A Study of Bicycle and Passenger Car Collisions Based on Insurance Claims Data

Irene Isaksson-Hellman, Fil.lic
If Insurance Company P&C Ltd.

ABSTRACT – In Sweden, bicycle crashes are under-reported in the official statistics that are based on police reports. Statistics from hospital reports show that cyclists constitute the highest percentage of severely injured road users compared to other road user groups. However, hospital reports lack detailed information about the crash. To get a more comprehensive view, additional data are needed to accurately reflect the casualty situation for cyclists.
An analysis based on 438 cases of bicycle and passenger car collisions is presented, using data collected from insurance claims. The most frequent crash situations are described with factors as to where and when collisions occur, age and gender of the involved cyclists and drivers. Information on environmental circumstances such as road status, weather- and light conditions, speedlimits and traffic environment is also included. Based on the various crash events, a total of 32 different scenarios have been categorized, and it was found that more than 75% were different kinds of intersection related situations. From the data, it was concluded that factors such as estimated impact speed and age significantly influence injury severity.
The insurance claims data complement the official statistics and provide a more comprehensive view of bicycle and passenger car collisions by considering all levels of crash and injury severity. The detailed descriptions of the crash situations also provide an opportunity to find countermeasures to prevent or mitigate collisions. The results provide a useful basis, and facilitates the work of reducing the number of bicycle and passenger car collisions with serious consequences.

INTRODUCTION

Almost half of all 1.2 million fatalities in road traffic crashes in the world each year are vulnerable road users, comprising pedestrians, cyclists and users of two-wheelers, in low-income countries this figure is even higher [WHO, 2009]. It is of great importance that the needs of all road users are taken into account when making policy decisions that impacts road safety. One issue in making the right priorities is to have the correct crash statistics covering both fatalities and severe injuries for all groups of road users. Elvik (1999) concluded in his analysis based on 49 studies from 13 different countries, that reporting of injuries in official road accident statistics was incomplete on all levels of injury severity. Injuries to car occupants were most frequently reported whereas injuries to cyclists were very rarely reported. In Sweden, only 59% of the injuries from bicycle collisions were reported in the official statistics. Under-reporting of bicycle injuries was confirmed in other studies. Bicycle and motor vehicle collisions at low speed and off road, as well as single bicycle crashes were rarely reported by the police [Aultman-Hall and Kaltenecker, 1999]. In France, under-reporting in police crash data was found to be strongly related to both road user type and involvement of a third party. Amoros (2006) showed that with crashes involving a third party, cyclists were 0.75 times less likely to be reported than car occupants.

Police reported crashes are often used as the primary source of information when evaluating and planning road safety, often with respect to fatal crashes. This also forms the basis of the official statistics in most countries. Obtaining a more accurate view of road safety also demands good representation of all road users and possible injuries, especially serious and incapacitating injuries. In a study of total costs of bicycle injuries in Norway, Veisten (2007) stated that under-reporting of bicycle injuries ‘disguises societal accident costs and curtail the identification of black spots and effective infrastructure improvements’.

Statistics from hospital reported crashes is an alternative source of information to police reports. In these reports, the injury outcome is often very well described, although they usually lack information about the crash. Comparing crash statistics from hospital reports with police reports, provide results that give information about the road safety situation emphasizing both serious and minor injuries. This alters the crash prevention prioritization for the most affected road user groups, especially for cyclists and other vulnerable road users. The lack of representative data for this group seems to be a general problem all around the world, [Elvik and Mysen, 1999; Amoros et. al., 2006; Veisten et. al., 2007].

