: The odds of the crash involving inappropriate speed were almost three times higher if the engine capacity of the motorcycle was over 250cc. Unlike for excessive speed, this relationship was not confounded by age.
- Speed zone: The odds of the crash involving inappropriate speed were decreased in speed zones >70 km/h, compared to speed zones of 70 km/h or less. However, once the location of the crash (city or rural) was taken into account, this association disappeared.
- Location: The odds of the crash involving inappropriate speed were decreased in rural areas, compared to city areas (including large country towns). However, once the speed zone of the crash was taken into account, this association disappeared.
- Number of other vehicles involved: The odds of the crash involving inappropriate speed were decreased by 87% if there were two or more other vehicles involved, compared to when it was a single-vehicle collision.
- Fault: The odds of the crash involving inappropriate speed were increased if the rider was partially (odds almost 30 times higher) or fully (odds over 9 times higher) at fault, compared to when they were not at fault.

Several other factors, while not reaching the conventional level of statistical significance, may also be of interest for further research because there are indications that they might increase the likelihood of the crash involving inappropriate speed. These factors were:

- Gender (being male). This relationship became even stronger once age was adjusted for.
- Not being married, however this potential association disappeared once age was adjusted for.
- A positive THC result
- Riding a motorcycle that was not registered
- Riding a motorcycle with engine capacity greater than 500 cc.
- Being involved in a crash in which the rider was not cut off by another road user.

DISCUSSION

By combining and linking the National Coroners Information System and the VicRoads Road Crash Information System, this study has assimilated the most detailed information available for fatal motorcycle crashes that occurred in Victoria during a five year period. A wealth of information about the rider, the motorcycle, the road environment and characteristics of the crash itself was assembled. Having such comprehensive information enabled the application of the Safe System framework to investigate the contribution of these factors and how they are related to excessive and inappropriate speed involvement.

There were 115 (57.2%) crashes in which the riders' speed relative to the speed limit could be confidently judged. Of the 115 crashes, almost half (56; 48.7%) involved excessive speed, that is, the rider was travelling faster than the speed limit. Whether or not the rider's speed was inappropriate for the conditions was confidently judged for 135 (67.2%) crashes. Of these 135 crashes, more than two-thirds involved inappropriate speed for the conditions (95; 70.4%). It is impossible from the information provided to say with confidence whether or not excessive speed was involved in the other 85 crashes (involving 86 riders) or if inappropriate speed was involved in the other 65 crashes (involving 66 riders). There was simply not enough information provided in the coroners findings to judge speed involvement in these cases. As such, we cannot postulate whether the proportion of these cases with speed involved would be the same or different to the cases where there was enough evidence to make this judgement.

Potential solutions to reduce excessive or inappropriate speed will be multifactorial and complex and must be examined from the viewpoint of the motorcyclist rather than assuming that any measure that is effective for a car driver is bound to be effective for a motorcycle rider. Countermeasures can be grouped into three areas – those aimed at the rider, those targeting the motorcycle and associated equipment, and those focused on the road environment.

Targeted education through rider-specific anti-speeding advertising may be useful, especially to make it clear that anti-hooning legislation means that motorcycles can be impounded and forfeited. Remedial training and/or a demotion in licence status could be trialled for speeding recidivists. Pre- and post-licence training could be modified to include a greater insight component, which aims to reveal a rider's misperceptions about their own abilities. Refresher insight courses could be required at each licence renewal and encouraged for those considering purchasing a more powerful motorcycle.

Regular enforcement blitzes focusing on speed and unsafe riding behaviours (including inappropriate speed choice) may be effective. These blitzes could also focus on other factors identified in the study as being related to speed-involved crashes, such as licence checks, random breath testing and checking that riders are not riding motorcycles too powerful for their licence conditions. In addition, the blitzes could focus on roadworthiness, particularly tyre wear. Tyre checks could be required on an annual basis before renewing motorcycle registration.

Technology, such as alcohol interlocks and intelligent speed adaptation systems (ISA), could play a large part. Future development of GPS based ISA systems could involve programming the system to warn motorcycle riders of approaching known motorcycle blackspots, corners with an unsafe camber or bad cornering line, and display advisory speeds in the approach to bends or other hazards.

The Guide to Traffic Engineering Practice: Motorcycle Safety (Part 15) (Austroads, 1999) provides guidance for design, construction and maintenance of the road and the environment to maximise motorcyclist safety and should be actively championed, particularly at local council level for minor works and installation of services. Sealing of roadside shoulders increases the margin for error, provides a buffer zone within which a recovery attempt can be made, and minimises debris and gravel on the road. The installation of perceptual countermeasures, e.g. by seemingly narrowing the approach to a corner, may also be effective in reducing speed-related crashes.

The current study highlighted the need to improve and standardise the data that is collected regarding traffic crashes in Victoria. In conducting retrospective crash investigations, however, it is difficult to collect evidence on driver behaviour (particularly human error and the pre-conditions) prior to the crash. Driver behaviour and human error are likely to be related to speed-involvement in a crash. Prospective studies should be conducted to enable the study of these important factors. Two potential study methodologies are recommended. The first is a case-control study of motorcycle crashes involving in-depth examination of the crash scene to estimate crash speed and interviews with the rider to reveal the circumstances surrounding the appropriateness of the speed at the time of the crash, to compare with a random sample of non-crashed motorcycle riders. The second is a long-term naturalistic riding study, akin to the 100 car study conducted by Virginia Tech. Naturalistic studies enable investigations to study not only crash situations where things have gone irretrievably wrong, but situations in which the road-user was able to recover from potentially disastrous situations. This approach is in line with current research in human error, in which the recovery from human error and avoidance of negative outcomes is a strong focus of research

BACKGROUND

The Monash University Accident Research Centre (MUARC) was awarded a tender by VicRoads to investigate the role of speed and speeding in motorcycle crashes. Previous research has determined that speed is a contributory factor in traffic crashes and that there is a relationship between speed and injury severity. However, few studies have investigated the proportion of crashes that involve the contribution of excessive (defined as travelling over the speed limit) and inappropriate (for the conditions) speed. The current research has addressed this question. First, a review of previous crash studies and in-depth case studies was conducted. National and international experts were also consulted to identify pertinent studies, and methods for assessing speed involvement in motorcycle crashes. Secondly, two existing data sources, the National Coroners Information System (NCIS) and the VicRoads Road Crash Information System (RCIS), were linked and used to identify 200 motorcycle crashes that occurred during the period from July 2000 to December 2005. The frequency and proportion of motorcycle crashes involving excessive and/or inappropriate speed was determined, and rider, motorcycle and environmental factors related to speed involvement were identified.

1. PREVIOUS AND ONGOING RESEARCH

1.1 LITERATURE REVIEW

Motorcyclists are one of the most vulnerable road user groups. They are over-represented amongst road user fatalities, representing 14% of road fatalities in 2006 despite comprising only 3% of registered vehicles in Victoria (VicRoads, 2007). To determine what is known about the role of speeding in crashes and the relationship to injury severity, a literature review was conducted. Academic and scientific databases including Medline, PsycINFO and RoadLit and the World Wide Web were searched for relevant research.

1.1.1 Speed as a risk factor for traffic crashes

Travel speed is acknowledged as a road safety risk factor – an increase in speed generally increases the likelihood of a crash due to a reduction in the time available to spot, interpret and react to a hazard. A crash at a higher speed is also likely to result in more injuries as well as an increased severity of any injury that does occur. In that sense, speed can be considered a contributory factor and the absolute travel speed at the time of the crash is the primary variable of interest. Whether a particular travel speed *causes* a crash is a more complicated question.

While they are often used interchangeably in the literature, the term "excess speed" is generally used to denote travelling at a speed in excess of the prevailing speed limit (although there are notable exceptions identified later, highlighting the need for caution when using the terms), and the term "inappropriate speed" indicates travelling at a speed unsuitable (or unsafe) for the prevailing conditions and road environment, or exceeding the capabilities of the driver, or exceeding the tolerances of the vehicle and its equipment. For instance, travelling at the speed limit of 100 km/h on a particular section of rural highway may be significantly less safe at dusk due to the increased possibility of animal incursion, or after drenching rather than light rain, or at night compared with daylight conditions, etc. It is possible to exceed the speed limit but not be travelling at an unsafe speed on a well-engineered road, and it is possible to travel at an inappropriate speed within the speed limit. However, in many road environments, both rural and urban, a driver travelling in excess of the speed limit is also likely to be travelling at an inappropriate speed.

One important reason excess and inappropriate speed are used interchangeably is the difficulty in identifying and separating them as risk factors (whether causal or contributory) during a crash investigation. Inappropriate speed in particular can be transitory, for example, weather conditions can change quickly and a rider or driver's level of alertness or vigilance can vary moment to moment due to a number of factors, and need not always reliably decrease with time spent driving. Lack of knowledge about the rider or driver's familiarity with the particular section of roadway and the vehicle in question may also complicate assigning inappropriate speed as a crash factor – both high and low familiarity can be problematic if the rider or driver was complacent or not expecting a particular hazard, respectively. Patterns of skid marks as part of a crash reconstruction and eyewitness statements can lead to a conclusion that the vehicle was travelling in excess of the prevailing speed limit, but a myriad of variables can determine whether the speed was inappropriate. In relation to motorcycles specifically, eyewitnesses "almost always overestimated motorcycle speeds, usually by 30% to 50% and other vehicles drivers often…said it came out of 'nowhere'" (Hurt, Ouellet & Thorn, 1981, p.25).

Speed as a crash risk factor is particularly pertinent for motorcycles and motorcycle riders. In many instances the quick acceleration and manoeuvrability, if not high speed, are features that attract many to motorcycling, especially leisure riders. But those very same features result in a smaller margin for error than might apply to most other vehicles, and the relative lack of protection offered when a crash does occur means that crash outcome is likely to be more severe for a motorcyclist involved in a crash.

1.1.2 Rider attitudes and behaviours related to speed

Clarke, Ward, Bartle and Truman (2004) conducted a survey of motorcyclists' opinions and attitudes towards crash risk factors and safe riding behaviours. One clear finding was the recognition by riders that there is a difference between exceeding the speed limit and riding too fast for the conditions. Of their 147 respondents, 80% considered observing the speed limit as one of the least important safety measures a motorcyclist can take; 58% always or frequently broke the speed limit, and the rest admitted to occasionally breaking the limit when they thought it was safe to do so. All of their rider respondents were prepared to speed. However, a quarter of all respondents said that riding "too fast for conditions" was a major cause of accidents.

Motorcyclists often report exceeding the speed limit, and willingly admit that travelling at speed is part of the thrill and challenge of riding a motorcycle, and indeed may not perceive such behaviour as particularly risky (Natalier, 2001). Consistent with the search for a thrill, Alway and Poznanski (2004) found that riders involved in fatal or serious injury crashes on straight sections of road were less likely to have exceeded the speed limit than riders who crashed on corners[2]. Sexton, Baughan, Elliot and Maycock (2004) found that getting pleasure from motorcycling and a liking for speed were both predictors of crash involvement.

1.1.3 Crash investigations

Clarke et al. (2004) conducted an in-depth study of 43 fatal, 520 serious injury and 1227 "other" motorcycle crashes in which the terms excessive speed, inappropriate speed and simply "speeding" were used interchangeably. From 1,790 crash investigations, travelling in excess of the speed limit was deemed to be a contributory factor in 3.5% of crashes, and "misjudging the appropriate speed for the conditions" (p. 35) was a contributory factor in another 5.6% of crashes where the speed limit was not actually broken. Overall, speed was directly implicated in just 9.2% of motorcycle crashes. A common speed-related crash, and the most common cause of single-vehicle motorcycle crashes in Clarke et al.'s study, resulted from riders misjudging the appropriate speed to negotiate a bend in the road.

In a prospective study of crash data, Mosedale and Purdy (2004) defined excessive speed as "either excessive for the conditions / location or exceeding the speed limit. These researchers believed it was not possible to differentiate between these two aspects" (p.1). As part of crash investigations, police forces across Britain noted what they considered was the principal "precipitating factor" of the crash and any attendant "contributory factors". A precipitating factor was a key action or failure without which the crash was not likely to have occurred, while contributory factors were those that caused the precipitating factor. Precipitating factors for which excessive speed was noted as a contributory factor included

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[2] Alternatively, given that Alway and Poznanski's (2004) statistics are for crashed riders, the high speeds of crashed riders on corners compared with straight sections of road may reflect a lack of skill or attention and be an inadvertent excess of speed rather than an intentional act to increase the thrill of the ride.

following too close, aggressive driving, reckless behaviour, etc. For crashes involving motorcycles, excessive speed was recorded as a contributory factor in 13% of all crashes and 40% of fatal crashes.

In Haworth, Smith, Brumen and Pronk's (1997) case-control study of 222 motorcycle crashes, 23% were judged to have involved inappropriate speed (although they referred to it as "excessive speed" for the conditions). Inappropriate speed contributed to 35% of single-vehicle crashes and 17% of multi-vehicle crashes, to 48% of crashes in which the rider had a BAC reading greater than zero and 25% of crashes with a zero BAC level. It also contributed to 25% of crashes in which the rider was aged less than 25 years and 15% of crashes in which the riders was 35 years and over.

Shankar (2001) reported ten years (1990-1999) of single vehicle crashes involving motorcycle fatalities that included whether the motorcycle was speeding at the time of the crash (it is assumed that in this instance that "speeding" refers to exceeding the speed limit rather than inappropriate speed, though insufficient detail is provided to be certain). On average, in 58% of fatal crashes the rider was speeding, compared with 41% of cases in which speeding was not noted (the remainder were unknowns).

It is difficult to draw conclusions from this research about the separate roles of excessive and inappropriate speed in motorcycle crashes, due to the different definitions of speeding that were used. However, although the previous estimates of the proportion of motorcycle crashes that involve speed vary, one thing is clear. Fatal motorcycle crashes are more likely to involve speed than non-fatal crashes.

Crash investigations that considered fault/blame

Due to the potential attractions of speed and acceleration for motorcycle riding, it is worthwhile attempting to ascertain who is primarily at fault for crashes involving motorcycles and for which crashes excessive speed has been identified as a crash factor.

From an in-depth motorcycle crash investigation study of 47 crashes in Victoria, Alway and Poznanski (2004) determined that in 77% of cases the rider was at fault or the "primary agent of the collision"; it is not known whether this figure includes single-vehicle crashes where the rider *must* be the "primary agent". Accordingly fault, meaning liability, may be less for multi-vehicle crashes. "Speeding", assumed to be exceeding the speed limit, increased the chance of being at fault 12-fold. The average pre-impact speed of those riders deemed to be at fault was 83 km/h, compared with 69 km/h for riders not at fault. Interestingly, all non-fault crashes occurred in metropolitan areas. If "at fault" includes single-vehicle crashes, then this finding may reflect the increased likelihood of a single-vehicle crash on rural roads.

In Mosedale and Purdy's (2004) UK study, excessive speed contributed to a greater proportion of crashes precipitated by "two-wheeled motor vehicles" (motorcycles, mopeds, etc.) than it did to all crashes involving motorcycles. Excessive speed as a crash factor was more likely to apply to younger drivers and riders, and to larger capacity motorcycles which, according to the authors, are more popular amongst older riders.

Lynam, Broughton, Minton and Tunbridge (2001) also considered speed as a crash factor in a database of 717 fatal crashes. As an indication of fault, they assigned the precipitating factor noted for the crash to one of the crash parties. In cases for which the precipitating factor was assigned to the motorcyclist the rider's speed was "known" (though that information may have come from a range of sources, including witness statements) at the time of the crash in 65% of cases; when the precipitating factor was assigned to another party (including pedestrians), the speed of the motorcyclist was known for 74% of cases. Figure 1.1 contains a speed distribution for the motorcyclist travelling speed at the time of the crash, differentiating between whether the precipitating factor had been assigned to the motorcyclist or the other party. Note that "speed" can not be a precipitating factor (rather it can be assigned as a contributory factor).

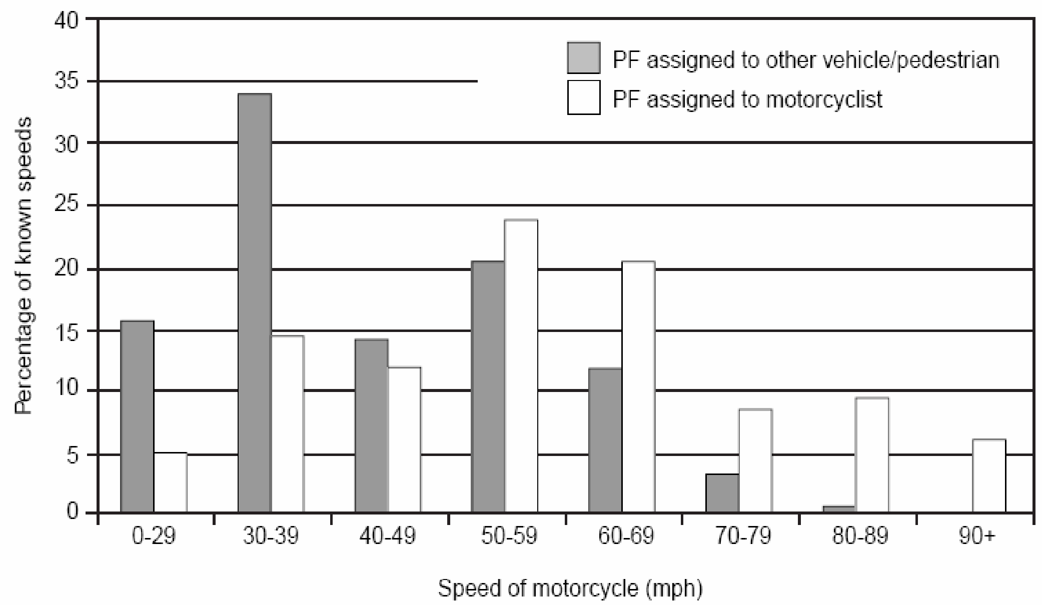

Figure 1.1. Whether the speed of the motorcycle or other vehicle was the crash precipitating factor (PF) as a function of the motorcycle speed at the time of the crash (from Lynam et al, 2001).

Figure 1.1 demonstrates that at speeds lower than 80 km/h (50 mph) the motorcyclist was less likely than the other party to be at fault (ie be assigned the crash precipitating factor), whereas when the rider's speed at the time of the crash was greater than 80 km/h the motorcyclist's actions were more critical. In the cases where the motorcyclist was assigned responsibility for the crash their mean speed was 91 km/h (57 mph), and the average speed of the motorcycle when the other party was primarily responsible was 69 km/h (43 mph). The counterpart average crash speeds for cars and larger vehicles were 54 km/h (34 mph) for other vehicles when the motorcyclist was deemed responsible, and 45 km/h (28 mph) for motorcycles when the other vehicle was responsible for the crash.

Clarke et al (2004) determined that motorcyclists were primarily blameworthy for around half of the crashes they had been involved in. This is a larger proportion than reported by the Association of European Motorcycle Manufacturers (ACEM, 2004) in the Motorcycle Accident In-Depth Study (MAIDS), in which the rider was found to be responsible for 37% of crashes, while the driver of the other vehicle was found to be the primary contributing factor in 50% of crashes, and the remainder made up of the environment, vehicle and other failure (ACEM, 2004). According to Haworth, Smith, Brumen and Pronk (1997), the motorcycle rider contributed to around two-thirds of crashes involving another vehicle.

According to Hurt et al's (1981) motorcycle crash investigation study, the most common offence being committed by riders at the time of their crash was exceeding the speed limit, which occurred in 16% of the cases (144 crashes). In 1.4% of cases the other vehicle was exceeding the speed limit. Although not specific to motorcyclists, Cooper (1997) found that licence holders with convictions for exceeding the speed limit or travelling at an inappropriate speed were more likely to be involved in a crash than others who had either no convictions or those with other types of driving convictions. Alway and Poznanski (2004) found that crashed Victorian motorcyclists who were deemed to be at fault in their crash tended to have more traffic infringements than those not at fault.

Lardelli-Claret, Jiménez-Moleón, de Dios Luna-del-Castillo, García-Martín, Bueno-Cavanillas, and Gálvez-Vargas (2005) analysed crashes involving two vehicles where one was a motorcycle, and in which one of the drivers/riders could be ascribed primary responsibility for the crash. In a logistic regression analysis covering a range of variables, they found that inappropriate speed for the road or traffic conditions was the best predictor of the risk of causing a collision, for both mopeds and motorcycles. Travelling at excess speed (i.e. breaking the speed limit) was also associated with an increased risk of a crash, but not to the same extent. They also found that these speed factors explained all of the increase in risk for males – that being female was no longer protective when the speed variables were removed from the analysis.

Crash investigations in which speed differential between the motorcycle and other traffic was considered

The MAIDS project (ACEM, 2004) involved a case-control in-depth investigation of 921 powered two-wheeler (PTW) crashes and 923 controls across five European countries. Their definition of a powered two-wheeler included mopeds and the like. (Given the focus of the current project, where ACEM supplied statistics for motorcycles separately from mopeds etc they will be noted.) The majority of crashes took place in urban environments (72% overall, and 62% for motorcycles only), and so travelling and impact speeds were not likely to be in "free speed" conditions. Additionally, the speed limits at crash locations were predominantly 30-60 km/h, possibly reducing the applicability of the results somewhat to the current project, "There were relatively few cases in which excess speed was an issue related to accident causation" (p. 9). Additionally, travel speed was not included as a control comparison variable and the speed limits at the crash location were also not provided.

In 72% of the MAIDS cases the motorcycle was considered to be travelling at a "normal" speed relative to the surrounding traffic or travelling without any other traffic (ACEM, 2004). In 21% of cases the speed difference was deemed to have contributed to the crash, and in the remaining 7% of crashes the speed was considered "unusual" but not a contributing factor. This speed could be higher or lower than the speed of the surrounding traffic. In 13% of crashes in which another vehicle was involved, that other vehicle was travelling at a speed higher or lower than the surrounding traffic, and in 5% of cases the speed difference was a contributing factor (note that these figures include moped crashes). Three-quarters of the PTW crashes occurred at speeds below 50 km/h, and only 5% of impacts were at speeds of 100 km/h or more.

1.1.4 Relationship between speed and crash risk

The likelihood of a crash also depends on speed relative to the surrounding traffic rather than just absolute travel speed. This may be particularly relevant to motorcycles given their potentially high acceleration rates and the practice of lane splitting and filtering, which involve a motorcycle sharing a lane with other vehicles travelling at a lower speed, or indeed stationary, in order to overtake them. In a summary report, DETR (2000) reproduced a figure from Taylor, Lynam and Baruya (2000) that shows the relative crash involvement of a driver travelling faster or slower compared to that of a driver travelling at the average speed (i.e. one with a relative speed of 1.0). Travelling at a speed 10% greater than the average would seem to increase risk (i.e. the number of crashes), ranging from a doubling to approximately 3.5 times (see Figure 1.2).

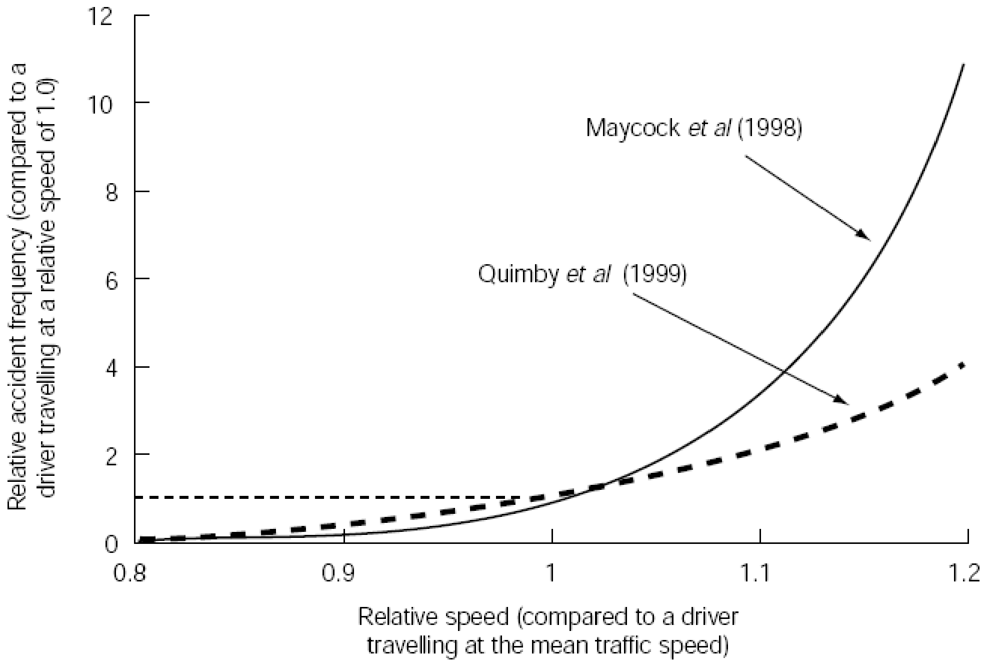

Figure 1.2. Relative crash frequency as a function of deviation from average traffic speed (from Taylor et al 2000, cited in DETR, 2000).

Figure 1.3 illustrates the relative risk of crash involvement as a function of speed deviation on a rural road. An increase in a vehicle's speed by 10 km/h doubles the risk, and at 20 km/h more the risk increases by a factor of six. They also note that, based on coroner's records, inappropriate speed (they called it excessive speed) is a causal factor in around 26% of fatal crashes (ATSB, 2004).

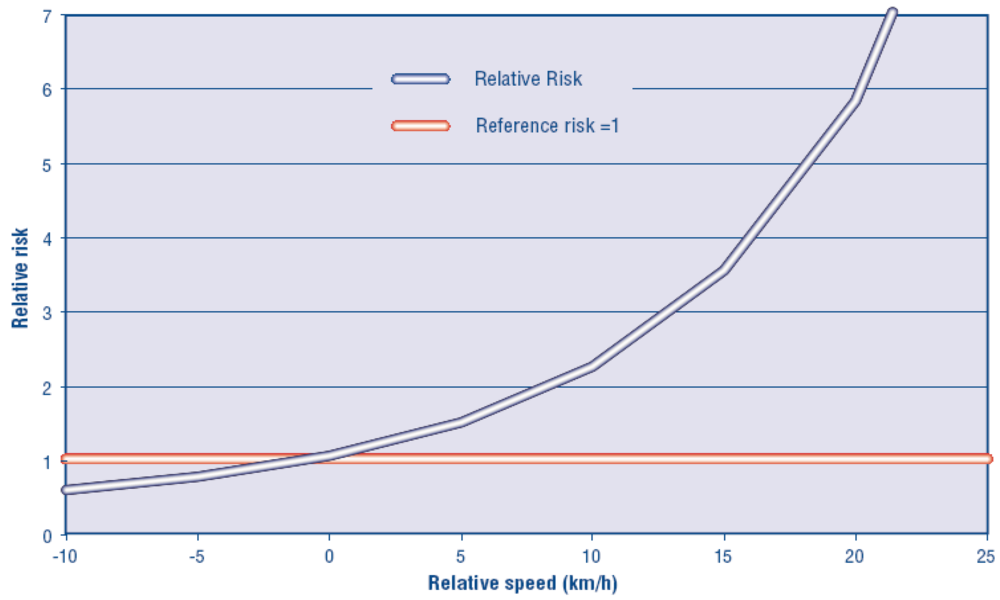

Figure 1.3. Relative risk based on change in speed for rural roads (from ATSB, 2004).

ERSO (2006) note that the complexity of the road environment also plays a part, such that risk curves start to climb earlier and more steeply as the number of intersections increases, traffic becomes heavier, pedestrians are more likely, etc. This can be seen in Figure 1.4, based on Australian data (Kloeden & colleagues, cited in ERSO 2006), which shows that the relative crash rate increases at a higher rate for urban roads than rural roads, even though speeds on the latter are likely to be higher.

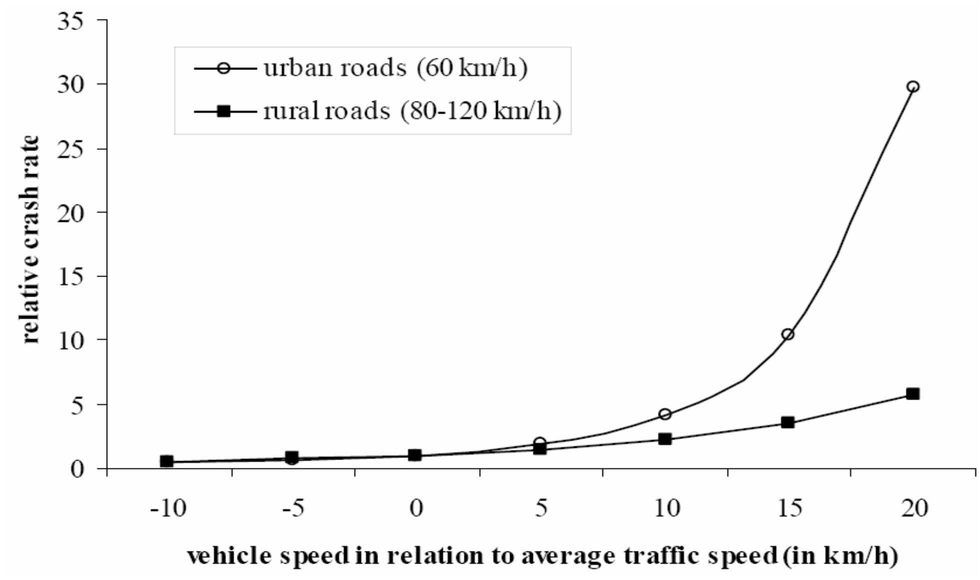

Figure 1.4. Relative crash rate as a function of relative traffic speed for urban and rural roads (from ERSO 2006, based on Kloeden & colleagues).

