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Injured cyclist profile: an in-depth study of a sample of cyclists injured in road crashes in South Australia

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TITLE

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ABSTRACT

Crashes involving pedal cyclists in South Australia have steadily increased over the past ten years. In 2001 pedal cycle crashes constituted around 12% of all traffic crashes resulting in hospital admission, increasing to 17.4% in 2010 (SA Heath and SA Police unpublished data sources). There have been several suggestions why the increase has occurred including a renewed interest in cycling and an increased awareness of the health and environmental benefits. In response to the demonstrated increase in crashes there is a need to identify those contributing factors that may place this vulnerable road user group at increased risk. This project explores the circumstances surrounding crash involvement for a group of 61 bicycle riders involved in a collision with a motorised vehicle who were admitted to the Royal Adelaide Hospital over the period between January 1 2008 and December 31 2010. Data collected and matched during the study included medical records data generated during hospitalisation, police data related to the crash and Forensic Science data related to mandatory testing for alcohol and drugs. This data was combined with information gathered during voluntary participation in interviews with the cyclists involved following informed consent.

Keywords

Cycling, traffic accident, injury, injury severity, accident investigation

Summary

Crashes involving pedal cyclists in South Australia have steadily increased over the past ten years. In 2001 pedal cycle crashes constituted around 12% of all traffic crashes resulting in hospital admission, increasing to 17.4% in 2010 (SA Heath and SA Police unpublished data sources). There have been several suggestions why the increase has occurred including a renewed interest in cycling and an increased awareness of the health and environmental benefits.

The main purpose of the study was to identify the circumstances surrounding casualty crash involvement for cyclists travelling on public roadways in South Australia. Participants for this study were drawn from data collected for those cyclists who were admitted to the Royal Adelaide Hospital as a result of crash involvement over the three year period between 1 January 2008 and 31 December 2010. There were 61 cyclists who were identified as being involved in a casualty crash during that period. Data for each of the 61 participants was collected and matched from three discrete data sources: hospital medical records, police data related to the crash event and Forensic Science data related to mandatory testing for alcohol and drugs. Further information was collected from those cyclists who voluntarily undertook an interview related to their involvement in the crash and their riding exposure.

Cyclists involved in crashes were generally found to be experienced road users who undertook road cycling activities on a regular basis. On average, cyclists self reported that their road cycling exposure involved close to 10,000 kilometres per annum. Male cyclists between the ages of 36 and 55 years were found to be the group most frequently involved in crashes involving a motorised vehicle. Vehicle drivers undertaking a turning manoeuvre posed the biggest threat to cyclists who were generally travelling straight on a carriageway. Those drivers undertaking a right turn manoeuvre were found to pose the greatest threat, particularly those turning across multiple traffic lanes and in peak hour traffic conditions. These crashes were more likely to involve young drivers.

The most serious injuries incurred by cyclists were fractures, followed by those who sustained internal organ injuries. Close to a third of cyclists experienced a loss of consciousness following the crash. More than half of the cyclists involved in the crashes had an injury severity score (ISS) of five or less, however, five per cent of the crashes resulted in the cyclists sustaining injuries where the ISS was 21 or more. Those cyclists who struck the side of a vehicle were generally found to sustain more serious injuries when compared with other crash types and resulted in hospitalisation for longer periods.

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1 Introduction and background

Crashes involving pedal cyclists in South Australia have steadily increased over the past ten years. In 2001 pedal cycle crashes constituted around 12% of all traffic crashes resulting in hospital admission, increasing to 17.4% in 2010 (SA Health and SA Police unpublished data sources). There have been several suggestions why the increase has occurred including a renewed interest in cycling and an increased awareness of the health and environmental benefits. In response to the demonstrated increase in crashes there is a need to identify those contributing factors that may place this vulnerable road user group at increased risk.

This project explores the circumstances surrounding crash involvement for a group of bicycle riders who were admitted to hospital following the crash using data collected from three sources. Between 2008 and 2010 the Centre for Automotive Safety Research undertook a study investigating the prevalence of medical conditions and acute medical events as a contributing factor in casualty crash causation [1]. The study involved examination of the circumstances surrounding drivers, motorcycle riders, cyclists and pedestrians involved in casualty crashes on public roads in South Australia who were admitted to the Royal Adelaide Hospital over the three year period from January 2008 to December 2010. Data for the crash involved participants was collected and matched from multiple sources to provide a more holistic understanding of the circumstances surrounding their crash involvement. Data collected and matched during the study included medical records data generated during hospitalisation, police data related to the crash and Forensic Science data related to mandatory testing for alcohol and drugs. Among this group of road users there were 61 cyclists identified as being involved in a collision with a motorised vehicle.

The report further explores the data related to these 61 bicycle riders and combines it with more specific data related to the crash experience for cyclists that was collected through interviews with the cyclist involved. Interviews were conducted on a voluntary basis and were undertaken following informed consent. The primary purpose of undertaking interviews was to gain an understanding of the cyclists' perceptions of the crash event and those factors that may have contributed to the crash. Issues surrounding the bicycle riders' experience and exposure to the prevailing traffic conditions, familiarity with the road environment and the impact of behaviours that are potentially protective such as the wearing of high visibility clothing and the use of effective bicycle illumination were also explored.

The report attempts to identify common themes amongst this road user group and to determine key issues that may lead to a better understanding of the circumstances surrounding crash involvement for cyclists travelling on public roadways in South Australia. This analysis has the potential to lead to a better understanding of the risks of crash involvement for cyclists and the development of countermeasures. The results of this study are also expected to inform those preparing to develop more targeted road safety media campaigns concerning cycling safety that are planned for South Australia in the lead up to the peak riding seasons.

2 Method

2.1 Overview

The main purpose of the study was to identify the circumstances surrounding crash involvement for a group of 61 cyclists who were involved in a casualty crash on a public roadway in South Australia. Data for each of the 61 participants was collected and matched from three discrete data sources: hospital medical records, police data related to the crash event and Forensic Science data related to mandatory testing for alcohol and drugs. Further information was collected from participants who voluntarily undertook an interview related to their involvement in the crash and their riding exposure.

2.1.1 Medical records

All persons who present to the Royal Adelaide Hospital for medical care that is of four hours duration or more are formally admitted to the hospital and are required to undergo International Classification of Disease coding utilising version ten, Australian Modification (ICD10-AM) [2]. Within the ICD10-AM are specific codes related to external sources of injury, some of which relate to road crashes. From these codes those individuals who were admitted to the hospital as a result of a motor vehicle accident were able to be identified. The original, primary source, medical records in these cases were examined in detail. The information available in the records included: South Australian Ambulance Service (SAAS) and/or Medical Retrieval reports, Emergency Department and hospital in-patient records.

2.1.2 Police generated records

Two discrete sources of information related to police records were made available: Vehicle Collision Reports (VCR) and the Traffic Accident Reporting System (TARS). While police crash records include data related to previous crashes for motor vehicle licence holders, cyclists are unable to be identified in this way; therefore data from police sources were limited to information related to the current crash.

2.1.3 Forensic Science records

Since 1972 those crash involved drivers, motorcycle riders, vehicle occupants, pedestrians and cyclists over the age of fourteen years, who present to hospital as a result of a crash, have been required to undergo mandatory testing for blood alcohol concentration in South Australia. Since July 2008 the mandatory screening has also included screening for the three drugs: methamphetamine, Tetrahydrocannabinol (THC) and 3,4-Methylenedioxymethamphetamin (MDMA). In 2010 legislation was altered to include all road users who were over the age of ten. This legislation requires a blood sample to be taken by hospital medical personnel within eight hours of being involved in the collision, with most occurring within the first one to two hours following the crash. The samples are sent to, and tested by, the South Australian Forensic Science Centre. The results of these tests were made available for matching for those cyclists identified within the study following a confidentiality agreement. The records provided include the results following testing as well as the time that the sample was taken.

2.1.4 Interviews

Cyclists in the study were provided with the opportunity to participate in an interview. Interviews were undertaken to gain an understanding of the circumstances of the crash event from the cyclists' perspective and to provide information related to their riding experience, including exposure detail and safety considerations. Interviews were undertaken on a voluntary basis following approval from the University of Adelaide Human Research Ethics Committee. The 61 cyclists were sent a letter of

invitation to participate, and were followed up with contact by telephone. Of the 61 cases there were 20 cases where the cyclist was unable to be contacted by these means. In the majority of these cases letters were returned to CASR stating that the person no longer lived at the address, while others were known to have returned home to an overseas location; attempts to make contact with these 20 cyclists by telephone were also unsuccessful. In two of these cases the cyclists was understood to have died since their crash, in circumstances not related to the crash events. Of the 41 remaining cases there were ten cyclists who chose not to participate in the interview process. Reasons for non-participation varied among this group, however, concerns regarding legal ramifications were expressed by three of the cyclists and there were three other cyclists who considered that they were continuing to experience distress related to the crash and that participation in an interview would add to that. Interviews with the remaining 31 cyclists were undertaken following informed consent.

2.2 Results

The hospital, police and Forensic Science records for the 61 cyclists were examined in detail. The results from this analysis are addressed in the following section and include an examination of the types of crashes, the road environment in which the crashes occurred, demographic detail of the cyclists and drivers involved in the crash, and the injury outcomes for cyclists as a result of the crash. Injury severity and types of injuries were found to differ depending on the mechanism of impact between the cyclist and the other vehicle. As a result of the identified differences, these are addressed separately in the report. Understandings of the cyclist crash from the above sources was further enhanced by information gathered from the 31 cyclists who undertook an interview. The information gained from the interviews is included in section four of the report.

3 Information from Police and hospital data sources

3.1 Crash details

3.1.1 Types of crashes

Close to 40 per cent of all crashes in the study involved an oncoming vehicle turning right across the path of a cyclist who was continuing straight. In more than 60 per cent of these cases the vehicle driver was crossing two or more traffic lanes while undertaking the right turn manoeuvre. The cyclist either struck the passenger side of the turning vehicle or the cyclist was struck on the right side. In more than half of all turning vehicles the driver was intending to turn into a side street, frequently occurring at a T-junction, while 25 per cent of cases involved a vehicle that was turning right at a signalised cross-intersection. In 13 per cent of cases involving a right turning vehicle the driver was understood to be negotiating entry into a shopping centre car park while most of the remaining cases involved drivers moving their vehicle into a parking space on the opposite side of the roadway. In three cases it is understood that the turning vehicle crossed through a gap made by congested vehicles to facilitate the turning manoeuvre, in each of these cases the vehicle driver was crossing two or more lanes. While providing a gap for turning traffic is known to have occurred in these three cases there is at least a possibility that this type of scenario may have occurred in other crashes, particularly on busier arterial carriageways during peak travelling times.

The second most common crash scenario involved vehicles travelling in the stem of a T-junction that came into the path of a cyclist who was travelling straight on the continuing road. This crash type accounted for close to 20 per cent of all cases. In some instances the driver of the vehicle attempted to negotiate a turn at the junction in the lead up to the crash but there were some cases where the vehicle was stationary but encroaching the continuing road and thereby creating an obstruction immediately ahead of the cyclist.

Collisions between a vehicle and a cyclist travelling in the same direction were the third most common movements leading to crashes in the study. In half of these cases the crash occurred as a result of the vehicle driver turning left into a side street immediately ahead of the cyclist, accounting for ten per cent of all crashes. A side-swipe collision between the right side of the cyclist and the passenger side of the vehicle were also common. There were three cases involving a cyclist who struck the rear of a vehicle and two crashes involving a cyclist who was rear-ended by a vehicle.

A more detailed account of each of the crashes within the study can be found in Appendix 1. The Appendix includes a diagrammatic representation of the crash type and a brief description of each crash. The descriptions are based on police and emergency services data collected and recorded at the crash scene and, in some instances, from accounts provided by cyclists at interview.

3.1.2 Location of crashes

Close to 90 per cent of the bicycle crashes within this study occurred within the metropolitan area, eight per cent of which occurred within the central business district (CBD). Those bicycle crashes outside the metropolitan area were identified as occurring in rural regions that were less than 100 kilometres of the CBD, with the majority being in the Adelaide Hills regions that are in close proximity to the metropolitan area.

3.1.3 Road configuration at the crash site and availability of bicycle lanes

Close to half of all crashes involving a cyclist and a vehicle occurred at a T-junction. In the vast majority of these cases the T-junction site involved a local government controlled road as the stem road and a major arterial carriageway as the continuing road. In all of the T-junction crashes the cyclist was travelling straight on the continuing road while the driver of the vehicle was negotiating a turn into or out of the stem road. In more than 30 per cent of cases the cyclist and the vehicle were positioned on the same road at the time of the crash. Crashes occurring at an intersection controlled by traffic signals accounted for around 13 per cent of cases; these signalised intersections involved a cross road type intersection in most cases with two crashes occurring at a signalised T-junction. There were two crashes involving a roundabout site, both of which involved a vehicle entering the roundabout that was already occupied by the cyclist.

The crash sites were viewed for evidence of a bicycle lane provision. In 25 cases the road ridden by the cyclist at the time of the crash event had a bicycle lane available, however, in five of these cases the bicycle lane came to a stop in the lead up to, or through a signalised intersection where the crash occurred. There were 36 cases where the road ridden by the cyclist had no bicycle lane provision. Figure 3.1 provides a breakdown of the road configuration at the site of the crash.

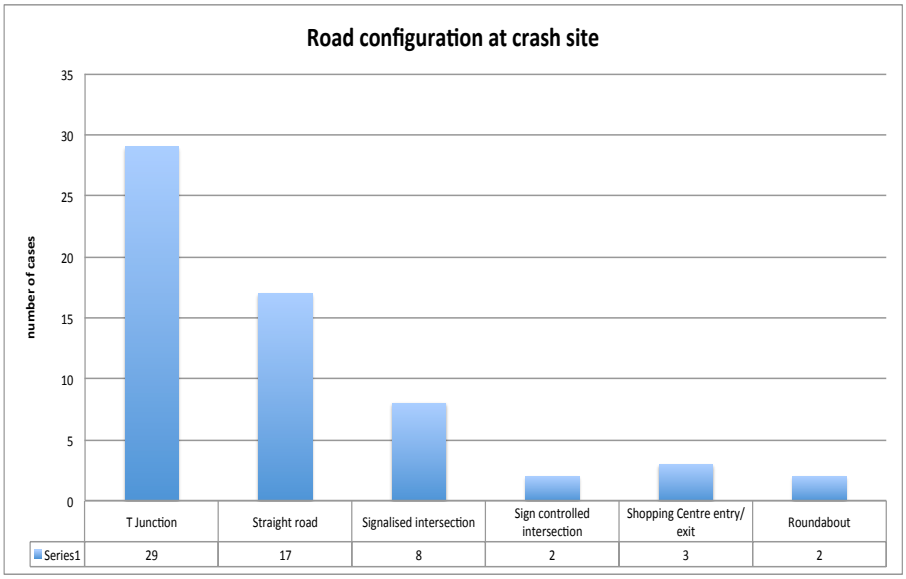

Figure 3.1

3.1.4 Speed zones where crashes occurred

Almost two thirds of all crashes occurred on a roadway with a 60 kilometre per hour (km/h) speed limit with a further 30 per cent occurring on a roadway with a speed limit of 50 km/h. Figure 3.2 shows the speed limits posted for the crash sites.