The official statistics in Sweden are, as in most countries, based on police reported crashes. The information is collected in STRADA police, Swedish Traffic Accident Data Acquisition, [Sjöö and Ungerbäck, 2007] and the statistics are annually published by Transport Analysis on the web.
The problem of under-reporting of bicycle injuries in Sweden is exemplified with data from road traffic crashes in 2010, comprising fatal and severe injuries, [Transport Analysis, 2011 (a)]. The non-fatal injuries are assessed by the police on the spot. The number of fatal bicycle crashes reported by the police in Sweden 2010 was 21 and the number of seriously injured cyclists was 269. In the same year, the number of fatal and seriously injured car occupants was respectively 165 and 1890.
In addition to the official statistics, hospital reports extracted from the Swedish National Patient Register (PAR) are compiled and published every year, [Transport Analysis, 2011 (b)]. In these reports a severe injury is defined as 'hospitalized 24 hours or more'. In the hospital reports 2010, the number of seriously injured cyclists was 2,589 and the number of seriously injured car occupants was 2,252. Other road users, motorcyclists, moped riders, pedestrians and truck/bus occupants have all a lower number of serious injuries compared to cyclists showing that cyclists constitute the highest percentage of severely injured road users compared to other groups. This is a strong indication that just looking at official statistics, where cyclists constitutes a small proportion of seriously injured, will not give the correct basis for decisions in the prioritization of road safety. However, in the data from PAR no information about the crash is included, differentiating between different types of bicycle crashes are not possible. Hospital reported crashes are also collected from a majority of the emergency hospitals in Sweden in STRADA hospital [Sjöö and Ungerbäck, 2007], this information is not summarized and published every year but available for research. In STRADA hospital information on injuries is coded based on the AIS scale [AAAM, 2005]. STRADA hospital includes demographic data and some additional information about the circumstances but no detailed information about the crash. Niska and Thulin (2009) based a study on bicycle crashes in STRADA hospital, where the number of single bicycle crashes was found to be 72%, but where the most serious injuries were reported from bicycle and motor vehicle collisions.

Some work aiming at complementing hospital reports were found in the literature review. In a study conducted by Stutts and Hunter (1999), information on 2,558 persons treated for injuries following crashes while cycling or walking was collected from eight hospital emergency departments in California, New York and North Carolina. Detailed data were collected on special survey forms with the objective of providing a more accurate description of the entire spectrum of events causing injuries to pedestrians and cyclists. 70% of the reported bicycle injury events did not involve a motor-vehicle or occurred outside the usual road network, but cyclists in collisions with motor vehicles were the most seriously injured group. In a study of relative injury severity among vulnerable, non-motorized road users in Australia, Chong (2010) stated that the significant burden of injuries arising from collisions between cyclists and motor vehicles must be addressed. Even if the number of single bicycle crashes is dominating in numbers, there is still a substantial part of non-reported bicycle and passenger car collisions and a strong motivation to capture these collisions due to the severe consequences.

Bicycle and passenger car collisions occur very often in intersections [Watchel and Lewiston, 1994; Wang and Nihan, 2004]. A literature review shows that intersection scenarios are of complex nature, [Wang and Nihan, 2004], with many influencing factors and a thorough description of these scenarios are therefore desirable. More in depth knowledge about the events and causes leading to a crash will give the opportunity for a better understanding that supports the process of finding countermeasures to prevent bicycle and passenger car collisions.

Additional information is needed to supplement the knowledge of bicycle crashes. This is necessary to ensure that correct conclusions can be drawn about road safety situations involving cyclists. The objective of this study is to present a first analysis of a new database collected from insurance data. This data complement traditional data sources including crash and injury severity, as well as description of details not always included in the reports from police and hospitals. The overall goal is to provide a basis for more effective evaluation and planning of road safety to create a safer bicycle environment.

METHODS

Data

Data were collected from the insurance company If, which insures about 25% of all cars in Sweden.
Bicycle and passenger car collisions were identified using motor insurance claims reported by the third party liability insurance, which cover damage to property and personal injuries. In Sweden there is a legal requirement of a third party liabilty insurance for all motor vehicles, and drivers in Sweden are obliged to report crashes with cyclists to the insurance company. This is a representative set covering crashes all over Sweden including different car models. In order to account for seasonal variation, a sample of 206 collisions was randomly selected from all bicycle and passenger car collisions reported to If during 2005-2009, and all, 232, bicycle and passenger car collisions from year 2010, a total of 438 collisions.

Insurance claims data include crashes of all severity levels from minor damage to crashes with fatal outcome, and thus a broad spectra of situations. Both insurance claims with and without personal injury were collected. In most collisions between passenger cars and cyclists, the cyclists suffered some sort of personal injury.