Andersson and Nilsson's (1997) model (reproduced in Figure 1.5) is also based on change in speed and separately plots fatal and injury crashes. It demonstrates that the probability of a fatal crash is related to the fourth power of the speed. ERSO (2006) note that according to this model a 1% change in speed would result in approximately a 2% change in injury crashes, a 3% change in severe injury crashes, and a 4% change in fatal crashes.

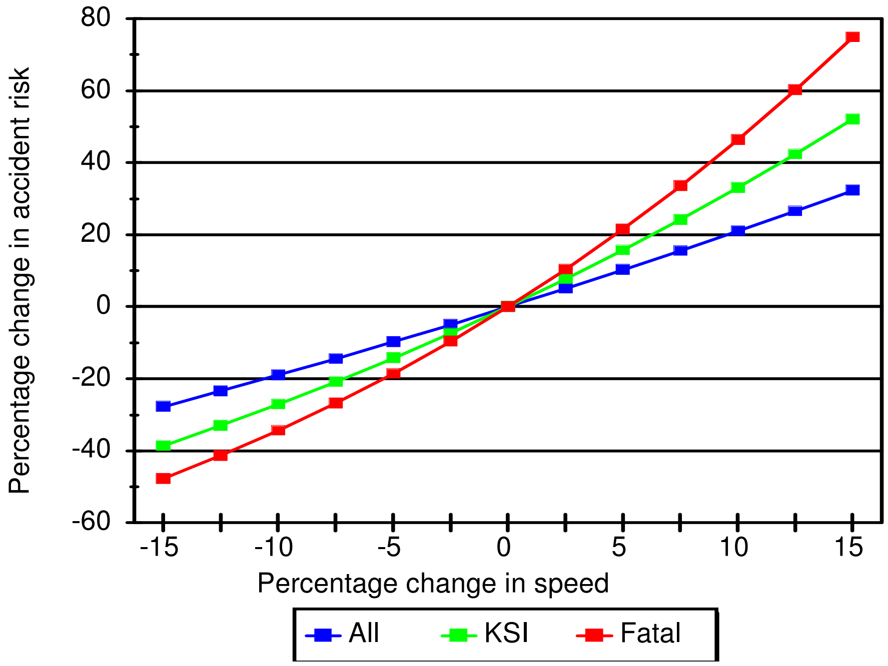

Figure 1.5. Percentage change in crash risk as a function of percentage change in mean speed (based on Andersson & Nilsson, 1997).(KSI = Killed and Serious Injury)

Neither Taylor et al's (2000) nor Andersson and Nilsson's (1997) models suggest the crash risk also increases when a vehicle's travel speed is *less* than that of the surrounding traffic. Wilmot and Khanal (1999) note that a speed variation, or speed dispersion, whether higher or lower than the rest of the traffic increases crash risk (see Figure 1.6).

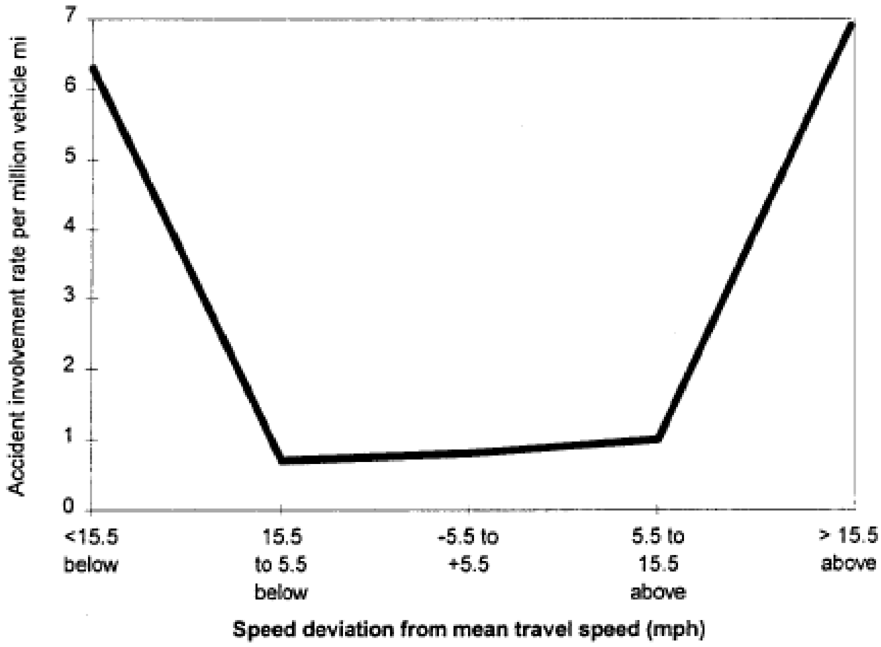

Figure 1.6. Crash involvement as a function of speed variation or dispersion in the traffic stream (from Wilmot & Khanal, 1999).

1.1.5 Relationship between speed and injury severity

Only two publications were found in which the relationship between speed and crash or injury risk was modelled or able to be derived specifically for motorcycles. Tominaga and Sakurai (2002) used logistic regression to determine the influence of a number of factors on motorcycle crash severity outcome, using the Maximum Abbreviated Injury Scale. Figure 1.7 demonstrates the probability of a minor injury (MAIS2+), serious injury (MAIS3+), and fatality or critical injury (MAIS 5+) occurring to the rider as a function of travel speed of the motorcycle and the speed of the opposing car. It can be seen that for both minor and serious injuries sustained by the rider, the speed of the motorcycle has a greater effect, but for fatal or critical injuries the speed of the opposing car is more important. A 25% chance of injury will be used to illustrate: there is a 25% chance of a minor injury if either the motorcycle or the car it impacts is travelling at around 30 km/h (note that the figure is in miles per hour and these speeds are estimated from the graphs), a 25% chance of a serious injury if the motorcycle is travelling at 45 km/h or the car involved in that crash is travelling at 56 km/h, and a 25% chance of the rider being killed or critically injured if the motorcycle is travelling at 100 km/h or the opposing vehicle is travelling at 85 km/h. These relationships were based on 509 crashes occurring in Hanover and Los Angeles.

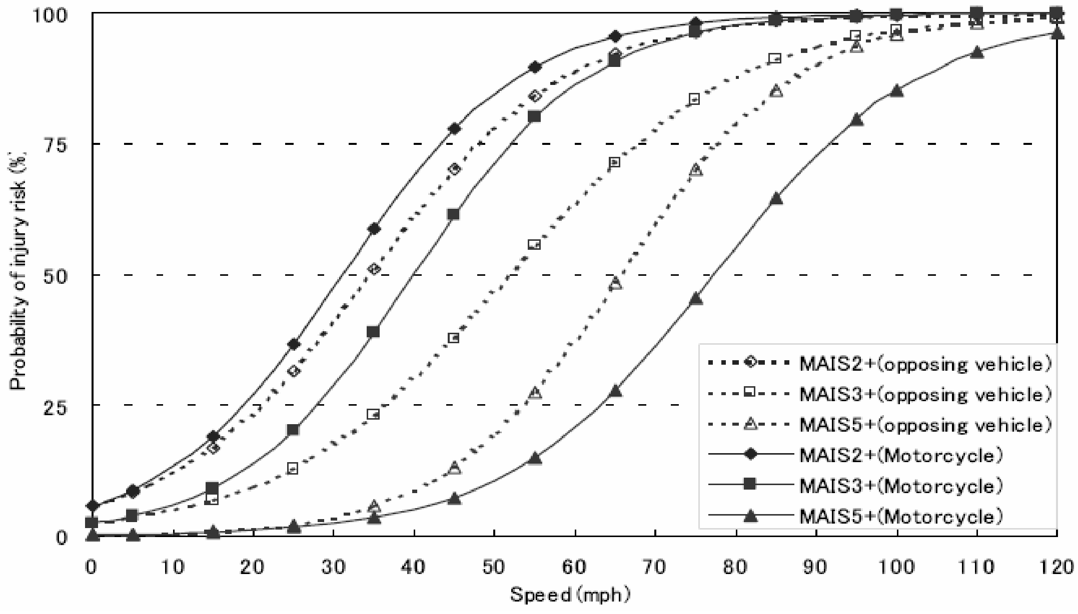

Figure 1.7. Relationship between injury risk (maximum abbreviated injury scale) for a motorcycle rider involved in a crash with a car, and the travel speed for the motorcycle and the opposing car (from Tominaga & Sakurai, 2002).

Given that a (unknown) proportion of Tominaga and Sakurai's (2002) crashes were taken from the Los Angeles crash database, it may be important to also report here the effect of helmet use, which they assessed for fatal and critical injury crashes. There is a 25% chance of an MAIS5+ injury when a helmeted motorcycle rider is travelling at 113 km/h. The speed required to achieve the same probability for a non-helmeted rider is 101 km/h (see Figure 1.8).

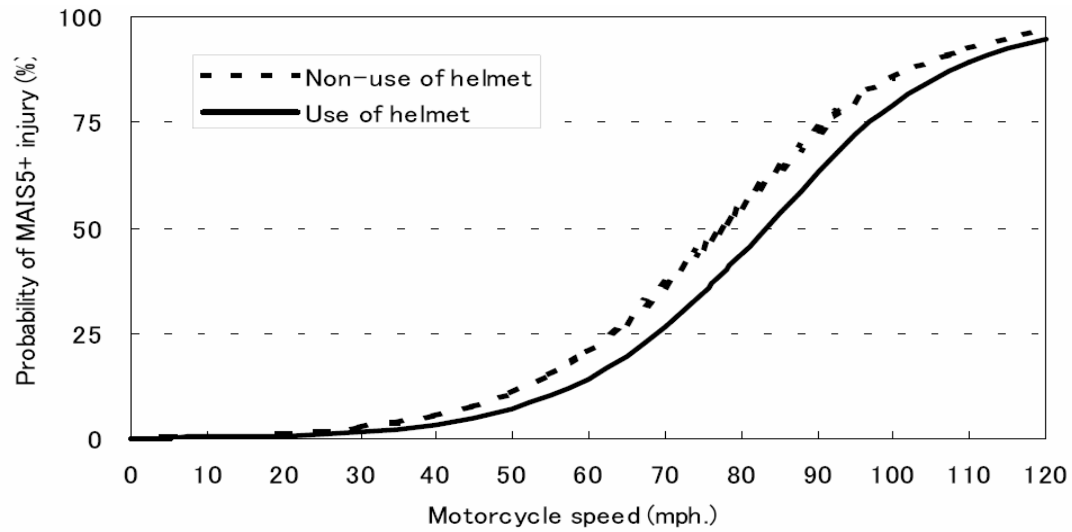

Figure 1.8. Relationship between injury risk (maximum abbreviated injury scale) for a helmeted or non-helmeted motorcycle rider involved in a crash with a car (from Tominaga & Sakurai, 2002).

The MAIDS report (ACEM, 2004) provides a table of the percentage of motorcycle crashes that were fatal at various speeds and these have been plotted in Figure 1.9. Consistent with Tominaga and Sakurai's (2002) modelling that showed that there was a 25% chance of the rider being killed or critically injured if the motorcycle was travelling at 100 km/h at the time of the crash, the MAIDS data also shows an approximately 25% chance of a fatality at speed from around 80 km/h to 100 km/h. The plot derived from the MAIDS data is not smooth at higher speeds due to the small number of crash cases collected at high speeds.

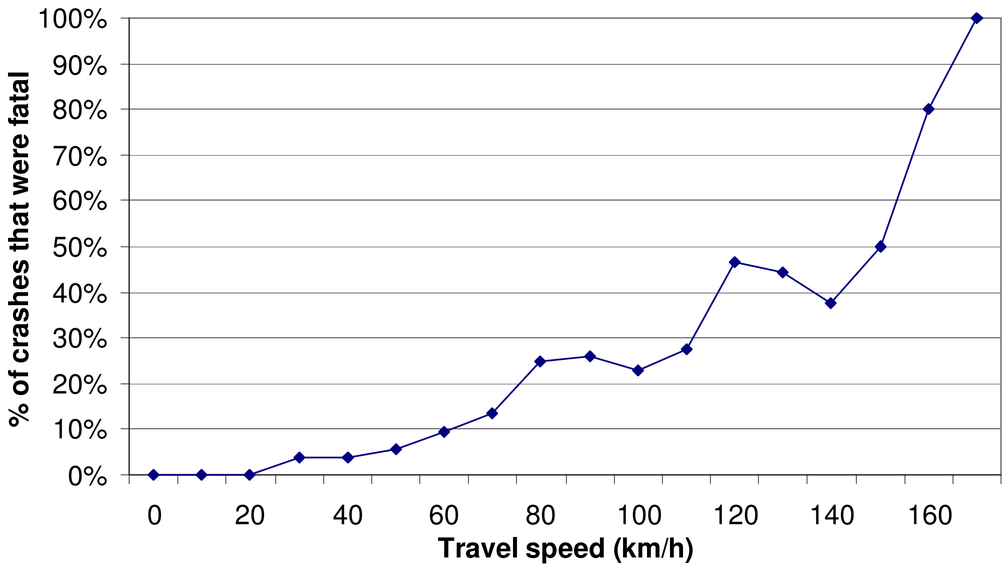

Figure 1.9. Percent of crashes that resulted in fatality as a function of travel speed (data from ACEM, 2004).

Due to their relative lack of protection it can be cogently argued that the injury risk for a motorcyclist is likely to be significantly higher than for a car occupant involved in a crash. It might be possible to take as a lower bound for such a relationship the risk to a pedestrian struck by a vehicle. DETR (2000) reproduced a figure from Ashton and Mackay (1979) that relates impact speed to pedestrian injury severity (see Figure 1.10). According to this model, there is a 50% chance of the pedestrian being killed at 50 km/h. However, according to more recent data (and therefore possibly involving cars that are more pedestrian-friendly), at 50 km/h the percentage of pedestrians killed range from around 3% to 20% depending on the age of the pedestrian (see Figure 1.11, taken from Leaf & Preusser, 1999), where older pedestrians are more likely to die from injuries sustained in a crash at a lower speed than younger pedestrians. According to Tominaga and Sakurai (2002), a travel speed of 100+ km/h is required for a 50% risk of a motorcyclist fatality.

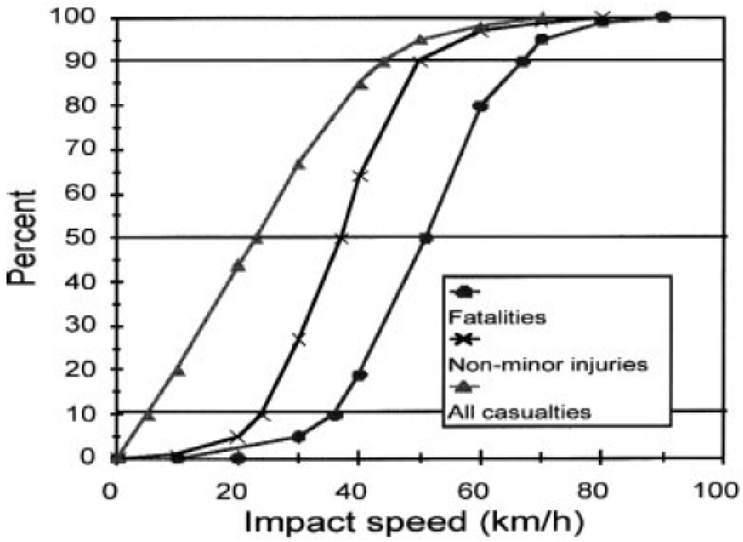

Figure 1.10. Probability of various pedestrian injury severities as a function of crash impact speed (Ashton & Mackay, 1979, cited in DETR, 2000).

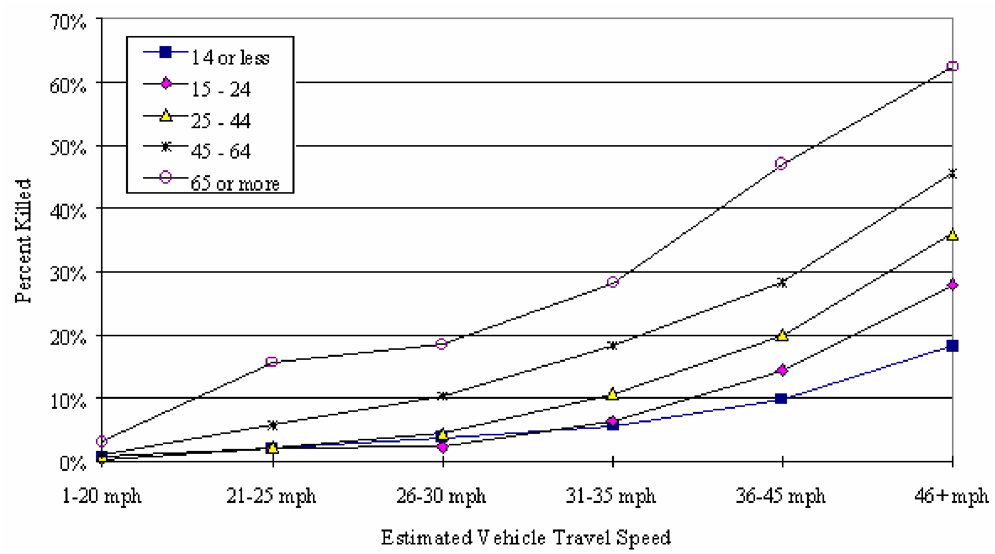

Figure 1.11. Percent of various age groups of pedestrians killed as a function of vehicle travel speed (from Leaf & Preusser, 1999).

1.1.6 Summary

Exceeding the speed limit and travelling at a speed inappropriate for the prevailing conditions can coincide or occur independently. Both increase the likelihood of being involved in a crash and increase the severity of a crash that does occur, for motorcycle riders and drivers. However, it is difficult to reliably separate these factors in crash investigations with certainty.

The high acceleration, speed and manoeuvrability of motorcycle riding attracts many to ride, and possibly encourages a significant proportion of riders to take advantage of these features. Riders travelling at speed, whether exceeding the limit or their limitations for the conditions, would seem to be more likely to be at fault in a crash.

At approximately 100 km/h there is a 25% chance of a rider dying as the result of a crash, and a 25% chance of a serious injury at 45 km/h. The risk of being involved in a crash, rather than suffering a certain injury level, must be based on models developed for car travel and will differ depending on a number of factors, including the complexity of the road environment, urban versus rural road, speed relative to traffic stream, and a number of individual variables, such as violation history.

1.2 CONSULTATION WITH AUSTRALIAN AND INTERNATIONAL EXPERTS

Literature reviews using traditional methods can fail to detect relevant research, for example, unpublished reports prepared for government or other organisations, and conference proceedings. In order to ensure that the literature review for this project covered as much relevant material as possible, organisations and individuals known to have worked in motorcycle safety research were consulted to identify research regarding the relationship between excessive and inappropriate speed and crash/injury risk for motorcycle riders. This was also taken as an opportunity to determine what methods the researchers were aware of, and recommended, to judge whether the speed of a motorcycle in a crash was inappropriate or excessive.

Thirty-four overseas and eight Australian/New Zealand motorcycle safety experts were contacted with the list of queries. The contact details of most of the overseas experts were obtained from the list of investigators of an EU project called 2-Wheeler Behaviour and Safety (2-BE-SAFE); a project with which MUARC is associated. Table 1.1 lists the investigators who were contacted.

Table 1.1 Investigators who were contacted for expert opinion

Name	Organisation/Country	Reply received
International		
Niccolò Baldanzini	UNIFI, Italy	No
Angelos Bekiaris	CERTH/HIT	No
Thierry Bellet	INRETS, France	No
Claudio Brenna	UNIFI, Italy	No
Mark Chattington	TRL, UK	**Yes**
Loic Courtot	Administrative co-ordinator of 2-BE-SAFE, ERT, France	No
Mauro Da Lio	Italy	No
Eric Dumont	France	No
Nikos Eliou	University of Thessaly, Greece	No
Christhard Gelau	Federal Highway Research Institute (BAST), Germany	No
Attila Gönczi	Romania	**Yes**
Elaine Hardy	Federation of European Motorcyclists' Association, UK	No
Tim Horberry	TRL, UK	**Yes**
Josef Krems	Germany	No
Jens Krzywinski	Germany	No

Lars Leden	Technical Research Centre of Finland, Finland	No
Paul Lemmen	Unknown	No
Roberto Lot	UNIPD, Italy	No
Maxime Moutreuil	CEESAR, France	No
Jim Ouellet	USA	**Yes**
Vuthy Phan	CEESAR, France	No
Marco Pierini	UNIFI, Italy	No
Ralf Risser	FACTUM, Austria	No
Peter Saleh	Arsenal Research, Austria	**Yes**
Bernard Schlag	TUD/TP, Germany	No
David Shinar	Ben Gurion University, Israel	No
Anabela Simoes	Portugal	No
Stéphane Espié	Scientific co-ordinator of 2-BE-SAFE, INRETS, France	No
Gail (surname unknown)	Federal Highway Research Institute (BAST), Germany	No
Geoff Underwood	University of Nottingham, UK	No
Jiri Vasek	Transport Research Centre, Czech Republic	No
Cavallo Viola	INRETS, France	No
Gert Weller	TUD/TP, Germany	No
Martin Winkelbauer	KfV (Austrian Road Safety Board), Austria	**Yes**
Australia/New Zealand		
Greg Allsop	Manager, Vulnerable Road Users, RTA, NSW	**Yes**
Trevor Bailey	DTEI, Transport SA	**Yes**
Liz De Rome	George Institute and Liz De Rome Consulting, NSW	**Yes**
Emma Hawkes	Office of Road Safety, DPC, WA	No
Narelle Haworth	Centre for Accident Research and Road Safety, QUT, QLD	No
Maree Hoyle	Department of Infrastructure, Energy and Resources, TAS	No
Matthew Yong	Strategic Planning team, Transport Qld	**Yes**
Anonymous	Land Transport, NZ	**Yes**

CEESAR – Centre Européen d'Etudes de Sécurité et d'Analyse des Risques; CERTH/HIT – Centre for Research and Technology Hellas/Hellenic Institute of Transport; ERT- European Research Transport; INRETS – The French National Institute for Transport and Safety Research; TRL – Transport Research Laboratory, UK; TUD/TP – The Faculty of Transportation Sciences of Dresden (Transportation Psychology); UNIFI – The Universita degli Studi di Firenze; UNIPD – Universita degli Studi di Padova

Six overseas experts, four Australians and Land Transport NZ replied to our request for advice. It was encouraging that the previous relevant research identified by the experts had already been discovered during the literature search phase, indicating that no major important studies had been overlooked. Of interest was the discovery of an ongoing Austrian study of 1100 court records of fatal crashes. The results pertaining to the motorcycle crashes were not available for inclusion in this report. Several researchers sent other documents related to motorcycle safety, which while of general interest, were not of direct relevance to the current issue.

Several respondents expressed general distrust in using the information available in crash databases with respect to speed being a contributing factor in a crash. One expressed the opinion that police often attribute motorcycle crashes to speed when no other cause is obvious (that is, blaming speed is seen as the default option). Another gave an example of a crash database in which any accident with certain keywords, such as "skid, swerve, slide" was coded as speed related. While this may be appropriate for crashes involving cars, it is often not the case for motorcycle crashes. It must be said however, that the researchers were not referring to the two information sources used in the current study specifically when making these comments, and there is no evidence that these practices are used when coding the data in either of these sources.

In terms of determining whether motorcycle speed was excessive or inappropriate from information available in existing data sources, there were a number of suggestions. Again, most were not applicable to the current study, but could be considered for future research. One respondent suggested mathematical modelling or using the available information on the crash, including road geometry, to simulate the crash using software such as PC Crash (http://www.dsd.at/PCCrash.htm). Two researchers were of the opinion that attending the crash site was the only way to perform such an investigation, although even then, an experienced crash investigator suggested that determining the speed of a motorcycle was as much an art as a science. Several other researchers noted the importance of using databases from in-depth crash investigations, or detailed accident reports, to determine the role of speed. Several European in-depth crash databases were identified which may be of use in future studies.

1.3 THE MUARC ENHANCED CRASH INVESTIGATION STUDY

1.3.1 The ECI Process

MUARC is currently conducting an Enhanced Crash Investigation (ECI) project, that collects in-depth data on serious injury crashes (defined as injury requiring hospitalisation for one night or more) by interviewing the driver/rider, accessing their medical records, examining the vehicle(s) involved, and inspecting the crash scene. Following post-collection analysis, the data is presented in de-identified format to a panel of local road safety stakeholders in the region in which the crash occurred. Panels are composed of the traffic engineers (VicRoads or local government) with responsibility for the section of road on which the crash occurred, representatives from the police and other emergency services, representatives from community road safety groups, and those with specialist knowledge which will aid consideration of a particular crash (for example if the crash involved a power pole, Powercor will be invited to attend). Where the crash involves a motorcycle, representatives from the Victorian Motorcycle Advisory Committee and riders organisations, such as Ulysses, attend. One of the objectives of the panels is to determine the factors which contributed to the occurrence of the crash (as a preliminary to determining actions to prevent similar crashes occurring in the future). Typically three contributory factors are determined per crash (range 1 to 7). These are subsequently categorised into predisposing factors (that made the crash more likely to occur) and precipitating factors (without which the crash would probably not have occurred).

1.3.2 Motorcycle crashes - Sample Description

To date, the ECI project has investigated 27 serious injury crashes involving motorcycle riders. All riders were male, with an average age of 42 years (range 19 to 66). Riding experience of the group ranged from a Learner who had had his Learner Permit for one week, through to an individual who had had accumulated 34 years of continuous riding experience. Average total years of riding experience was 13 (range 0 to 37) and average continuous years of riding experience was 8.4 (range 0 to 34). Twelve (44.4%) of the crashes occurred in rural locations and 15 (55.6%) occurred in urban areas. Nine (33.3%) of the crashes occurred on roads zoned at 50 or 60 km/h, five (18.5%) on roads zoned at 70 or 80 km/h, and the remainder (48.1%) occurred on roads zoned at 100 km/h. Ten (37.0%) of the crashes involved only the motorcycle, one (3.7%) of the crashes involved a rider who ran into a wallaby, and the remainder (59.3%) involved at least one other vehicle. Sixteen (59.3%) of the crashes occurred on weekdays, and 17 (63.0%) occurred in the spring or summer months. Seven crashes (25.9%) occurred in the morning, and the remainder (74.1%) occurred after midday. The majority (16; 59.3%) of the crashes occurred between midday and six pm. The motorcycles ridden ranged from a scooter with a power to weight ratio of 39kW/t through to a sports replica with a power to weight ratio of 450kW/t; the average ratio was 193 kW/t. The average Injury Severity Score (ISS) of the riders was 12.6 (range 4 to 36).

In the sample of 27 crashes described above, excessive speed by the rider was judged to be the precipitating factor in five crashes (18.5%), and inappropriate speed by the rider the precipitating factor in a further four crashes (14.8%). Combining these two categories, speed (either excessive or inappropriate) was thus judged to be a precipitating factor in a third of the motorcycle crashes.

1.3.3 Characteristics of Excessive Speeders in the Sample

The riders involved in crashes where their excessive speed (travelling faster than the speed limit) was judged to be the precipitating factor had a lower average age (34; range 19 to 51) than that of the whole group (42; range 19 to 66). On average, they also had both a lower total amount of riding experience (7.4 years; range 0 to 20) than that of the group as a whole (13.1 years; range 0 to 37), and a lower amount of continuous riding experience (2.7 years; range 0 to 10) than the whole group (8.4 years; range 0 to 34). The riders in this subset also tended to be riding bikes with a higher power to weight ratio (average 269kW/t; range 137 to 383kW/t) than the sample as a whole (average 193kW/t; range 39 to 450kW/t). The average ISS for the subset (11.4; range 5 to 19) was slightly lower than that for the whole group (12.6; range 4 to 36).

1.3.4 Characteristics of Inappropriate Speeders in the Sample

Similar characteristics were observed for the subset of riders whose choice of inappropriate speed for the conditions was judged to be the precipitating factor. Again, in comparison to the whole sample, average age (34; range 21 to 58) was lower, average total years of riding experience were lower (6.5 years; range 0 to 14), and average years of continuous riding experience were lower (3.1; range 0 to 8). As with the excessive speeders, the riders in this subset tended to be riding bikes with higher power to weight ratios (average 253kW/t; range 161 to 339kW/t). The average ISS for the subset (18.3; range 10 to 36) was also higher than that for the whole group.