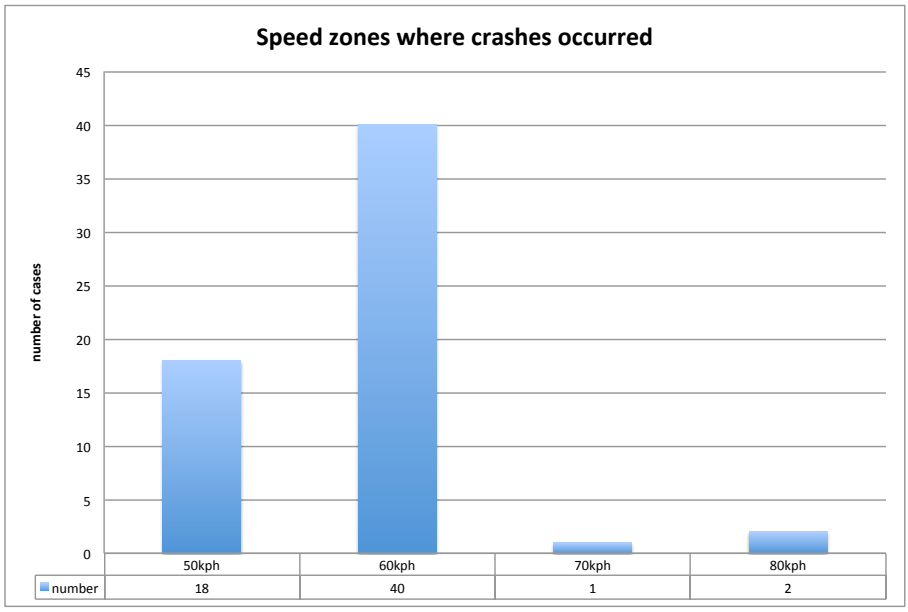

Figure 3.2

3.1.5 Types of vehicles involved in crashes with cyclists

In more than 90 per cent of cases the vehicle involved in the collision was a car or car derivative, including three vehicles that were identified in police or emergency service records as being a four wheel drive. The remaining vehicles were identified as a truck (three cases), a bus (one case) and there was one crash involving a collision between the bicyclist and a motorcycle.

3.1.6 Times of day and day of week of crashes

More than 80 per cent of the crashes occurred in daylight conditions. Three per cent of the crashes were considered to have occurred in twilight or early morning lighting with the remainder occurring during night-time conditions. Night-time crashes generally occurred prior to 2000 hours or after 0400 hours in the morning. More than 40 per cent of the crashes occurred during the peak commuting times of 0700-0900 hours or 1700-1900 hours. While crashes occurred across all days of the week they were more likely to occur during the Monday to Friday working week. In 21 per cent of cases the crash occurred on a weekend with more than twice as many occurring on Saturday when compared to Sunday. Figure 3.3 provides a breakdown of the times of day of the crash while Figure 3.4 shows the day of week.

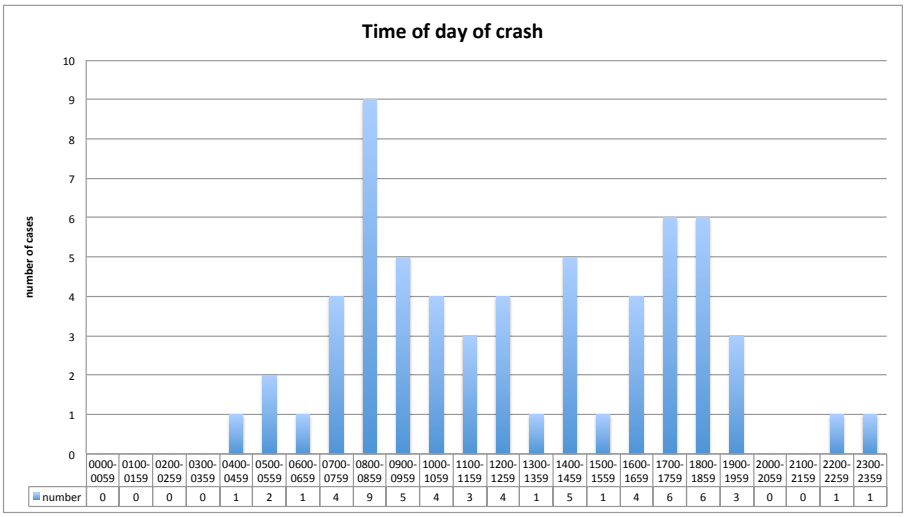

Figure 3.3

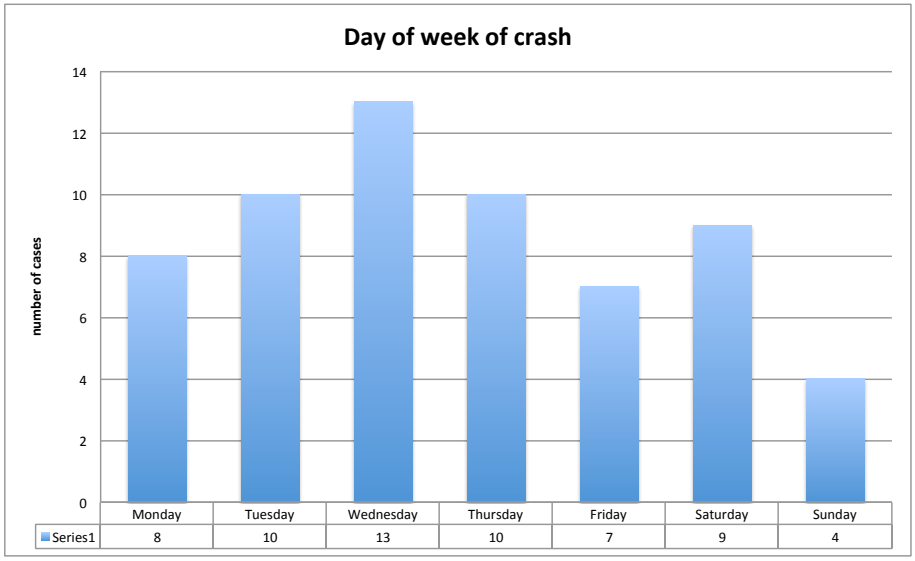

Figure 3.4

3.1.7 Season and weather conditions at time of crash

Figure 3.5 provides a breakdown of the month and season when the crashes occurred. Cyclists were involved in crashes across all seasons throughout the year, however, close to two thirds occurred during the autumn and summer periods. Police crash records identified the prevailing weather conditions at the time of the crash. In four cases the cyclist was identified in these records as travelling in rainy conditions while all other cyclists were travelling in fine or non-rainy conditions.

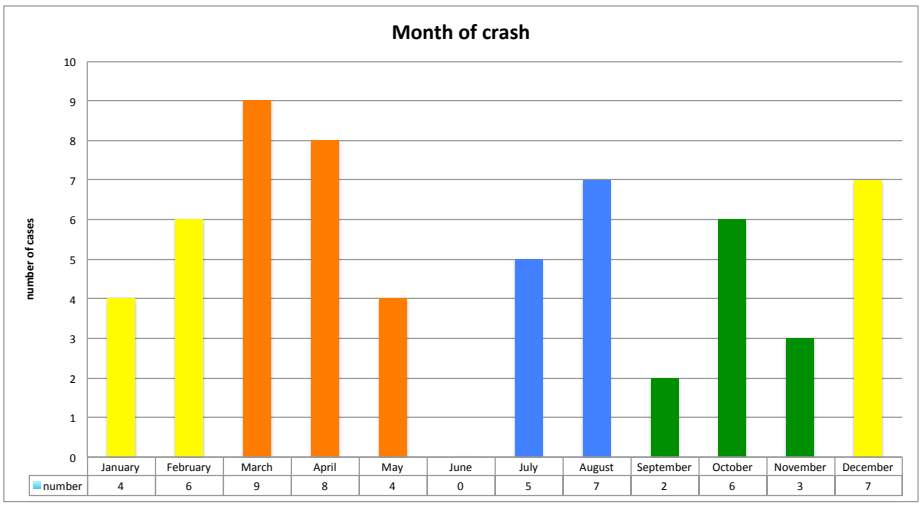

Figure 3.5

3.1.8 SAPOL allocation of at fault status in crash

At fault status for the crash was identified in police generated records. In 79 per cent of cases the driver of the vehicle was deemed to be at fault for the crash while the cyclist was deemed at fault in 21 per cent of cases. Fail to stand or fail to give way were the most common at fault categories identified for vehicle drivers while inattention was identified for almost half of all bicyclists who were deemed at fault for the crash. There was one driver who was deemed at fault for the crash where the reason for the at fault determination was not further specified (NFS). Figure 3.6 provides a breakdown of the at fault categories used by police and the number of cases found within each of these categories for both vehicle drivers and cyclists.

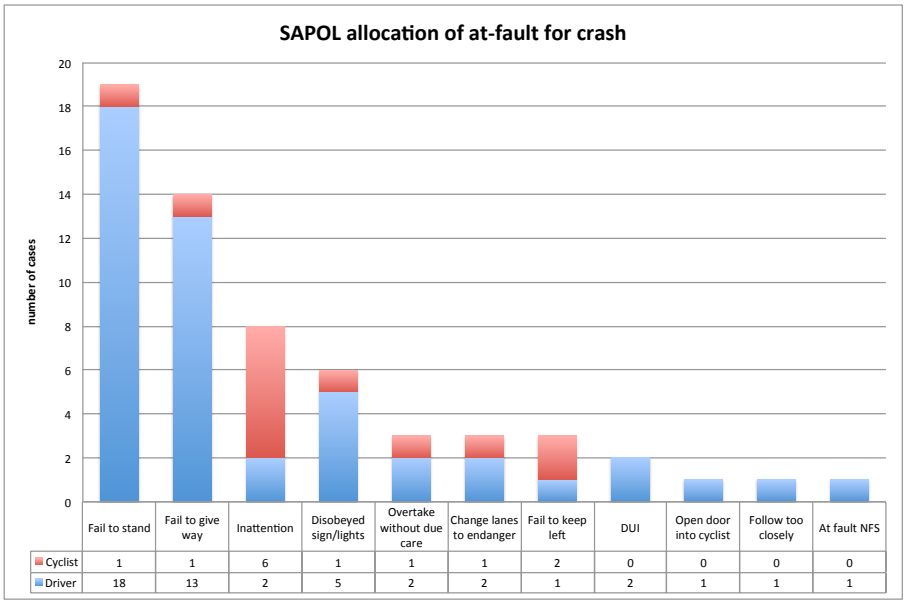

Figure 3.6

3.2 Person details

3.2.1 Age and gender of cyclist

Male cyclists were significantly over-represented in the crashes, constituting more than 88 per cent of the study group. Cyclists were found across all age groups but were more likely to be young or middle aged. In more than half of the cases (52.5%) the cyclist was aged between 36 and 55 years, all but one of whom were male. Cyclists over the age of 55 years accounted for 13 per cent of all cases. Figure 3.7 provides the age and gender breakdowns for the cyclist group.

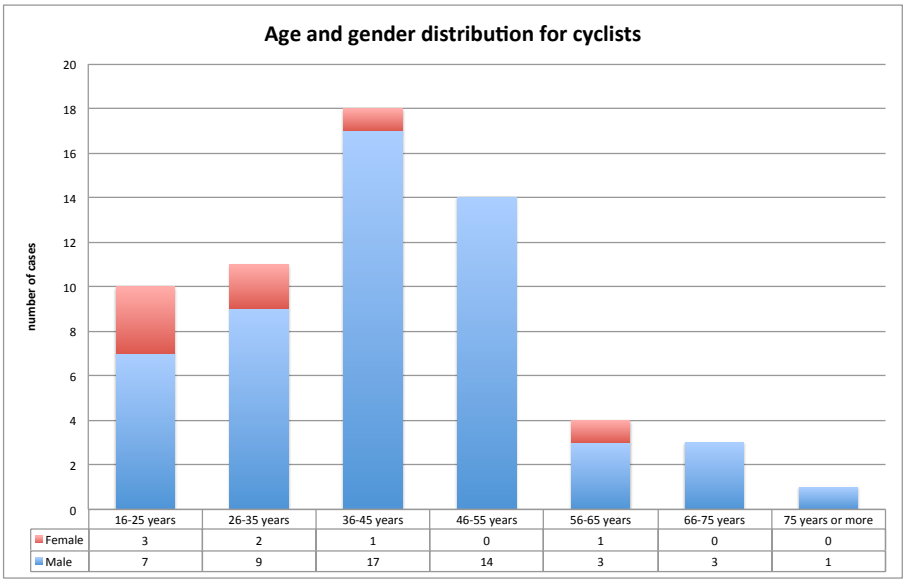

Figure 3.7

3.2.2 Age and gender of vehicle driver

The age and gender of vehicle drivers involved in the cyclist crashes were sourced from the Traffic Accident Reporting System (TARS) which is based on police generated Vehicle Collision Record (VCR) data. In four cases there was no data related to the driver that could be identified from this source because the vehicle was either unoccupied at the time or the vehicle failed to stop following the crash event. Of the cases where this information was available it was found that the gender and age distribution of vehicle drivers was markedly different to that seen for the cyclist group. The gender of drivers was found to be more evenly distributed with 47 per cent identified as female and 53 per cent male. In 31 per cent of cases the driver of the vehicle was aged between 16 and 25 years. Young women were particularly noted as being involved in these collisions with close to 20 per cent of all drivers found to be young women between the ages of 16 and 25 years, four (6.6%) of whom were between the ages of 16 and 18 years. Figure 3.8 provides the age and gender breakdowns for the vehicle driver group.