For each case, detailed information was coded using collision descriptions both from the driver and the cyclist. If the police were summoned to the crash site, the police report was used, and in some cases there was also complementary witness information. The cyclist was always contacted by the personal injury department following each bicycle and passenger car collision reported to the insurance company. From this contact, which usually consisted of a telephone call, additional information was collected about the collision, the personal injuries, and any other relevant details.

Age and gender of the cyclist and the driver of the car, as well as information on environmental circumstances and when and where the collision occurred was coded. To protect persons included in the study, all cases were decoded so that persons can not be identified. A written description of the collision provided insight into pre-crash as well as crash events. In most cases, sketches were available making it possible to characterize the crash scenarios. If the cyclist was injured, hospital reports and medical information was also available. Personal injuries were coded with respect to the Abbreviated Injury Scale (AAAM, 2005). In case of existing information the following were included: property damage, helmet use, and influence of alcohol for the driver of the car and the cyclist.
The data were categorized into five main crash situations:
1.Intersection collisions
2.Collisions when travelling in the same or opposite direction
3.Door opening, cyclist running into a car door opening
4.Parking lot collisions
5.Collisions with cars reversing
Within the categories, a total of 32 detailed scenarios were classified, see Table 1 below. The last three categories were usually not covered in police reports. Roundabout denotes collisions that occurred in a roundabout without a bicycle lane. Crossing the road before or after the roundabout on a bicycle lane was coded as an intersection with bicycle lane.

Table 1. - Crash Scenario Denominations and Number of Each.

Intersection	Road crossing without bicycle lane	5 detailed
	Road crossing with bicycle lane	8 detailed
	Road/drive way crossing without bicycle lane	3 detailed
	Road/drive way crossing with bicycle lane	6 detailed
	Roundabout	1 detailed
Same /opposite direction		6 detailed
Door opening		1 detailed
Parking lot		1 detailed
Reversing		1 detailed

Variables describing the crash event, such as point of impact and the direction of bicycle and passenger car respectively, as well as relative position between bicycle and car were also coded. In some cases the bicyle had hit the car. Actions such as braking, steering and movement pattern of the car were registered. Some variables were of more subjective character such as estimated impact speed (of the car), whether the cyclist/driver saw the other vehicle, etc. A total of 95 variables were available and coded in the database.

Exposure data from the national travel survey, RES 2005-2006, [RES, 2005-2006], in Sweden were used in this study. It contains information on the everyday movements and longer journeys made by Sweden's population aged between 6 and 84 years. This data were collected from autumn 2005 until autumn 2006. The survey includes information on the individuals and on the use of communication equipment. This study includes data about number of bicycle journeys per day calculated in thousands distributed per age group, Table 3.

Analysis

A dataset of 438 cases of bicycle and passenger car collisions collected all over Sweden between 2005 and 2010 was analyzed.

Descriptive statistics were used to obtain a general overview of the total dataset.

The rate of bicycle and passenger car crashes per age group was estimated using the number of crashes and exposure data stated in number of journeys per day counted in thousands.

The cyclist's age, estimated impact speed of the car and darkness were factors indicated to affect injury severity. Logistic regression was performed to assess the effect of age and estimated impact speed on injury severity. For estimated impact speed, this was done for the subset where the car had hit the cyclist, and the estimated speed was known.
An evaluation of injury severity of crashes occurring in darkness versus daylight was conducted using a Chi-square test.

RESULTS

Data summary

Most bicycle and passenger car collisions occurred during May, August, and September, see Figure 1 below.
The distribution of collisions over the course of the day shows that most collisions occurred between 7-8 a.m. in the morning and between 4-5 p.m. in the afternoon, Figure 2.