1.3.5 Preliminary statistical comparisons

Preliminary statistical comparisons (two-sample t-tests for means with unequal variances) were conducted to determine whether the riders who were involved in crashes where speed (inappropriate or excessive) was a precipitating factor differed from riders involved in crashes where speed was not a precipitating factor, in terms of age, total years of riding experience, continuous years of riding experience, the power to weight ratio of the motorcycle and the ISS. The choice was made to pool the data from the crashes involving excessive and inappropriate speed because of the low numbers of either type of crash, in order to increase the power to detect any differences that might exist.

The riders in crashes where speed was a precipitating factor had fewer total years riding experience, $t(25)=2.36$, $p<0.03$, fewer continuous years of riding experience, $t(22)=2.58$, $p<0.02$, and more powerful motorcycles, $t(16)=-2.92$, $p<0.01$, than those riders involved in crashes where speed was not a precipitating factor. There was also a trend for these riders to be younger, although the standard level of statistical significant was not reached, $t(18)=2.04$, $p=0.06$. There was no significant difference in the ISS of the two groups of riders, $t(14)=-0.77$, $p=0.46$.

1.4 CONCLUSIONS BASED ON PREVIOUS RESEARCH

Quick acceleration and high manoeuvrability, and probably, high speed, are interacting features that attract many to motorcycling. However, these features also result in a smaller margin for error than might apply to most other vehicles, and the relative lack of protection offered when a crash does occur means that crash outcome is likely to be more severe for a motorcyclist involved in a crash. Speed is known to be related to the risk of having a crash, and the severity of injury given that a crash has occurred, however most of the research that has studied the role of speed in crashes has neglected to distinguish between speed that was excessive (i.e. over the speed limit) and speed that was inappropriate for the conditions. Those studies that have attempted to do so have not been consistent in how the judgement of whether the speed was excessive or inappropriate was made. Consultation with experts also failed to identify a consistent method.

The preceding section outlined the current state of knowledge about the role of speed (including excessive and inappropriate speeds) in motorcycle crashes and the relationship to injury severity. The contribution of factors other than speed, and their inter-relationships with speed were also considered. Although there is some information in the literature about contributing factors other than speed (e.g. alcohol and drug use, age, etc.), there are few studies that have attempted to identify the inter-relationships between these other factors, speed and crash risk.

The occurrence of human-errors in complex systems such as traffic almost always involves multiple errors and contributory factors at various levels of system operation. This has been established in other complex systems including aviation and medicine, whereby the role of both operator errors and other system failures (poor equipment design, substandard training procedures, etc) are noted. The Safe System framework adopted for road transport in Australia notes the contribution of the road user, vehicle, and road environment and infrastructure on the occurrence of errors and the severity of the outcomes. While human-error frameworks have been developed to guide incident investigation processes and to develop preventative programs in various other domains such as aviation, their application in road-transport has been largely neglected. As a result, relatively little is currently known about the different errors that road users make and their associated contributory factors.

Hence, there is a need to apply the systems-based approach to elucidate the relationship between other contributing factors and speed involvement in traffic crashes.

2. AIMS & OBJECTIVES

The aims and objectives of the current study are as follows:

1. To develop a method for determining the involvement of excessive and inappropriate speed from the information available in coroners records of fatal motorcycle crashes.

2. To apply this method to determine the proportion of motorcycle fatalities that involved excessive and/or inappropriate speed.

3. To apply the Safe System framework to investigate the contribution of the road-user, the motorcycle and the environment to the crash, and how these factors relate to excessive and inappropriate speed involvement.

3. METHOD

3.1 DATA SOURCES AND LINKAGE

3.1.1 National Coroners Information System (NCIS)

The NCIS database was one of the two data sources used for this study. It is an internet based storage and retrieval system containing information on Australian coronial cases and is managed by the Victorian Institute of Forensic Medicine (www.ncis.org.au). The NCIS contains up to four text documents for each case: a police summary of circumstances (a report prepared for the coroner within 24 hours of the incident), a toxicology report, an autopsy report and a coronial finding. The coronial finding often assimilates information discovered during investigations subsequent to the initial police report, and from an inquest if one was held. Some pre-coded information, including demographic data, medical cause of death and mechanism of death, is also available from the NCIS database, and can be requested in excel format.

3.1.1.1 NCIS search criteria

NCIS cases that met the following criteria were downloaded for review.

- Cases where the coronial investigation was complete
- The death occurred between 1st July 2000 and 31st December 2005
- The death occurred in Victoria
- The primary mechanism of injury was
    - Level 1: Blunt force
    - Level 2: Transport Injury Event
    - Motorcyclist/Motorcycle Rider

The NCIS documents and pre-coded information available for the cases that were identified using these search criteria were reviewed to determine if the cases met further selection criteria. These criteria were.

- Crash occurred on a public road
- Case died within 30 days of crash
- Case died from crash-related outcomes

The final sample of cases were the 205 most recent crashes identified through this search strategy. All of these cases occurred between 2001 and 2005.

3.1.2 Victorian road crash information system (RCIS)

The VicRoads Road Crash Information System (RCIS) is the traffic crash database for Victoria, Australia. The database is administered by VicRoads, and is based upon police reports of police-attended property damage crashes and casualty crashes that occur on public roads in Victoria. The State Coroner is also notified of all fatality crashes.

There is extensive information available about the person, vehicle and environmental factors involved in each crash. It includes information about the number of vehicles and individuals involved, the type of vehicles involved, the type of collision, when the crash occurred (time, day of week, etc.), BAC readings, initial point of impact, and pedestrian movements. The crash is classified according to the Definitions for Classifying Accidents (DCA). Information about the location of the crash is also available, and the VicRoads Road Network Database to provides details of the road infrastructure.

3.1.2.1 RCIS search criteria

The cases of interest were extracted from the RCIS using the following criteria. Initially, all crashes where the road user type was classified as a motorcyclist or pillion passenger or the vehicle type was classified as a motorcycle were selected. From this sample, the cases where the accident severity was classified as fatal were selected.

3.1.3 Database linkage

The NCIS and RCIS data were linked manually, using information available on the date of the crash, the street name and the age of the motorcyclist. Although it is possible to perform this task automatically using software, the researchers believed that a more accurate linkage would be possible with a manual approach, as this would allow for slight variations in data (e.g. a date that is one or two days different, or a mis-spelt street name or suburb). Considering the relatively small number of cases, this was a realistic and accurate method for the current project. Of the sample of 205 cases in the NCIS search, 203 (99.0%) were successfully linked with the RCIS database.

3.2 SELECTION OF DATA ITEMS AND DATABASE DEVELOPMENT

The data of interest for the present study were identified from previous research in the area of speed and motorcycle crashes combined with the research team's experience in applying a systemic framework for road safety research. Overall, the data of interest for this project can be categorized as crash and person characteristics (e.g. demographics, pre-crash risk factors, individual actions), vehicle factors and environmental factors.

The pre-coded data available from the NCIS and RCIS includes only a small proportion of the information required for the present study. Further information was obtained from the NCIS documents which were coded into a database devised specifically for this project. The Statistical Package for the Social Sciences (SPSS) software package was used for this purpose. A data dictionary was also developed.

3.3 DATA CODING

The data dictionary included a list of all the variables to be coded from the NCIS documents, the categories for each variable, and any coding rules pertaining to each variable. Any other information important for interpreting the data was also included, for example, details of motorcycle licence conditions in Victoria. The final version of the data dictionary also included information on the variables that were pre-coded by NCIS, and the RCIS variables that were used in this study.

Three researchers were involved in coding the cases. Double-data entry was performed for 106 of the cases to ensure accuracy. One researcher coded all of the cases, while the second researcher coded 87, and the third researcher coded a further 19 cases. Where discrepancies were identified between the coding of the cases with double-data entry, the original documents were consulted in order to determine the correct circumstances. Overall, the coding of the data across different researchers was consistent.

It is worth noting that the individual, motorcycle and environmental characteristics of the crash were coded independently of knowledge of the outcome of interest (speed involvement).

3.4 JUDGEMENT OF EXCESSIVE AND INAPPROPRIATE SPEED

The information available in the NCIS documents was used to determine whether excessive or inappropriate speed was involved in the crash. Initially, one researcher judged excessive and inappropriate speed involvement separately, using the following scale:

- Definitely involved
- Probably involved
- Possibly involved
- Possibly not involved
- Probably not involved
- Definitely not involved
- Not noted

A rating of “definitely involved” was given for cases where the coroner stated that excessive or inappropriate speed for the conditions was a contributing factor or cases where police crash reconstruction investigators had judged the pre-impact speed as above the speed limit. A rating of “probably” was given if there was strong evidence for the involvement of speed, for example, the coroner noting reliable witness statements regarding the speed of the motorcycle, for example, other motorists who had been passed at a much faster speed by the fatally injured rider while they themselves were travelling at the speed limit. A rating of “possibly” was given if there was less reliable indication that speed may have been involved, for example, passers by who judged the motorcycle as travelling at a noticeably fast rate of speed. Crashes where excessive or inappropriate speed were not involved were judged using similar criteria. Where no information was present, a rating of “not noted” was given.

Cases rated as possibly, possibly not, or not noted were those in which there was no strong statement in the NCIS documents regarding the involvement of excessive or inappropriate speed. These cases were considered separately by another member of the research team with experience in crash investigation. Evidence available in the crash reports, such as the length of brake marks, slide marks, ejection distance, the geometry of the crash site, reported weather conditions, knowledge of the vehicles involved, and other crash circumstances were taken into account in the expert judgements. The cases where there was uncertainty as to excessive or inappropriate speed involvement were then judged according to the following criteria.

- Definitely involved
- Probably involved
- Probably not involved
- Definitely not involved
- Not enough information

This coding scheme was devised such that there was a strong level of confidence in the cases that were classified as definitely or probably involving (or not involving) excessive or inappropriate speed.

3.5 DATA ANALYSIS

Prior to data analysis, the data were checked for outliers and cleaned. There were several data items of interest where relevant information was obtained both from NCIS and RCIS. The information from both sources was checked for consistency. In several cases, the data were not consistent. Where this occurred, a judgement was made as to which data source was more reliable. For example, several of the BAC results available in the RCIS were out by a factor of ten compared to the NCIS toxicology reports. Given the care with which the toxicology reports are completed and checked by the Victorian Institute of Forensic Medicine, the NCIS was the preferred data source for this information. In situations where there was no good reason to believe one data source over another, the cases where discrepancies existed were noted and then excluded from that part of the analysis.

Initially, the sample of motorcycle crashes were described in terms of the two outcomes (excessive speed involvement and inappropriate speed involvement), and the rider, vehicle and environmental factors of interest. Following this, analytical comparisons were made to determine if crashes involving excessive speed differed from crashes not involving excessive speed in terms of the rider, vehicle and environment factors noted. The same comparisons were made for crashes involving inappropriate speed.

Statistical tests were conducted to determine if there was a difference between crashes involving speed and crashes not involving speed for each factor of interest. For continuous data that was not normally distributed, the non-parametric Wilcoxon Mann Whitney U test was used. For categorical data, the Fishers exact test was performed. In a small number of situations where it proved inefficient to conduct the Fisher exact test (which is computationally more intensive due to its exact nature), the χ^2 test was performed instead. Univariate and multivariate logistic regression were used to provide an estimate of the strength of the association between speed involvement and other factors. Statistical analyses were performed using SPSS and Stata statistical software packages.

3.6 ETHICS APPROVAL

Approval to access and use the NCIS data was obtained from the Victorian Department of Justice (DOJ) Ethics Committee. Permission to access and use the RCIS data was obtained from VicRoads. Approval for the conduct of the project was obtained from the DOJ ethics committee and the Monash University Standing Committee on Ethics in Research Involving Humans (SCERH).

4. RESULTS

The project aimed to analyse 200 motorcycle fatalities to determine the involvement of excessive and inappropriate speed, and the characteristics of such crashes. A search was conducted for completed coronial cases of motorcycle fatalities that occurred between July 2000 and December 2005. This search identified an initial sample of 284 fatalities. Inspection of the case files led to 32 of the cases being excluded because they did not meet the case selection criteria. For example, several cases were excluded because they occurred on private property or on race tracks rather than on public roads. In the four crashes in which both the rider and the pillion passenger died, the latter were excluded from the data-set of motorcycle fatalities so that particular crash was not over-represented amongst the crashes analysed.

Of the remaining 252 cases, the most recent 205 cases were selected for further analysis. The remaining eligible cases were placed in a pool to select from if less than 200 of the chosen cases could be analysed. From the 205 fatalities chosen for analysis, 201 rider fatalities (representing 200 crashes) were included in the final sample. Of the other four cases, two could not be matched with data in the RCIS, one rider died from pulmonary embolism and deep vein thrombosis after a very minor collision, and the final case was a 12 year old pillion passenger. Considering all the other included cases were rider fatalities (that is, this was the only crash in the five year period where only the pillion passenger and not the rider died), this was felt to be sufficiently different from the other crashes, both in terms of the crash outcome and the data available regarding the crash, that it was excluded based on those factors.

The following results are divided into two main sections. The first section describes all of the motorcycle crashes in terms of rider details (e.g. demographics, actions, rider state), environmental factors and vehicle factors. In addition, the number and proportion of crashes that involved excessive or inappropriate speeds is reported. The second section reports the results of analyses conducted to determine the characteristics of excessive and inappropriate speed-related crashes, and whether these crashes differ from crashes that did not involve speed in terms of factors relating to the rider, the vehicle or the environment.

4.1 DESCRIPTIVE ANALYSES OF THE MOTORCYCLE FATALITIES/CRASHES

There were 201 rider fatalities representing 200 crashes within the sample. Thus, there was one crash in which two motorcycle riders died. For individual rider or motorcycle related characteristics, all 201 fatalities were included in the analysis. For environment/road characteristics, the data were analysed on a per-crash basis, that is, 200 crashes were analysed.

4.1.1 Overview (by rider)

A police report of circumstances was available for all 201 cases. Coronial findings documents were available for 196 (97.5%) of cases, while toxicology and autopsy reports were attached for 182 (90.5%) and 139 (69.2%) of the cases respectively. An inquest was held in 20 (10.0%) of the 201 cases and a recommendation or warning was made by the coroner in 7 (3.5%) cases.

4.1.2 Outcome (by rider)

The outcome of interest in this study was whether or not excessive and/or inappropriate speed was involved in each crash. This was determined initially by studying the NCIS documents, and following that, by the judgement of an experienced crash investigator.

Table 4.1. Involvement of excessive or inappropriate speed, as reported in the NCIS documents

	Excessive speed Frequency	Excessive speed Percent (% of known)	Inappropriate speed Frequency	Inappropriate speed Percent (% of known)
Definitely	31	15.4 (28.4)	36	17.9 (31.3)
Probably	20	10.0 (18.3)	36	17.9 (31.3)
Possibly	20	10.0 (18.3)	23	11.4 (20.0)
Definitely not	11	5.5 (10.1)	4	2.0 (3.5)
Probably not	24	11.9 (22.0)	12	6.0 (10.4)
Possibly not	3	1.5 (2.8)	4	2.0 (3.5)
Not Noted	92	45.8	86	42.8
Total	201	100.0	201	100.0

From the 109 (54.2%) cases where the definite, probable or possible contribution of excessive speed could be judged from the NCIS documents, excessive speed was definitely involved in just over a quarter of the cases, and definitely not involved in 10%. Furthermore, excessive speed was probably or possibly involved in just over a third of the cases (Table 4.1).

Of the 115 (57.2%) cases where the definite, probable or possible contribution of inappropriate speed could be judged from the NCIS documents, inappropriate speed was definitely involved in just under a third of cases, and probably involved in the same proportion. Inappropriate speed was definitely not involved in only 3.5% of cases, and probably not involved in a further 10% (Table 4.1).

Table 4.2. Involvement of excessive or inappropriate speed after expert judgement

	Excessive speed Frequency	Excessive speed Percent (% of known)	Inappropriate speed Frequency	Inappropriate speed Percent (% of known)
Definitely	33	16.4 (28.7)	44	21.9 (32.6)
Probably	23	11.4 (20.0)	51	25.4 (37.8)
Definitely not	20	10.0 (17.4)	14	7.0 (10.4)
Probably not	39	19.4 (33.9)	26	12.9 (19.3)
not enough info	86	42.8	66	32.8
Total	201	100.0	201	100.0

For the cases where the NCIS documents led to a rating of possibly, possibly not, or not noted, an expert judged whether or not excessive and inappropriate speed were definitely or probably involved. Taking into account all of the cases, based on a combination of evidence in the NCIS documents and the expert judgement (Table 4.2), there were 115 (57.2%) cases where the definite or probable involvement of excessive speed could be judged. Of these, 28.7% of cases definitely involved excessive speed, while a further 20%

probably did. Less than a fifth of crashes (17.4%) of cases definitely did not involve excessive speed, with a further 33.9% probably not involving excessive speed.

Approximately two-thirds of cases (135 cases; 67.2%) could be classified as to the contribution of inappropriate speed. Of these cases, almost a third definitely involved inappropriate speed, while 37.8% probably did. Only 10.4% definitely did not involve inappropriate speed, and 19.3% probably did not (Table 4.2).

The judgements were made such that a confident judgement of speed was classed as definitely or probably. As such, the cases in which speed was definitely or probably involved were pooled and categorised as cases where speed was involved (Table 4.3). Likewise, cases in which speed was definitely not, or probably not, involved were further categorised as cases where speed was not involved. With this binary classification, of the 57.2% of cases where the involvement of excessive speed could be judged confidently, almost half (48.7%) involved excessive speed. Of the 67.2% of cases where inappropriate speed could be judged confidently, more than two-thirds involved inappropriate speed (70.4%).

Table 4.3. Binary classification of the involvement of excessive or inappropriate speed

		Excessive speed Frequency	Excessive speed Percent (% of known)	Inappropriate speed Frequency	Inappropriate speed Percent (% of known)
Valid	Speed involved	56	27.9 (48.7)	95	47.3 (70.4)
	Speed not involved	59	29.4 (51.3)	40	19.9 (29.6)
	Total	115	57.2	135	67.2
Missing	not enough info	86	42.8	66	32.8
Total		201	100.0	201	

Table 4.4 Relationship between excessive and inappropriate speed involvement

	Excessive speed involvement			
Inappropriate speed involvement	**No**	**Yes**	**Not enough information**	**Total**
No	39	0	1	40
Yes	17	56	22	95
Not enough information	3	0	63	66
Total	59	56	86	201

The 56 (27.9%) crashes that involved excessive speed also involved inappropriate speed, that is, the rider was traveling faster than the speed limit and too fast for the conditions (Table 4.4). For 17 (8.5%) crashes, the rider was traveling too fast for conditions, but not faster than the speed limit. A further 22 (10.9%) crashes involved traveling too fast for conditions, but whether the rider was exceeding the speed limit was unknown. There were no crashes in which the rider was judged to be traveling at an appropriate speed for the conditions when they were exceeding the speed limit. There were 63 (31.3%) crashes in which neither the involvement of excessive nor inappropriate speed could be judged.

4.1.3 Rider demographics

This sample of fatally injured motorcycle riders were predominantly male (192 cases; 95.5%) and ranged in age from 13 to 81. Just over one-quarter (25.4%) of the sample were aged between 17 and 24 years, while nearly one-third (32.8%) were between 25 and 34 years of age. Figure 4.1 reveals that the age of the fatally injured riders is skewed towards the younger age-groups. However, without reliable data on the age distributions of motorcycle riders (or licence holders or registered motorcycle owners), it is not clear whether this skew represents an over-involvement of younger riders in fatal crashes or an over-involvement of younger riders in riding.

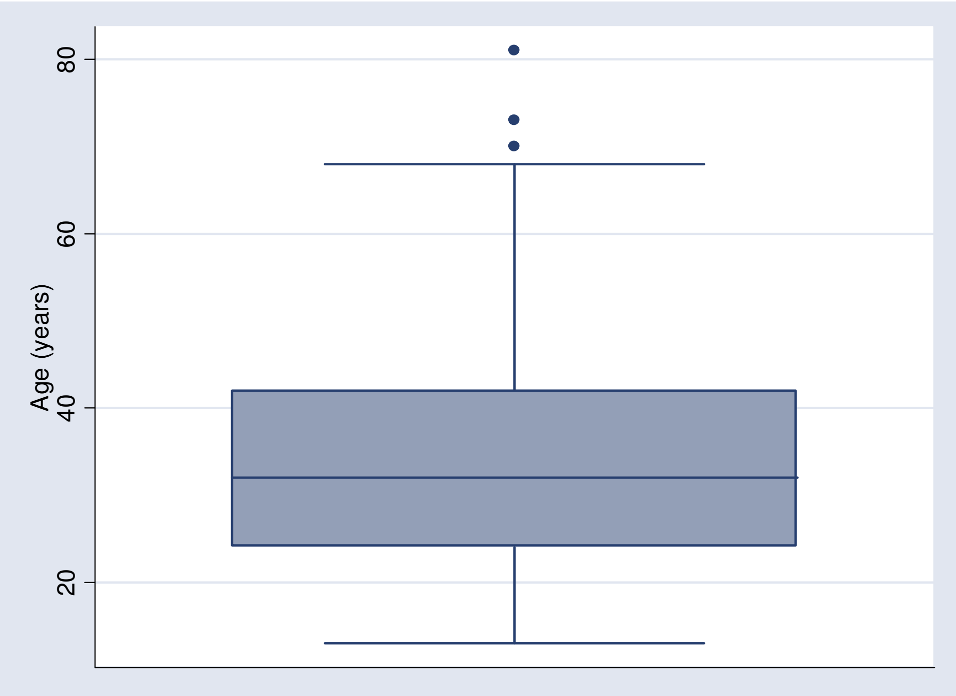

Figure 4.1. Age distribution of the sample of fatally injured motorcycle riders.

Most of the riders (168, 83.6%) were employed. A small number (10, 5%) were unemployed, retired/pensioners (8, 4%) or students (7, 3.5%).

The Australian Standard Geographical Classification (ASGC) code was used to classify where the riders lived, according to Australian Bureau of Statistics (ABS) statistical division (table 4.5). As would be expected, a large proportion resided in the Melbourne statistical division (113, 62.1%). The death rate per 100,000 population however, was lowest for Melbourne (3.15) and highest for Barwon (6.02), Wimmera (5.92) and Ovens-Murray (5.21) divisions. While using the rate per 100,000 population allows comparison of the death rates amongst different areas, this would be more accurate if the denominator used was the number of motorcyclists per statistical division. This could be estimated from registration records, however, not all people who ride motorcycles are licenced, and so the death rate per 100,000 population serves as a reasonable estimate.

Table 4.5. Residence details of the fatally injured motorcycle riders, by statistical division and death rate per 100,000 population

Statistical Division	Motorcycle fatalities - frequency	2004 VIC resident population (ABS, 2005)	deaths per 100,000 pop'n
Melbourne	113	3,592,975	3.15
Barwon	16	265,588	6.02
Central Highlands	6	145,898	4.11
East Gippsland	3	82,114	3.65
Gippsland	6	163,992	3.66
Goulburn	7	200,646	3.49
Loddon	7	172,889	4.05
Mallee	3	91,439	3.28
Ovens-Murray	5	95,909	5.21
Western District	5	100,808	4.96
Wimmera	3	50,712	5.92
Victorian Total	174*	4,962,970	3.39

** 7 riders resided interstate, one rider's residential address was unknown and the ASGC code for residential address was unknown for 19 riders.*

For 132 (65.7%) of the 201 rider fatalities, licence status was available from either NCIS or RCIS records. Forty of the riders (19.9% overall or 30.3% of those whose licence status was known) were noted not to have a valid motorcycle licence, while 92 (45.8%, or 69.6% of those whose licence status was known) did have a valid licence. The licence status of 67 of the riders could not be determined from the information available in the two databases. For the remaining two riders, the RCIS and statements within the Coroner's findings were in conflict with regard to the riders' licence status.

Of the 40 riders who were classified as not holding a valid motorcycle licence, further information was obtained where possible.

- Five riders had cancelled licences. Of these, two were motorcycle licences, two were car licences, and in the other case the licence category could not be ascertained.
- Four riders had disqualified licences, one of whom had a disqualified car licence, while for the remaining three, the category of the disqualified licence could not be ascertained.
- Five riders had expired licences; three of which were motorcycle licences, one was an expired car licence, and the remaining licence category was unknown.
- Four of the riders had suspended licences, three of which were motorcycle licences, and the category of the remaining one could not be determined.
- In seven cases, information available in the NCIS documents stated the rider did not hold a motorcycle licence. Of these seven, the RCIS noted two to hold valid car licences, and a further three to hold a valid licence without stating the category.
- Of the remaining 14 riders without a motorcycle licence, six were noted to hold a valid car licence, 6 were noted to be unlicenced, one had a car licence the status of which was unknown, and one was noted to hold a motorcycle licence of unknown status (which was not classified as valid).

Of the 92 riders who were known to hold a valid motorcycle licence, 22 were identified as either learners (14) or novices (8). For the remaining 70 riders with a valid motorcycle licence, it was difficult to determine if they were novices or holders of full licences due to the coding system used.

Rider experience was only mentioned specifically in the NCIS documents in 35 (17.4%) of the cases. Of these cases, 17 were noted to be experienced riders, while 18 were noted to be inexperienced. The type of motorbike experience that the rider had was rarely mentioned (three cases). Likewise, the duration of time that the rider had held a licence and the duration of the most recent continuous licence was only determined for nine riders. Of those nine riders, most had their licence for a very short time (less than one year) and so there appears to be some bias in reporting.

Of those cases where the riders' marital status was known, most (60.6%) were married or in de facto relationships, while just over a third (34.9%) had never been married. Few of the riders were divorced or separated (Table 4.6).

Table 4.6. Marital status of the fatally injured motorcycle riders

		Frequency	Percent	Percent of known
Valid	**never married**	38	18.9	34.9
	divorced	3	1.5	2.8
	separated	2	1.0	1.8
	married (incl. de facto)	66	32.8	60.6
	Total	109	54.2	100.0
Missing	**unlikely to be known**	92	45.8	
Total		201	100.0	

4.1.4 Rider factors

The NCIS reports were used to determine if certain factors that could potentially contribute to the occurrence of a crash were present (Table 4.7). It must be noted that very little information was available regarding the presence or absence of these factors in most cases. No assumptions can be made about the presence or absence of these factors where they were not specifically mentioned, and there is a real danger in assuming that the factor was not present, just because it was not mentioned.

Table 4.7. Presence/absence of rider factors

Pre-conditions	Involvement of factor as noted in NCIS documents: Number (%)		
	Present	Absent	Not Noted
Medical conditions	28 (13.9)	67 (33.3)	106 (52.7)
Ill health	0	6 (3)	195 (97)
Prior convictions	4 (2)	0	197 (98)
Adverse mental state	3 (1.5) * in one case, it was other driver	3 (1.5)	195 (97)
Fatigue at time of crash	3 (1.5)	0	198 (98.5)
Mental conditions	2 (1)	0	199 (99)
Sensory handicap	2 (1)	0	199 (99)
Other physical handicap	0	0	201 (100
Recent hospitalisation	0	0	201 (100)
Previous crash involvement	0	0	201 (100)
Prior sleep problem (incl. sleep disorders)	0	0	201 (100)

The presence/absence of medical conditions could be assessed in almost half of the cases, from information available in the autopsy report. The forensic pathologists often reported that there was "no significant naturally occurring disease present", or else noted the presence of naturally occurring disease, with a description of said disease. It must be noted that the presence of naturally occurring disease (or any of these factors) does not mean that it contributed to the crash.

Of the 28 riders with disease discovered at autopsy, 18 had some form of cardiovascular disease, the most common being coronary artery arteriosclerosis (ten cases ranging from mild to severe). Three riders had chronic hepatitis (Hepatitis C), a disease noted by the coroner to be associated with drug abuse. Two riders were noted to be obese, one of whom died from complications of obesity after the motorcycle crash.

The NCIS toxicology report was used to identify riders in whom alcohol and/or drugs were detected, and the concentration of these drugs. The date of the crash and the date of sample collection were used to identify riders for whom a sample was not collected within a day of the crash. The toxicology results of these riders were excluded from this analysis due to the potential for false negatives.

Table 4.8. Alcohol, THC and drug involvement

	Number (%) of cases where drug was present	Number (%) of cases where drugs was absent	Number (%) of cases were drug status was not tested/not reported/Test too late
Alcohol	49 (24.4)	137 (68.2)	15 (7.5)
& THC=0	*32 (65.3)*	*117 (85.4)*	*0 (0)*
& THC>0	*15 (30.6)*	*17 (12.4)*	*1 (6.7)*
THC	33 (16.4)	149 (74.1)	19 (9.5)
BAC=0	*17 (51.5)*	*117 (78.5)*	*3 (15.8)*
BAC>0	*15 (45.5)*	*32 (21.5)*	*2 (10.5)*
Other drugs	43 (21.4)	136 (67.7)	22 (10.9)

Table 4.8 shows the number of riders who had alcohol, THC or other drugs detected. Of the 49 (24.4%) of riders with alcohol detected, almost one-third (15, 30.6% of BAC+ riders) also tested positive for THC. Of the 33 (16.4%) of riders with THC detected, almost half (15, 45.5% of THC+ riders) also tested positive for alcohol.