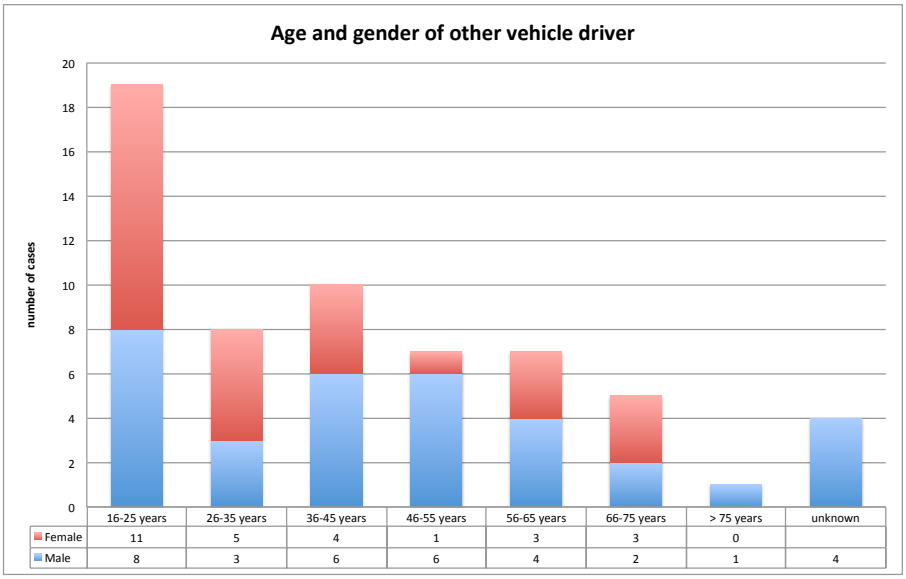

Figure 3.8

3.2.3 Location of crash in relation to cyclists residential address

The locations of crashes were matched to the cyclists residential address as one measure that may indicate the cyclists familiarity with the roadway. In more than two thirds of cases the cyclist resided within five kilometres of the crash site with 46 per cent residing within two kilometres. Figure 3.9 provides the distribution of distances between the cyclists residential address and the crash site.

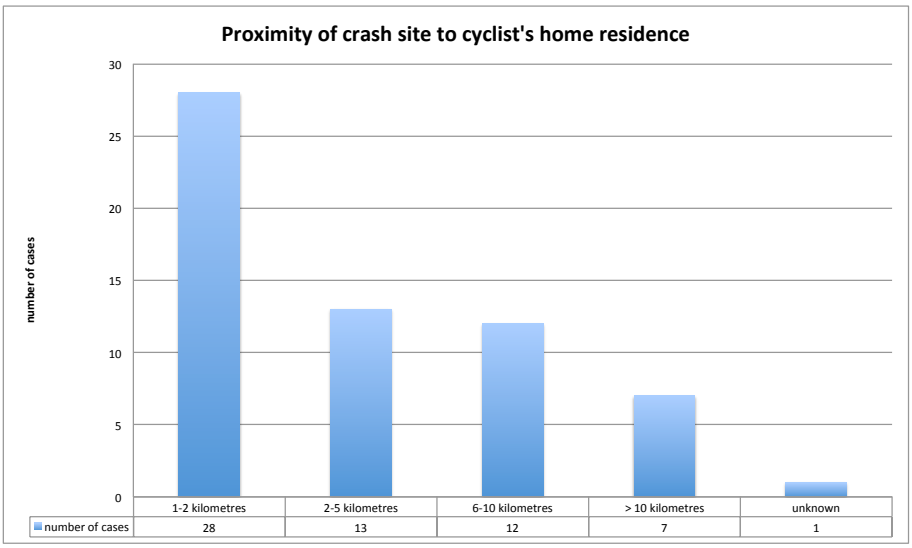

Figure 3.9

3.2.4 Helmet use among cyclists

Data related to the use or non-use of a bicycle helmet at the time of the crash was sourced from emergency services documentation recorded at the crash scene. Within these records there were nine cases where the use or non-use was not documented. In cases where helmet use was recorded there was one case where a cyclist was found not to be wearing a helmet.

3.2.5 Impact of alcohol and drugs

Mandatory blood alcohol and drug testing results for those cyclists and vehicle drivers involved in the crash were sourced from the South Australian Forensic Science Centre. Of the 61 cyclists there were 22 cases where a blood sample was either not taken or a result was unable to be matched from this source, while there was one case where a sample was taken but denatured and therefore unable to be analysed. Of the 38 remaining cases 34 were found to have a negative results for both alcohol and the three drugs methamphetamine, MDMA and THC. There were three cyclists who were found to be impaired by alcohol at the time of involvement in the crash and there was one cyclist who was positive for methamphetamine and THC. The three alcohol impaired cyclists were found to have blood alcohol readings ranging between 0.156 and 0.245gm/100ml. Among the drivers involved in the bicycle crashes there was only one who required transport to hospital following the crash. This one driver was tested and found to be negative for alcohol and drugs. In two other cases police data identified that the driver was impaired on alcohol at the time of the crash. This police data identified one driver who had a blood alcohol concentration (BAC) of 0.197gm/100ml while the other driver was recorded as driving under the influence of alcohol (DUI) without a specific reading recorded.

3.2.6 Injury severity score, body region injured and length of hospitalisation

The injury severity score (ISS), specific body region injured and length of hospitalisation for the 61 cyclists were examined. In close to two thirds of cases the cyclist had an injury severity score of five or less. There were three cases (5%) where the cyclist had an injury severity score of 21 or more; these cases involved two cyclists who were struck by an oncoming vehicle turning right across the cyclists path and one case where the cyclist was struck from behind by a vehicle travelling in the same direction on the roadway. These three cyclists sustained injuries that included facial and skull fractures with associated closed head injuries (two cases) and there was one more senior cyclist who sustained severe pelvic fractures; all three of these cyclists required extended periods of hospitalisation as a result of the injuries incurred. The injuries for the 61 cyclists were categorised using the body regions identified in the Abbreviated Injury Scale (AIS) - 2005 version, developed by the Association for the Advancement of Automotive Medicine [3]. Injuries to the upper and lower extremities and the head were found to be the most common body region where injuries were sustained.

More than half of the cyclists were hospitalised for one day or less as a result of the crash, however, around 16 per cent required a period of hospitalisation that was of one week or more. Figure 3.10 provides details related to the injury severity scores for the 61 cyclists in the study group whilst Figure 3.11 shows the body regions where injuries were incurred. The length of hospitalisation for the group can be seen in Figure 3.12.

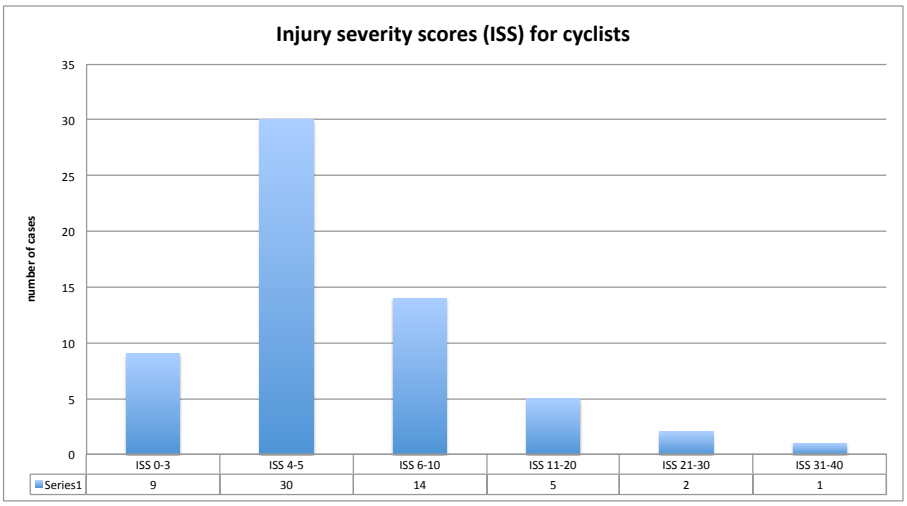

Figure 3.10

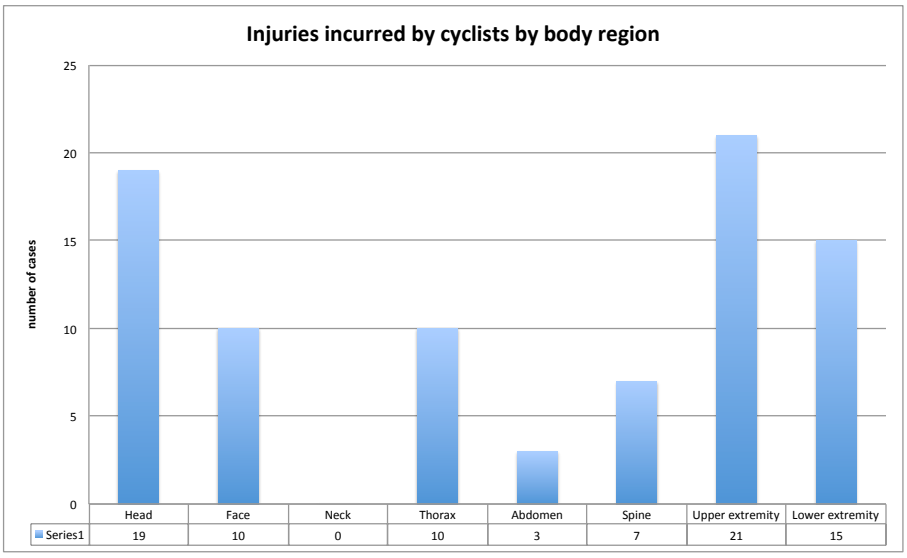

Figure 3.11

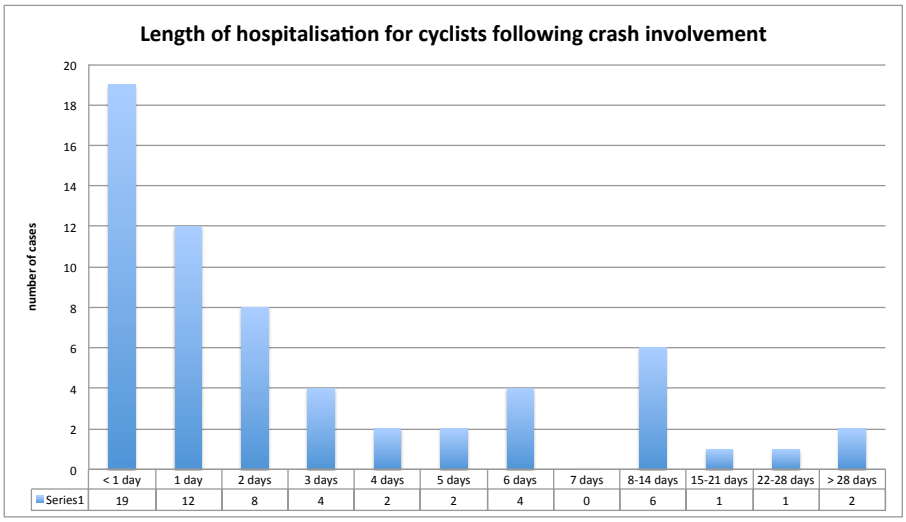

Figure 3.12

Patterns and severity of injuries incurred by the cyclist as a result of the crash were identified as being different when the mechanism of impact between the cyclist and the vehicle were isolated. As a result of these identified differences the injury severity score, body region injured and lengths of hospitalisation were explored in more depth for the three most common impact types: bicycle striking side of vehicle, vehicle striking side of bicycle and side-swipe collisions between bicycle and a vehicle.

Bicycle striking side of a vehicle

There were 29 cyclists who struck the side of a vehicle. In 22 cases the cyclist struck an oncoming vehicle that turned right across their path. There were three cyclists who struck a vehicle that had come out of a side street and into their path, three cyclists who struck a vehicle that turned left ahead of them and one where the vehicle came across an intersection into the path of the cyclist. In half of these cases the cyclist was ejected over the bonnet or roof of the vehicle following the impact, while the remaining cases consisted of the cyclist falling to the roadway at or near the impact point. Injury severity scores (ISS) for the 29 cyclists ranged between one and 38 with close to two thirds having an ISS of five or less. ISS for cyclists who were ejected over the bonnet following the impact were similar to those of cyclists who fell to the roadway with the exception of the one cyclist who was ejected across the roof of the vehicle before landing on the roadway from a considerable height and sustaining serious injuries including tension pneumothorax and closed head injury. Figure 3.13 provides a breakdown of the ISS for this group of cyclists.

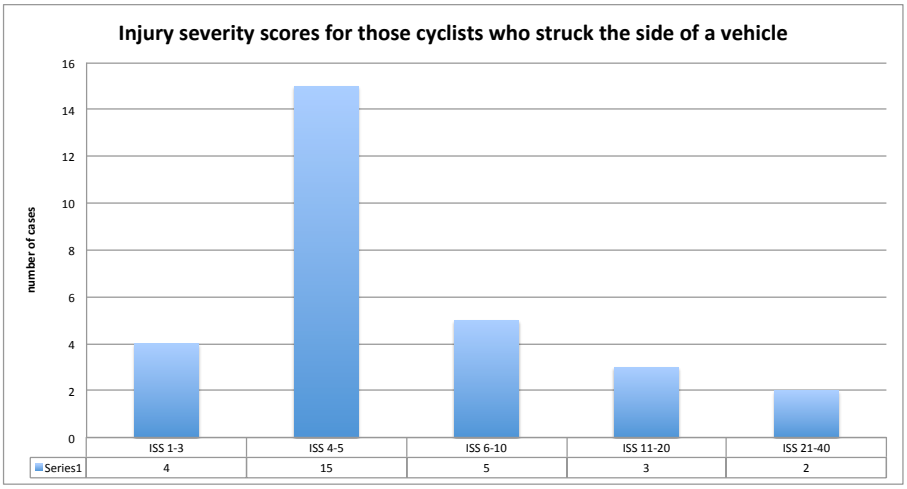

Figure 3.13

Fractures were the most frequently reported serious injury for cyclists who struck the side of a vehicle. The most common fractures were those to the upper extremities including clavicle, scapula and arms (nine cases), followed by rib fractures (four cases), facial bone fractures (three cases), lower leg and ankle fractures (three cases) and minor spinal fractures (three cases). There were ten cyclists amongst this group who experienced a loss of consciousness at the scene, generally for a short period. Trauma to organs including cerebral contusions, lung contusions, haemothorax and liver lacerations were seen in seven cases. Close to two thirds of cyclists in this group were hospitalised for two days or less. Figure 3.14 provides a breakdown of injuries based on the specific body regions as identified in the AIS while Figure 3.15 shows the length of hospitalisation for this group.