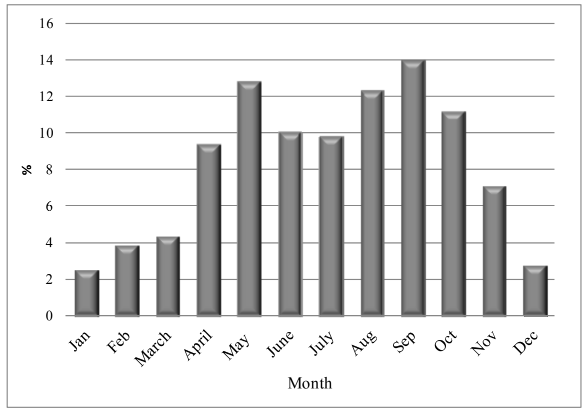


Figure 1. - Crash Distribution over Year

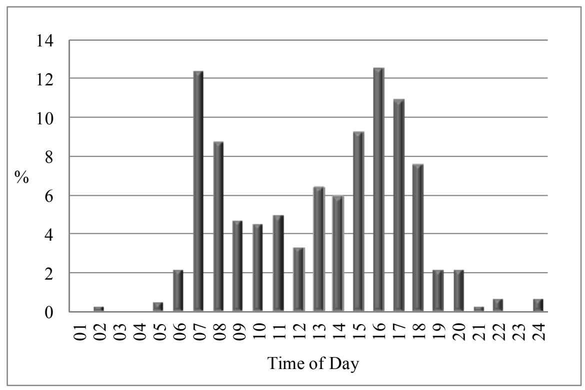


Figure 2. - Crash Distribution over the Course of the Day

Almost 90% of all collisions occurred in urban areas and only 4% in rural areas. In 75% of the collisions the speed limit was 50 km/h or less. Crashes during daylight were most frequent with 82%, while 8.7% took place in darkness and 4.8% during dusk or dawn. The weather was good in 72.8% of the collisions while it was raining in 5.2%. In 68% of all cases the road conditions were dry, see Table 2.

Table 2. – Distribution of Traffic Environment, Light Conditions, Road State, Weather Conditions and Speed Limits.

	Number	%
Traffic environment		
Urban areas	390	89.2
Non urban areas	18	4.1
Unknown	29	6.6
Light condition		
Daylight	359	82.0
Dark	38	8.7
Dusk/dawn	21	4.8
Unknown	20	4.6
Road state		
Dry	298	68.0
Wet	50	11.4
Ice/snow	14	3.2
Unknown	76	17.4
Weather conditions		
Clear	319	72.8
Fog	1	0.2
Rain	23	5.2
Snow/mixed snow-rain	2	0.5
Unknown	93	21.2
Speed limit		
20 km/h	1	0.2
30 km/h	44	10.1
40 km/h	8	1.8
50 km/h	278	63.8
60 km/h	1	0.2
70 km/h	17	3.9
90 km/h	3	0.7
Unknown	84	19.3

The number of female and male cyclists were almost equally distributed, 50.2% male and 49.5% female. The age distribution shows that most cyclists involved in collisions between cars and cyclists occurred in the age group of 35-45 years.

The number of mild injuries according to AIS was 72% (MAIS1), moderate injuries 21% (MAIS2), severe injuries 5% (MAIS3+). There were 1% uninjured and 1% had unknown injury severity, 1.6% (7) of the collisions resulted in a fatal injury, see Table 3.

Table 3. - Age, Gender, MAIS and Exposure Distribution for Cyclists; Age and Gender Distribution for Passenger Car Drivers.

	Bicyclist			Driver	
Age	Number	%	Exposure journeys/ day *1000	Number	%
6-14	48	11.0	231	0	0
15-24	63	14.4	224	29	6.6
25-34	70	16.0	194	58	13.2
35-44	76	17.4	174	79	18.0
45-54	66	15.1	165	80	18.3
55-64	63	14.4	179	62	14.2
65-74	32	7.3	61	63	14.4
75-84	12	2.7	19	28	6.4
85-94	8	1.8		11	2.5
>94				1	0.2
Unknown				27	6.2
Gender	Number	%		Number	%
Male	220	50.2		298	68.0
Female	217	49.5		130	29.7
Unknown	1	0.2		10	2.3
MAIS	Number	%			
0	2	0.5			
1	315	71.9			
2	93	21.2			
3+ (fatal)	23(7)	5.2			
Unknown	5	1.1			

Relating to exposure in number of thousand journeys per day, the rate of young cyclists were fewer than average, and the rate of cyclists aged 35 to 54 years was higher than average, see Figure 3.