Table 4.9. BAC and THC Levels of riders where alcohol or THC were detected

BAC levels (g/ mL)	Count (%)	THC levels (ng/mL)	Count (%)
< 0.05	9 (18.4)	< 5	10 (32.3)
0.05 – 0.10	14 (28.6)	5 - 10	7 (22.6)
0.11 – 0.15	9 (18.4)	11 - 25	7 (22.6)
0.16 +	17 (34.7)	26 +	7 (22.6)
	49 (100)		31*
Median concentration	0.11 g/mL		9.0 ng/mL

* *There were two 2 cases for which THC levels were not obtainable.*

Table 4.9 reports the BAC and THC levels of those riders with alcohol or THC detected in their blood. Of those 49 riders with a BAC greater than zero, the BAC of nine (18.4%) was less than 0.05. Over half of those who tested positive for alcohol had a BAC over 0.10g/mL. THC concentrations in excess of 5 ng/mL are indicative of recent use (Drummer, 2001).

Table 4.10. Other drugs detected unlikely to be from medical treatment post crash

Drug Name	Count	Concentration range (mg/L)
6-monoacetylmorphine*	1	0.04
caffeine	1	6
oxazepam	1	0.8
Anti-depressants		
citalopram	4	0.1 - 0.8
venlafaxine	1	3.2
nortriptyline	1	< 0.1
amitriptyline	1	< 0.1
fluoxetine	1	2.4
norfluoxetine	1	2.4
dothiepin	1	< 0.1

* *this is one of the active metabolites of heroin*

Forty-three riders (21.4% of all riders) had drugs other than alcohol or THC detected in their blood. The drugs detected in 30 of these riders (69.8%) were drugs that may have been administered iatrogenically after the crash (e.g. codeine, diazepam, mianserin). Those riders detected with substances not likely to have been administered iatrogenically are reported in Table 4.10.

Several actions that could contribute to the occurrence of a crash were identified and the presence or absence of these actions was ascertained using the NCIS documents.

Table 4.11. Rider/driver actions

	Involvement of factor as noted in NCIS documents: Number (%)		
	Present	**Absent**	**Not Noted/Not applicable**
Avoidance behaviour	51 (25.4)	8 (4.0)	142 (70.7)
Following too closely	7 (3.5)	2 (1)	192 (95.5)
Disregarded traffic control (lights, stop signs)	13 (6.5)	7 (3.5)	181 (90)
Distraction	4 (2)	0	197 (98)
Insufficient gap to change lanes	5 (2.5)	0	198 (97.5)
Insufficient gap to turn	4 (2)	0	197 (98)
Oversteering	1 (0.5)	8 (4)	191 (95.5)
Failed to give way	12 (6)	0	189 (94)
Improper passing	26 (13)	2 (1)	171 (86)
Rider cut off by other road-user	57 (28.6)	140 (70.4)	2 (1)
Police involvement (e.g. pursuit)	3 (1.5)	198 (98.5)	0

Again, many of the cases did not mention whether or not the rider displayed any of these potentially unsafe actions (Table 4.11). The exception to this is that in most of the crashes it was possible to determine whether or not the rider was cut-off by another road-user which occurred in over a quarter of cases. In these 57 cases, the rider had the right of way in the overwhelming majority of cases (52, 91.2%), while the other road user had right of way in only 4 cases (7%).

In the three cases with police involvement, the police were in pursuit of another vehicle in one case, and had interacted with the rider in two cases.

Safety related behaviours such as the use of helmets and protective clothing were assessed using information available in the RCIS and the NCIS documents.

Table 4.12. Safety –related behaviours

	Involvement of factor: Number (%)		
	Present	**Absent**	**Unknown**
Helmet use	158 (78.6)	13 (6.5)	30 (14.9)
Protective clothing	17 (8.5)	6 (3.0)	178 (88.6)
Learners only n=14			
Riding a motorcycle too powerful for current licence conditions	6 (42.9)	2 (14.3)	6 (42.9)
Riding a motorcycle too powerful under LAMS	6 (42.9)	1 (7.1)	7 (50)

Thirteen riders (6.5%) were not wearing helmets, which is of some concern (Table 4.12). It is interesting to note that the mean BAC of riders who were noted not to be wearing a helmet was significantly higher (0.15g/mL, sd=0.08), compared to those wearing a helmet (0.02g/mL, sd=0.05) ($t(156)=7.51$, $p<0.0001$).

Protective clothing was not mentioned in most of the cases (Table 4.12). However, of those who were noted to be wearing protective clothing, the following items were noted to be present; full protective clothing (4 riders), leather gear/motorcycle clothing of unspecified nature (2 riders), jacket only noted (3 riders), gloves and boots noted (3 riders), gloves only noted (2 riders), jacket and boots noted (1 rider), jacket and gloves noted (1 rider), and boots only (1 rider).

Learners and novice riders (those in the first 12 months of their probationary or full motorcycle licences) are currently not permitted to ride motorcycles of over 260 cubic centimetres (cc). From the data that was available, it was difficult to consistently assess whether a rider was a novice or not, so these comparisons are restricted to Learners only. Of the 14 riders who were identified as being learners over 40% were riding motorcycles of over 260 cc, while approximately 14% were not. The engine capacity of the motorcycle was not available for 43% of these riders. .

On 1st July 2008, the Learner Approved Motorcycle Scheme (LAMS) was introduced, which assesses the suitability of motorcycles for learners and novices according to power to weight ratio and engine capacity. Of the 14 identified learner riders in the sample, six (43%) were riding motorcycles that are not approved under LAMS, while one (7%) was not. For 50% of these riders, there was not enough information to determine if the motorcycle was LAMS approved or not.

4.1.5 Environmental factors (by crash)

The presence/absence of several important environmental factors were assessed for each crash, using the RCIS and NCIS documents.

Table 4.13. Road conditions

Road surface type	Number (%) of crashes
Sealed	177 (88.5)
Unsealed	12 (6.0)
Unknown	11 (5.5)
Road surface	**Number (%) of crashes**
Dry	177 (88.5)
Wet	22 (11.0)
Unknown	1 (0.5)

Most of the crashes occurred on sealed roads and on dry surfaces (Table 4.13). This information was available for a high proportion of the cases.

Table 4.14. Weather

	Atmospheric conditions			
	Clear	**Raining**	**Fog**	**Unknown**
No (%) of cases	183 (91.5)	12 (6.0)	2 (1.0)	3 (1.5)

A greater proportion of crashes occurred in clear weather, with only a small proportion occurring during rain or foggy conditions (Table 4.14).

Table 4.15. Speed zone

Speed zone	Number (%) of cases
50 km/h	15 (7.5)
60 km/h	39 (19.5)
70 km/h	21 (10.5)
80 km/h	23 (11.5)
90 km/h	3 (1.5)
100 km/h	95 (47.5)
110 km/h	1 (0.5)
Not known	3 (1.5)

Almost half of the crashes occurred in 100 km/h zones. Close to 20% occurred in 60 km/h zones (Table 4.15).

Of the 200 crashes, 129 (64.5%) occurred on straight roads, while 71 (35.5%) occurred on curves. Further information on the road character was available for 58 of the crashes; 54 occurred on divided roads, two in roadwork areas and two on bridges, culverts or causeways.

Table 4.16. Traffic control

Traffic control	Number (%) of cases
No control	172 (86.0)
Stop-Go lights	13 (6.5)
Give way sign	4 (2.0)
Roundabout	3 (1.5)
Stop sign	3 (1.5)
Railway crossing gates & booms	1 (0.5)
Other	1 (0.5)
Unknown	3 (1.5)

Most crashes occurred where no traffic control was present, while a small proportion occurred at traffic lights (Table 4.16).

Table 4.17. Road geometry

Road geometry	Number (%) of cases
Not at intersection	121 (60.5)
T-intersection	53 (26.5)
Cross intersection	21 (10.5)
Multiple intersection	3 (1.5)
Y-intersection	1 (0.5)
Dead-end	1 (0.5)

Approximately 60% of crashes did not occur at an intersection (Table 4.17). Just over one quarter of the crashes occurred at T-intersections, and 10% occurred at cross-intersections. Further analysis (not presented here) revealed that of the 74 crashes that occurred at T or cross intersections, 41 involved the rider being cut-off by another road user.

The NCIS documents were also studied to determine the presence or absence of other environmental factors, such as whether any traffic control signals were visible to the rider, whether the rider or other driver's view was obstructed, and whether any infrastructure issues were noted (Table 4.18).

Table 4.18. Other environmental factors (by rider or crash)

	Number (percent) of cases where factor was noted as present, absent or not noted		
	Yes	**No**	**Unknown**
Traffic control signals (e.g. lights/signs) visible to rider	12 (6.0)	2 (1.0)	22 (11.0) 165 (82.1) not applicable
Rider's view obstructed	18 (9.0)	10 (5.0)	173 (86.1)
Other driver's view obstructed	14 (7.0)	16 (8.0)	101 (50.3) 70 (34.8) n/a
Infrastructure issues	37 (18.5)	10 (5.0)	153 (76.5)

There were only two cases where it was noted that the traffic control signals were not visible to the rider. Likewise, obstruction of the view of either the rider or the other road-user was only noted to be a factor in a small proportion of cases. Infrastructure was noted to be an issue in 10 cases, six of which had a brief description of the problem. In three of these cases, the infrastructure issue related to the road having a steep descent or curve that impaired the rider or the other road users' view. In the remaining three cases, the infrastructure issues related to a tree that blocked a sign alerting the rider to a speed hump, the condition of the a dirt road was poor and the layout of an intersection was noted to be poorly designed.

4.1.6 Motorcycle factors

The make, model, and engine capacity of the motorcycle were determined, where possible, from the RCIS database and the NCIS documents (Table 4.19).

Table 4.19. Motorcycle characteristics

Yamaha			51 (25.4)
Yamaha Model		*Yamaha CC*	
WTR	2	125	1
R	1	250	6
R1	1	400	1
R6	2	600	6
Road tourer	1	750	1
V-max	1	850	2
YZ	1	900	2
YZF R1	1	1000	3
YZF R6	1	1200	1
Honda			46 (22.9)
Honda Model		*Honda CC*	
CBR	7	80	1
Fireblade	1	110	1
CR	1	250	8
Repsol	1	500	1
VT	2	600	5
VTR	1	900	2
XL	1	929	1
XR	1	1100	2
Suzuki			30 (14.9)
Suzuki Model		*Suzuki CC*	
		250	4
		600	3
GSXR	5	750	3
GSX	3	1000	2
GSF	1	1100	2
RF	1	1200	1
Kawasaki			26 (12.9)
Kawasaki Model		*Kawasaki CC*	
		80	1
		125	2
KX	2	200	1
ZX	3	250	6
ZZR	2	600	2

		750	1
		900	1
		1000	2
		1500	1

Harley Davidson 17 (8.5)

Harley Davidson Model		*Harley Davidson CC*	
Ultra classic	1	1130	1
VRSCA	1	1340	1

Ducati 5 (2.5)

Ducati Model		*Ducati CC*	
996 30b	1	75	1
		996	1

Triumph 5 (2.5)

Triumph Model		*Triumph CC*	
Sprint	1		

Aprilia 3 (1.5)

Aprilia Model		*Aprilia CC*	
None reported		250	1

KTM 3 (1.5)

KTM Model		*KTM CC*	
None reported		250	1
		380	1

Other Makes

BMW	1 (0.5)
CAGIVA	1 (0.5)
JAWA	1 (0.5)
MZ	1 (0.5)
NORTON	1 (0.5)
BSA	1 (0.5)
Unknown	9 (4.5)

Many of the crashes involved popular motorcycle makes such as Yamaha, Honda and Suzuki. The motorcycles were categorised according to engine capacity. Of the 85 motorcycles that could be categorised, 51 (60%) were greater than 250cc, while 48 (56.5%) were greater than 500cc.

Motorcycle age was determined from information available in the RCIS database on the year of manufacture, and the year of the crash. The age of the motorcycle ranged from 0 years to 31 years, with a median age of 5 years. From Figure 4.2, it can be seen that the age of the motorcycle was skewed towards younger motorcycles.

Figure 4.2. Motorcycle age

Whether the motorcycle had any mechanical or other defects or not was noted in only 54 of the cases. Of these, 20 were noted to have defects. In six of these cases, the defects were noted to have contributed to the crash, while in five cases, the defects did not contribute. In the remaining nine cases, the contribution of the defects to the crash was not mentioned.

The defects present were summarised. Thirteen of the 20 motorcycles with defects had problems with the tyres; seven had insufficient rear tyre tread depth, one had insufficient front tyre tread depth, one had "knobby tyres", two were fitted with inappropriate tyres (one off-road, and one racing slicks) and two had unspecified tyre problems. Nine of the motorcycles had brake defects; three had problems with the front brakes, three motorcycles had rear brake defects, one had thin brake discs, one had unspecified brake problems and the final one had no brakes at all. Four motorcycles had no lights, while two had no indicators. One motorcycle had front dampers weeping hydraulic fluid and excessive head stem freeplay. Several motorcycles had more than one defect present. Of the six motorcycles where the defects were noted to have contributed to the crash, four had tyre problems, three had brake problems and two had no lights.

The registration status of the motorcycle was extracted, where possible, from the NCIS documents. Eighty (39.8%) motorcycles were noted to be registered, while 17 (8.5%) were not. Registration status could not be determined for 104 (51.7%) of the motorcycles.

Where possible, the motorcycles were classified as to whether they were on-road or off-road motorcycles. Ninety-five (47.3%) of the motorcycles could be classified in this way; 79 were on-road and 16 were off-road.

Nineteen (9.5%) of the riders were riding a motorcycle borrowed (or stolen) from somebody else, while 127 (63.2%) riders were on their own motorcycle. Motorcycle ownership could not be ascertained for 55 (27.4%) of the riders.

4.1.7 Trip details

Of the 200 crashes, 105 (52.5%) occurred in rural areas, while the other 95 (47.5%) occurred in metropolitan areas, or large country cities (e.g. Geelong, Warrnambool, Bendigo).

Twelve (6.0%) of the riders were carrying a pillion passenger, while the remaining riders were not. Just over three-quarters of the riders (154, 76.6%) were riding alone, while 45 were riding in pairs (19, 9.5%) or in a larger group (26, 12.9%). One other rider was noted to be riding with other friends, but it was not noted what type of vehicle/s the friends were travelling in. For the remaining rider, it was unclear whether or not they were alone, as they were found by another rider, but it was not mentioned whether or not they were riding together.

4.1.8 Crash details

The location of the crash was summarised by Local Government Area (LGA), the details of which were obtained from the RCIS database (Table 4.20).

Table 4.20. Location of the crash (LGA)

Local Government Area (LGA)	Frequency (%)
Whittlesea	12 (6.0)
Hume	11 (5.5)
East Gippsland	10 (5.0)
Melbourne	10 (5.0)
Yarra Ranges	10 (5.0)
Brimbank	8 (4.0)
Geelong	8 (4.0)
Colac-Otway	7 (3.5)
Cardinia	6 (3.0)
Wyndham	6 (3.0)
Kingston	5 (2.5)
Mount Alexander	5 (2.5)
Murrindindi	5 (2.5)
Surf Coast	5 (2.5)
Casey	4 (2.0)
Dandenong	4 (2.0)
Knox	4 (2.0)
Bendigo	3 (1.5)
Glenelg	3 (1.5)
Golden Plains	3 (1.5)
Hobsons Bay	3 (1.5)
Latrobe	3 (1.5)
Melton	3 (1.5)
Mildura	3 (1.5)
Moorabool	3 (1.5)
Mornington Peninsula	3 (1.5)
Shepparton	3 (1.5)
Towong	3 (1.5)

Baw Baw	2 (1.0)
Corangamite	2 (1.0)
Darebin	2 (1.0)
Hepburn	2 (1.0)
Macedon Ranges	2 (1.0)
Maroondah	2 (1.0)
Mitchell	2 (1.0)
Monash	2 (1.0)
Moreland	2 (1.0)
Port Philip	2 (1.0)
Stonnington	2 (1.0)
Strathbogie	2 (1.0)
Wangaratta	2 (1.0)
Warrnambool	2 (1.0)
Whitehorse	2 (1.0)
Alpine	1 (0.5)
Ballarat	1 (0.5)
Bass Coast	1 (0.5)
Benalla	1 (0.5)
Boroondara	1 (0.5)
Campaspe	1 (0.5)
Central Goldfields	1 (0.5)
Frankston	1 (0.5)
Hindmarsh	1 (0.5)
Loddon	1 (0.5)
Manningham	1 (0.5)
Maribynong	1 (0.5)
Moira	1 (0.5)
Pyrenees	1 (0.5)
Southern Grampians	1 (0.5)
Yarra	1 (0.5)
Yarriambiack	1 (0.5)

More than 10 crashes occurred in each of the LGAs of Whittlesea, Hume, East Gippsland, Melbourne and the Yarra Ranges.

When the crash occurred, in terms of month of year, day of week and time, was determined from the RCIS database and summarised (Figure 4.3; Table 4.21).

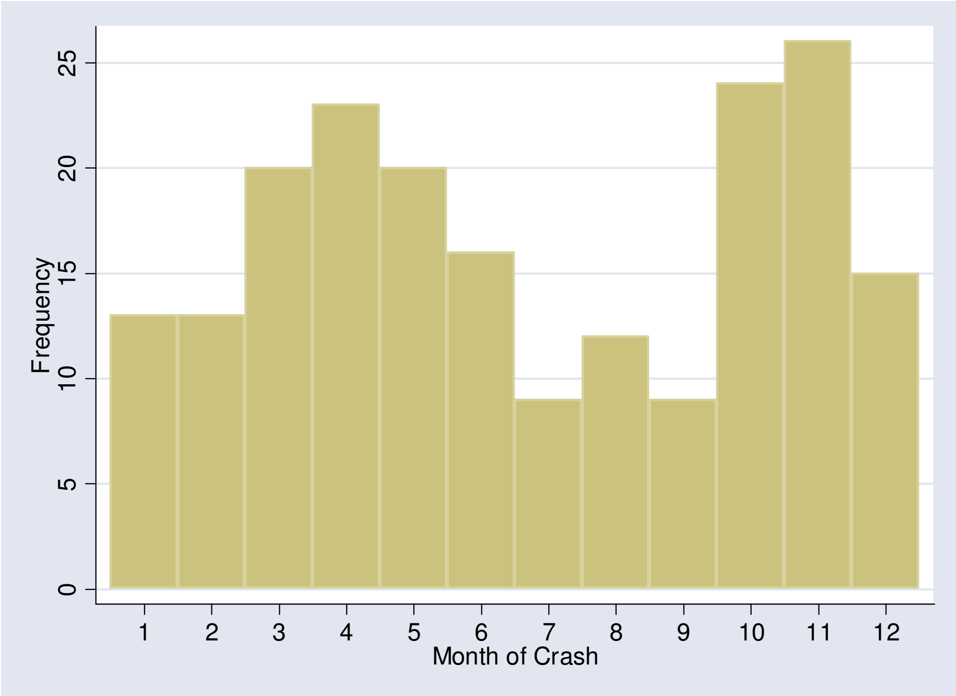

Figure 4.3 Month of crash

A quarter of the crashes occurred during the months of October and November (50 crashes, 25%). The months of March through to May accounted for 63 (36.5%) of the crashes. The motorcycle fatalities were least frequent in July and September (9 crashes; 4.5% in each month).

Table 4.21. Day of week by time of day for each crash.

	Day of week							
Time	**Monday**	**Tuesday**	**Wednesday**	**Thursday**	**Friday**	**Saturday**	**Sunday**	**Total**
12-6am	0	0	1 (0.5)	0	3 (1.5)	4 (2.0)	3 (1.5)	11 (5.5)
6-9am	4 (2.0)	3 (1.5)	7 (3.5)	4 (2.0)	1 (0.5)	5 (2.5)	1 (0.5)	25 (12.5)
9am-12pm	1 (0.5)	1 (0.5)	0	1 (0.5)	3 (1.5)	2 (1.0)	5 (2.5)	13 (6.5)
12pm-4pm	11 (5.5)	4 (2.0)	5 (2.5)	1 (0.5)	5 (2.5)	11 (5.5)	19 (9.5)	56 (28.0)
4pm-7pm	5 (2.5)	7 (3.5)	8 (4.0)	6 (3.0)	7 (3.5)	11 (5.5)	13 (6.5)	57 (28.5)
7pm-12am	3 (1.5)	6 (3.0)	8 (4.0)	6 (3.0)	5 (2.5)	5 (2.5)	4 (2.0)	37 (18.5)
Total	24 (12.0)	21 (10.5)	29 (14.5)	18 (9.0)	24 (12.0)	38 (19.5)	45 (22.5)	199 (99.5)

The time of day was not known for one crash (which occurred on a Saturday). Sunday was the most common day for crashes to occur, followed by Saturday. More than half of the crashes occurred between hours of midday and 7pm.

The activities that the riders were involved in were obtained from the NCIS. A large proportion of the riders (184, 91.5%) were engaged in travelling (not elsewhere classified) while 15 (7.5%) of the riders were engaged in paid work activities.

The type of crash was obtained from the RCIS. The researchers also coded the crash type separately based on NCIS data. The results, reported in Table 4.22, were compared to the RCIS crash type variable and some discrepancies were noted, however these were relatively minor.

Table 4.22. Type of crash

Crash type	Frequency (%) from RCIS	Frequency (%) from NCIS
Collision with vehicle	122 (61.0)	117 (58.2)
Collision fixed object	56 (28.0)	51 (25.4)
Struck animal	4 (2.0)	4 (2.0)
Collision other object	4 (2.0)	1 (0.5)
Vehicle overturned	4 (2.0)	9 (4.5)
Fall from/in moving vehicle	2 (1.0)	16 (8.0)
No collision and no object hit	8 (4.0)	2 (1.5)

The Definition for Classifying Accidents (DCA) was also tabulated for each crash (Table 4.23). DCAs are used to classify the movements of the road-user prior to impact.

Table 4.23. DCA for each crash

Definition for Classifying Accidents	Number (%)
Head on (not overtaking)	34 (17)
Right through	30 (15)
Off left bend into object/parked vehicle	24 (12)
Off right bend into object/parked vehicle	15 (7.5)
Left off carriageway into object/parked vehicle	13 (6.5)
Right near (intersections only)	12 (6)
Out of control on carriageway (on straight)	8 (4)
Pulling out (overtaking)	6 (3)
Right off carriageway into object/parked vehicle	5 (2.5)
U-turn	5 (2.5)
Cross traffic (intersections only)	4 (2)
Right rear	4 (2)
Struck animal	4 (2)
Head on (overtaking)	3 (1.5)
Rear end (vehicles in same lane)	3 (1.5)
Right far (intersections only)	2 (1.0)
Left near (intersections only)	2 (1.0)
Lane side swipe (vehicles in parallel lanes)	2 (1.0)
Lane change left (not overtaking)	2 (1.0)
Vehicle strikes another vehicle while emerging from driveway	2 (1.0)
Pulling out - rear end	2 (1.0)
Vehicle collides with vehicle parked on left of road	2 (1.0)
Off carriageway on right bend	2 (1.0)
Left rear	1 (0.5)
Lane change right (not overtaking)	1 (0.5)
Entering parking	1 (0.5)
Out of control (overtaking)	1 (0.5)
Cutting in (overtaking)	1 (0.5)
Accident or broken down	1 (0.5)
Struck object on carriageway	1 (0.5)
Off carriageway to left	1 (0.5)
Off carriageway to right	1 (0.5)
Off end of road/T-intersection	1 (0.5)
Other accidents-off straight not incl. in 170-175	1 (0.5)
Out of control on carriageway (on bend)	1 (0.5)
Other accidents not classifiable elsewhere	1 (0.5)
Other opposing (manoeuvres not incl in 120-125)	1 (0.5)

Sixty eight (34%) of the crashes were single-vehicle collisions. Over half of the crashes involved one other vehicle (115; 57.5%), thirteen crashes (6.5%) involved two other vehicles, three crashes (1.5%) involved three other vehicles and only one crash (0.5%) involved four other vehicles.

None of the crashes involved pedestrians. Just over half (102; 51%) of the crashes involved cars (including utilities and four-wheel drives). Trucks were involved in 27 crashes (13.5%). Only four crashes (2%) involved other motorcycles.

From the RCIS database, it was stated that the rider was totally ejected in 149 cases (74.1%) and partially ejected in one case (0.5%). The ejection status was classified as not applicable in 50 cases (24.9), and unknown in one case (0.5%). Whether or not the rider separated from the motorcycle, and if so, before or after the crash, was also ascertained from the NCIS documents. Although separation was not noted for 83 (41.3%) of cases, the rider separated from the motorcycle in 114 cases (56.7%), and did not separate from the motorcycle in only 4 cases (2.0%). When the rider was noted to have separated from the motorcycle, this occurred prior to impact in 13 cases and after impact in 84 cases. It is worth noting however, that the RCIS data on ejection and the information obtained on separation from the NCIS documents did not reliably agree.

Notwithstanding the need to take a systemic approach to motorcycle safety and move away from simply blaming the road-user for the crash, whether or not the rider was at fault, in the traditional sense, was determined from the contextual NCIS reports. In some cases, the coroner made a specific finding that the rider was partially or fully at fault, however, in many cases this was not specifically stated. For these cases, the data coders used the Victorian road rules to ascertain who was at fault. It must be noted that the coders' judgement of fault was independent of whether or not speed was involved. The only cases in which vehicle speed was related to fault were in cases when the coroner specifically stated that the rider was partially at fault because they were travelling so fast that the other vehicle either did not see them or did not have time to react. Forty of the riders (19.9%) were regarded as not at fault, while 113 (56.2%) were fully at fault and 17 (8.5%) were partially at fault. Fault could not be ascertained in 31 (15.4%) of the cases.

4.1.9 Cause of death

ABS codes for cause of death are available from the NCIS, however, these were found to be inaccurate (e.g. for some of these crashes, the death was coded as being a passenger involved in a motorcycle collision, despite the fact that all the deaths included in this study were riders). These ABS codes are obtained from the death certificate, which is often written prior to the case being closed by the coroner, and as such, are not always accurate. Previous research has found discrepancies between the ABS codes and NCIS records in up to 50% of cases (Daking & Dodds, 2007).

4.2 ANALYTICAL COMPARISONS OF THE RELATIONSHIP BETWEEN SPEED INVOLVEMENT (EXCESSIVE AND INAPPROPRIATE) AND OTHER FACTORS.

The analyses presented in the following section consider only those cases where the involvement of excessive or inappropriate speed could be reliably judged. Hence, for the comparisons of cases involving excessive speed with cases that did not involve excessive speed, 115 cases are included. For the comparison of crashes involving inappropriate speed with crashes that do not involve inappropriate speed, 135 cases are considered.

4.2.1 Rider factors

Table 4.24. Riders by Excessive and Inappropriate speed and sex

Gender	**Excessive speed involved (% for each gender)**	
	Yes	**No**
Male	56 (50)	56 (50)
Female	0	3 (100)
	Inappropriate speed involved	
	Yes	**No**
Male	94 (71.8)	37 (28.2)
Female	1 (25)	3 (75)

Where the involvement of excessive speed could be judged, half of the 112 males were involved in crashes where excessive speed was involved, compared to none of the three females (Table 4.24). For inappropriate speed, 71.8% of the 131 males were involved in crashes where inappropriate speed was a factor, compared to only one (25%) of the three females.

Gender was not related to being involved in a crash involving excessive speed ($p=0.24$, Fishers exact), however there was some evidence that crashes involving inappropriate speed was related to gender ($p<0.08$, Fishers exact). It must be noted that because so few females were involved in fatal crashes, these comparisons lack statistical power.

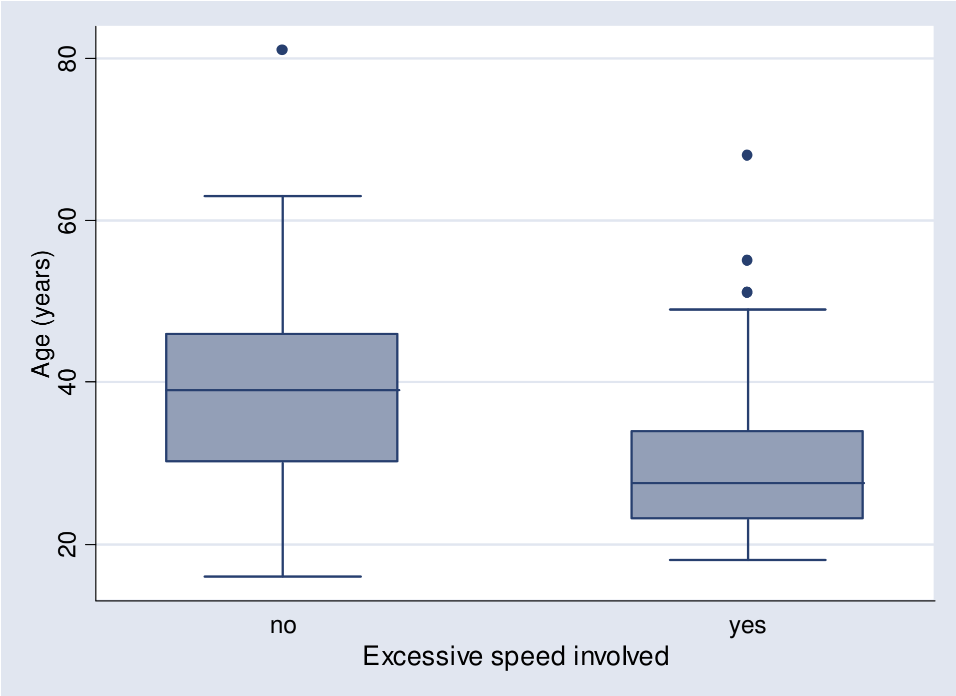

Figure 4.4. Age distribution of riders involved in crashes where excessive speed was, and was not, involved.