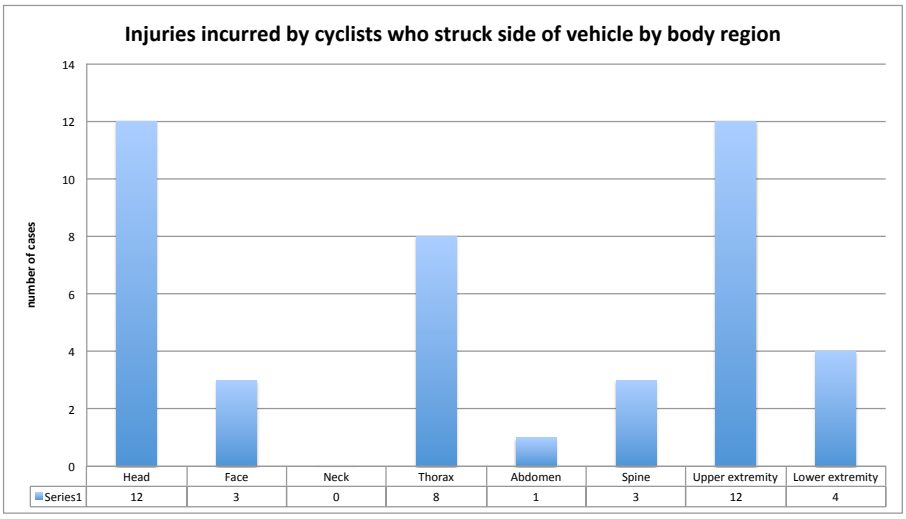

Figure 3.14

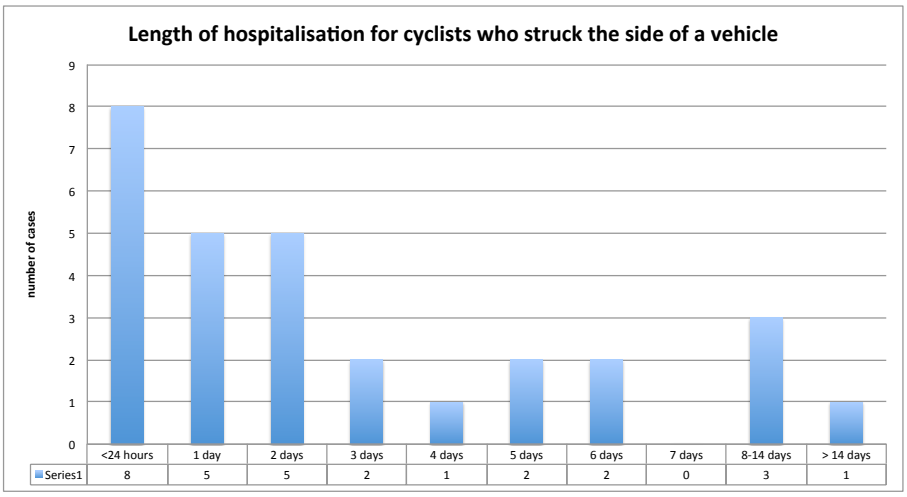

Figure 3.15

Cyclist struck on side by a vehicle

There were fifteen cases where a vehicle is known to have struck the cyclist from the side. In seven of these cases the cyclist was struck by a vehicle entering the roadway from a side street. Other crash scenarios included a cyclist who turned right into the path of an oncoming vehicle (two cases), a cyclist being struck by a vehicle entering a roundabout already occupied by the cyclist (2 cases) and three other cases involving cyclists who were crossing the path of through vehicles. In 40% of these cases the cyclist was ejected over the bonnet of the vehicle following the impact, while the remaining cases consisted of the cyclist falling to the roadway at or near the impact point. Injury severity scores (ISS) for the 15 cyclists ranged between one and thirteen, with close to two thirds having an ISS of five or less. Injury severity scores for cyclists who were ejected over the bonnet following the impact tended to be higher when compared to those cyclists who fell to the roadway including three cyclists who had an ISS of nine or ten. Coming onto the bonnet of the vehicle following the collision may reflect a higher vehicle speed at the time of impact but this is speculative. Figure 3.16 provides a breakdown of the ISS for this group of cyclists.

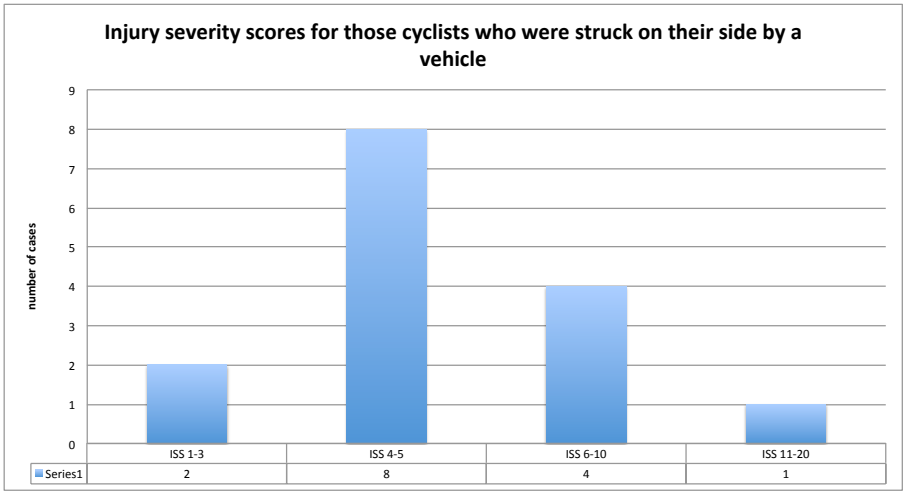

Figure 3.16

Fractures were the most frequently reported serious injury for cyclists who were struck on the side by a vehicle. The most common fractures were those to the lower extremities including lower leg, ankle and pelvis (5 cases) followed closely by upper extremities fractures to clavicle or arm (four cases), minor spinal fractures involving one or more transverse process (two cases), rib fractures (two cases), and one cyclist who sustained facial bone fractures. Trauma to organs including pneumothorax and arterial lacerations were seen in three cases. There were two cyclists amongst this group who experienced a brief loss of consciousness at the scene. Two thirds of cyclists in this group were hospitalised for two days or less, however one cyclist was hospitalised for 29 days. Figure 3.17 provides a breakdown of injuries based on the specific body regions as identified in the AIS while Figure 3.18 shows the length of hospitalisation for this group.

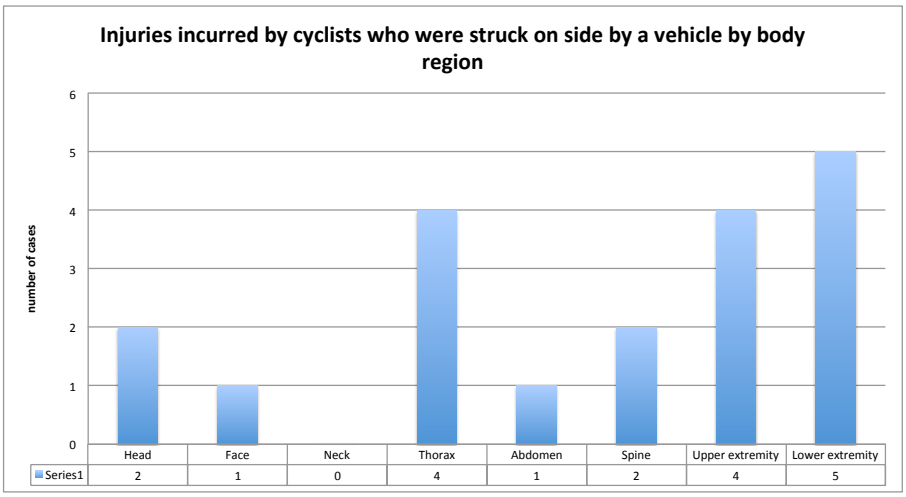

Figure 3.17

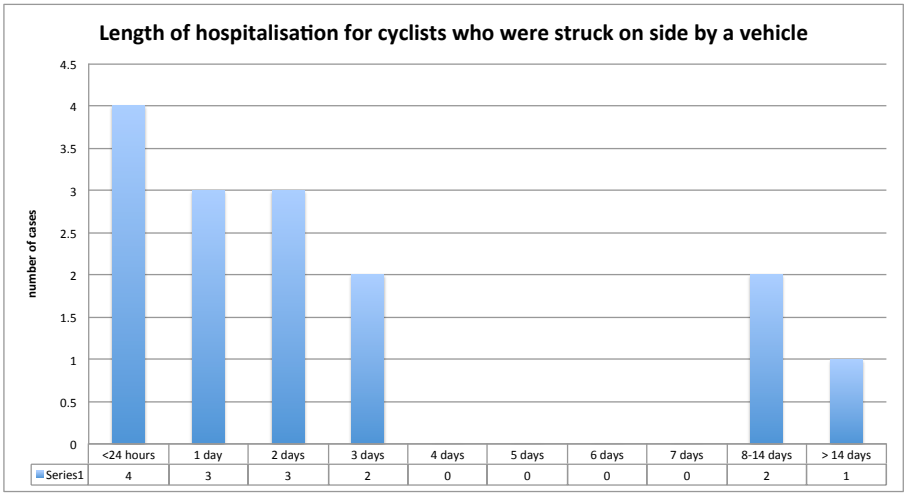

Figure 3.18

Cyclists involved in side-swipe crashes with a vehicle

There were seven cases where a cyclist was involved in a side-swipe incident with a vehicle. In four of these cases the cyclist was struck by a vehicle that was travelling on the same section of roadway and in the same direction. The three other crash scenarios included a cyclist striking the side of a parked and unoccupied vehicle (two cases), and a cyclist who was riding in the centre of a carriageway and

was struck by an oncoming truck while negotiating a bend in the road. In all cases the cyclist fell to the roadway at or near the impact point. Injury severity scores (ISS) for the seven cyclists ranged between one and ten, four of whom had an ISS of five or less. Figure 3.19 provides a breakdown of the ISS for this group of cyclists.

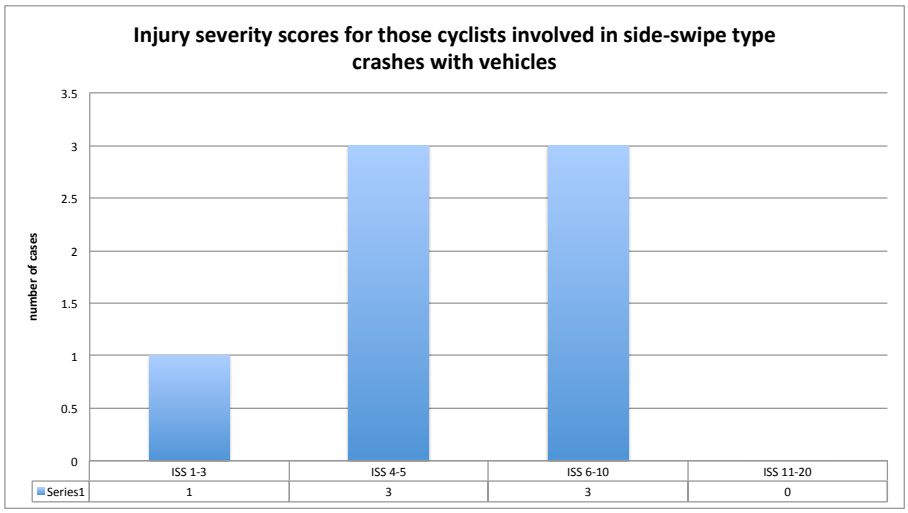

Figure 3.19

Fractures were the most frequently reported serious injury amongst this group of cyclists. These fractures were seen to involve the arm, upper or lower leg (2 cases each) and teeth (1 case each). There was one cyclist who sustained cerebral contusions as a result of their involvement in the crash and one cyclist sustained a de-gloving injury to their hand. Three of the cyclists amongst this group are understood to have experienced a brief loss of consciousness at the scene. In all but one case the cyclist was hospitalised for one day or less. Figure 3.20 provides a breakdown of injuries based on the specific body regions as identified in the AIS while Figure 3.21 shows the length of hospitalisation for this group.

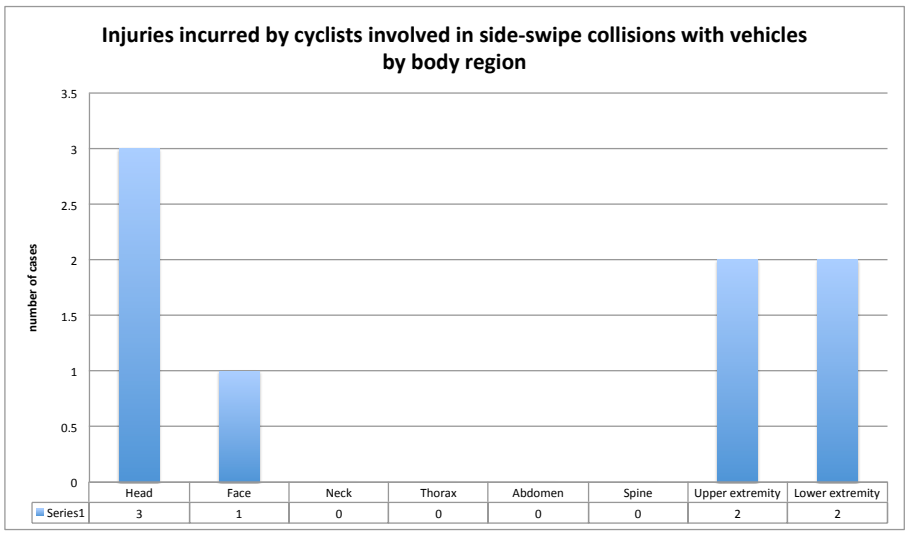

Figure 3.20

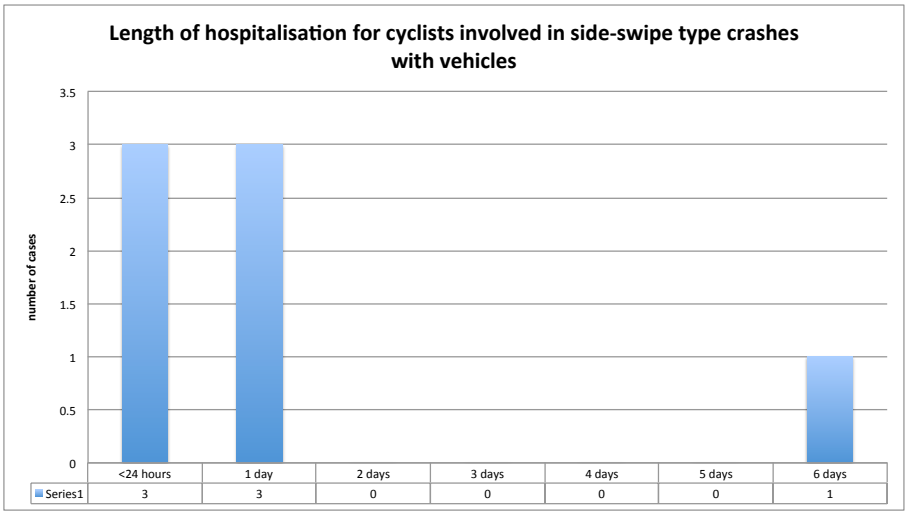
Length of hospitalisation for cyclists involved in side-swipe type crashes with vehicles
number of cases
3.5
3
2.5
2
1.5
1
0.5
0
<24 hours
1 day
2 days
3 days
4 days
5 days
6 days
Series1
3
3
0
0
0
0
1

Figure 3.21

4 Information gained from interviews

4.1 Non-crash related characteristics of the cyclists

4.1.1 Length of experience as a cyclist

While in most cases the cyclist identified that they had owned and ridden bicycles in some form during their youth, around 60 per cent described a renewed interest and engagement in cycling after a period of ten to twenty five years of limited or no riding. Reasons cited for returning to cycling included health and fitness motivations, social recreation activity with partners or friends and financial considerations related to expenses of car parking and/or a reduced need for a second family car. Of the 40 per cent of cyclists who described a continuation of cycling since childhood, most described their riding experience as including competitive or club based activities as well as social and commuting purposes. More than 85 per cent of the cyclists had undertaken regular cycling activities for three years or more prior to their involvement in the crash and in all cases the cyclist engaged in cycling on a public roadway, 25 per cent of whom had been doing so for 20 years or more. Figure 4.1 shows the length of serious riding exposure on public roadways reported by the cyclists.