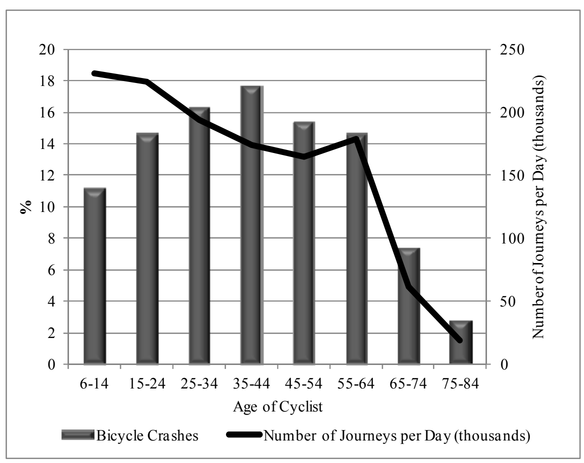


Figure 3. - Distribution of age for Cyclists and Exposure in Journeys per Day in Thousands

Factors influencing injury risk

The mean, median and standard deviation of estimated impact speed (of the car) are shown in Table 4. The distributions of all cases where the car had hit the bicycle with known estimated impact speed, and the subset of MAIS2+ injuries within the cases are shown. The average estimated impact speed is higher in the subset of MAIS 2+ injuries indicating an effect of these factors on injury severity.

Table 4. - Mean, Median and Standard Deviation for Estimated Impact Speed.

All with known imp.speed	N	Mean	Median	Std
Estimated impact speed	235	14	10	13.1
MAIS 2+	N	Mean	Median	Std
Estimated impact speed	58	19	12.5	18.1

A logistic regression model was performed to assess the influence of estimated impact speed on injury severity. The model proved significant and the result of the parameter estimates is shown in Table 5.

Table 5. –Logistic Regression Result for Estimated Impact Speed Affecting the Risk of MAIS 2+ Injuries

	Estimate	Standard error	Wald χ^2	P-value
Intercept	-1.63	0.24	46.6	<0.0001
Impspeed	0.036	0.011	10.1	0.0015

In Table 6 the mean, median and standard deviation for the cyclist's age are shown, with a higher mean and median age in the MAIS2+ subset than in the total dataset.

Table 6. - Mean, Median and Standard Deviation for Age.

Total Dataset	N	Mean	Median	Std
Age(cyclist)	430	39.6	39	18.8
MAIS 2+	N	Mean	Median	Std
Age(cyclist)	114	46.1	48	18

A logistic regression was applied and the model was proved significant with the estimated parameters in Table 7.

Table 7. – Logistic Regression Result for Age Affecting the Risk of MAIS 2+ Injuries

	Estimate	Standard error	Wald χ^2	P-value
Intercept	-1.9	0.27	51.7	<0.0001
Age(cyclist)	0.021	0.005	15.3	<0.0001

The percentage of MAIS 2+ injuries in darkness is equal to 38% and in light equal to 26%. The independence of injury risk MAIS2+ in darkness versus light was tested with a χ^2- test. The observed values are presented in Table 8.

Table 8. – Number of Injured/Uninjured in Darkness and Light

MAIS 2+	Light	Dark
Uninjured	262	23
Injured	93	14

The p-value was p=0.13, hence no significant difference in injury severity between collisions occurring in darkness and daylight can be proved.

Crash situation categories

Collisions in intersections were the most common crash situations representing 76.7% of all crashes. In 13.2% the cyclist was on the same road as the vehicle, travelling in the same or opposite direction. Door opening, cyclist running into car door opening comprised 4.3%. Whereas reversing and parking situations were rare, see Table 9 below.

Table 9. – Distribution of Crash Situations

Intersection	76,7%
Same/opposite direction	13,2%
Dooropening	4,3%
Parking lot	2,0%
Reversing	1,6%

Intersections

Of all intersection collisions, intersections on roads that included a bicycle lane were the most common location for crashes representing 50.9% of collisions. Intersection on roads without bicycle lane comes next, comprising 25.9% of collisions. Road and driveway intersections/with or without bicycle lane were together 18.2% of all intersection collisions, and roundabouts 5.1%.