Figure 4.4 reveals that the riders who were involved in crashes where excessive speed was a factor were younger than those where it was not a factor. The median age for the riders involved in excessive speed related crashes was 27.5 (interquartile range: 11) while that for the riders involved in crashes where excessive speed was not a factor was 39 (IQR:16). This difference was statistically significant (Mann-Whitney U test, z=-4.30, p<0.0001).

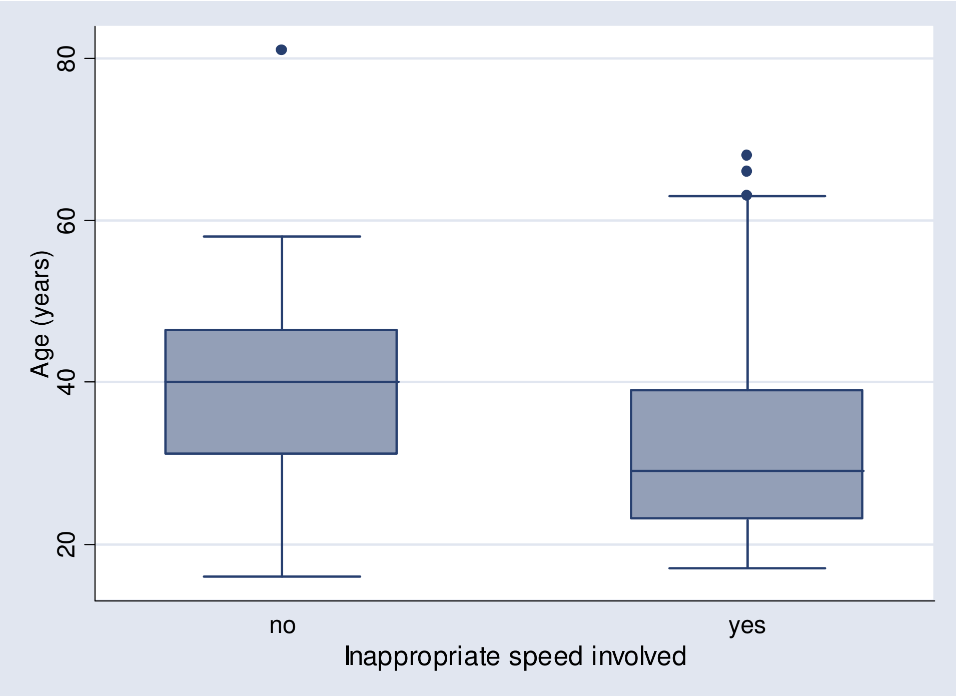

Figure 4.5. Age distribution of riders involved in crashes where inappropriate speed was, and was not, involved.

Figure 4.5 reveals that the riders who were involved in crashes where inappropriate speed was a factor were younger than those where it was not a factor. The median age for the riders involved in inappropriate speed related crashes was 29 (interquartile range: 16), while for the riders involved in crashes where inappropriate speed was not a factor it was 40 (IQR:15.5). This difference was statistically significant (Mann-Whitney U test, z=-3.12, $p<0.002$).

Table 4.25. Excessive speed involvement by Statistical Division of Residence

Statistical Division	Excessive speed involved Frequency (percent in statistical division)		
	Yes	No	Total
Melbourne	35 (46.7)	40 (53.3)	75
Barwon	6 (100)	0	6
Central Highlands	1 (50)	1 (50)	2
East Gippsland	1 (100)	0	1
Gippsland	1 (50)	1 (50)	2
Goulburn	1 (25)	3 (75)	4
Loddon	2 (50)	2 (50)	4
Mallee	1 (100)	0	1
Ovens-Murray	0	1 (100)	1
Western District	3 (60)	2 (40)	5
Wimmera	1 (100)	0	1
Other states	1 (20)	4 (80)	5
Total	54 (50.5)	53 (49.5)	107

Due to the small number of people residing in most of the areas, the interpretation of the data in Table 4.25 data is difficult. Of the 107 crashes where excessive speed involvement was judged and the area of residence was known, the most notable finding was that each of the six crashes where the rider lived in the Barwon statistical division involved excessive speed. While six crashes is not a large number, this result may be worth further investigation. For the other divisions, there was no obvious preponderance of crashes involving excessive speed.

Table 4.26. Inappropriate speed involvement by Statistical Division of Residence

Statistical Division	Inappropriate speed involved Frequency (percent in statistical division)		
	Yes	No	Total
Melbourne	58 (66.7)	29 (33.3)	87
Barwon	6 (100)	0	6
Central Highlands	3 (100)	0	3
East Gippsland	2 (100)	0	2
Gippsland	2 (66.7)	1 (33.3)	3
Goulburn	1 (25)	3 (75)	4
Loddon	4 (80)	1 (20)	5
Mallee	1 (100)	0	1
Ovens-Murray	1 (50)	1 (50)	2
Western District	4 (80)	1 (20)	5
Wimmera	1 (100)	0	1
Other states	4 (66.7)	2 (33.3)	6
Total	87 (69.6)	38 (30.4)	125

Again, due to the small number of people residing in most of the areas, the interpretation of the data in Table 4.26 are difficult. However, the finding that all six fatalities residing in Barwon were involved in crashes involving inappropriate speed may be worth further investigation.

Table 4.27. Excessive/ Inappropriate speed involvement by Licence Status

Licence	Excessive speed involved	
	Yes	**No**
Valid motorcycle licence	22 (42.3)	30 (57.7)
No valid motorcycle licence	15 (75)	5 (25)
	Inappropriate speed involved	
	Yes	**No**
Valid motorcycle licence	41 (67.2)	20 (32.8)
No valid motorcycle licence	21 (84)	4 (16)

Of the 72 riders where both licence status and involvement of excessive speed could be determined (Table 4.27), a significantly higher proportion (75%) of those riders without a valid motorcycle licence were involved in crashes involving excessive speed, compared to those riders with a valid motorcycle licence (42.3%) ($p=0.02$, Fishers exact).

Of those 86 cases where both licence status and involvement of inappropriate speed was determined (Table 4.27), a higher proportion of those riders without a valid motorcycle licence were involved in crashes involving inappropriate speed (84%) than riders with a valid motorcycle licence (67.2%), however this difference was not statistically significant ($p=0.19$, Fishers exact).

Table 4.28. Excessive/ Inappropriate speed involvement by Rider Experience

Rider experience	Excessive speed involved	
	Yes	**No**
Inexperienced	5 (45.5)	6 (54.5)
Experienced	1 (8.3)	11 (91.7)
	Inappropriate speed involved	
	Yes	**No**
Inexperienced	11 (78.6)	3 (21.4)
Experience	8 (61.5)	5 (38.5)

While the experience level of the motorcyclists was only known for 35 cases overall, there is good reason to hypothesise that experience is related to speed involvement in crashes, and so comparisons were conducted despite the low numbers available for analysis. Of the 23 riders where both rider experience and involvement of excessive speed could be determined (Table 4.28), a higher proportion (45.5%) of those riders who were inexperienced were involved in crashes involving excessive speed, compared to those with experience (8.3%) ($p=0.07$, Fishers exact). Although this did not reach the conventional level for statistical significance, given the small number of cases, and the resulting low power to detect a difference, a p-value of less than 0.10 still indicates a finding of interest that could be worth exploring in future research.

Of the 27 riders where both rider experience and involvement of inappropriate speed could be determined (Table 4.28), a higher proportion (78.6%) of those riders who were inexperienced were involved in crashes involving inappropriate speed, compared to those with experience (61.5%) (p=0.42, Fishers exact), although this difference was not statistically significant.

Table 4.29. Excessive/ Inappropriate speed involvement by Marital Status

Marriage status	Excessive speed involved	
	Yes	**No**
Not married	12 (54.6)	10 (45.5)
Married incl. de facto	12 (27.9)	31 (72.1)
	Inappropriate speed involved	
	Yes	**No**
Not married	23 (74.2)	8 (25.8)
Married incl. de facto	25 (54.4)	21 (45.7)

Of the 65 riders where both rider marital status and involvement of excessive speed could be determined (Table 4.29), a higher proportion (54.6%) of those riders who were not married were involved in crashes involving excessive speed, compared to those who were married (27.9%) (p=0.06, Fishers exact). Although this did not reach the conventional level for statistical significance, a p-value of less than 0.10 still indicates a finding of interest that could be worth exploring in future research.

Of the 77 riders where both rider marital status and involvement of inappropriate speed could be determined (table 4.29), a higher proportion (74.2%) of those riders who were not married were involved in crashes involving inappropriate speed, compared to those who were married (54.4%) (p=0.10, Fishers exact), although this difference was not statistically significant.

It is worth noting that the relationship between marital status and speed involvement may be confounded by the age of riders in each group. The median age at first marriage in Australia in 2006 was reported as being at 31.6 years for men and 29.3 years for women (Australian Bureau of Statistics, 2006). Since we know that younger riders are more likely to be involved in speed related crashes than older riders, this may explain any difference observed between married and unmarried riders, as married riders are likely to be older. This will be explored in multivariate analyses (see section 4.2.6).

Table 4.30. Excessive/ Inappropriate speed involvement by Presence of a Medical Condition

Medical condition	Excessive speed involved	
	Yes	**No**
No	17 (40.5)	25 (59.5)
Yes	9 (50)	9 (50)
	Inappropriate speed involved	
	Yes	**No**
No	31 (64.6)	17 (35.4)
Yes	12 (63.2)	7 (36.8)

There was no relationship found between the presence of a medical condition, and whether excessive (p=0.58, Fishers exact) or inappropriate speed (p=1.00, Fishers exact) were involved in the crash (Table 4.30).

For the other rider-related factors extracted from the NCIS documents, so little information was available regarding the presence or absence of these factors that comparisons between speed related and non-speed related crashes on these factors were not performed.

Table 4.31. Excessive/ Inappropriate speed involvement by Presence of Alcohol

Alcohol detected	**Excessive speed involved**	
	Yes	**No**
No	34 (41.0)	49 (59.0)
Yes	18 (69.2)	8 (30.8)
	Inappropriate speed involved	
	Yes	**No**
No	63 (66.3)	32 (33.7)
Yes	23 (76.7)	7 (23.3)

Of the 109 riders where involvement of both alcohol and excessive speed could be determined (Table 4.31), a significantly higher proportion (69.2%) of those riders with alcohol detected were involved in crashes involving excessive speed, compared to those riders with no alcohol detected (41.0%) (p=0.01, Fishers exact).

Of the 125 riders where involvement of both alcohol and inappropriate speed could be determined (Table 4.31), there was no relationship found between the detection of alcohol and the involvement of inappropriate speed (p=0.37, Fishers exact).

Table 4.32. Excessive/ Inappropriate speed involvement by Presence of THC

THC detected	**Excessive speed involved**	
	Yes	**No**
No	37 (43.0)	49 (57)
Yes	11 (61.1)	7 (38.9)
	Inappropriate speed involved	
	Yes	**No**
No	64 (64.7)	35 (35.4)
Yes	19 (86.4)	3 (13.6)

Of the 104 riders where involvement of both THC and excessive speed could be determined (Table 4.32), there was no relationship found between the detection of THC and the involvement of excessive speed (p=0.20, Fishers exact).

Of the 121 riders where involvement of both THC and inappropriate speed could be determined (Table 4.32), a higher proportion (86.4%) of those riders in whom THC was detected were involved in crashes involving inappropriate speed, compared to those in whom THC was not detected (64.7%) (p=0.07, Fishers exact). Although this did not reach the conventional level for statistical significance, a p-value of less than 0.10 still indicates a finding of interest that could be worth exploring in future research.

Table 4.33. . Excessive/ Inappropriate speed involvement by BAC level

BAC Level	Excessive speed involved	
	Yes	No
less than 0.05	4 (66.7)	2 (33.3)
0.05 – 0.15	11 (84.6)	2 (15.4)
0.16 or higher	3 (42.9)	4 (57.1)
	Inappropriate speed involved	
	Yes	**No**
less than 0.05	4 (57.1)	3 (42.9)
0.05 – 0.15	13 (86.7)	2 (13.3)
0.16 or higher	6 (75.0)	2 (25.0)

Of the 26 riders who had alcohol detected and where blood alcohol concentration and excessive speed data were available (Table 4.33), there was no relationship found between the BAC and the involvement of excessive speed (χ^2 (2) = 3.75, p=0.15).

Of the 30 riders who had alcohol detected and where blood alcohol concentration and inappropriate speed data were available (Table 4.33), there was no relationship found between the BAC and the involvement of inappropriate speed (χ^2 (2) = 2.34 p=0.31). An inspection of the data shows that cases in 0.05 to 0.10 range appear to have greater involvement with excessive and inappropriate speed. Due to the small number cases in each category, these comparisons may not have enough power to detect any difference.

Table 4.34. Excessive/Inappropriate speed involvement by Crash Avoidance

Tried to avoid crash	Excessive speed involved	
	Yes	No
Yes	16 (53.3)	14 (46.7)
No	2 (40)	3 (60)
	Inappropriate speed involved	
	Yes	**No**
Yes	28 (75.7)	9 (24.3)
No	5 (71.4)	2 (28.6)

There was no relationship found between whether the rider tried to avoid a crash and whether excessive (n=35, p=0.66, Fishers exact) or inappropriate speed (n=44, p=0.57, Fishers exact) were involved in the crash (Table 4.34).

Table 4.35. Excessive/ Inappropriate speed involvement by Improper Passing

Was passing improper?	Excessive speed involved	
	Yes	No
No	0	2 (100)
Yes	10 (55.6)	8 (44.4)
	Inappropriate speed involved	
	Yes	**No**
No	1 (50)	1 (50)
Yes	16 (76.2)	5 (23.8)

There was no relationship found between whether the rider was passing another vehicle improperly and whether excessive (n=20, p=0.47, Fishers exact) or inappropriate speed (n=23, p=0.46, Fishers exact) were involved in the crash (Table 4.35).

Table 4.36. Excessive/ Inappropriate speed involvement by whether Rider was cut-off

Was the rider cut-off by another road-user	Excessive speed involved	
	Yes	No
No	35 (48.0)	38 (52.1)
Yes	19 (47.5)	21 (52.5)
	Inappropriate speed involved	
	Yes	No
No	67 (74.4)	23 (25.6)
Yes	26 (60.5)	17 (39.5)

No relationship was found between whether or not the rider was cut-off by another road user and the involvement of excessive speed (n=113, p=1.00, Fishers exact). However, 74.4% of the riders who were not cut-off by another road user were involved in crashes involving inappropriate speed, compared to 60.5% of riders who were cut-off by another road user (Table 4.36). This difference did not reach the conventional level for statistical significance (p=0.08, Fishers exact).

Table 4.37. Excessive/Inappropriate speed involvement by whether Rider was wearing a helmet

Was the rider wearing a helmet?	Excessive speed involved	
	Yes	No
No	1 (20)	4 (80)
Yes	49 (52.7)	44 (47.3)
	Inappropriate speed involved	
	Yes	No
No	3 (75)	1 (25)
Yes	77 (71.3)	31 (28.7)

There was no relationship found between whether the rider was wearing a helmet and whether excessive (n=98, p=0.20, Fishers exact) or inappropriate speed (n=112, p=1.00, Fishers exact) were involved in the crash (Table 4.37).

Table 4.38. Excessive/Inappropriate speed involvement by whether Motorcycle was too powerful for current licence conditions – learner riders only

Was the motorcycle too powerful for the licence conditions?	Excessive speed involved	
	Yes	No
No	1 (50)	1 (50)
Yes	4 (100)	0 (0)
	Inappropriate speed involved	
	Yes	No
No	1 (50)	1 (50)
Yes	5 (100)	0 (0)

Although information on both the involvement of speed and the rider riding a motorcycle too powerful for their licence conditions was not available for many of the 14 learner riders the results are worth noting (Table 4.38). For the 6 cases where information was available, all of the cases where the rider was riding a motorcycle too powerful for the licence conditions (100%) involved excessive speed compared to when the motorcycle was not too powerful for the licence conditions (50%). This result was not significant (p=0.33, Fishers exact), however the low numbers indicate a lack of power to detect a real effect. .

For the 7 cases where information was available, all the cases where the rider was riding a motorcycle too powerful for the licence conditions (100%) involved inappropriate speed than when the motorcycle was not too powerful for the licence conditions (50%) (p=0.29, Fishers exact). Again, this comparison lacked statistical power due to low numbers.

Table 4.39. Excessive/Inappropriate speed involvement by whether Motorcycle was or was not approved under LAMS – riders with restrictions only

Was the motorcycle approved under LAMS	**Excessive speed involved**	
	Yes	**No**
No	4 (100)	0
Yes	1 (100)	0
	Inappropriate speed involved	
	Yes	**No**
No	5 (100)	0
Yes	1 (100)	0

It is difficult to draw conclusions about the relationship between speed involvement (excess or inappropriate) the whether or not the motorcycle was LAMS approved for those riders to whom the new restrictions will apply because of a lack of data.

4.2.2 Environmental factors

Table 4.40. Excessive/Inappropriate speed involvement by Road Surface Type

Road surface type	**Excessive speed involved**	
	Yes	**No**
Sealed	49 (47.1)	55 (52.9)
Unsealed	1 (20)	4 (80)
	Inappropriate speed involved	
	Yes	**No**
Sealed	84 (67.7)	40 (32.3)
Unsealed	4 (100)	0

There was no relationship found between the road surface type and whether excessive (p=0.37, Fishers exact) or inappropriate speed (p=0.31, Fishers exact) were involved in the crash (Table 4.40). It must be noted however, that there were so few cases where the road was unsealed, that this comparison may not have enough power to detect any difference. It is interesting to note that the few crashes that occurred on unsealed roads rarely involved excessive speed, but often involved inappropriate speed.

Table 4.41. Excessive/Inappropriate speed involvement by Road Surface Conditions

Road surface conditions	Excessive speed involved	
	Yes	No
Dry	51 (48.1)	55 (51.9)
Wet	4 (50.0)	4 (50.0)
	Inappropriate speed involved	
	Yes	No
Dry	86 (69.4)	38 (30.7)
Wet	8 (80.0)	2 (20.0)

There was no relationship found between whether the road surface was wet or dry and whether excessive (p=1.00, Fishers exact) or inappropriate speed (p=0.72, Fishers exact) were involved in the crash (Table 4.41). It must be noted however, that there were so few cases where the road was wet, that this comparison may not have enough power to detect any difference.

Table 4.42. Excessive/Inappropriate speed involvement by Atmospheric Conditions

Atmospheric conditions	Excessive speed involved	
	Yes	No
Clear	52 (48.6)	55 (51.4)
Raining	3 (60.0)	2 (40.0)
	Inappropriate speed involved	
	Yes	No
Clear	88 (69.3)	39 (30.7)
Raining	6 (100)	0

There was no relationship found between whether the atmospheric conditions were clear or raining and whether excessive (p=0.68, Fishers exact) or inappropriate speed (p=0.18, Fishers exact) were involved in the crash (Table 4.42). It must be noted however, that there were so few cases when it was raining, that this comparison may not have enough power to detect any difference. It is interesting to note than in crashes where both atmospheric condition information and information on inappropriate speed involvement was available, all crashes that occurred in the rain were noted to involve inappropriate speed.

Table 4.43. Excessive/Inappropriate speed involvement by Speed Zone

Speed zone(km/h)	Excessive speed involved	
	Yes	No
50	6 (75)	2 (25)
60	17 (73.9)	6 (26.1)
70	10 (76.9)	3 (23.1)
80	7 (46.7)	8 (53.3)
90	1 (50)	1 (50)
100	14 (26.4)	39 (73.6)
	Inappropriate speed involved	
	Yes	**No**
50	9 (81.8)	2 (18.2)
60	20 (76.9)	6 (23.1)
70	14 (93.3)	1 (6.7)
80	10 (62.5)	6 (37.5)
90	2 (66.7)	1 (33.3)
100	39 (61.9)	24 (38.1)

Whether or not excessive speed was involved in the crash differed across speed zones (χ^2 (5)=22.78, p<0.001), however, the involvement of inappropriate speed did not significantly differ across speed zones (χ^2(5) =7.64, p=0.18). An inspection of the results indicates that excessive speed involvement, and to a lesser extent, inappropriate speed involvement, seems more likely to occur in speed zones of 70km/h or less (Table 4.43). This was tested by categorising the speed zones as 70 km/h or less and above 70 km/h.

Table 4.44. Excessive/Inappropriate speed involvement by Speed Zone Group

Speed zone (km/h)	Excessive speed involved	
	Yes	No
50, 60 or 70	33 (75)	11 (25)
80, 90, or 100	22 (31.4)	48 (68.8)
	Inappropriate speed involved	
	Yes	**No**
50, 60 or 70	43 (82.7)	9 (17.3)
80, 90, or 100	51 (62.2)	31 (37.8)

The results revealed that crashes involving excessive speed were significantly more likely to occur in speed zones of 70 km/h or less than in higher speed zones (p<0.001, Fishers exact). Three-quarters of crashes that occurred in lower speed zones involved excessive speed, compared to less than a third of crashes in higher speed zones (Table 4.44). Crashes involving inappropriate speed were also significantly more like to occur in lower speed zones (p=0.01, Fishers exact). Just over 80% of crashes in lower speed zones involved inappropriate speed, compared to just over 60% in higher speed zones.

Table 4.45. Excessive/Inappropriate speed involvement by Road Character

Road character	Excessive speed involved	
	Yes	**No**
Straight	40 (53.3)	35 (46.7)
Curve	16 (40)	24 (60)
	Inappropriate speed involved	
	Yes	**No**
Straight	58 (68.2)	27 (31.8)
Curve	37 (74)	13 (26)

There was no relationship found between whether the road was straight or curved and whether excessive (p=0.24, Fishers exact) or inappropriate speed (p=0.56, Fishers exact) were involved in the crash (Table 4.45).

Table 4.46. Excessive/Inappropriate speed involvement by Traffic Control

Traffic control	Excessive speed involved	
	Yes	**No**
No control	49 (49)	51 (51)
Stop-Go lights	3 (50)	3 (50)
Railway crossing gate	0	1(100)
Roundabout	2 (100)	0
Stop sign	0	2 (100)
Give way sign	1 (50)	1 (50)
Other	0	1 (100)
	Inappropriate speed involved	
	Yes	**No**
No control	82 (70.7)	34 (29.3)
Stop-Go lights	6 (75)	2 (25)
Railway crossing gate	1 (100)	0
Roundabout	2 (100)	0
Stop sign	1 (33.3)	2 (66.7)
Give way sign	2 (100)	0
Other	0	1 (100)

There was no relationship found between the type of traffic control and whether excessive (p=0.57, Fishers exact) or inappropriate speed (p=0.43, Fishers exact) were involved in the crash (Table 4.46). Further investigation that classified the traffic control as either present or absent also failed to find a relationship (results not shown).

Table 4.47. Excessive/Inappropriate speed involvement by Road Geometry

Road geometry	Excessive speed involved	
	Yes	No
Cross-intersection	8 (57.1)	6 (42.9)
T-intersection	16 (50)	16 (50)
Multiple intersection	2 (66.7)	1 (33.3)
Not at intersection	29 (44.6)	36 (55.4)
Dead end	1 (100)	0
	Inappropriate speed involved	
	Yes	No
Cross-intersection	12 (75)	4 (25)
T-intersection	24 (64.9)	13 (35.1)
Multiple intersection	3 (100)	0
Not at intersection	55 (70.5)	23 (29.5)
Dead end	1 (100)	0

There was no relationship found between the road geometry and whether excessive (p=0.73, Fishers exact) or inappropriate speed (p=0.80, Fishers exact) were involved in the crash (Table 4.47). Further investigation that classified the road geometry as either intersection or no intersection also failed to find a relationship (results not shown).

There was little information available for whether any traffic signals were visible to the rider, or whether the rider or other road-user's view was obstructed, so the relationship between those variables and speed involvement is not reported.

Table 4.48. Excessive/Inappropriate speed involvement by Infrastructures Issues

Infrastructure issues noted	Excessive speed involved	
	Yes	No
No	1 (20)	4 (80)
Yes	9 (40.9)	13 (59.1)
	Inappropriate speed involved	
	Yes	No
No	4 (57.1)	3 (42.9)
Yes	17 (65.4)	12 (36.4)

There was no relationship found between whether or not infrastructure issues were noted in the NCIS documents and whether excessive ($\chi^2(5)=7.22$, p=0.21) or inappropriate speed ($\chi^2(5)=6.04$, p=0.31) were involved in the crash (Table 4.48).

4.2.3 Motorcycle factors

Prior to assessing the relationship between motorcycle make and speed related crashes, the motorcycle makes were re-categorised such that the most common makes (Harley Davidson, Honda, Kawasaki, Suzuki and Yamaha) were considered separately and the other makes were re-categorised into an "other" category (Table 4.49).

Table 4.49. Excessive/Inappropriate speed involvement by Motorcycle make

Motorcycle make	Excessive speed involved	
	Yes	**No**
Harley Davidson	1 (11.1)	8 (88.9)
Honda	18 (58.1)	13 (41.9)
Kawasaki	8 (53.3)	7 (46.7)
Suzuki	11 (57.9)	8 (42.1)
Yamaha	12 (44.4)	15 (55.6)
Other	6 (54.6)	5 (45.5)
	Inappropriate speed involved	
	Yes	**No**
Harley Davidson	6 (46.2)	7 (53.9)
Honda	27 (77.1)	8 (22.9)
Kawasaki	12 (75)	4 (25)
Suzuki	17 (81.0)	4 (19.1)
Yamaha	20 (66.7)	10 (33.3)
Other	11 (73.3)	4 (26.7)

There was no relationship found between motorcycle make and whether excessive (p=0.62, Fishers exact) or inappropriate speed (p=0.69, Fishers exact) were involved in the crash.

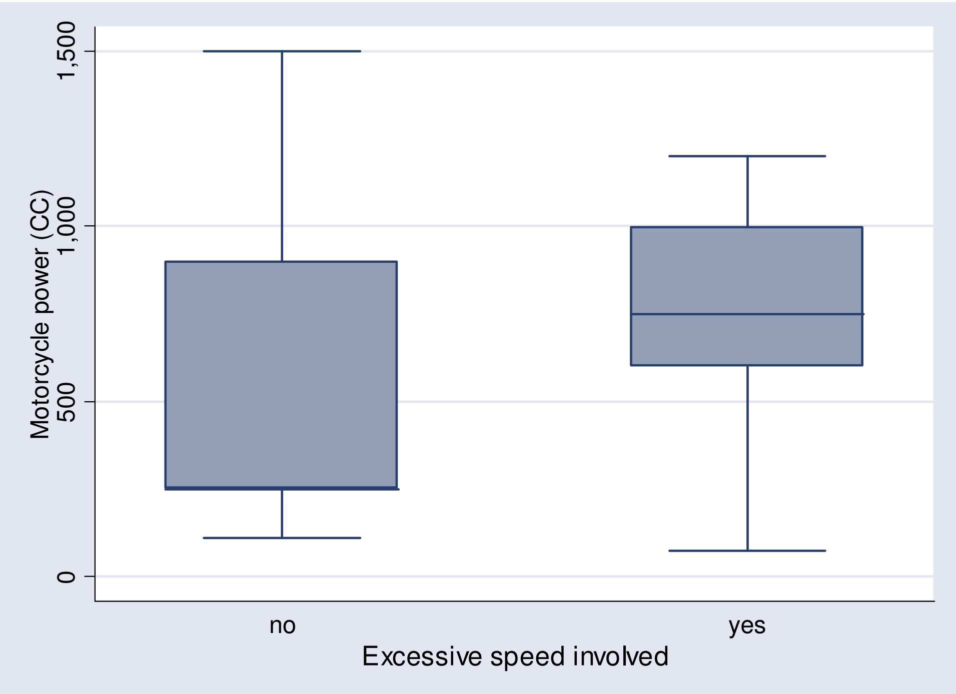

Figure 4.6. Engine capacity (CC) of the motorcycle for crashes that did, and did not, involve excessive speed

Figure 4.6 indicates that, for the 46 crashes in which the engine capacity of the motorcycle and the involvement of excessive speed was known, the median engine capacity of motorcycles in crashes that did not involve excessive speed was lower (median 250cc, IQR 650cc), than the median cc of motorcycles involving excessive speed (median 750cc, IQR

398cc). This difference did not reach the conventional level for assessing statistical significance (z=-1.26, p=0.21).