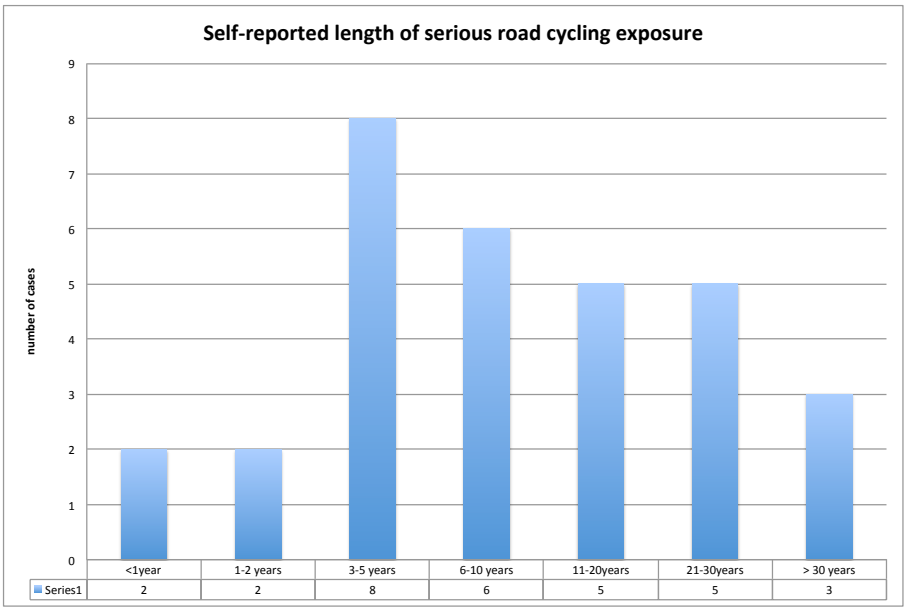

Figure 4.1

4.1.2 Type of bicycle and other bicycle usage

Two thirds of the cyclists were travelling on road racer type bicycles while the remaining were travelling on bicycles described as mountain bikes or hybrids. In all but three cases the cyclist had purchased the bicycle new. Length of ownership of the bicycle ranged between four months and twenty years with an average of three years. Close to half of the cyclists were understood to own two or more bicycles that they used on other occasions but most described the bicycle they were riding at the time of the crash as the one they used most frequently. The purchase price cited by the cyclists varied considerably from those around $1,000 to three cyclists who had purchased elite Italian import bicycles made from carbon and/or magnesium that were in the vicinity of $15,000 to $18,000. Figure 4.2 shows the years of cycling experience that were reported by the cyclists.

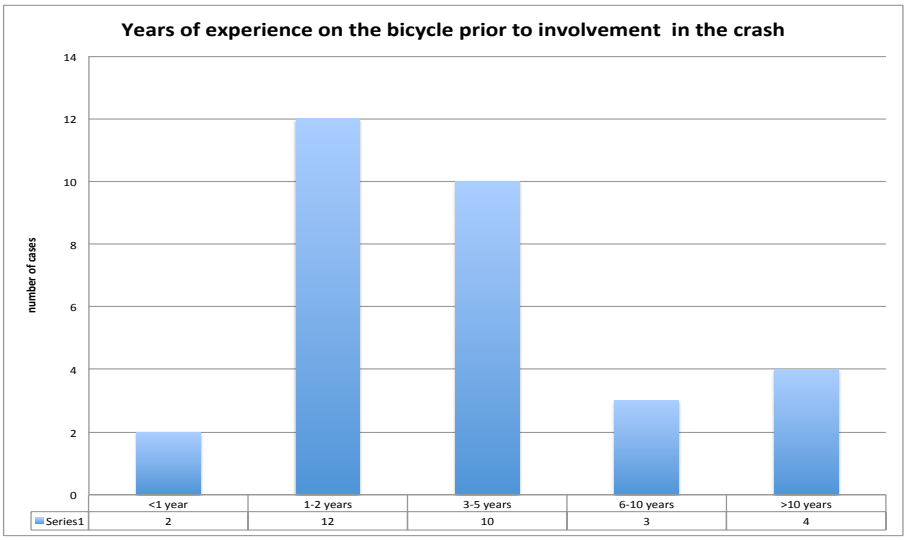

Figure 4.2

4.1.3 Exposure detail

The cyclists were asked to provide some detail related to their frequency of riding, the context of their riding and an estimate of the number of kilometres they rode per annum. With the exception of one cyclist who had begun commuting to work in the same week as the crash, all other cyclists reported riding on at least one occasion per week throughout the year. More than 60 per cent of the cyclists reported that they were regular commuters who rode five or more days a week with a further 17 per cent reporting that they regularly rode three to four days per week. Three quarters of the cyclists reported riding recreationally on at least one occasion weekly. The majority of cyclists undertook a combination of both commuting and recreational cycling activities. In more than 33 per cent of cases the rider self reported being involved in organised recreational cycling events. These events included participation in the public stages of the Tour Down Under, the Ride Like Crazy, and the Amy Gillett Foundation charitable ride, as well as participation in other club based rides and marathon events such as Iron Man competition.

The self reported kilometres travelled per annum ranged between 500 kilometres per annum (km/annum) for one cyclist to 25,000 km/annum for another, with the average being close to 10,000 km/annum. Those cyclists who undertook more than 10,000 km/annum were more likely to describe their riding experience as consisting of several long trips per week. These riding experiences frequently involved trips that were of 100 kilometres or more. A combination of frequent long trips combined with regular commuting was also common. The cyclist who reported travelling 25,000 km/annum had never held a motor vehicle licence and cycling was their primary mode of transport. In all cases the cyclists' reported that the activity they were undertaking at the time of the crash was consistent with their usual cycling exposure. Figure 4.3 provides the distribution of kilometres ridden per annum as reported by this group.

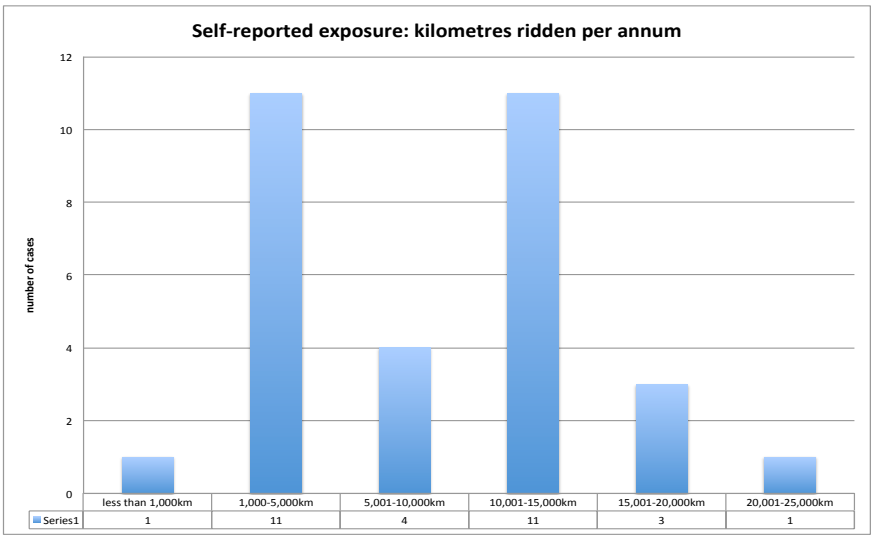

Figure 4.3

4.1.4 Cyclist conspicuity

The interviews sought information regarding rider conspicuity with particular attention to the type and colour of clothing worn, helmet colour, the use of backpacks and the fitting and use of lights. The information also included an exploration of the riders motivations for choosing the particular forms of clothing, for example whether they made deliberate choices when purchasing and wearing clothing that made them more visible to other road users.

Close to two thirds of the riders self-reported wearing specialist cycling attire in the form of lycra vests and pants, almost all of which were combinations of two or more bright colours that were punctuated with text. In most cases the cyclist reported that their choice of attire in relation to colour was dictated by the colours chosen by the club or team in which they were a member or that the vests were purchased specifically for an event that they had undertaken. In other cases the cyclist reported that a large proportion of the attire that was available for purchase consisted of brighter colours and so much of the choice was based on availability. Of the eleven riders who reported wearing normal street wear, there were three who stated they were wearing high visibility vests or jackets over their clothing in an effort to increase their conspicuity while riding. Helmets were worn by all of the cyclists who were interviewed. In close to 80 per cent of cases the cyclist was wearing a helmet that was of a light/bright colour or a combination of light/bright colours. In at least five cases the cyclist reported that the helmet had reflective panels within the coating that made the helmet more visible in car headlights at night. While light clothing and helmets may provide some protection by making cyclists more visible, the effectiveness of these may be diminished by the use of backpacks and other carried objects. Close to 40 per cent of the cyclists self reported that they were wearing a backpack at the time of the crash with almost all reported to be dark blue or black in colour and of a medium to large size. In three cases the cyclist was transporting a medium sized laptop within the backpack and there were at least two cyclists who were carrying a large quantity of heavy textbooks.

All cyclists reported that the bicycle was fitted with lights at the time of the crash, however, more than 70 per cent of cyclists stated that the lights were not in use at the time because a good level of daylight did not necessitate their use. In 20 per cent of cases the cyclist stated that they were travelling in night time conditions or in early morning/late afternoon conditions that warranted the use of both their front and rear lights and in all of these cases the lights were in use. A further 10 per cent of cyclists reported using their rear light at the time of the crash that occurred under daylight

conditions. Anecdotal observations of cyclists in the Adelaide CBD during the 2012 period suggest that cyclists have begun to increase their level of conspicuity by including extra lighting sources that are fitted to backpacks and, in some cases, to helmets; this appears to be a recent phenomenon. However, none of the cyclists who were interviewed reported wearing these additional illumination sources at the time of the crash.

4.1.5 Shoe and pedal configurations

Close to 70 per cent of the cyclists reported wearing a cleated shoe and pedal combination at the time of the crash event. In all cases the cyclist reported that they were familiar and comfortable with the fitted pedal mechanism and did not consider that this played any role in the lead up to the crash events. In all but one of the remaining cases the cyclist self reported wearing a sneaker or lace-up type shoe on normal pedals while one cyclist was wearing a normal shoe combined with a pedal fitted with a toe clip.

4.1.6 The use of media devices and headphones

The use of media devices such as MP3 players, iPods and mobile phones has the potential to place a cyclist at an increased risk of a crash due to a reduced ability to hear approaching vehicles and because they are a potential distraction. This is particularly the case when paired with headphones. The cyclists were asked to disclose their general use of such devices whilst cycling and whether they were in use at the time of the crash event. There were three cyclists who were using headphones connected to a media device at the time of the crash with each reporting that they were listening to music or the radio. In one case the cyclist stated that they used only one headphone whilst listening to music to allow them to hear traffic and one other stated that the volume was set low to allow the noise of traffic to also be heard. Close to two thirds of the cyclists reported that they do not use media devices at any time while riding, while 25 per cent stated that they do use them on occasion but not at the time of this crash. Those who reported never using devices frequently expressed that the use of media devices posed a significant safety risk and should be discouraged while riding.

4.2 Events related to the crash

4.2.1 Purpose and duration of riding activity at time of crash

Close to 60 per cent of the cyclists reported that they were involved in recreational riding at the time of the crash, with a third of this group undertaking some form of training in the lead up to a specific cycling event. There was one cyclist who was travelling between two work sites that were approximately 15 kilometres apart while all remaining cyclists reported that they were travelling to or from work. Of those cyclists who were undertaking a trip for commuting purposes, half were travelling to work and half were returning home following work. In one case the commuting cyclist was travelling a different route home due to road closures but all others were travelling a route they were familiar with. More than half of the cyclists who were undertaking a recreational activity at the time of the crash had been riding for between two and twenty kilometres before the crash event but there were three cyclists who had travelled a distance between 100 and 115 kilometres before being involved in the crash. In all cases the cyclist reported that the distances they had travelled prior to the crash were within their normal riding capacity with no cyclist reporting that they were fatigued as a result of the activities being undertaken. In all cases the cyclist undertaking a recreation related trip reported that they were familiar with and had travelled on the roadway at the crash site on previous occasions.

4.2.2 Self reported estimations of speed in lead up to crash event

One third of the cyclists estimated that they were travelling at a speed above 30 kilometres per hour (km/h) in the lead up to the crash events with one cyclist estimating that speed to be up to 60 km/h. A further third estimated their speed to be in the vicinity of 21 to 30 km/h. The cyclists reported that their travelling speed at the time was consistent with their normal riding practices and within their abilities. In one case the cyclist was stationary at the time of the crash and reported that they had been stationary at a red traffic signal for up to a minute prior to the crash. Figure 4.4 provides a breakdown of the speed estimates reported by the cyclists.