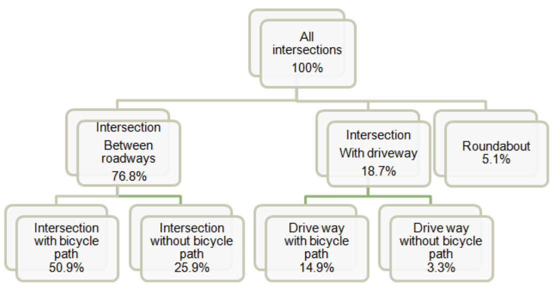


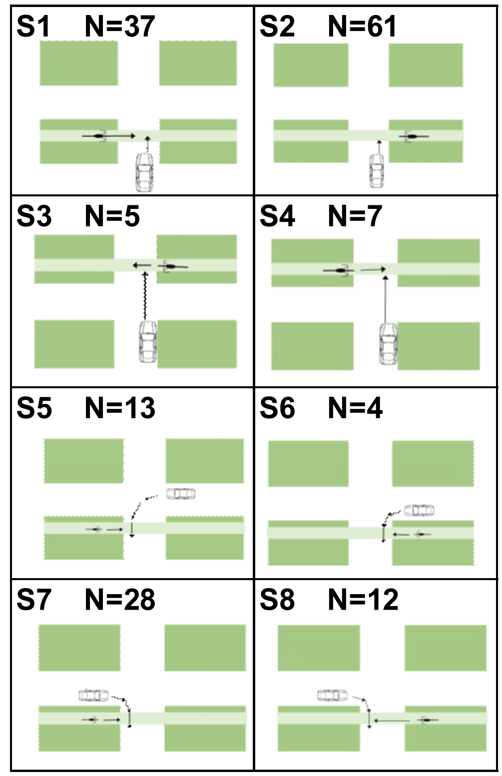
Figure 4. - Distribution of Type of Intersection Collisions

More than 50% of all collisions occurred at intersections on roads that include a bicycle lane. They are categorized in eight different scenarios:

S1 Car straight, bicycle from left before intersection
S2 Car straight, bicycle from right before intersection
S3 Car straight, bicycle from left after intersection
S4 Car straight, bicycle from right after intersection
S5 Car turning left, bicycle opposite direction
S6 Car turning left, bicycle same direction
S7 Car turning right bicycle same direction
S8 Car turning right bicycle opposite direction

The most frequent scenario is S2, intersection on road including a bicycle lane, cyclist approaching from the right crossing before the intersection. For each scenario it is possible to control for variables influencing the injury outcome. No test of significance was conducted in this analysis, due to few observations. More data will be available in future analysis.

Table 10. – Scenarios Describing Intersections on Roads Including a Bicycle Lane.



DISCUSSION

Incomplete reporting of road traffic crashes is a common problem in official statistics in many countries [Elvik and Mysen, 1999]. This applies mainly to crashes that are of less serious nature and of crashes involving vulnerable road users. By comparing data from official statistics and hospital reports the same problem was identified for road traffic crashes in Sweden. Statistics from hospital reports show that cyclists constitute the highest percentage of severely injured compared to other road user groups, however, hospital reports lack information about the crash. This study focuses how insurance data can add valuable information on bicycle and passenger car collisions.

This new dataset collected from insurance claims from bicycle and passenger car crashes proved to be a valuable source of information. Insurance claims reported from the third party liability insurance cover both damages and personal injuries for the cyclist in these collisions. Drivers in Sweden are obliged to report crashes with cyclists to the insurance company. Insurance claims also include less severe crashes and injuries and off road crashes not usually reported to the police. This was confirmed in this study since only about 50% of data from the insurance company was covered in police reports. The subset of non-police reported crashes was on average less severe than police reported crashes, but a substancial proportion had AIS2 injuries to the head and the extremities. Injuries that can result in incapacitating injuries. Crash situations not found in police reported data were typically dooropening, reversing and non-road crashes.

Most bicycle and passenger car collisions occurred during, May, August and September; during the course of a day, most collisions occurred during the morning hours between 7-8 a.m. and in the afternoon between 4-5 p.m. This coincides with the time of year and time of day when people cycle most frequently, to and from work/school, and the times when the traffic density is generally highest. Of the crashes 90% occurred in urban areas and 75% where the speed limit was 50 km/h or less. A majority of the crashes, 82%, took place during daylight, 72.8% in good weather and 5.25 % in rain. In 68% of all cases the road conditions were dry.
Summary statistics describing environmental circumstances, where and when the crash took place are often provided in police reports and is not unique in this database. However, distributions of these factors can vary depending on the collection criteria in different databases. For example, if only fatal crashes are selected, risk factors influencing injury severity like speed can result in another distribution of crashes for urban versus rural areas.