Further analysis involved classifying the motorcycles according to whether they were 250cc or less, or greater than 250cc, and also whether or not they were over 500cc. Of the 31 motorcycles with engine capacity greater than 250cc, 22 (71%) were involved in crashes involving excessive speed compared to 7 (43.8%) of the 16 motorcycles with engine capacity of 250cc or less. This association was not significant (p=0.11, Fishers exact). However, of the 30 motorcycles with engine capacity greater than 500cc, 22 (73.3%) were involved in crashes involving excessive speed compared to 7 (41.2%) of those 17 motorcycles with engine capacity of 500cc or less (p=0.06, Fishers exact).

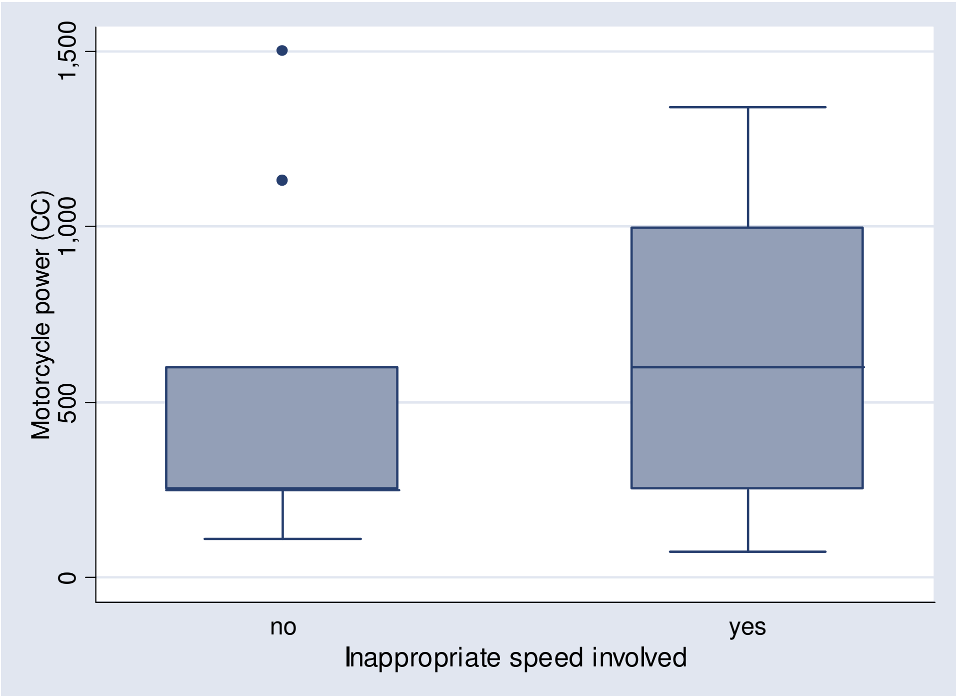

Figure 4.7. Engine capacity (CC) of the motorcycle for crashes that did, and did not, involve inappropriate speed

Comment [JE1]: The boxplot for crashes without inappropriate speed looks odd, is it correct? Just a very restricted range with outliers?

Figure 4.7 indicates that, for the 54 crashes in which the engine capacity of the motorcycle and the involvement of inappropriate speed was known, the median engine capacity of motorcycles in crashes that did not involve inappropriate speed was lower (median 250cc, IQR 350cc), than the median cc of motorcycles involving inappropriate speed (600cc, IQR 748cc). This difference did not reach the conventional level for statistical significance (z=-1.74, p=0.08), however the result is still of interest.

For inappropriate speed involvement, a significantly higher proportion of motorcycles over 250cc were involved in crashes involving inappropriate speed (32; 86.5%) compared to motorcycles of 250cc or less (11; 61.1%) (p=0.04, Fishers exact). Likewise, 30 (85.7%) of 35 motorcycles with engine capacity greater than 500cc were involved in a crash involving inappropriate speed compared to 13 (65%) of 20 motorcycles of engine capacity less than

500cc (p=0.096, Fishers exact). While this result does not reach the conventional level for statistical significance, it is still worth noting

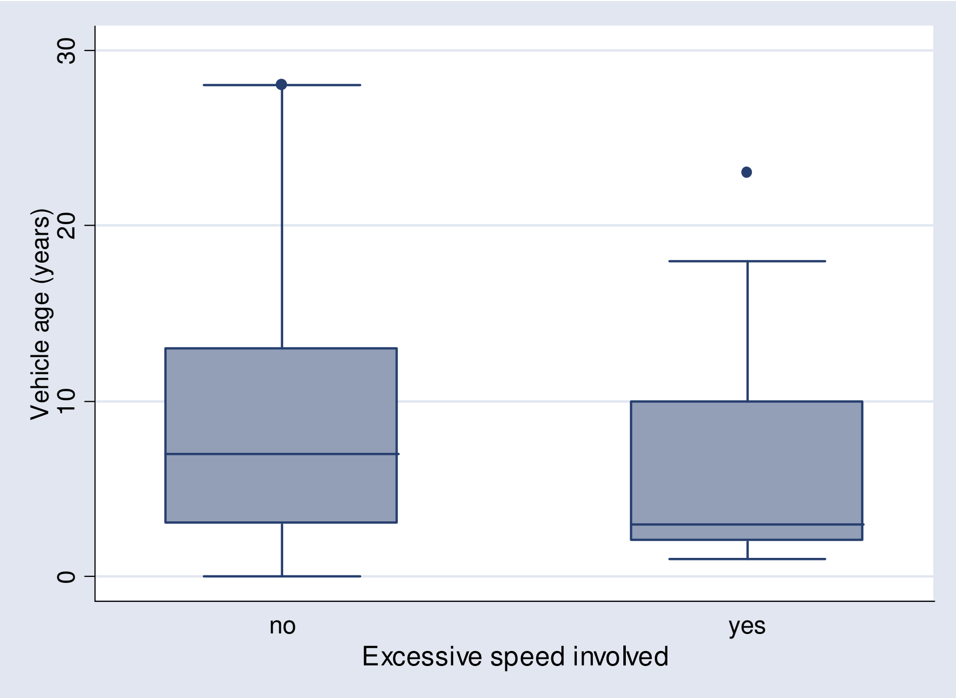

Figure 4.8. Age of the motorcycle for crashes that did, and did not, involve excessive speed

For the 82 motorcycles where age of the motorcycle was known and the involvement of excessive speed could be judged (Figure 4.8), the median age of motorcycles in crashes involving excessive speed was 3 years (IQR=8), compared to 7 years (IQR=10) for crashes not involving excessive speed. This difference was not statistically significant (z=1.61, p=0.11).

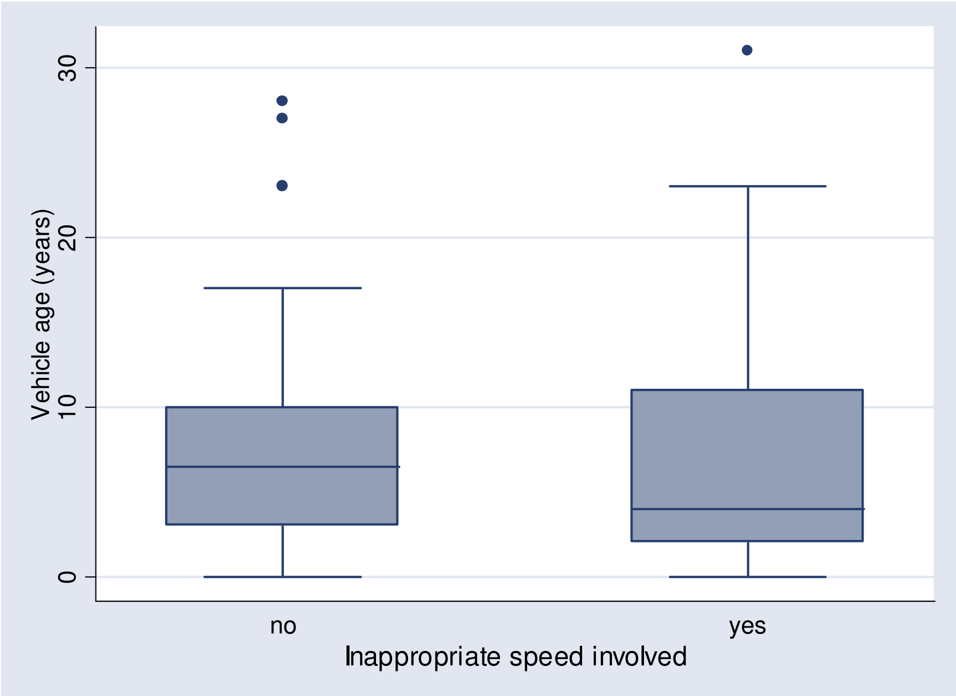

Figure 4.9. Age of the motorcycle for crashes that did, and did not, involve inappropriate speed

For the 97 motorcycles where age of the motorcycle was known and the involvement of inappropriate speed could be judged (Figure 4.9), the median age of motorcycles in crashes involving inappropriate speed was 4 years (IQR=9), compared to 6.5 years (IQR=7) for crashes not involving inappropriate speed. This difference was not statistically significant (z=0.61, p=0.54).

Table 4.50. Excessive/Inappropriate speed involvement by defective Motorcycles

Motorcycle defects noted	**Excessive speed involved**	
	Yes	**No**
No	5 (41.7)	7 (58.3)
Yes	11 (47.8)	12 (52.2)
	Inappropriate speed involved	
	Yes	**No**
No	12 (80)	3 (20)
Yes	17 (68)	8 (32)

There was no relationship found between whether motorcycle defects were noted and whether excessive (n=35, p=1.00, Fishers exact) or inappropriate speed (n=40, p=0.49, Fishers exact) were involved in the crash (Table 4.50).

Table 4.51. Excessive/Inappropriate speed involvement by Motorcycle Registration

Was the motorcycle registered?	Excessive speed involved	
	Yes	No
No	4 (50)	4 (50)
Yes	23 (48.9)	24 (51.2)
	Inappropriate speed involved	
	Yes	**No**
No	11 (91.7)	1 (8.3)
Yes	34 (65.4)	18 (34.6)

For the 55 cases in which information was available about whether the motorcycle was registered and where the involvement of excessive speed could be judged (Table 4.51), there was no relationship between the motorcycle registration status and excessive speed (p=1.00, Fishers exact).

For the 64 cases in which information was available about whether the motorcycle was registered and where the involvement of inappropriate speed could be judged (Table 4.51), a larger proportion of cases where the motorcycle was not registered involved inappropriate speed (91.7%), compared to when the motorcycle was registered (65.4%), however this did not reach the conventional level for statistical significance (p=0.09, Fishers exact).

Table 4.52. Excessive/Inappropriate speed involvement by Motorcycle Type

What type of motorcycle was it?	Excessive speed involved	
	Yes	No
On-road	26 (55.3)	21 (44.7)
Off-road	1 (20)	4 (80)
	Inappropriate speed involved	
	Yes	**No**
On-road	41 (70.7)	17 (29.3)
Off-road	5 (83.3)	1 (16.7)

There was no relationship found between whether the motorcycle and on-road or off-road motorcycle and whether excessive (n=52, p=0.18, Fishers exact) or inappropriate speed (n=64, p=0.67, Fishers exact) were involved in the crash (Table 4.52). It must be noted however, that there were so few cases where the motorcycle was an off-road motorcycle, that this comparison may not have enough power to detect any difference. It is interesting to note that the crashes involving off-road motorcycles did not often involve excessive speed, but often involved inappropriate speed.

Table 4.53. Excessive/Inappropriate speed involvement by Motorcycle Ownership

Was the rider riding their own motorcycle?	Excessive speed involved	
	Yes	No
No	7 (100)	0
Yes	35 (44.9)	43 (55.1)
	Inappropriate speed involved	
	Yes	**No**
No	8 (100)	0
Yes	68 (70.8)	28 (29.2)

For the 85 cases in which information was available about whether the rider was riding their own motorcycle or someone else's and where the involvement of excessive speed could be judged (Table 4.53), a larger proportion of the riders riding someone else's motorcycle (100%) had crashes involving excessive speed than riders riding their own motorcycle (44.9%) (p=0.005, Fishers exact).

For the 104 cases in which information was available about whether the rider was riding their own motorcycle or someone else's and where the involvement of inappropriate speed could be judged (table 4.53), no relationship was found (p=0.11, Fishers exact).

4.2.4 Trip details

Table 4.54. Excessive/Inappropriate speed involvement by Crash Location

Did the crash occur in city (incl. large provincial towns) or rural areas?	Excessive speed involved	
	Yes	**No**
City (incl. large towns)	41 (69.5)	18 (30.5)
Rural	15 (26.8)	41 (73.2)
	Inappropriate speed involved	
	Yes	**No**
City (incl. large towns)	57 (80.3)	14 (19.7)
Rural	38 (59.4)	26 (40.6)

Significantly more of the crashes that occurred in the city, or large provincial towns, involved excessive speed (69.5%) compared to crashes that occurred in rural areas (26.8%) (p<0.001, Fishers exact). Likewise significantly more of the crashes that occurred in the city, or large provincial towns, involved inappropriate speed (80.3%) compared to crashes that occurred in rural areas (59.4%) (p=0.009, Fishers exact) (Table 4.54).

As noted previously, more of the speed related crashes occurred in lower speed zones, and considering rural areas generally have speed zones of 100 km/h or greater, this could explain the result. Further multivariate analysis is needed to tease out the separate effects of where the crash occurred (city/country) and speed zone (see section 4.2.6).

Table 4.55. Excessive/Inappropriate speed involvement by whether a Pillion Passenger was present or not

Was there a pillion passenger present?	Excessive speed involved	
	Yes	**No**
No	54 (50.5)	53 (49.5)
Yes	2 (25)	6 (75)
	Inappropriate speed involved	
	Yes	**No**
No	91 (71.7)	36 (28.4)
Yes	4 (50)	4 (50)

There was no relationship found between whether the rider had a pillion passenger and whether excessive (p=0.27, Fishers exact) or inappropriate speed (p=0.24, Fishers exact) were involved in the crash (Table 4.55).

Table 4.56. Excessive/Inappropriate speed involvement by whether Rider was in a Group

Was the rider riding alone or in a group?	**Excessive speed involved**	
	Yes	**No**
Alone	46 (52.3)	42 (47.7)
In pairs	4 (40)	6 (60)
In a group of more than 2	6 (35.3)	11 (64.7)
	Inappropriate speed involved	
	Yes	**No**
Alone	73 (71.2)	29 (28.4)
In pairs	9 (69.2)	4 (30.8)
In a group of more than 2	13 (65)	7 (35)

There was no relationship found between whether the rider was riding alone, in pairs or in a larger group and excessive speed (p=0.40, Fishers exact) or inappropriate speed (p=0.81, Fishers exact) were involved in the crash (Table 4.56). Further investigation that classified the riders as riding alone or with others also failed to find a relationship (results not shown).

4.2.5 Crash details

The crashes were spread across 62 LGAs. Those LGAs in which 10 or more crashes occurred were considered to determine if excessive or inappropriate speed-related crashes occurred more in one LGA than another.

Table 4.57. Excessive/Inappropriate speed involvement by Crash LGA

LGA	**Excessive speed involved**	
	Yes	**No**
East Gippsland	2 (66.7)	1 (33.3)
Hume	3 (60)	2 (40)
Melbourne	2 (66.7)	1 (33.3)
Whittlesea	7 (63.6)	4 (36.4)
Yarra Ranges	1 (16.7)	5 (83.3)
	Inappropriate speed involved	
	Yes	**No**
East Gippsland	4 (80)	1 (20)
Hume	5 (71.4)	2 (28.6)
Melbourne	3 (75)	1 (25)
Whittlesea	8 (72.7)	3 (27.3)
Yarra Ranges	4 (57.1)	3 (42.9)

No relationship was found between the LGA where the crash occurred and excessive speed (p=0.39, Fishers exact) or inappropriate speed (p=0.96, Fishers exact) were involved in the crash (Table 4.57). It must be noted that information on where the crash occurred and speed involvement was only available for a small number of crashes, which is unlikely to provide enough power to detect any differences that may exist. Visual inspection of the results does suggest however, that most of the areas are the same in terms of the involvement of speed-related crashes, except perhaps the Yarra Ranges, which appears to have a lower proportion of speed-related crashes, particularly those involving excessive speed, than the other areas.

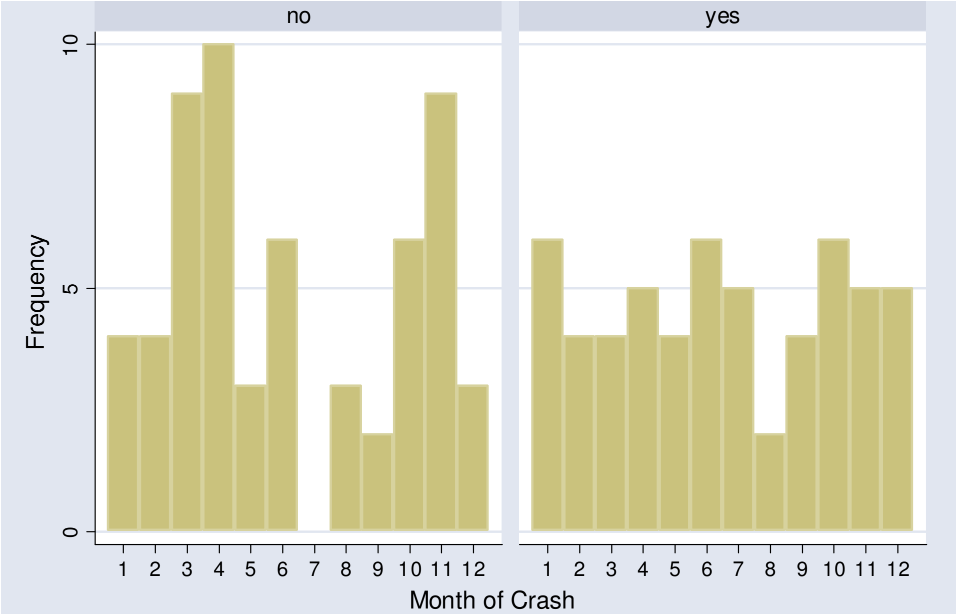

Figure 4.10 Month of crash for crashes that did, and did not, involve excessive speed

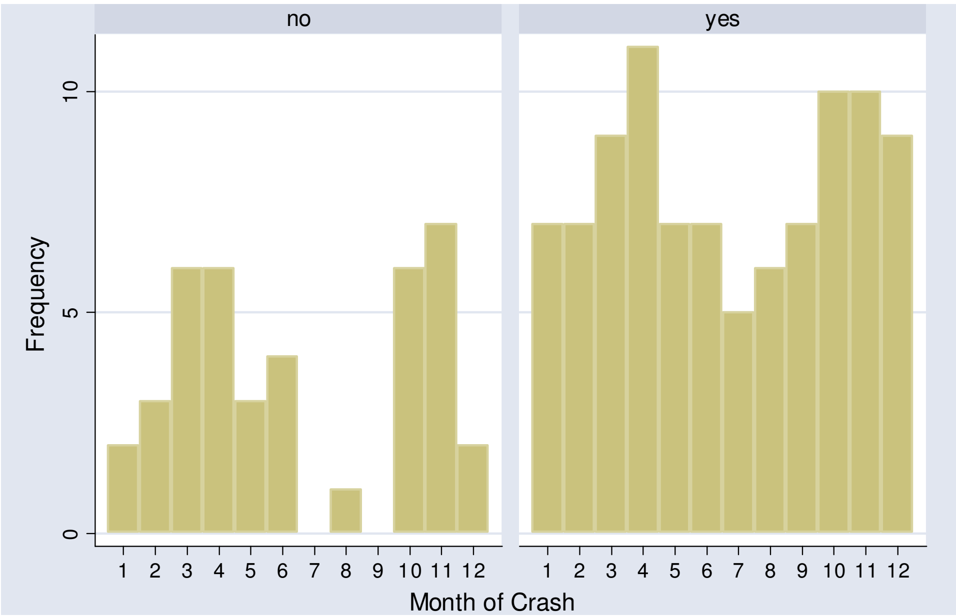

Figure 4.11 Month of crash for crashes that did, and did not, involve inappropriate speed

There was no relationship found between the month in which the crash occurred and whether excessive ($\chi^2(11)=11.57$, $p=0.40$) or inappropriate speed ($\chi^2(11)=9.61$, $p=0.57$)

were involved n the crash (Figures 4.10 and 4.11). To look at the results at a broader level, the months were categorised into seasons.

Table 4.58. Excessive/Inappropriate speed involvement by Season of Crash

Season	Excessive speed involved	
	Yes	No
Summer	15 (57.7)	11 (42.3)
Autumn	13 (37.1)	22 (62.9)
Winter	13 (59.1)	9 (40.9)
Spring	15 (46.9)	17 (53.1)
	Inappropriate speed involved	
	Yes	**No**
Summer	23 (76.7)	7 (23.3)
Autumn	27 (64.3)	15 (35.7)
Winter	18 (78.3)	5 (21.7)
Spring	27 (62.5)	13 (32.5)

No relationship was found between season and the involvement of excessive (p=0.30, Fisher exact) or inappropriate (p=0.56, Fisher exact) speed (Table 4.58).

Table 4.59. Excessive/Inappropriate speed involvement by Day of the Week

Day of week	Excessive speed involved	
	Yes	No
Sunday	12 (42.9)	16 (57.1)
Monday	9 (52.9)	8 (47.1)
Tuesday	4 (33.3)	8 (66.7)
Wednesday	8 (53.3)	7 (46.7)
Thursday	6 (60)	4 (40)
Friday	8 (61.5)	5 (38.50
Saturday	9 (45)	11 (55)
	Inappropriate speed involved	
	Yes	**No**
Sunday	20 (66.7)	10 (33.3)
Monday	12 (66.7)	6 (33.3)
Tuesday	9 (60)	6 (40)
Wednesday	17 (77.3)	5 (22.7)
Thursday	6 (60)	4 (40)
Friday	13 (81.3)	3 (18.8)
Saturday	18 (75)	6 (25)

There was no relationship found between the day of week on which the crash occurred and whether excessive ($\chi^2(6)=3.25$, p=0.78) or inappropriate speed ($\chi^2(6)=3.26$, p=0.78) were involved in the crash (Table 4.59).

Table 4.60. Excessive/Inappropriate speed involvement by Time of Day

Time of day	Excessive speed involved	
	Yes	No
12-6am	6 (100)	0
6-9am	3 (25)	9 (75)
9am-12pm	4 (66.7)	2 (33.3)
12pm-4pm	14 (40)	21 (60)
4pm-7pm	15 (44.1)	19 (55.9)
7pm-12am	14 (63.6)	8 (36.4)
	Inappropriate speed involved	
	Yes	No
12-6am	7 (100)	0
6-9am	9 (56.3)	7 (43.8)
9am-12pm	4 (66.7)	2 (33.3)
12pm-4pm	33 (78.6)	9 (21.4)
4pm-7pm	25 (64.1)	14 (35.9)
7pm-12am	17 (68)	8 (32)

Whether excessive speed was involved in the crash significantly differed according to the time of the crash (p=0.02, Fishers exact), however, this was not so for whether inappropriate speed was involved (p=0.23, Fishers exact). All crashes for which the involvement of speed could be determined and which occurred between midnight and 6am involved both excessive and inappropriate speed (Table 4.60). Only 25% of the crashes that occurred between six and nine in the morning involved excessive speed.

Table 4.61. Excessive/Inappropriate speed involvement by Activity

Activity	Excessive speed involved	
	Yes	No
Paid work	5 (50)	5 (50)
Travelling not elsewhere classified	51 (49.0)	53 (51)
	Inappropriate speed involved	
	Yes	No
Paid work	7 (70)	3 (30)
Travelling not elsewhere classified	88 (71)	26 (29)

There was no relationship found between the activity the rider was involved in and whether excessive (p=1.00, Fishers exact) or inappropriate speed (p=1.00, Fishers exact) were involved in the crash (Table 4.61).

Table 4.62. Excessive/Inappropriate speed involvement by Crash Type (RCIS classification)

Crash type	Excessive speed involved	
	Yes	No
Collision with vehicle	30 (41.1)	43 (58.9)
Struck animal	2 (66.7)	1 (33.3)
Collision fixed object	18 (62.1)	11 (37.9)
Collision other object	0	1 (100)
Vehicle overturned	2 (100)	0
Fall from/in moving vehicle	1 (100)	0
No collision and no object hit	3 (50)	3 (50)
	Inappropriate speed involved	
	Yes	**No**
Collision with vehicle	57 (66.3)	29 (33.7)
Struck animal	3 (100)	0
Collision fixed object	27 (79.4)	7 (20.60
Collision other object	1 (50)	1 (50)
Vehicle overturned	2 (100)	0
Fall from/in moving vehicle	2 (100)	0
No collision and no object hit	3 (50)	3 (50)

There was no relationship found between type of crash and whether excessive ($p=0.15$, Fishers exact) or inappropriate speed ($p=0.42$, Fishers exact) were involved in the crash (Table 4.62).

The crashes were categorised across 37 different DCAs. The six DCAs for which there were more than five crashes that could be classified as to whether excessive speed was involved or not were considered to determine if DCAs differed as to whether excessive or inappropriate speed were involved.

Table 4.63. Excessive/Inappropriate speed involvement by DCA

DCA	Excessive speed involved	
	Yes	No
Right near (intersections only)	2 (28.6)	5 (71.4)
Head on (not overtaking)	2 (12.5)	14 (87.5)
Right through	10 (43.5)	13 (56.5)
Left off carriageway into object/parked vehicle	6 (100)	0
Off right bend into object/parked vehicle	6 (75)	2 (25)
Off left bend into object/parked vehicle	6 (40)	9 (60)
	Inappropriate speed involved	
	Yes	**No**
Right near (intersections only)	5 (55.6)	4 (44.4)
Head on (not overtaking)	16 (72.7)	6 (27.3)
Right through	14 (60.9)	9 (39.1)
Left off carriageway into object/parked vehicle	8 (100)	0
Off right bend into object/parked vehicle	9 (90)	1 (100
Off left bend into object/parked vehicle	11 (64.7)	6 (35.3)

Whether excessive speed was involved in the crash significantly differed according to the DCA of the crash (p=0.002, Fishers exact), however, this was not so for whether inappropriate speed was involved (p=0.18, Fishers exact). All crashes for which the involvement of speed could be determined and which were classified as "left of carriageway into object/parked vehicle" involved both excessive and inappropriate speed (Table 4.63). A large proportion of the crashes defined as "off right bend into object/parked vehicle" also involved excessive (75%) and inappropriate (90%) speed.

Table 4.64. Excessive/Inappropriate speed involvement by Number of Vehicles Involved

Number of other vehicles involved	Excessive speed involved	
	Yes	No
0	24 (63.2)	14 (36.8)
1	31 (44.9)	38 (55.1)
2 or more	1 (12.5)	7 (87.5)
	Inappropriate speed involved	
	Yes	**No**
0	34 (79.1)	9 (20.9)
1	58 (69.9)	25 (30.1)
2 or more	3 (33.3)	6 (66.7)

Excessive (p=0.02, Fishers exact) and inappropriate speed (p=0.03, Fishers exact) were more likely to occur the fewer the number of vehicles involved in the collision (Table 4.64). Excessive speed was involved in 63.2% of the single-vehicle collisions, compared to

41.6% of the multi-vehicle collisions. Likewise, inappropriate speed was involved in 79.1% of the single vehicle collisions and 66.3% of the multi-vehicle collisions.

As mentioned previously, there was some disagreement between the data in the RCIS and the information in the NCIS documents as to whether the rider was ejected from the motorcycle. For that reason, the data has not been presented here, although it is worth noting that whichever data were considered, there was no relationship found with excessive or inappropriate speed involvement.

Table 4.65. Excessive/Inappropriate speed involvement by whether Rider was at fault

Fault	**Excessive speed involved**	
	Yes	**No**
Rider not at fault	4 (16.7)	20 (83.3)
Rider partially at fault	10 (71.4)	4 (28.6)
Rider fully at fault	31 (51.7)	29 (48.3)
	Inappropriate speed involved	
	Yes	**No**
Rider not at fault	7 (28)	18 (72)
Rider partially at fault	12 (92.3)	1 (7.7)
Rider fully at fault	63 (79.8)	16 (20.3)

Table 4.65 displays the proportion of riders involved in excessive and inappropriate speed related crashes who were partially, fully or not at fault. Riders who were judged not to be at fault were significantly less likely have been involved in crashes where excessive speed was involved (16.7%) compared to riders who were partially or fully at fault (71.4% and 51.7% respectively) ($p=0.001$, Fishers exact). Likewise riders who were judged not to be at fault were significantly less likely have been involved in crashes where inappropriate speed was involved (28%) compared to riders who were partially or fully at fault (92.3% and 79.8% respectively) ($p<0.001$, Fishers exact).