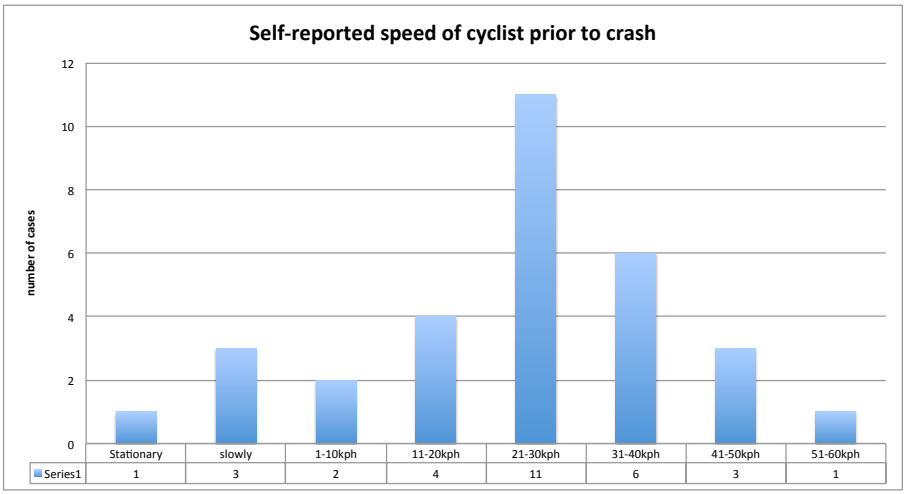

Figure 4.4

4.2.3 Cyclists accounts of the crash event

The circumstances of each individual crash were often diverse and therefore difficult to explain as a homogenous group, however, there were some common details related to the crash events that are explored further in this section. These should be viewed in conjunction with the more specific accounts of the crashes outlined in Appendix 1.

In the vast majority of cases the cyclist was travelling alone at the time of the crash. There were five cyclists who were travelling with others prior to the crash including two cyclists who were travelling in a tight group of six before being involved in the same crash event. In the remaining cases the cyclist reported that they were travelling ten metres or more ahead or behind the cyclist(s) they were accompanying.

The cyclists were asked to comment on their positioning on the roadway at the time of the crash. In most cases the cyclist reported that they were travelling in the bicycle lane if it was provided or to the left edge of the carriageway in those cases where no bicycle lane was available. There were six cyclists who reported travelling toward the centre of the trafficable lane, these included a cyclist travelling through a roundabout, two cyclists travelling on a hills roadway that was almost free of other vehicles and two cyclists intending to turn right at a signalised intersection. In all but one case the cyclist was travelling in single file prior to the crash; this one case involving the two cyclists who were travelling two abreast in the group of six.

In nine cases the cyclist was suddenly confronted with a vehicle ahead of them that had come or was thought to have come into their path through a visual obstruction created by other vehicles. In the

remaining cases the cyclist either reported that they saw the vehicle involved in the crash at some stage prior to the crash events or at least were in a position to see the vehicle because they did not perceive that there was a visual obstructions to impede this. Vision of other vehicles in the vicinity prior to the crash was reported to have led to a small number of the cyclists slowing down but in most cases the cyclists reported no change to their riding behaviour until the crash was imminent. It was suggested by some cyclists that this may in part be related to the cyclists experience and exposure to the road network as a vehicle driver. Only one cyclist reported that they had never held a motor vehicle licence while all other cyclists either had a drivers licence or were in the process of getting a licence. It was frequently suggested by the cyclists that the knowledge and experience related to driving rules is likely to have influenced their actions and perceptions of danger in the lead up to the crash. For example four of the cyclists specifically reported that they saw the vehicle but knew, as drivers, that the vehicle should have stopped and given way to them and so took no evasive action. In all but five cases the cyclist reported that the time between realising a crash was imminent and the crash occurring was too short to undertake any evasive action. Those cyclists that stated that they did undertake evasive action reported that they braked heavily and in two cases attempted to steer away from the vehicle.

In several instances the cyclists reported that the vehicle involved in their crash had undertaken a manoeuvre, for example a right turn, through a break in vehicle traffic, suggesting that the driver of the vehicle was primarily concentrating on vehicle traffic without consideration of other road users such as cyclists. This was frequently supported by statements provided by drivers to the cyclist at the scene following the crash, including twelve drivers who stated that they did not see the cyclist and were not aware of them until the crash occurred. In two cases the cyclist reported that the driver involved in the crash had told police that they saw the cyclist but believed they had time to negotiate the manoeuvre safely ahead of the cyclists position, suggesting that they may have under-estimated the cyclists travel speed.

4.2.4 Cyclists' accounts related to at fault status

Cyclists' explanations of why the crash occurred and identification of who was at fault were explored. In most cases cyclists who were deemed at fault or not at fault for the crash by police agreed with that judgement. In some cases the cyclist reported that while they were technically not at fault their more assertive riding style may have contributed to the crash outcome and had they been riding more defensively the crash may have been avoided. Two of the behaviours reported by cyclists as less than defensive included travelling at a faster rate that other vehicles travelling on the same carriageway and increasing their speed in the lead up to an intersection to ensure they were through before the light sequence changed. Frequently these cyclists reported that their riding behaviours have altered as a result of the crash and that they were less likely to undertake more assertive riding practices, assume that a vehicle driver had seen them or assume that a driver would necessarily abide to an obligation such as give way. This may in part be a recognition of the more deleterious outcomes as a cyclist compared to drivers who are less likely to be injured.

5 Discussion

This study involved the examination of the circumstances surrounding the crash events for 61 bicycle riders who required hospitalisation as the result of a crash with a motorised vehicle on a public roadway in South Australia. The main purposes of the study were to identify common themes related to these crashes and to determine the key issues that may lead to a better understanding of the circumstances surrounding their crash involvement.

The study incorporated information from the hospital medical records with linked data related to police crash records and data related to drug and alcohol use among both the cyclists and the vehicle drivers at the time of the crash. This linkage approach provided a more holistic understanding of the crash events. This understanding was further enhanced with information gathered at interviews with the crash involved cyclists. A number of key issues were identified that proved to have the most impact on the cyclists involvement in the crash; in particular the manoeuvre being undertaken by the vehicle driver in the lead up to the crash, the road configuration at the site of the crash including issues surrounding the division of attention experienced by vehicle drivers while negotiating that configuration, the age of the vehicle driver, relationship between cyclist injuries and crash type, and cyclist practices in relation to riding style and travel speed.

Manoeuvre being undertaken by drivers of vehicles and cyclists in lead up to the crash event and the impact of the road configuration

The intended paths of vehicle drivers and cyclists in the lead up to the crash events were found to be significantly different from one another. More than 85 per cent of the cyclists in the study were identified as travelling straight on a single carriageway with the intention of continuing straight at the time of the crash. Drivers of vehicles, however, were more likely to be turning, with more than 64 per cent of all drivers undertaking a turn manoeuvre into or out of another roadway at the time of the crash. The most common turning manoeuvres being attempted by vehicle drivers were right turns across a carriageway (38% of cases), coming along the stem and entering a T junction with the intention of turning left or right (18% of cases) or turning left into another road (8% of cases). Drivers turning right into a side street or turning right from the stem of a T junction were known to be negotiating that turn across two or more lanes in more than 60 per cent of cases, making the turning manoeuvre more challenging. In all of these cases the driver of the vehicle was obliged to give way to other traffic, including cyclists. Adding further to the challenges faced by turning drivers were the number who were attempting the right turn in peak traffic times, accounting for 20 per cent of cases; with the majority undertaking that manoeuvre over two or more lanes. Turning across higher volumes of traffic under these conditions creates an added burden related to division of attention; it also has the potential to lead drivers toward smaller gap acceptance and an increase in attention to vehicle traffic at the expense of attention to cyclists and other road users. Cyclists are also less visible when they are travelling to the left of heavy oncoming traffic as demonstrated in the number of cases where the driver stated at scene that they were not aware of the presence of the cyclist prior to the crash.

Age and gender distributions of cyclist and vehicle drivers

Vehicle drivers were frequently identified as being younger, with close to a third of all drivers involved in the cyclist crashes identified as being between 16 and 25 years of age. In ten per cent of cases the driver was aged between 16 and 19 years. Young female drivers were frequently identified as being involved in collisions with cyclists. More than half of the young driver crashes involved the driver undertaking a right turn across the path of the cyclist and in the majority of these cases the driver was undertaking that turn in peak hour traffic conditions. Lack of experience, including less refined division

of attention skills may explain why this group were more likely to be involved in this type of crash event. Another explanation may relate to a reduced level of hazard perception among younger drivers.

Relationship between injuries and crash type

The most serious injuries incurred by cyclists were fractures, followed by those who sustained internal organ injuries. Close to a third of cyclists experienced a loss of consciousness following the crash, most frequently for a short period. The body regions where injuries occurred differed depending on the mechanism of the crash. For example those who struck the side of a vehicle were more likely to sustain injuries to their upper extremities while those cyclists struck on the side by the front of a vehicle were more likely to experience injuries to their lower extremities. Coming onto the bonnet of the vehicle was seen to occur in both of these crash types. More than half of the cyclists involved in the crashes had an injury severity score (ISS) of five or less, however, five per cent of the crashes resulted in the cyclists sustaining injuries where the ISS was 21 or more. Those cyclists who struck the side of a vehicle were generally found to sustain more serious injuries than other crash types and were hospitalised for longer periods.

Cyclist riding style and travel speed

As a general rule, drivers are all pedestrians at some time. Drivers, however, do not always have experience as a cyclist, particularly as a cyclist who undertakes riding in a road traffic environment involving moderate to heavy traffic levels. Cyclists in this study self reported their speeds in the lead up to the crash event. In one third of cases the cyclist reported their speed to be above 30 km/h with some reporting a speed of 50 km/h or more. Potentially, drivers who do not engage in road cycling may not recognise that a cyclist may be travelling at these speeds. This is particularly relevant for drivers undertaking right turns and those undertaking a left turn into a side street ahead of a cyclist. Statements offered by two of the drivers to police at the scene of the crash indicated that the driver had seen the cyclist but had not anticipated them reaching the junction where the crash occurred before undertaking their manoeuvre. It is likely that other drivers may have also under-estimated the cyclists approaching speed and the potential conflict. Cyclists also identified that their speed choice and assertive riding styles may have contributed to the crash events, with cyclists suggesting that a more defensive riding style may have reduced their risk of crash involvement in some cases.

6 Conclusion

Cyclists involved in crashes were generally found to be experienced road users who undertook road cycling activities on a regular basis. On average cyclists self reported that their road cycling exposure involved close to 10,000 kilometres per annum. Male cyclists between the ages of 36 and 55 years were found to be the group most frequently involved in crashes involving a motorised vehicle. Vehicle drivers undertaking a turning manoeuvre posed the biggest threat to cyclists who were generally travelling straight on a carriageway. Those drivers undertaking a right turn manoeuvre posed the greatest threat, particularly those turning across multiple traffic lanes and in peak hour traffic conditions. Young drivers were seen as the group of drivers most likely to be involved in these types of crashes.

7 Study limitations

The study included interviews undertaken on a voluntary basis with the cyclists involved in the crashes. Interviews provided important detail related to the crash event and the traffic environment at the time of the crash. In a third of cases the cyclist was unable to be contacted. Drivers of the vehicles involved in the crashes were not involved in the interview process, potentially leading to a reduced understanding of the crash events and a bias based on the cyclists perspective of the crash.

Acknowledgements

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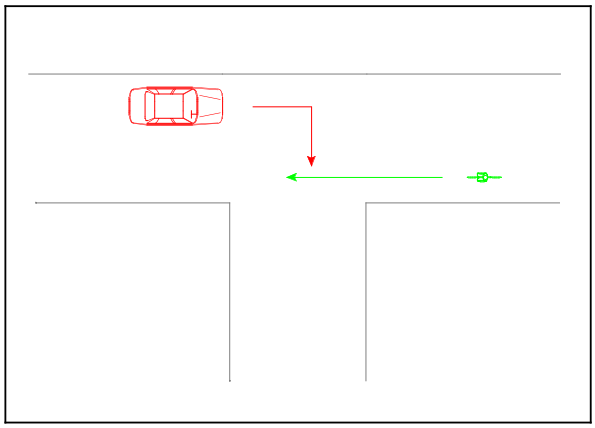
The views expressed in this report are those of the author and do not necessarily represent those of the University of Adelaide or the funding organisations.

References

1. Lindsay VL and Ryan GA (2011) Medical conditions as a contributing factor in crash causation (AP-R389-11). Sydney: Austroads.
2. WHO (1992) International Classification of Diseases, Tenth Edition - Australian Modification (ICD10-AM). Geneva: World Health Organisation.
3. AAAM (2005) Abbreviated Injury Scale (AIS). Barrington: Association for the Advancement of Automotive Medicine.

Appendix 1 - Crash types

Oncoming vehicle turned right into side street across path of cyclist: 14 cases



Case 103: Cyclist was travelling straight on an arterial road when an oncoming vehicle attempted a right turn into a side street. The cyclist struck the passenger side of the vehicle before rolling across the bonnet and striking the windscreen.

Case 227: Cyclist was travelling straight on a local road when an oncoming vehicle attempted a right turn into a parking space. The cyclist struck the passenger side wing mirror of the vehicle before rolling across the bonnet.

Case 436: Cyclist was travelling straight on a city roadway when an oncoming vehicle attempted a right turn into a parking space. The cyclist struck the left side of the vehicle before falling to the roadway at or near the impact point.

Case 603: Cyclist was travelling straight on a local road when an oncoming vehicle attempted to turn right into a side street. The cyclist struck the passenger side of the vehicle before coming onto the bonnet and striking their head on the windscreen.

Case 640: Cyclist was travelling straight on a hills roadway when an oncoming vehicle attempted to turn right into a side street. The cyclist struck the passenger side of the vehicle before rolling across the bonnet. The turning vehicle is understood to had been travelling closely behind a large truck prior to attempting the right turn.

Case 713: Cyclist was travelling straight on an arterial road when an oncoming vehicle attempted to turn right into another arterial road. The cyclist struck the passenger side of the vehicle before rolling across the roof of the car. Witnesses stated to police that the cyclist was texting on his mobile phone at the time of the crash but this could not be confirmed.

Case 820: Cyclist was travelling straight on an arterial road when an oncoming vehicle attempted to turn right into a side street. The cyclist struck the left side of the vehicle.

Case 1051: Cyclist was travelling straight on a city roadway when an oncoming vehicle attempted to turn right into a parking space. The cyclist struck the left side of the vehicle before striking another vehicle that was parallel parked at the side of the road and then coming to rest on the roadway.

Case 1080: Cyclist was travelling straight on an arterial road when an oncoming vehicle attempted to turn right across two lanes of traffic to enter a side street. The cyclist struck the left side of the four wheel drive vehicle before rolling across the roof and falling to the roadway from a considerable height. The driver of the vehicle stated that they had seen the cyclist prior to undertaking the turn but thought that they were able to negotiate the turn before the cyclist arrived at the junction.