Exposure data for cyclists is hard to obtain and is often limited and impossible to use with disaggregated data, as in the case of this study. However, in the National Travel Survey made in Sweden 2005-2006 [RES, 2005-2006], the number of bicycle journeys per age group was calculated. This piece of exposure data was used together with the frequency of bicycle and passenger car crashes per age group showed that younger age groups have a lower rate of collisions, and age-groups between 35-55 years have a higher rate than average.

Variables influencing the injury severity of bicycle and passenger car collisions were evaluated. A tendency to cause more severe bodily injury was found in certain situations. Kim et al. (2007) found that inclement weather and darkness without streetlights significantly increase the probability of fatal injury. Bíl et al. (2010) pointed on that in terms of time of the day and visibility, the most fatal are consequences of crashes that occur at night in places without streetlight. Testing the independence of injury severity in crashes occurring in darkness or daylight in this study resulted in a p-value of 0.13 which is a low but not significant value. With more data at hand describing crashes in darkness, a more specific analysis can be performed within this data. Darkness is of course a risk for the cyclist if the visibility is low, and lamplight and reflexes are very important for the cyclists to be seen. These risks could be highlighted by campaigns and information.

A significant relationship between injury severity and estimated impact speed and age was found in this study. Similar results were found by Stone and Broughton (2003) who found an increasing fatality rate with age and increased speed limits. Kim et al. (2007) showed in their research that speed prior to impact and age over 55 years as factors contributing to the injury severity in bicycle and motor vehicle crashes. Bíl et al. (2010) similarly identified speeding as the most fatal factor. Speed is an important factor to take into account in planning road environments, road sites where cyclists and cars share the space should be areas with lower speed limits.

Bicycle and passenger car collisions in intersections were found to be the most frequent crash situations, 76.7% both with and without bicycle lanes. Results that support this conclusion were found in several other studies, and statistical models have been suggested to quantify different factors influencing the risk. In this paper the overall definition intersections included both ordinary intersections of roadways with and without bicycle lanes, but also driveways intersecting a road. These are classified into different scenarios due to existing differences in infrastructure, design and operations. Watchel and Lewiston (1994) found that 74% of bicycle and passenger car crashes occurred at intersections using a very similar definition of intersections. Many other sources pointed out that intersections are places where most collisions between bicycles and motor vehicles occur [Wang and Nihan, 2004; Traffic Safety Basic Facts, 2010]. Intersections are by nature conflict situations where vehicles and bicycles cross each other's path. Other studies found in the literature, e.g. Wang and Nihan (2004) developed a methodology for estimating accident risks in bicycle and motor vehicle collisions in intersections. Different models were found to be most appropriate for different scenarios, showing the complexity of intersection conflicts. The most common situation found in this study was at an intersecting road with a bicycle lane which represented about 50% of all intersections, and for which eight detailed scenarios were identified. For each scenario, distributions of variables can be studied and factors influencing rates and injury risks can be found. By using information from detailed scenarios together with movement patterns and crash events in intersections, factors influencing injury risks can be identified. This can be useful both in traffic planning and in the development of countermeasures in motor vehicles.

Collisions between bicycles and passenger cars were external to an intersection in 13.2%. These 'road' crashes include collisions 'in the same direction' such as sideswipe collisions, rear end collisions or lane changing as well as collisions 'in opposite direction' such as head-on collisions. Some collisions that occurred in rural areas often had more serious consequences due to higher impact speed. Door opening can result in substantial injury never reported to the police. Such collisions were often a problem related to larger cities, where bicycling took place outside of the parked cars. Reversing and parking situations were found to be a minor cause for bicycle collisions, for pedestrian and-car collisions this is often found to be a substantial problem [Lindman et al. 2011].