4.2.6 Results summary – characteristics of speed-related motorcycle fatalities

For those individual rider, motorcycle, environment and crash characteristics that were found to be related to excessive and/or inappropriate speed involvement, the magnitude of the association was determined using univariate logistic regression models. The measure of effect obtained from logistic regression is the odds ratio (OR, i.e. the odds of the risk factor being present in crashes involving excessive/inappropriate speed divided by the odds of the risk factor being present in crashes not involving excessive/inappropriate speed). The OR measures the relative odds of crashes involving excessive/inappropriate speed displaying a particular characteristic compared with crashes not involving excessive/inappropriate speed. An odds ratio of one indicates no difference in the odds of crashes involving excessive/inappropriate speed and crashes not involving excessive/inappropriate speed displaying a particular characteristic. An odds ratio of greater than one indicates the odds of crashes involving excessive/inappropriate speed displaying a characteristic is greater than for crashes not involving excessive/inappropriate speed, and the opposite is true for an odds ratio of less than one. The precision or accuracy of the odds ratio estimate is indicated by 95% confidence intervals, where narrower confidence intervals indicate more precise estimates. The p-value indicates whether the observed association is likely to be due to chance.

One of the limitations of the univariate analyses is that the influence of each factor on excessive speed involvement is considered in isolation from each other. As some of these factors are correlated (e.g., marital status and age), it would be helpful to be able to determine the independent contribution of these potentially confounding factors. Therefore, multivariate logistic regression was conducted to simultaneously examine the relationship between a number of the potentially confounding characteristics. Of the rider characteristics, gender, marital status and rider experience were thought to be potentially correlated with age. There is also some mention in the literature that older riders are more likely to ride more powerful motorcycles, so the relationship between motorcycle engine capacity and speed involvement might also be confounded by age. As such, even though some of the univariate comparisons did not show a significant association between motorcycle engine capacity and speed involvement, this association was still assessed, adjusting for age. Of the environment characteristics, there is likely to be some confounding between speed zone and location.

The association of various rider, motorcycle, environment and crash characteristics with excessive speed involvement is shown in Table 4.66, and for inappropriate speed involvement, in Table 4.67. Where necessary, potential confounders have been adjusted for.

Table 4.66. Factors associated with excessive speed involvement in a sample of fatal motorcycle crashes.

Risk Factor	**Excessive speed involved n [%]**	**Excessive speed not involved n [%]**	**Odds Ratio [95% CI]** *Adjusted odds ratio*	**p-value**
RIDER				
Age - median [iqr]	27.5 [11]	39 [16]	**0.93 [0.90, 0.97]**	**<0.001**
Licence status				
Yes No	22 [42.3] 15 [75]	30 [57.7] 5 [25]	1 **4.09 [1.29. 12.95]**	 **0.02**
Rider experience				
Experienced Inexperienced	1 [8.3] 5 [45.5]	11 [91.7] 6 [54.5]	1 9.17 [0.86, 97.7] *Adjusted for age* *4.97 [0.33, 74.7]*	 0.07 *0.25*
Marital status				
Married incl. de facto Not married	12 [27.9] 12 [54.6]	31 [72.1] 10 [45.5]	1 **3.10 [1.06, 9.05]** *Adjusted for age* *1.17 [0.29, 4.61]*	 **0.04** *0.83*
Alcohol				
Absent Present	34 [41.0] 18 [69.2]	49 [59.0] 8 [30.8]	1 **3.24 [1.27, 8.31]**	 **0.01**
BAC = 0 BAC > 0 and <0.05 BAC> 0.05 and <0.15 BAC>0.15	34 [41.0] 4 [66.7] 11 [84.6] 3 [42.9]	49 [59.0] 2 [33.3] 2 [15.4] 4 [57.1]	1 2.88 [0.50, 16.63] **7.93 [1.65, 38.06]** 1.08 [0.23, 5.14]	 0.25 **0.01** 0.94
MOTORCYCLE				
Engine capacity of motorcycle				

<=250 cc >250 cc	7 [43.8] 22 [71.0]	9 [56.3] 9 [29.0]	1 **3.14 [0.90, 11.03]** ***Adjusted for age*** ***7.37 [1.48, 36.66]***	 **0.07** **0.02**
<=500 cc >500 cc	7 [41.2] 22 [73.3]	10 [58.8] 8 [26.7]	1 3.93 [1.11, 13.85] *Adjusted for age* *10.69 [1.96, 58.37]*	 0.03\ *0.006*
Riding own bike				
No Yes	7 [100] 35 [44.9]	0 43 [55.1]	Cannot be computed	
ENVIRONMENT				
Speed zone				
<=70 km/h > 70 km/h	33 [75] 22 [31.4]	11 [25] 48 [68.8]	1 **0.15 [0.07, 0.36]** *Adjusted for location* ***0.31 [0.11, 0.90]***	 **<0.001** ***0.03***
Location				
City (incl. large town) Rural	41 [69.5] 15 [26.8]	18 [30.5] 41 [73.2]	1 **0.16 [0.07, 0.36]** *Adjusted for speed zone* ***0.33 [0.12, 0.93]***	 **<0.001** ***0.04***
CRASH				
No. of other vehicles involved				
0 1 2+	24 [63.2] 31 [44.9] 1 [12.5]	14 [36.8] 38 [55.1] 7 [87.5]	1 0.48 [0.21, 1.07] **0.08 [0.01, 0.75]**	 0.07 **0.03**
Fault of rider				
Not at fault Partially at fault Fully at fault	4 [16.7] 10 [71.4] 31 [51.7]	20 [83.3] 4 [28.6] 29 [48.3]	1 **12.50 [2.57, 60.7]** **5.34 [1.63, 17.51]**	 **0.002** **0.006**

Results in bold are those that met the conventional level for statistical significance (<0.05). Other results, where the p-value lies between 0.05 and 0.10 are also of interest).

Amongst the sample of fatally injured motorcycle riders, the following factors were significantly associated with being involved in a collision involving excessive speed:

- Age: On average, as rider age increased by one year, the odds of the fatal crash involving excessive speed decreased by 7%.
- Licence status: The odds of the crash involving excessive speed were increased by over three times if the rider did not have a valid motorcycle licence.
- Marital status: The odds of the crash involving excessive speed were increased by over two times if the rider was not married, however, once the confounding effect of age was taken into account, this association disappeared.
- Use of alcohol: The odds of the crash involving excessive speed were increased by 224% if the rider had a positive alcohol reading. Looking at this in more depth, compared to those riders with a zero BAC, those with a BAC of between 0.05 and 0.15 were more likely to be involved in a crash involving excessive speed. However, riders with alcohol detected at levels less than the legal threshold (i.e. <0.05), and riders with very high BAC (over 0.15) did not differ from those with no alcohol detected in terms of the odds of the crash involving excessive speed.

- Motorcycle engine capacity: The odds of the crash involving excessive speed were increased if the engine capacity of the motorcycle was over 250cc, although the univariate association was not significant. However, older riders were more likely to ride more powerful motorcycles, for riders of a comparable age, the odds of the crash involving excessive speed were over six times higher when the motorcycle was over 250cc. Likewise, for riders of a comparable age, the odds of the crash involving excessive speed were almost ten times higher when the motorcycle was over 500cc.
- Speed zone: The odds of the crash involving excessive speed were decreased in speed zones >70 km/h, compared to speed zones of 70 km/h or less. The effect of speed zone remained, even when the location (a potential confounder) was adjusted for. The odds of the crash involving excessive speed decreased by 69% in speed zones >70 km/h, compared to speed zones of 70km/h or less when adjusted for the effect of location (city or rural).
- Location: The odds of the crash involving excessive speed were decreased in rural areas, compared to city areas (including large country towns), even when the speed zone (a potential confounder) was adjusted for. The odds of the crash involving excessive speed decreased by 67% in rural areas compared to city areas, when adjusted for the effect of speed zone.
- Number of other vehicles involved: The odds of the crash involving excessive speed were decreased by 92% if there were two or more other vehicles involved, compared to when it was a single-vehicle collision.
- Fault: The odds of the crash involving excessive speed were increased if the rider was partially (odds 11.5 times higher) or fully (odds over 4 times higher) at fault, compared to when they were not at fault.

Other factors, while not reaching the conventional level of statistical significance, may also be of interest for further research because there are indications that they might increase the likelihood of the crash involving excessive speed.

- Rider inexperience, however, once the confounding effect of age was taken into account, this association disappeared.
- Compared to single-vehicle collisions, the odds of the crash involving excessive speed may be decreased if there is one other vehicle involved.

Riding someone else's motorcycle was also related to excessive speed involvement, however the magnitude of this association could not be computed. Time of day and DCA were also related. For those crashes where excessive speed could be judged, all crashes occurring between midnight and six am involved excessive speed compared to only 25% that occurred between six and nine am. In terms of DCA, a larger proportion of crashes classified as left off carriageway into object/parked vehicle and off right bend into object/parked vehicle involved excessive speed than for other crash types.

There were many rider, motorcycle and crash characteristics that were not found to be related to excessive speed involvement. These were; gender, medical conditions, testing positive for THC, helmet use, avoidance behaviour, improper passing, being cut-off by another road-user, road surface type and condition, road character, road geometry, traffic control, infrastructure issues, weather, motorcycle make, motorcycle age, motorcycle registration status, motorcycle type, presence of motorcycle defects, month or season of crash, day of week, presence of a pillion passenger, riding in a group, crash type, or work-related travel. It must be noted that for some of these variables, there may not have been enough power to detect an effect. This was particularly a problem for those comparisons of the relationship with restrictions (current and future) for learner and novice drivers, due to the low numbers available for analysis.

Table 4.67. Factors associated with inappropriate speed involvement in a sample of fatal motorcycle crashes

Risk Factor	Inappropriate speed involved n [%]	Inappropriate speed not involved n [%]	Odds Ratio [95% CI]	p-value
RIDER				
Gender				
Female Male	1 [25] 94 [71.8]	3 [75] 37 [28.2]	1 7.62 [0.77, 75.63] *Adjusted for age* *9.72 [0.96, 98.59]*	 0.08 *0.05*
Age median [iqr]	29 [16]	40 [15.5]	**0.96 [0.93, 0.99]**	**0.007**
Marital status				
Married incl. de facto Not married	25 [54.4] 23 [74.2]	21 [45.7] 8 [25.8]	1 2.42 [0.90, 6.51] *Adjusted for age* *0.89 [0.25,3.181]*	 0.08 *0.86*
THC				
Absent Present	64 [64.7] 19 [86.4]	35 [35.4] 3 [13.6]	1 3.46 [0.96, 12.53]	 0.06
MOTORCYCLE				
Engine capacity of motorcycle				
<=250 cc >250 cc	11 [61.1] 32 [86.5]	7 [38.9] 5 [13.5]	1 **4.07 [1.07, 15.50]**	 **0.04**
<=500 cc >500 cc	13 [65.0] 30 [85.7]	7 [35.0] 5 [14.3]	1 3.23 [0.86, 12.09]	0.08
Motorcycle registered				
Yes No	34 [65.4] 11 [91.7]	18 [34.6] 1 [8.3]	1 5.82 [0.70, 48.78]	 0.10
ENVIRONMENT				
Speed zone				
<=70 km/h > 70 km/h	43 [82.7] 51 [62.2]	9 [17.3] 31 [37.8]	1 **0.34 [0.15, 0.80]** *Adjusted for location* *0.52 [0.17, 1.58]*	 **0.01** *0.25*
Location				
City (incl. large town) Rural	57 [80.3] 38 [59.4]	14 [19.7] 26 [40.6]	1 **0.36 [0.17, 0.77]** *Adjusted for speed zone* *0.54 [0.20, 1.48]*	 **0.009** *0.23*
CRASH				
Cut off				
No Yes	67 [74.4] 26 [60.5]	23 [25.6] 17 [39.5]	1 0.53 [0.24, 1.14]	 0.10

No. of other vehicles involved				
0	34 [79.1]	9 [20.9]	1	
1	58 [69.9]	25 [30.1]	0.61 [0.26, 1.46]	0.27
2+	3 [33.3]	6 [66.7]	**0.13 [0.03, 0.64]**	**0.01**
Fault of rider				
Not at fault	7 [28]	18 [72]	1	
Partially at fault	12 [92.3]	1 [7.7]	**30.86 [3.35, 283.81]**	**0.002**
Fully at fault	63 [79.8]	16 [20.3]	**10.13 [3.61, 28.39]**	**<0.001**

Results in bold are those that met the conventional level for statistical significance (<0.05). Other results, where the p-value lies between 0.05 and 0.10 are also of interest).

Amongst the sample of fatally injured motorcycle riders, the following factors were associated with being involved in a collision involving inappropriate speed:

- Age: As age increases by one year, the odds of the fatal crash involving inappropriate speed decreased by 4%.
- Motorcycle engine capacity: The odds of the crash involving inappropriate speed were almost three times higher if the engine capacity of the motorcycle was over 250cc. Unlike for excessive speed, this relationship was not confounded by age.
- Speed zone: The odds of the crash involving inappropriate speed were decreased in speed zones >70 km/h, compared to speed zones of 70 km/h or less. However, once the location of the crash (city or rural) was taken into account, this association disappeared.
- Location: The odds of the crash involving inappropriate speed were decreased in rural areas, compared to city areas (including large country towns). However, once the speed zone of the crash was taken into account, this association disappeared.
- Number of other vehicles involved: The odds of the crash involving inappropriate speed were decreased by 87% if there were two or more other vehicles involved, compared to when it was a single-vehicle collision.
- Fault: The odds of the crash involving inappropriate speed were increased if the rider was partially (odds almost 30 times higher) or fully (odds over 9 times higher) at fault, compared to when they were not at fault.

Several other factors, while not reaching the conventional level of statistical significance, may also be of interest for further research because there are indications that they might increase the likelihood of the crash involving inappropriate speed. These factors were:

- Gender (being male) and this relationship became even stronger once age was adjusted for.
- Not being married, however this potential association disappeared once age was adjusted for.
- A positive THC result
- Riding a motorcycle that was not registered
- Riding a motorcycle with engine capacity greater than 500cc.
- Being involved in a crash in which the rider was not cut off by another road user.

There were many rider, motorcycle and crash characteristics that were not found to be related to inappropriate speed involvement. These were; licence status, rider experience, medical conditions, testing positive for alcohol, avoidance behaviour, improper passing, helmet use, road surface type and condition, road character, road geometry, traffic control, infrastructure issues, weather, riding someone else’s motorcycle, motorcycle make, motorcycle age, motorcycle type, presence of motorcycle defects, month or season of crash, day of week, time of day, DCA, presence of pillion passenger, riding in a group, work-related travel, and crash type. It must be noted that for some of these variables, there may not have been enough power to detect an effect. As for excessive speed involvement, this was particularly a problem for those comparisons of the relationship with restrictions (current and future) for learner and novice drivers, due to the low numbers available for analysis.

For other variables, there was not enough data to investigate the relationship with excessive or inappropriate speed involvement. These were; rider's area of residence, LGA of crash location, ill health, prior convictions, adverse mental state, fatigue or sleep problems, mental conditions, sensory or physical handicap, recent hospitalisation, previous crash involvement, following too closely, disregarding traffic control, distraction, insufficient gap to turn or change lanes, failing to give way, police involvement, use of protective clothing, signal visibility and obstruction of the rider or other drivers' view.

CHAPTER 5. DISCUSSION

5.1 STATEMENT OF PRINCIPAL FINDINGS

Excessive and inappropriate speed played a role in a large proportion of this sample of 201 fatal motorcycle crashes that occurred in Victoria between 2001 and 2005. Of the 115 crashes in which the role of excessive speed could be judged, close to half involved the rider exceeding the speed limit. Of the 135 crashes in which the role of inappropriate speed could be judged, 70% involved the rider travelling at a speed faster than was appropriate for the conditions.

A comparison of the rider, motorcycle and environmental characteristics of crashes involving excessive speed and those that did not revealed several characteristics associated with excessive speed involvement. Riders involved in crashes involving excessive speed were more likely to be younger, not to hold a valid motorcycle licence, to be riding another person's motorcycle, to test positive for alcohol (in particular, those with BAC between 0.05 and 0.15) and to be partially or fully at fault in the crash. They were also more likely to be riding high-powered motorcycles. Crashes that occurred in speed zones of 70km/h or less and in city locations were more likely to involve excessive speed, compared to higher speed zones and rural areas. The relationship with speed zone was not just due to a reporting bias: those crashes where speed involvement could not be judged were equally as likely to be in low speed zones as high speed zones. However, the speed involvement of a greater proportion of rural crashes was unknown compared to city areas, and this may have had an effect. Single vehicle collisions were also more likely to involve excessive speed than multi-vehicle collisions. For those crashes where excessive speed could be judged, all crashes occurring between midnight and six am involved excessive speed compared to only 25% that occurred between six and nine am. In terms of DCA, a larger proportion of crashes classified as left off carriageway into object/parked vehicle and off right bend into object/parked vehicle involved excessive speed than for other crash types.

Crashes involving inappropriate speed also displayed different characteristics to crashes that did not involve inappropriate speed. Riders killed in crashes involving inappropriate speed were more likely to be younger, to be riding high powered motorcycles, and to be partially or fully at fault. Single-vehicle collisions were more likely to involve inappropriate speed than multi-vehicle collisions. There was some evidence for crashes involving inappropriate speed to be more likely for male riders, for riders under the influence of cannabis and for motorcyclists riding an unregistered motorcycle. In addition, crashes in which the rider was not cut off by another road user may be more likely to involve inappropriate speed than crashes where the rider was cut off.

5.2 STRENGTHS AND WEAKNESSES OF THE STUDY

By combining and linking the National Coroners Information System and the VicRoads Road Crash Information System this study has assimilated the most detailed information available for fatal (or indeed any) motorcycle crashes that occurred in Victoria during a five year period. A wealth of information about the rider, the motorcycle, the road environment and characteristics of the crash itself was assembled. Having such comprehensive information enabled the application of the Safe System framework to investigate the contribution of these factors and how they are related to excessive and inappropriate speed involvement.

Any research project using existing data sources is limited by the type and amount of information that is collected, something over which the researcher has no control. Both of the data sources used in this study exist for different purposes. The primary purpose of the NCIS is to assist coroners in conducting death investigations, however it is also intended for use by researchers conducting public health research. The information included in the police summary of circumstances and the findings reports for each crash is restricted to those points that the investigating police officer/s and the coroner, respectively, felt were important to note. Hence, the reporting of traffic crashes is not consistent. While this narrative style of report does have the potential to include a great deal of information about what happened, there is little emphasis on what did not happen, which is sometimes of as much interest to researchers. For many of the factors of interest, the lack of information in the database meant that their role in motorcycle crashes overall, and in speed-related crashes in particular, could not be determined.

A good example is the outcome of interest in this study; speed involvement. It was often mentioned that speed was involved in the crash, however it was rarely mentioned if speed was not involved and such instances must be treated as unknowns rather than the absence of the factor. This raises the potential for bias in reporting. It is dangerous to assume that just because speed (or any factor) was not mentioned, that it was not a contributing factor. This is why the current project enlisted the assistance of an experienced crash investigator to study the NCIS reports to determine the involvement of excessive or inappropriate speed in those crashes for which this involvement was unclear from the statements of the police and coroner. However, the role of speed could not be judged for some crashes. Again, it is important to note that it is dangerous to assume that just because the involvement of speed could not be judged, that it was not a contributing factor. There simply was not enough information available in some case reports to be able to confidently determine if speed was or was not involved. As such, we cannot postulate whether the proportion of these cases with speed involved would be the same or different to the cases where there was enough evidence to make this judgement.

It is still important to note however, that the involvement of excessive and inappropriate speed could not be judged for every crash. This introduces the potential for bias when determining if the characteristics of speed-related crashes differ from non-speed related crashes. With this missing data, if speed involvement is more likely to be reported for some crashes (e.g. for young drivers, or males) the association between that factor and speed involvement may be incorrect. However, the data revealed that those cases where speed involvement could not be judged had a similar distribution across the categories of the factors of interest. This means that it does not appear that the likelihood of speed involvement being reported is related to any of the factors reported in this study. The one exception to this was for the relationship between alcohol use and speed involvement. Less of the cases with high BACs (over 0.15 g/mL) compared to lower BACs were able to be classified as either speed-related or not. While the current study still found that alcohol use increases the likelihood of the fatal crash involving excessive speed, the relationship may be stronger than indicated by the current study, as for over half of the crashes where the riders had a BAC of over 0.15 g/mL, the role of speed could not be judged. This could also have obscured any relationship between inappropriate speed and alcohol use.

The RCIS exists for monitoring crash information, and is also used for research purposes. Most of the data comes from a report completed by the investigating police officer. Up until 2006, the police completed the Victoria Police Collision Report (Form 510, see appendix). Although the RCIS database holds much information about characteristics of the crash and the environment, the information about the road-user could be improved. For example, one of the variables of interest in this study was whether or not the motorcyclist was riding a motorcycle that was too powerful for their licence conditions. Learners and riders in the first 12 months of their probationary or full licences are not permitted to ride motorcycles of over 260cc. Yet, the database does not distinguish between motorcyclists with restricted and non-restricted licences, and so for riders who were not learners and were riding higher powered motorcycles, it was impossible to determine what their actual licence conditions were at that time.

For several data items of interest, information was available from both data sources. When the data was linked and the two information sources compared, some discrepancies were noted. The most reliable data source was used when this occurred, for example, when the BAC test results did not agree, the NCIS toxicology documents were the preferred source of information. For some data items however, there was no good reason to prefer one data source over another.

5.3 COMPARISON TO PREVIOUS STUDIES

The percentage of motorcycles found to be travelling at excessive and inappropriate speeds in this study appears at first glance to be higher than that reported in past literature. For example, Clarke et al. (2004) found that 3.5% of crashes involved excessive speed and a further 5.6% involved inappropriate speed (9.2% of crashes in total), while Haworth et al. (1997) found 23% of crashed riders to be travelling at inappropriate speeds for the conditions. The MUARC Enhanced Crash Investigation Study has found 18.5% of motorcycle crashes to involve excessive speed and a further 14.8% to involve inappropriate speed, which is higher than that reported in the past, but still lower than what was found in the present study. These studies, however, included non-fatal crashes, and where fatal crashes were included, their results were not reported separately.

Mosedale and Purdy's (2004) study included both fatal and non-fatal crashes and found that the percentage of crashes involving speed (excessive or inappropriate) was much higher for fatal crashes than non-fatal crashes. Forty percent of fatal crashes that involved a motorcycle had speed as a contributory factor, compared to only 13% of all crashes. This explains the discrepancy between our findings and those of Clarke et al. (2004) and Haworth et al. (1997). Shankar (2001) also investigated speed involvement in fatal crashes, and found that 58% of those riders were speeding at the time of the crash. The estimates of Mosedale and Purdy and Shankar are more comparable to our estimate of roughly half the fatalities, where speed involvement could be judged, involving excessive speed and 70% involving inappropriate speed.

Regarding rider-related factors that have been shown to be related to crashes involving speed, the finding that younger riders are more likely to be involved in crashes involving excessive and inappropriate speed replicates findings from previous research (Haworth et al, 1997; Mosedale & Purdy, 2004; Alway & Poznanski, 2004). It is also in accordance with the initial trend from the MUARC Enhanced Crash Investigation Study (ECIS). In our sample, alcohol was more likely to be detected in riders involved in excessive speed crashes, which agrees with the Alway & Poznanski study. Haworth et al. also found alcohol use to be associated with inappropriate speed related crashes whereas the current study failed to detect this association. Riders involved in both excessive and inappropriate speed crashes were more likely to be partially or fully at fault, which is in agreement with previous research (Haworth et al.; Always & Poznanski). The finding that crash involved unlicenced riders and those travelling on someone else's motorcycle are more likely to be involved in crashes involving excessive speed has not been demonstrated before in the literature.

More powerful motorcycles have also previously been shown to be more likely to be involved in speed related crashes (Mosedale & Purdy, 2004) although those investigators did not distinguish between excessive and inappropriate speed. The ECIS has also demonstrated this relationship. The current study has extended upon this knowledge to show that more powerful motorcycles are a risk factor for both excessive and inappropriate speed related crashes. It also provided support for the hypothesis that older riders are more likely to ride high powered motorcycles. Once age was adjusted for, the association between high powered motorcycles and excessive speed involvement became even stronger.

For the crashes in the current study, both excessive and inappropriate speed were more likely be a factor in single-vehicle crashes, which agrees with the findings of Haworth et al.'s (1997) case-control study. However, Mosedale and Purdy's (2004) UK study found that speed was involved in a slightly higher proportion of multi-vehicle collisions compared to single-vehicle collisions. These authors, however, only reported descriptive results and so it is unclear whether or not this discrepancy may have been due to chance.

The major discrepancy between the findings of the current study and previous research is that crashes occurring in city areas were more likely to involve excessive speed than those occurring in country areas. Excessive speed related fatal crashes were also more likely to occur in slower speed zones, however the effect of location remained even when the confounding effect of speed zone was taken into account. In contrast, Mosedale & Purdy (2004) found speed-related crashes to be more common in rural areas in the UK, while Alway and Poznanski (2004) also found this to be the case in Victorian motorcycle crashes that occurred between May 2002 and April 2003. Considering the fatalities that were investigated on the Alway study were part of the sample in the current study, this is difficult to explain. However, given that the current study had a larger sample size of Victorian cases than that of Alway and Poznanski (2004), these results should be considered as more robust. Alway and Poznanski (2004) also found that crashes involving riders travelling over the speed limit were more likely to occur on bends than crashes not involving excessive speed, however this result was not replicated in the current study.

5.4 MEANING OF THE STUDY: IMPLICATIONS FOR PREVENTION/POLICY

Travelling at speeds that exceed the prevailing speed limit (excessive speed) or exceed the capabilities of the operator or the limitations of the vehicle or the constraints of the situation or environment, or any combination thereof, (inappropriate speed) tends to increase the risk of a crash for all vehicle types. In addition, crash severity is directly related to travel speed. These relationships are less forgiving for motorcycle riders. For example, the inherent instability of a motorcycle allows a lower margin for error and reduces the opportunity to correct even a seemingly minor error, and the relative lack of protection is likely to result in a greater degree of injury in any given crash for a motorcycle rider than for a car driver. However, with instability comes manoeuvrability and responsiveness, and with vulnerability comes a sense of connection with the environment and the road – the very elements that draw many individuals to riding and encourage them to approach, push against and sometimes exceed the boundaries for the resultant thrill and accompanying adrenaline.

Any potential countermeasure must take account of the thrill that comes from riding a motorcycle in challenging circumstances. For example, a number of routes in Victoria, such as the Great Ocean Road and roads in the Yarra Ranges, are particularly popular with recreational riders. Engineering treatments such as realignments to remove or reduce bends would make these routes significantly safer for riders. However, a risk homeostasis view would suggest that making the popular recreational riding roads safer will encourage those who still use it to take greater risk to obtain the same level of thrill and enjoyment, with no net reduction in safety. And finally, improving a picturesque route may increase car traffic, which in turn may result in a greater number of traffic interactions and crashes involving motorcycles. Potential solutions to reduce excessive or inappropriate speed will be multifactorial and complex and must be examined from the viewpoint of the motorcyclist rather than assuming that any measure that is effective for a car driver is bound to be effective, or even positive, for a motorcycle rider.

Countermeasures can be grouped into three areas – those aimed at the rider, those targeting the motorcycle and associated equipment, and those focused on the road environment. Some countermeasures would target both excessive speed and inappropriate speed. Some countermeasures would be aimed at reducing the behaviour and others at decreasing the severity of the crash given that a speeding-involved crash has occurred. Some countermeasures would be unique to motorcycle riders (or at least have a minimal safety benefit for other road users – none would have a negative effect for other road users), and others could be generalised to other drivers with little or no modification. A non-exhaustive list of various countermeasures will be discussed briefly, but could be more carefully assessed with additional data collection and analyses as appropriate to estimate their potential benefit in future research projects.

Many countermeasures intended to reduce the propensity of motorcyclists to exceed the speed limit are essentially the same as for other road users – education, enforcement and governing the top speed that the vehicle can travel (as heavy vehicles currently are). Targeted education through rider-specific anti-speeding advertising may be useful so that the message is perceived to be relevant to the rider. In particular, this could be targeted at young males, or riders with high powered motorcycles. It may be possible to convince some riders that they can achieve the thrill they seek without exceeding the speed limit. Advertising and news items can also be used to make it clearer that anti-hooning legislation means that motorcycles can be impounded and forfeited. Remedial training and/or a demotion in licence status might be trailed for speeding recidivists.

Pre- and post-licence training could be modified to include a greater insight component. In instances in which the speed at the time of the crash is inappropriate but not excessive, the rider has mis-read the situation and/or their own capabilities (or the performance capabilities of their motorcycle). Insight training aims to reveal a rider's (or driver's) misperceptions about their own abilities. As opposed to traditional defensive rider/driver training that may decrease safety by inflating confidence to unwarranted levels, insight training would seek to highlight vulnerability. For example, a training motorcycle could be fitted with outriggers that would serve to stop a crash on a closed circuit but allow the rider to understand how easily they can find themselves in a situation that ordinarily can not be recovered. Refresher insight courses could be required at each licence renewal to reduce the effect of complacency. Given the increased risk for motorcyclists riding high powered vehicles, those riders who are considering purchasing a more powerful motorcycle would also particularly benefit from such insight training.