Case 1147: Cyclist was travelling straight on a hills carriageway with a steep descent when an oncoming vehicle attempted to turn right into a side street. The cyclist reports that the driver significantly cut the corner while undertaking the turning manoeuvre. The cyclist struck the passenger side of the vehicle, striking their head on the windscreen before falling to the roadway close to the point of impact.

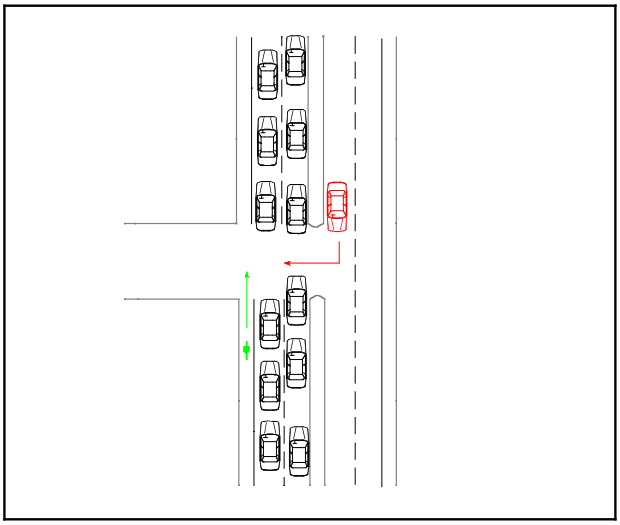
Case 1194: Cyclist was travelling straight on an arterial road when an oncoming vehicle attempted to turn right across two lanes of traffic to enter a side street. The vehicle struck the right side of the bicycle and the cyclist rolled onto the bonnet and windscreen before coming to rest on the roadway.

Case 1211: Cyclist was travelling straight on a local road when an oncoming vehicle attempted to turn right into another road. The vehicle struck the right side of the bicycle and the cyclist rolled onto the bonnet. There is a possibility that the cyclist was travelling on the footpath immediately prior to the crash events but this could not be confirmed.

Case 1364: Cyclist was travelling straight on an arterial road when an oncoming vehicle attempted a right turn across two lanes of traffic to enter a side street. The cyclist struck the left side of the vehicle before rolling across the bonnet and striking the windscreen.

Case 1462: Cyclist was travelling straight on an arterial road when an oncoming vehicle attempted a right turn across two lanes of traffic to enter a side street. The cyclist struck the left side of the vehicle before rolling across the bonnet.

Oncoming vehicle turned right through gap in congested traffic across path of cyclist: 3 cases

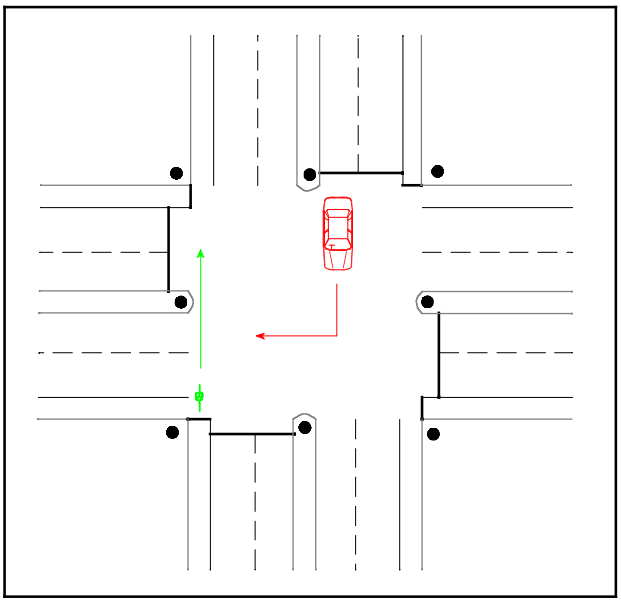


Case 35: Cyclist was travelling straight on a major arterial road in congested traffic that had become stationary. The traffic had left a gap to facilitate a right turning manoeuvre for oncoming vehicles. An oncoming vehicle attempted a right turn across three lanes of traffic to enter a side street through the provided gap. The cyclist struck the left side of the vehicle before falling to the roadway at the point of impact.

Case 126: Cyclist was travelling straight on a major arterial road in congested traffic that had become stationary. The traffic had left a gap to facilitate a right turning manoeuvre for oncoming vehicles. An oncoming vehicle attempted a right turn across two lanes of traffic to enter a side street through the provided gap. The cyclist struck the left side A pillar of the vehicle before falling to the roadway at the point of impact.

Case 133: Cyclist was travelling straight on a major arterial road in congested traffic that had become stationary. The traffic had left a gap to facilitate a right turning manoeuvre for oncoming vehicles. An oncoming vehicle attempted a right turn across two lanes of traffic to enter a shopping centre car park. The cyclist struck the left side A pillar of the vehicle before falling to the roadway at the point of impact.

Oncoming vehicle turned right at signalised intersection across path of cyclist: 6 cases



Case 83: Cyclist was travelling straight through a green light at a signalised intersection of two arterial roads that had three lanes of traffic for each direction of travel. The driver of the oncoming vehicle attempted a right turn across three lanes of traffic. The cyclist struck the front left corner of the vehicle before rolling across the bonnet and striking the windscreen. It is unknown whether the vehicle had been stationary prior to undertaking the right turn manoeuvre.

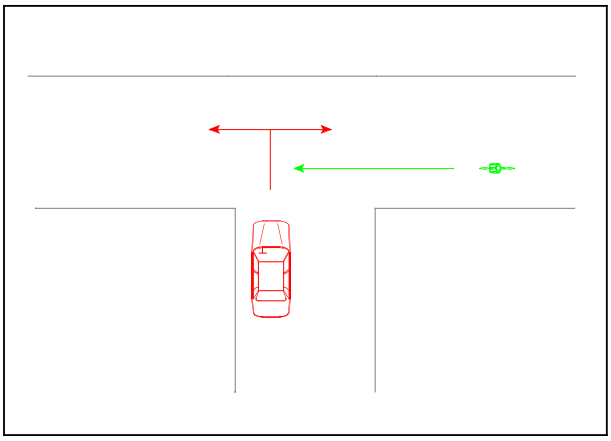
Case 153: Cyclist was travelling straight through a green light at a signalised intersection of two arterial roads when an oncoming vehicle attempted a right turn across two lanes of traffic. The cyclist struck the left side of the vehicle before rolling across the bonnet and striking the windscreen of the vehicle. It is unknown whether the vehicle had been stationary prior to undertaking the right turn manoeuvre.

Case 972: Cyclist was travelling straight through a green light at a signalised intersection of two arterial roads that had two lanes of traffic for each direction of travel. An oncoming vehicle that was understood to have been stationary at the intersection for some time attempted to undertake a right turn and came into the path of the cyclist. The cyclist struck the front left corner of the vehicle and rolled across the bonnet before entering the vehicle cabin through the windscreen.

Cases 1276 and 1358: Six cyclists were travelling straight through a green light at a signalised intersection of two arterial roads in light traffic conditions. The riders were known to each other and were travelling two abreast at a speed in the vicinity of 50 km/h. An oncoming vehicle attempted a right turn at the intersection across two lanes of traffic, coming into the path of all six riders. Three of the six cyclists struck the left side of the vehicle in various sites before falling to the roadway.

Case 1286: Cyclist was travelling straight through a signalised intersection within the CBD. It is understood that the lights turned to amber at the point of the cyclist entering the intersection. An oncoming vehicle attempted to turn right at the intersection through the amber light. The front left corner of the vehicle struck the front of the cyclist who fell to the roadway at the point of impact.

Vehicle came out of side street or shopping centre car park across path of cyclist: 11 cases



Case 122: Cyclist was travelling straight on a local road when a vehicle came out of shopping centre car park and struck the cyclist on their left side.

Case 149: Cyclist, accompanied by other cyclists, was travelling straight on a winding hills roadway when a vehicle came out of a concealed driveway and struck the cyclist on their left side.

Case 174: Cyclist was travelling straight on a local road when a vehicle came to the roadway from a side street. The driver brought the vehicle to a stop but was encroaching the continuing road. The cyclist slowed and attempted to pass in front of the vehicle at the same time as the vehicle driver began to accelerate. The front of the vehicle struck the left side of the cyclist.

Case 391: Cyclist was travelling straight on a rural road when a vehicle came out of a side street through a stop sign. The cyclist was struck on their left side before coming to rest on the roadway.

Case 493: Cyclist was travelling on a footpath parallel to an arterial road when they crossed a T junction. The cyclist was struck by a vehicle coming onto the arterial road from a side street.

Case 542: Cyclist was travelling straight on an arterial road when a vehicle came out of a side street via a designated left turn lane and struck the cyclist on their left side. The cyclist was dragged ahead of the vehicle for approximately 20 metres before coming to rest; they did not go under the vehicle.

Case 587: Cyclist was travelling straight on an arterial road when a vehicle came out of a side street and struck the cyclist on their left side. The cyclist fell to the roadway at or near the impact point.

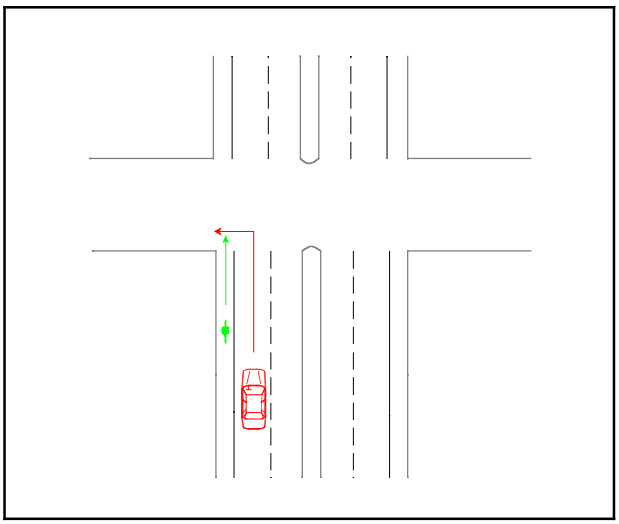
Case 635: Cyclist, accompanied by other riders, was travelling straight on an arterial road when a vehicle came out of a side street in front of the cyclist. The cyclist struck the A pillar on the drivers side of vehicle before coming to rest on the roadway.

Case 686: Cyclist was travelling straight on an arterial road when a vehicle came out of side street and the cyclist struck the drivers side of the vehicle. The cyclist account of the collision suggests that the driver of the vehicle failed to give way to other vehicles that were travelling on the major arterial road, including a vehicle that was preparing to turn right into the side street once the cyclist had cleared the junction.

Case 839: Cyclist was travelling straight on an arterial road when a vehicle came out of a side street and struck the cyclist on their left side. The cyclist was thrown forward from the impact and struck the roadway with their head.

Case 1422: Cyclist was travelling straight on an arterial road when a vehicle came out of a side street and the cyclist struck the drivers side of the vehicle. The cyclist came to rest on the roof of the vehicle.

Both vehicles in same direction when vehicle turned left across path of cyclist: 5 cases



Case 424: Cyclist was travelling straight through a major arterial intersection that was controlled by traffic lights. The vehicle driver turned left at the intersection and the cyclist struck the passenger side A pillar of the vehicle. The cyclist rolled across the bonnet before coming to rest on the roadway.

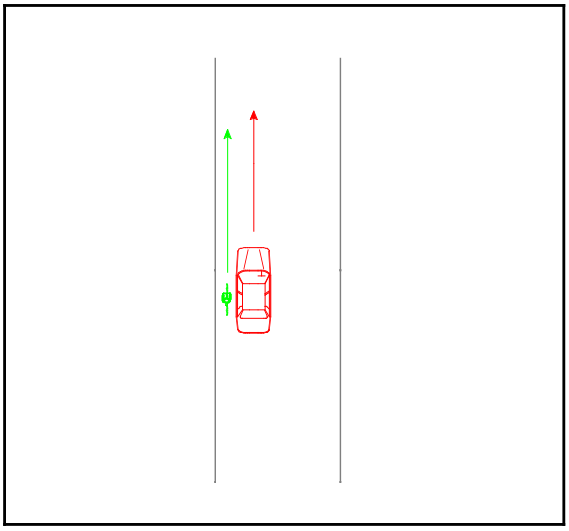
Case 450: Cyclist was travelling straight on carriageway when a vehicle ahead of their position commenced a left turn at a slow speed. The cyclist, who was travelling at a self reported high speed, misjudged the time taken by the vehicle driver in negotiating the turn and struck the rear of the turning vehicle.

Case 528: Cyclist was travelling straight on carriageway when the driver of a truck with trailer commenced a left turn ahead of the cyclist. The cyclist struck the left side of the trailer.

Case 662: Cyclist was travelling straight on an arterial road when the driver of a vehicle ahead indicated and attempted to turn left into the car park of a business. The cyclist struck the rear passenger side of the vehicle and fell across the boot area before coming to rest on the roadway.

Case 808: Cyclist was travelling straight through on an arterial road intersection that was controlled by traffic lights. The cyclist had increased their speed to ensure they got through the lights prior to the signal changing. The vehicle driver turned left at the intersection and struck the rear right of the bicycle as it was entering the intersection ahead of the vehicles position. The cyclist reported that the vehicle indicator was not operating in the lead up to the crash.

Both vehicles in same direction: 6 cases



Case 231: Cyclist was travelling straight on an arterial road when they were sideswiped by a vehicle travelling in the same direction. The cyclist fell to the roadway. The vehicle did not stop following the collision.

Case 457: Cyclist was travelling straight on a footpath when they suddenly entered the arterial carriageway to continue straight, coming into the path of a through vehicle which struck the cyclist on their right side. The cyclist rolled across the front of the vehicle before coming to rest on the roadway.

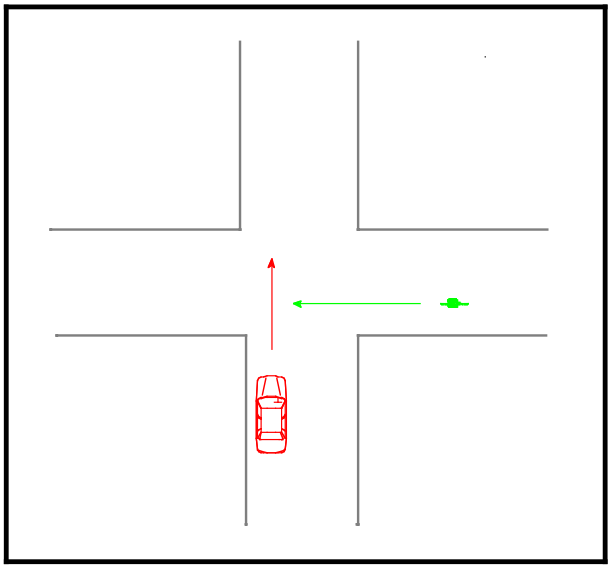
Case 1229: Cyclist was travelling straight within a designated bicycle lane in close proximity to the rear of a truck that was travelling in the same direction. The bicycle lane came to a sudden stop and the cyclist hit the rear of the truck that was at this time directly ahead of their position.