Regular enforcement blitzes specifically targeting riders and popular recreational riding routes will reduce both excessive and particularly inappropriate speed (that might be assessed as dangerous riding and attract a fine and demerit points). Such blitzes would have to focus on weekends and holiday periods to target leisure riders. These blitzes could focus on speed and unsafe riding behaviours, as well as other factors amenable to enforcement that were identified in the current study as being related to speed-involved crashes, such as licence checks, random breath testing, and checking that riders are not riding motorcycles too powerful for their licence conditions. In addition, the blitzes could also focus on roadworthiness, particularly tyre wear, matching tread patterns, etc. A tyre check could be required on an annual basis before renewing motorcycle registration.

Technology solutions could play a large part. A consistent relationship has been shown between alcohol use and excessive speed. A number of the crashes in this study involved a rider with a high BAC borrowing a friend's motorcycle to go for a joy ride. The fitment of alcohol interlocks to motorcycles could reduce this behaviour. Intelligent Speed Adaptation (ISA), or GPS-based systems that can detect or are programmed with the prevailing speed limit, are at various stages of development and deployment. They could serve as an alert or act to control a speed limiting device. In addition, they could be progressively programmed with information for motorcycle riders and warn when approaching known motorcycle blackspots, corners with an unsafe camber or bad cornering line, etc., and display advisory speeds in the approach to bends or other hazards. Since motorcycles are often a second vehicle for many riders, a tamper-proof GPS system could be used to limit the speed of riders on routes such as the Great Ocean Road or to limit their access, where those riders are not sufficiently advanced in their licence or training (though such a device limits the motorcycle rather than the rider and limits sharing such an enabled motorcycle). Such intelligent transport systems are currently being developed and tested in Europe (SafeRider, 2008).

The road environment, including the road surface itself, can be reasonably safe for cars but still be particularly hazardous for motorcycle riders. A relatively minor defect, particularly if not seen or fully comprehended by the rider can quickly mean that an otherwise appropriate speed becomes inappropriate. The Guide to Traffic Engineering Practice: Motorcycle Safety (Part 15) (Austroads, 1999) provides guidance for design, construction and maintenance of the road and its environment to maximise motorcyclist safety. For example, thermoplastic road markings are more slippery than other methods and particularly hazardous for motorcyclists, more so if applied on a bend or at an intersection. Repairs to potholes that leave even minor height differences with the surrounding road surface or use different materials with different degrees of slipperiness can remain unnoticed by a car driver but be catastrophic for a motorcycle rider. It is critical that the Part 15 Guide be actively championed, particularly at local council level for minor works and installation of services.

Roadside shoulders should be sealed along with the approaches of intersecting roads. These measures both increase the margin for error and provide a buffer within which an attempt can be made at recovery. They also minimise debris and gravel on the road, which can be difficult to see in advance and reduces the speed that would be appropriate for a given location.

Another type of countermeasure that might be trailed is the installation of perceptual countermeasures that make a section of road such as a corner seem more risky than it actually is. By taking caution engendered by the perceptual measure there is a safety "buffer" before the tolerances (of the rider, the motorcycle, the road, etc) are exceeded.

This might be done by seemingly narrowing the approach to a corner or giving the impression of a bad road camber. Care must be taken, however, to ensure that the effect takes place before the rider has chosen his or her speed and line through a corner, and no in-lane road markings are present in the corner to increase slipperiness.

The crash data analyses performed here indicate a particular problem when motorcyclists are cut off by another road user. Such a crash may not seem speed related and place most or all of the blame on the driver who has offended the rider's right of way. However, in at least some instances the other driver is likely to have misjudged the speed of the approaching motorcyclist. Due to its size, an oncoming speeding motorcycle may not appear to be travelling as fast as it actually is (though this is an empirical question that may not have been answered yet). Both car driver and motorcyclist need to be aware of this effect so that the driver is less likely to impede the rider's right of way, and the rider approaches at a more cautious speed to allow more time for evasive action – i.e. assumes a more appropriate speed. The sharing of blame in such cases was noted in more than one NCIS coroner's report.

5.5 UNANSWERED QUESTIONS AND FUTURE RESEARCH

Based on these analyses of 200 fatal motorcycle crashes it would seem that both excessive and inappropriate speed are significant crash risk factors. However, while previous research suggests the size of the issue is relatively greater for fatally crashed motorcycle riders versus other types of motorcycle crashes (Mosedale & Purdy, 2004), it is unknown whether this is the case for other crashed vehicles. Several avenues for further research exist. For example, a similar analysis of NCIS-RCIS linked data for crashes of other vehicles could be carried out to make comparisons.

There is a need to work towards improving the data that is collected for traffic crashes in Victoria, particularly data relating to the road-users behaviour and pre-conditions for the crash. For many of these variables, there was not enough information in the NCIS or RCIS to judge whether or not they contributed to the crash, let alone whether or not they are related to speed involvement. This limitation of the current data systems in terms of collecting standardised information for each traffic crash has been recognised by others and the NCIS has developed a national Police death notification form to standardise the information the police report to the coroner for all deaths. This form has been trialled in Victoria (http://www.ncis.org.au/web_pages/national_police_form.htm). It was demonstrated to be feasible and should be implemented in the near future. Researchers investigating work related heavy vehicle crashes (Bugeja, Symmons, Brodie, Osborne & Ibrahim, 2007) have also noted the lack of consistent information available in this context. As a result of this the Victorian Institute of Forensic Medicine and Victoria's Coroner is currently devising for trial a new crash report form to collect data for heavy vehicle crashes not currently captured by the standard crash report form. Given the differences between motorcycles and cars, such an approach is warranted for motorcycle crashes as well. In both cases the aim is to address glaring gaps in the data that serve to diminish the power and usefulness of studies such as the current one. The European MAIDS project would serve as a starting model to establish what additional data should be collected for motorcycle crashes.

It must be noted however, that retrospective crash investigations are unlikely to be able to collect information on many behavioural factors, and in particular, human error and the behaviours leading up to the crash. A prospective crash analysis study could be conducted with in-depth examination of the crash scene to estimate crash speed, and interviews with the rider (for non-fatal crashes) would reveal the circumstances surrounding the "appropriateness" of the speed at the time of the crash. Using speed measuring equipment at the same site to collect non-crash speed data and stopping a random sample of riders for interview would produce a powerful case-control study. Such a study could be augmented further by instrumenting a motorcycle with accelerometers and other measuring equipment and riding through the crash site. This type of study could also be used to further investigate the relationship between speed zone, location (city/rural) and speed involvement in crashes.

Consideration could also be given to conducting a long-term naturalistic riding study, like the 100 car (driving) study (Dingus, Klauer, Neale et al., 2006), with motorcycle riders to obtain further in-depth data about their riding behaviour and the risks they contend with every day. This sort of study could investigate not only crash situations where things have gone irretrievably wrong, but situations in which the rider was able to recover from the situation. This approach is in line with current research in human error, in which the recovery from human error and avoidance of potentially disastrous consequences is a focus of behavioural research.

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APPENDIX: VICTORIA POLICE COLLISION REPORT (FORM 510)

COLLISION COVER SHEET

Officer in Charge [ ] DATE:

COLLISION DATE:
LOCATION:

Collision Category ☐ Fatal ☐ Injury ☐ Police Collision ☐ Non Injury

Date reported to Police / / Date Submitted / /

Reason if not submitted same day ....

....

NOTE: Collision Report **(V.P. FORM 510) must** be submitted prior to end of shift, if all details are not available, a supplementary report must follow.

Police Action Taken

1. ☐ Fatality—Inquest brief to be compiled at station level
   ☐ Hit Run (NFPA)—report attached
   ☐ Arrest—Brief to be compiled at station level Bail date / /
   ☐ Penalty Notice Number [ ] Issued [ ] own authority
   [ ] authority of ....
   ☐ Penalty Notice not issued because ....
   ....

Police Action Recommended

2. ☐ Preparation of ordinary brief— ☐ By TACO ☐ Station Level
   ☐ Follow up/Further enquiries re ....
   ....

No Action Recommended

3. ☐ No Offence disclosed
   ☐ Insufficient evidence because ....
   ....
   ☐ Other..

Correspondence

4. Statements attached from ....
   ....
   ....

(..)
Rank and Number

Officer in Charge TACO [ ] DATE:

1. I recommend: ☐ No further action, matter finalised
   ☐ Preparation of Ordinary Brief ☐ By TACO ☐ Station Level
   ☐ Further enquiries or statements to be obtained from

(..)
Rank and Number

VICTORIA POLICE

COLLISION REPORT

(REV 1990) VP FORM 510

STATION ACCIDENT No.	T.A.I.S. No.	D.C.A. CODE

TOTAL No. OF VEHICLES INVOLVED ▶ PERSONS INVOLVED ▶ | FATAL ☐ | INJURY ☐ | NON-INJURY ☐

LOCATION

OCCURRED ON — (Name of Street, Road or Highway)

SUBURB | MUNICIPALITY | OF

URBAN: DISTANCE (METRES/KMS) ☐ N/S/E/W FROM (NAME OF NEAREST INTERSECTING STREET, ROAD OR HIGHWAY) OR

RURAL: DISTANCE (METRES/KMS) ☐ N/S/E/W FROM NEAREST KM POST No ☐ Landmark

Between the towns of ... and ...

OFF ROAD USE ONLY (ACCURATELY DESCRIBE LOCATION)

DAY | DATE | TIME 24 HRS

DID POLICE ATTEND SCENE YES ☐ NO ☐ TIME: 24 HRS

HIT/RUN YES ☐ NO ☐

CODE TYPE OF COLLISION | INSERT CODE

1 COLLISION WITH VEHICLE
2 STRUCK PEDESTRIAN
3 STRUCK ANIMAL
4 COLLISION WITH FIXED OBJECT†
5 COLLISION WITH SOME OTHER OBJECT†
6 VEHICLE OVERTURNED (NO COLLISION)
7 FALL FROM/IN MOVING VEHICLE
8 NO COLLISION AND NO OBJECT STRUCK

†SPECIFY

MELWAY/UBD MAP | GRID

POLICE SUB-DISTRICT OCCURRED IN

SPEED ZONE | KPH

VIC ROADS

UNIT 1

OFFENDING DRIVER (if applicable) | Total Occupants including Driver ☐ | VEHICLE ☐ Specify by code | BICYCLIST ☐ Helmet Y/N ☐ | PEDESTRIAN ☐

FAMILY NAME (DRIV/PED) | FIRST NAME | SECOND NAME | D.O.B. | SEX

PROP. TITLE OR FLAT/STREET No. | STREET | SUBURB | POSTCODE | STMN

INJURY* | S/B/H* | EJECTED* | NAME OF HOSPITAL TAKEN TO (LEAVE BLANK IF NOT APPLICABLE) | ADMITTED YES ☐ NO ☐

VEHICLE MAKE | YEAR | COLOUR | OWNER (VEHICLE/PROPERTY) | STMNT

LICENCE ☐ | PERMIT ☐ No. | RECEIPT ☐ | STATE*

P.B.T. YES ☐ NO ☐* | BREATH TEST YES ☐ NO ☐* | REASON NO TEST ▶ ☐*

VEHICLE REGISTRATION No. | ADDRESS | INJURY

EXPIRY DATE | TYPE* | CATEGORY* | STATUS* | EXPIRY DATE | STATE* | POSTCODE

STREET OF TRAVEL | DIRECTION | PRESC. LAMPS* | UNIT TOWED AWAY YES ☐ NO ☐ | UNIT TOWED TO | TOW TRUCK REG. No.

OTHER OCCUPANTS

FAMILY NAME | FIRST NAME | SECOND NAME | SEX | D.O.B. | POS.* | INJURY* | S/B/H* | EJECTED* | STMNT

ADDRESS | POSTCODE | HOSPITAL NAME IF APPLICABLE | ADMITTED YES ☐ NO ☐

FAMILY NAME | FIRST NAME | SECOND NAME | SEX | D.O.B. | POS.* | INJURY* | S/B/H* | EJECTED* | STMNT

ADDRESS | POSTCODE | HOSPITAL NAME IF APPLICABLE | ADMITTED YES ☐ NO ☐

UNIT 2

Total Occupants including Driver ☐ | VEHICLE ☐* Specify by code | BICYCLIST ☐ Helmet Y/N ☐ | PEDESTRIAN ☐ | OBJECT/PROPERTY ☐* Specify by code

FAMILY NAME (DRIV/PED) | FIRST NAME | SECOND NAME | D.O.B. | SEX

PROP. TITLE OR FLAT/STREET No. | STREET | SUBURB | POSTCODE | STMNT

INJURY* | S/B/H* | EJECTED* | NAME OF HOSPITAL TAKEN TO (LEAVE BLANK IF NOT APPLICABLE) | ADMITTED YES ☐ NO ☐

VEHICLE MAKE | YEAR | COLOUR | OWNER (VEHICLE/PROPERTY) | STMNT

LICENCE ☐ | PERMIT ☐ No. | RECEIPT ☐ | STATE*

P.B.T. YES ☐ NO ☐* | BREATH TEST YES ☐ NO ☐* | REASON NO TEST ▶ ☐*

VEHICLE REGISTRATION No. | ADDRESS | INJURY

EXPIRY DATE | TYPE* | CATEGORY* | STATUS* | EXPIRY DATE | STATE* | POSTCODE

STREET OF TRAVEL | DIRECTION | PRESC. LAMPS* | UNIT TOWED AWAY YES ☐ NO ☐ | UNIT TOWED TO | TOW TRUCK REG. No.

OTHER OCCUPANTS

FAMILY NAME | FIRST NAME | SECOND NAME | SEX | D.O.B. | POS.* | INJURY* | S/B/H* | EJECTED* | STMNT

ADDRESS | POSTCODE | HOSPITAL NAME IF APPLICABLE | ADMITTED YES ☐ NO

FAMILY NAME | FIRST NAME | SECOND NAME | SEX | D.O.B. | POS.* | INJURY* | S/B/H* | EJECTED* | STMNT

ADDRESS | POSTCODE | HOSPITAL NAME IF APPLICABLE | ADMITTED YES ☐ NO

WITNESSES

NAME	ADDRESS	DATE OF BIRTH	STMT

INVESTIGATING OFFICER'S DETAILS			REPORT CHECKED & FOUND CORRECT BY				PENALTY NOTICE No.	OFFENCE CODES	BRIEF	ACTION
Signature	Rank	Reg. No	Signature			UNIT 1			YES / NO	YES / NO
NAME (Block letters)	Station Code	Date Compiled	Rank	Reg. No.	Date	UNIT 2			YES / NO	YES / NO

PART I

PRINTED 12/90 REVISED 11/90

VIC ROADS

COLLISION REPORT

FORM 510

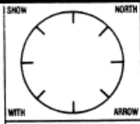
TIME OF COLLISION	DATE OF COLLISION	INVESTIGATING OFFICER	T.A.I.S. No.
24 HRS	/ /	RANK No.	

THIS PAGE MUST BE USED FOR FATAL OR INJURY COLLISIONS

STATION ACC. No.

DETAILED SKETCH OF COLLISION SCENE

SHOW NORTH WITH ARROW



INSTRUCTIONS

1 VEHICLE

② PEDESTRIAN (No. EACH UNIT)

DIRECTION OF TRAVEL

——→ PRIOR TO IMPACT

- - - → AFTER IMPACT

INCLUDE ALL MEASUREMENTS:
—ROAD WIDTH
—LANES
—SKIDMARKS
—TO LANDMARKS, ETC.
SHOW ALL TRAFFIC CONTROL DEVICES

ROAD SURFACE TYPE (UNIT 1 2)
1 PAVED
2 UNPAVED
3 GRAVEL
9 NOT KNOWN

ROAD SURFACE CONDITIONS
(SELECT ONE/MORE)
1 DRY
2 WET
3 MUDDY
4 SNOW
5 ICY
9 NOT KNOWN

LIGHT CONDITIONS
1 DAYLIGHT
2 DUSK/DAWN
3 DARK—STREET LIGHTS ON
4 DARK—STREET LIGHTS OFF
5 DARK—NO STREET LIGHTS
6 DARK—STREET LIGHT DETAILS UNKNOWN
9 UNKNOWN

REFER TO VEHICLES AND PEDESTRIANS BY THE SAME NUMBER AS IN THE DETAILED SKETCH. DESCRIBE COLLISION BRIEFLY
DO NOT REFER TO SOBRIETY, VERBAL STATEMENT/ADMISSIONS.

ATMOSPHERIC CONDITIONS
(SELECT ONE/MORE)
1 CLEAR
2 RAINING
3 SNOWING
4 FOG
5 SMOKE
6 DUST IN THE AIR
7 STRONG WINDS
9 NOT KNOWN

SECTION 61 RSA
COMPLIED WITH (UNIT 1 2)
0 N/A
1 YES
2 NO
9 NOT KNOWN

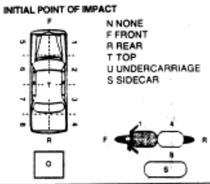
SPECIALIZED VEHICLE INVOLVED
UNIT 1 UNIT 2
1 POLICE (ON EMERG. CALL)
2 AMBULANCE (ON EMERG. CALL)
3 FIRE TRUCK (ON EMERG. CALL)
4 STATE EMERG. SERVICE
5 OTHER EMERG. VEH. (ON CALL) ★
6 TOW TRUCK
7 SCHOOL BUS
8 4-WHEEL DRIVE
9 RECREATIONAL VEHICLE ★
★ SPECIFY

DRIVER INTENTIONS PRIOR TO COLLISION
UNIT 1 UNIT 2
(USE PREVIOUS CODES)

TRAFFIC CONTROL
UNIT 1 UNIT 2
00 NOT APPLICABLE
01 INTERSECTION SIGNALS OPERATING (STOP/GO)
02 INTERSECTION SIGNALS FLASHING
03 CONTROL OUT OF ORDER/MALFUNCTIONING
04 PED. OPERATED SIGNALS—NOT AT INTERSECTION
05 PEDESTRIAN CROSSING
06 RAILWAY XING—GATES/BOOMS
07 RAILWAY XING—FLASHING LIGHTS/BELL ONLY
08 RAILWAY XING—NO AUTOMATIC SIGNALS
09 ROUNDABOUT SIGN
10 STOP SIGN
11 GIVE WAY SIGN
12 SCHOOL CROSSING WITH FLAGS
13 SCHOOL CROSSING WITHOUT FLAGS
14 POLICE
15 OTHER (SPECIFY)
99 NOT KNOWN

INITIAL POINT OF IMPACT
UNIT 1 UNIT 2
1 RIGHT FRONT PANEL
2 RIGHT FRONT DOOR
3 RIGHT REAR DOOR
4 RIGHT REAR PANEL
5 LEFT FRONT PANEL
6 LEFT FRONT DOOR
7 LEFT REAR DOOR
8 LEFT REAR PANEL
9 UNKNOWN
0 TOWED UNIT

N NONE
F FRONT
R REAR
T TOP
U UNDERCARRIAGE
S SIDECAR



LEVEL OF DAMAGE
UNIT 1 UNIT 2
1 MINOR
2 MODERATE—DRIVEABLE VEHICLE
3 MODERATE—VEHICLE TOWED AWAY
4 MAJOR—UNIT TOWED AWAY
5 EXTENSIVE—UNREPAIRABLE
6 NIL DAMAGE

DRIVER/UNIT MOVEMENT PRIOR TO IMPACT
UNIT 1 UNIT 2
01 GOING STRAIGHT AHEAD
02 TURN RIGHT
03 TURN LEFT
04 LEAVING A DRIVEWAY
05 U TURNING
06 CHANGING LANES
07 OVERTAKING
08 MERGING
09 REVERSING
10 PARKING—INTO/OUT
11 PARKED—LEGALLY
12 PARKED—ILLEGALLY
13 STATIONARY—COLLISION
14 STATIONARY—BROKEN DOWN
15 OTHER STATIONARY
16 AVOIDING AMIMALS
17 SLOW/STOPPING
18 OUT OF CONTROL
19 WRONG WAY
99 NOT KNOWN

DID UNIT CATCH FIRE?
UNIT 1 UNIT 2
0 NOT APPLICABLE
1 YES
2 NO
3 NOT KNOWN

TYPE OF TRAILER TOWED BY UNIT
UNIT 1 UNIT 2
1 CARAVAN
2 TRAILER (GENERAL)
3 TRAILER (BOAT)
4 HORSE FLOAT
5 MACHINERY
6 FARM/AGRICULT. EQUIP.
7 NOT KNOWN
8 NOT APPLICABLE

TRAILER REG. IF APPLICABLE — UNIT 1 — UNIT 2

HAZCHEM U.N. CODE No — UNIT 1 — UNIT 2

PART 2

PEDESTRIAN MOVEMENTS
0 NOT APPLICABLE
1 CROSSING CARRIAGEWAY
2 WORK, PLAY, LIE, STAND ON CARRIAGEWAY
3 WALK ON CARRIAGEWAY WITH TRAFFIC
4 WALK ON CARRIAGEWAY AGAINST TRAFFIC
5 PUSHING OR WORKING ON VEHICLE
6 WALKING TO, FROM OR BOARDING TRAM
7 WALKING TO, FROM/BOARDING OTHER VEH
8 NOT ON CARRIAGEWAY (e.g. FOOTPATH)
9 NOT KNOWN

REPORT CHECKED AND FOUND CORRECT BY

Signature

Rank	Reg. No.	Date

TO BE USED FOR ALL ENTRIES WHERE · IS MARKED

OBJECT
01 POLES (TELEPHONE ELECTRICITY)
02 TREE (SHRUBS AND SCRUB)
03 FENCE AND WALLS (INCLUDE GATES)
04 EMBANKMENTS
05 GUIDE POSTS (INCLUDING KM/POSTS)
06 TRAFFIC SIGNS (INCLUDES NO STANDING, NO PARKING)
07 GUARD RAIL
08 FIRE HYDRANTS
09 BUILDINGS
10 OTHER (RAILWAY FURNITURE, CULVERT, TELEPHONE BOX, ETC)
11 NOT KNOWN
12 TRAFFIC SIGNALS (IE. TRAFFIC LIGHTS)
13 BRIDGE (WHEN IT IS NOT ON PATH)
14 ROAD CLOSURE BARRIERS
17 TRAFFIC ISLAND
21 BRIDGE (WHEN IT IS ON PATH—SEE 13)
23 ROADWORKS (PILE OF DIRT, EXCAVATION, SIGN, BARRIER)
24 SAFETY ZONE (IE. TRAM SAFETY ZONE)
30 PROTRUDING KERB
31 ANIMALS—DOMESTIC (CATS AND DOGS)
32 ANIMALS—CATTLE
33 ANIMALS—SHEEP
34 ANIMALS—HORSE (NOT RIDDEN)
35 ANIMALS—OTHER TAME ANIMALS
36 ANIMALS—KANGAROO/WALLABY
37 ANIMALS—WOMBAT
38 ANIMALS—OTHER WILD ANIMAL BIRD
39 ANIMALS—UNKOWN

INJURY
1 KILLED OR DIED WITHIN 30 DAYS
2 MAJOR INJURIES—INJURIES REQUIRING HOSPITAL ADMITTANCE
3 SERIOUS INJURIES—REQUIRE MEDICAL TREATMENT (BRUISING, CONTUSIONS, UNCONSCIOUS, PAIN, ETC)
4 MINOR INJURIES—COMPLAINED OF PAIN, SORENESS, ETC
5 NIL INJURIES—NO COMPLAINT RE PAIN, ETC

SEATBELT/HELMET (S/B/H)
1 SEATBELT WORN
2 SEATBELT NOT WORN
3 CHILD RESTRAINT WORN
4 CHILD RESTRAINT NOT WORN
5 SEATBELT/RESTRAINT NOT FITTED
6 CRASH HELMET WORN
7 CRASH HELMET NOT WORN
8 NOT APPLICABLE TO VEHICLE TYPE
9 NOT KNOWN

EJECTION
0 NOT APPLICABLE
1 TOTALLY EJECTED
2 PARTIALLY EJECTED
3 PARTIAL EJECTION—INVOLVING EXTRICATION

STATE CODES
A AUSTRALIAN CAPITAL TERRITORY
B COMMONWEALTH
D NORTHERN TERRITORY
N NEW SOUTH WALES
O OVERSEAS
Q QUEENSLAND
S SOUTH AUSTRALIA
T TASMANIA
V VICTORIA
W WESTERN AUSTRALIA
Z NOT KNOWN

PBT/BREATH TESTS
0 DECEASED
1 REFUSED TEST
2 OUTSIDE 3 HOUR TIME LIMIT
3 INJURIES NEGATE TEST
4 REFUSED TO ACCOMPANY TO STATION
5 REFUSED TO REMAIN AT STATION
6 NIL READING
7 INJURED—TAKEN TO HOSPITAL
8 NOT DRIVING/IN CHARGE
9 NOT APPLICABLE

WERE PRESCRIBED LAMPS ALIGHT? (HEAD, PARK, CLEARANCE (TRUCK ONLY))
0 NOT APPLICABLE
1 YES
2 NO
9 NOT KNOWN

STATEMENT (STMNT)
1 WRITTEN STATEMENT MADE
2 WRITTEN STATEMENT NOT MADE
9 NOT APPLICABLE

VEHICLE BODY TYPE
01 CAR
02 STATION WAGON
03 TAXI
04 UTILITY
05 PANEL VAN
06 ARTIC VEH (SEMI)
07 TRUCK (EXCLUDE SEMI)
08 BUS COACH
09 MINI BUS (9-13 SEATS)
10 MOTOR CYCLE
11 MOPED
12 MOTOR SCOOTER
13 BICYCLE
14 HORSE DRAWN RIDDEN
15 TRAM
16 RAILWAY TRAIN TROLLE
17 OTHER VEHICLE*
18 NOT APPLICABLE
19 NOT KNOWN
* SPECIFY

LICENCE TYPE
1 LEARNER
2 PROBATIONARY
3 PROBATIONARY AND CONDITIONAL
4 STANDARD (FULL)
5 STANDARD AND CONDITIONAL
6 NOT APPLICABLE
7 UNLICENCED
8 INAPPROPRIATE CATEGORY
9 NOT KNOWN

LICENCE CATEGORY
CA —MOTOR CAR
LT —LIGHT TRUCK
HT —HEAVY TRUCK
LA —LIGHT ARTICULATED
HA —HEAVY ARTICULATED
RT —ROAD TRAIN
MC —MOTORCYCLE
SB —SMALL BUS
LB —LIGHT BUS
HB —HEAVY BUS
AB —ARTICULATED BUS

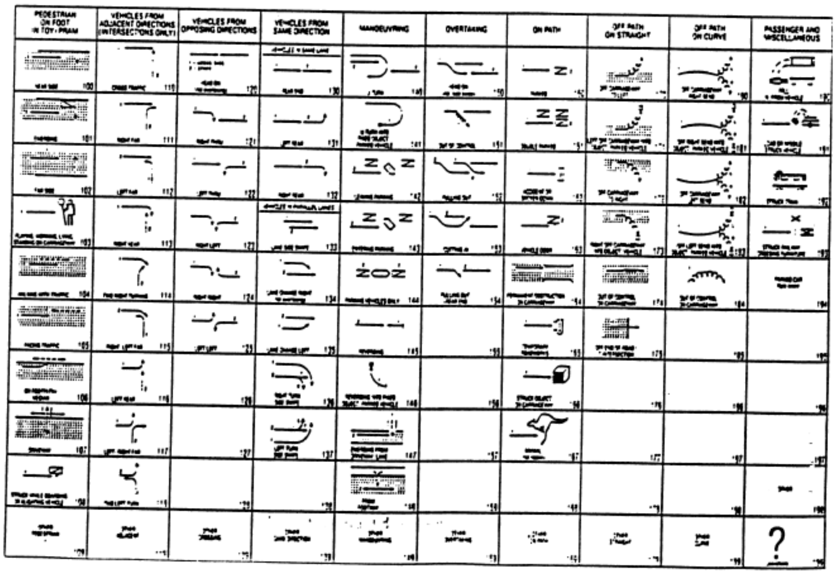
LICENCE STATUS
V VALID
C CANCELLED
D DISQUALIFIED
L SUSPENDED
E EXPIRED
S SURRENDERED

SEATING POSITION (POS)

LF	CF	
LR	CR	RR
OR		

BLANK—PEDESTRIAN (DO NOT CODE)
PL —MOTORCYCLE PILLION PASSENGER
PS —MOTORCYCLE SIDECAR PASSENGER
OR —OTHER REAR PASSENGER—INCLUDES LUGGAGE AREA OF STATION WAGON, REAR OF GOODS CARRYING VEHICLE, BUS, TRAM, ETC.
NK —NOT KNOWN

DEFINITIONS FOR CLASSIFYING ACCIDENTS



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