Case 1233: Cyclist and motorcycle were travelling in the same direction when the cyclist came into path of motorcycle and was struck. The cyclist's intended path of travel prior to the crash events is unclear.

Case 1420: Cyclist was travelling straight within a bicycle lane and approaching a signalised intersection. The bicycle lane abruptly ended and the cyclist was sideswiped by a vehicle that was moving to the left of the carriageway in preparation for negotiating a left turn at the intersection ahead. The cyclist came to rest on the roadway at or near the impact point.

Case 1433: Cyclist was travelling straight in a designated bicycle lane when a cyclist ahead (who was not known to them) came to an abrupt halt in response to movements of an emergency vehicle in a side street. The following cyclist veered to the right to avoid a collision with the forward cycle and sideswiped a vehicle that was travelling straight in the left lane. The cyclist tumbled across the length of the left side of the vehicle before coming to rest on the roadway.

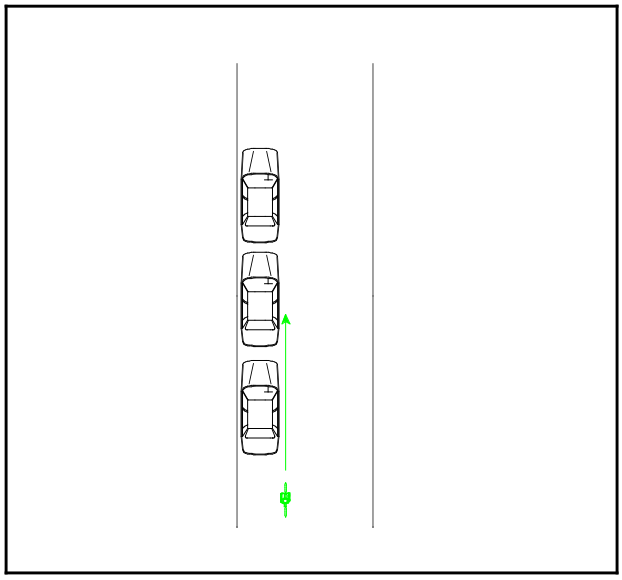
Vehicle crossing carriageway into path of cyclist: 2 cases



Case 381: Cyclist approached a sign controlled intersection of a rural road with the intention of turning right. A vehicle that was travelling on an adjacent roadway approached the intersection from the cyclists left. The vehicle failed to stop at controls and collided with the left side of cyclist who fell to the roadway.

Case 522: Cyclist was travelling straight on an arterial road when a vehicle attempted to cross from a local side street to another side street on the other side of the major arterial road. The cyclist struck the A pillar on the passenger side of vehicle and then struck the windscreen. Eye witnesses to the crash are alleged to have told police that the driver of the vehicle had attempted to cross the carriageway in heavy traffic conditions and had aggressively accelerated to negotiate the path through a small gap in vehicle traffic.

Parked and stationary vehicles - sideswipe incident: 3 cases

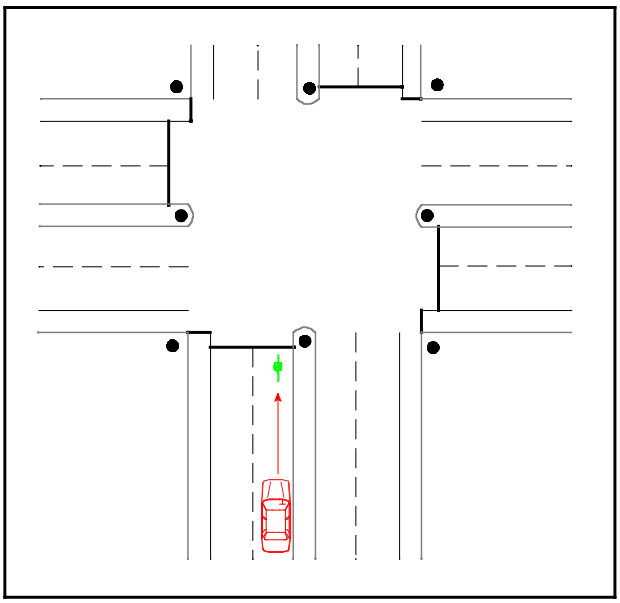


Case 230: Cyclist who was travelling straight on a roadway when they side-swiped a vehicle that was parked and unattended at the side of the road. It is understood that no other vehicles were involved or in close proximity at the time of the crash. The cyclist fell to the roadway at or near the impact point.

Case 1257: Cyclist was travelling straight on an arterial road when the driver of a parked vehicle opened the door of the car immediately ahead of the cyclist. The cyclist struck the open door and was thrown to the roadway.

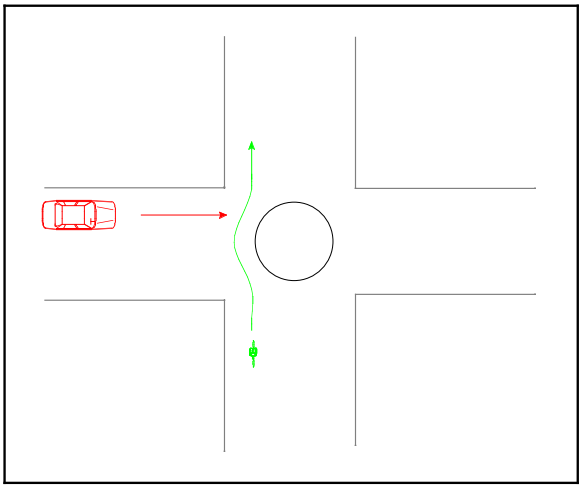
Case 1412: Cyclist was travelling straight on a city roadway when they sideswiped a parked and unattended vehicle at the side of the road.

Cyclists stationary at red signal when vehicle rear ended cyclist: 1 case



Case 1492: Cyclist was stationary in a designated right turn lane at a signalised intersection that was displaying a red light for the cyclist's direction of travel. A vehicle approached the cyclist from behind and came to a stop for a short period before accelerating into the rear of the bicycle. The signals at the intersection are understood to had remained red throughout the crash events.

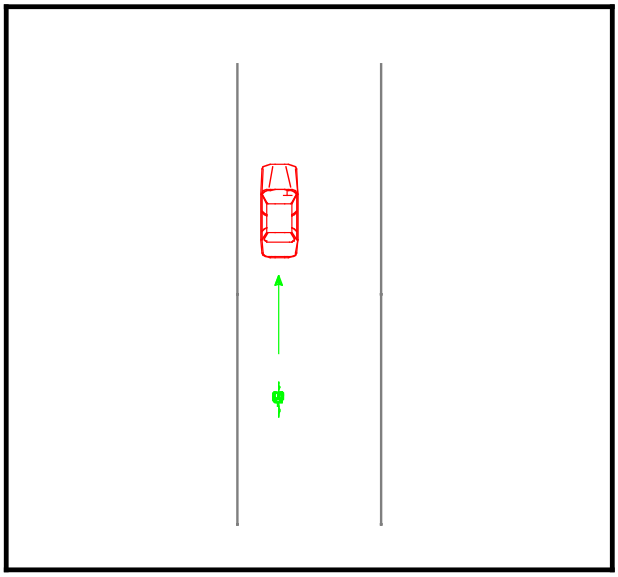
Cyclists in roundabout when struck by a vehicle: 2 cases



Case 732: Cyclist had entered and was travelling within a roundabout in a rural township when a vehicle entered and struck the cyclist. The cyclist rolled over the bonnet of the vehicle before coming to rest on the roadway.

Case 1034: Cyclist had entered and was travelling within roundabout at a local road intersection at low speed when a vehicle entered and struck the left side of the cyclist. The cyclist fell to the roadway at or near the point of impact.

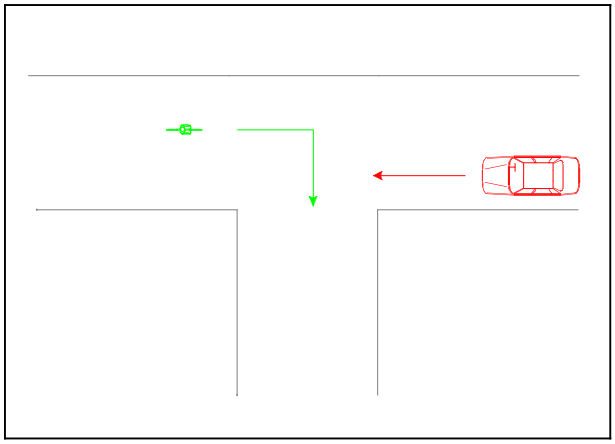
Cyclists rear ended a stationary vehicle: 2 cases



Case 968: Cyclist was travelling straight on an arterial road when it struck the rear of a stationary bus and came to rest on the roadway. It is understood that the cyclist had seen the bus move off from the bus stop and had expected it to clear before arriving at its position, however, the bus had come to a stop again prior to the crash events.

Case 1012: Cyclist was travelling straight when the driver of a forward vehicle came to an abrupt stop. The cyclist struck and came onto the rear of the vehicle, before falling to the roadway.

Cyclists turned right across path of oncoming vehicle: 2 cases



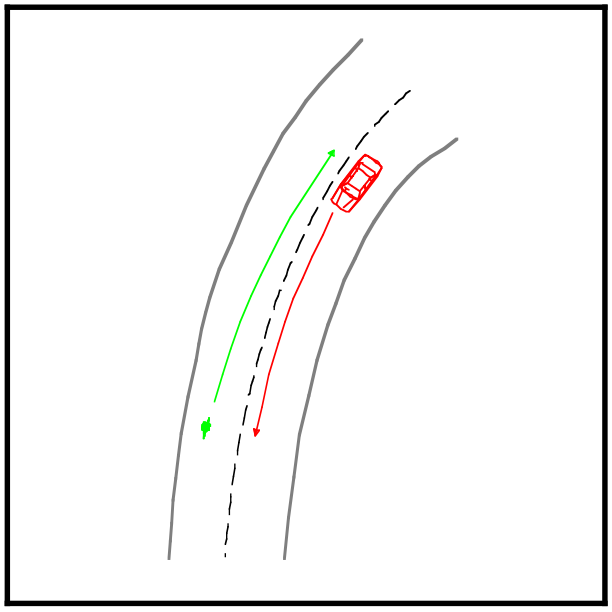
Case 636: Cyclist was travelling on an arterial road and approaching a signalised T-junction with the intention of turning right into a side street. The cyclist had experienced difficulty in reaching the centre of the carriageway due to heavy traffic and expressed some agitation as a result of those efforts. Once in the centre of the carriageway the cyclist moved directly across the path of oncoming vehicles that were travelling through the intersection on a green light. The cyclist was struck on the left side by one of those vehicles. The cyclist rolled over the bonnet and struck the windscreen before landing on the roadway.

Case 1121: Cyclist was travelling on a local road with the intention of turning right into a side street. The cyclist came into the path of an oncoming vehicle. The cyclist rolled over the bonnet and smashed the vehicle windscreen before landing on the roadway.

Cyclists riding through pedestrian crossing when vehicle drove through a red light: 1 case

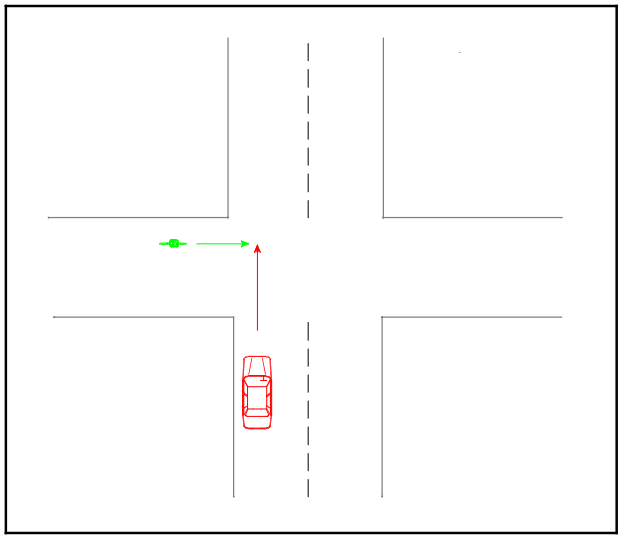
Case 1202: Cyclist was travelling through a pedestrian crossing with a green signal when they were struck on the right side by a vehicle that had travelled through a red light. The cyclist rolled onto the bonnet and struck the windscreen before landing on the roadway.

Cyclists and vehicle in opposite directions resulting in a sideswipe collision: 1 case



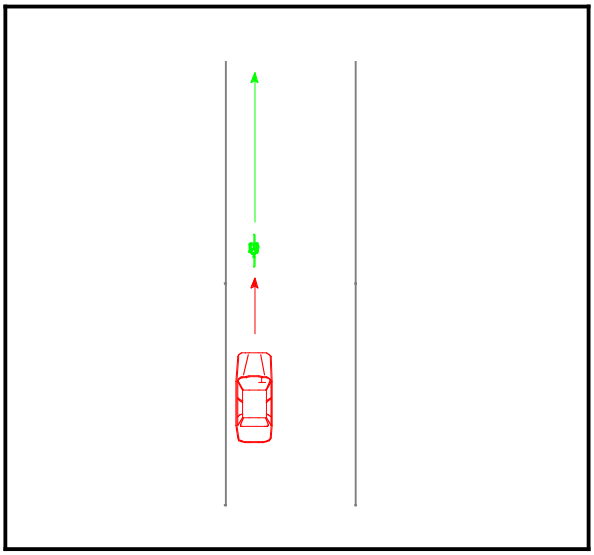
Case 481: Cyclist was negotiating a bend on a narrow road toward or over the centre of the carriageway when an oncoming truck sideswiped the cyclist who then fell to the roadway.

Cyclists crossing main road and into path of a through vehicle: 1 case



1432: Cyclist was travelling straight on a local road approaching an intersection with an arterial road, with the intention of crossing to local road on other side. The events took place during peak hour conditions and traffic at the time of the crash was considered to be heavy. The cyclist rode into the intersection ahead of a vehicle that was turning left into the side street. The cyclist was struck on the right side by a through vehicle on the arterial that had been travelling behind the turning vehicle. The cyclist rolled onto the bonnet and struck the windscreen before falling to the roadway.

Cyclists rear ended by a vehicle: 1 case



Case 1353: Cyclist was travelling to the left side of a local road in light traffic conditions when they were struck from behind by a vehicle travelling in the same direction.