In this study, data from bicycle and passenger car collisions were emphasized. Due to the risk of serious consequences of such collisions, they required further examination. It is of great importance to correlate the crash situation with the injury outcome and to cover situations that are estimated as harmless but can imply injuries. In this way insurance claims data can contribute to raise awareness, and to obtain a more comprehensive approach to accident prevention. The accurate description and calculated frequency of crash scenarios can give traffic planners knowledge of how roads can be improved to avoid crashes. It also provides an understanding of how laws and regulations are followed. Detailed information about crash events, car and bicycle interaction and factors influencing risks in a crash provide information to car manufacturers in developing countermeasures to protect cyclists in a collision.

In future work, research should include single bicycle crashes, due to their dominating role in numbers and number of personal injuries. Alternative methods to collect data for single bicycle crashes are needed since crash data are not captured via the third party liability insurance in Sweden. This study pointed out critical situations for cyclists on the road and highlighted intersections as a common conflict situation with cars. Continuous collection of detailed data, including other bicycle crash types will increase the knowledge and supports the objective of creating a safer bicycle environment.

CONCLUSION

Data from insurance claims adds valuable information about bicycle and passenger car collisions, in addition to the information available from police and hospital reports. The data include detailed description of crash events and personal injuries as well as severity levels from minor damage to crashes with fatal outcome. With detailed data it is possible to classify different scenarios and the presence of them, but also to evaluate risk factors important for injury outcome and occurrence of collisions. The most common crash situations between bicycles and passenger cars are different intersection scenarios.
To make the right priorities and progress in the work with traffic safety it is of great importance to have data of good quality. Data collected from insurance claims provide a comprehensive view of bicycle and passenger car collisions, which is very useful in the development of traffic safety for cyclists.

ACKNOWLEDGMENTS

This data were collected by the personal injury department at If Insurance Company.

REFERENCES

Amoros E, Martin J-L, Laumon B. Under-reporting of road crash casualties in France. Accident Analysis and Prevention 38: 627-635, 2006.

AAAM (Assosiation of the Advancement of Automotive Medicine). The Abbrieviated Injury Scale (AIS), 2005 Revision; AAAM, Des Plaines,IL,USA. 2005.

Aultman-Hall L, Kaltenecker G. Toronto bicycle commuter safety rates. Accident Analysis and Prevention 31: 675-686, 1999.

Bíl M, Bílová M, Müller I. Critical factors in fatal collisions of adult cyclists with automobiles. Accident Analysis and Prevention 42: 1632-1636, 2010.

Chong S, Poulos R, Olivier J, Watson W L, Grzebieta R. Relative injury severity among vulnerable non-motorised road users: Comparative analysis of injury arising from bicycle-motor vehicle and bicycle-pedestrian collisions. Accident Analysis and Prevention 42: 290-296, 2010.

Elvik R, Mysen A.B. Incomplete Accident Reporting, Meta-Analysis of Studies Made in 13 Countries.

Transportation Research Record 1665: 133-140, 1999.

Kim J-K, Kim S, Ulfarsson G F, Porello L A. Bicyclist injury severities in bicycle-motor vehicle accidents. Accident Analysis and Prevention 39: 238-251, 2007.

Lindman M, Jakobsson L, Jonsson S. Pedestrians interacting with a passenger car a study of real world accidents. Proc of IRCOBI, Krakow, Poland, 2011: IRC-11-61; 2011.

Niska A, Thulin H. Tema cykel- skadade cyklister, analys baserad på sjukvårdregistrerade skadade i STRADA.VTI rapport 644. Available online at www.vti.se/publications. 2009.

RES 2005-2006 . The National Travel Survey. SIKA Statistics 2007:19. Available online at: http://www.trafa.se/resvanor , 2007.

Sjöö and Ungerbäck, 2007 *STRADA slutrapport.* Borlänge; Sweden. Nytt nationellt informations system för skador och olyckor inom hela vägtransportsystemet; Swedish National Road Administration; Publikation. 2007.

Stone M, Broughton J. Getting off your bike: cycling accidents in Great Britain in 1990-1999. Accident Analysis and Prevention 35: 549-556, 2003.

Stutts J, Hunter W. Motor vehichle and roadway factors in pedestrian and bicyclist injuries: an examination based on emergency department data. Accident Analysis and Prevention 31: 505-514, 1999.

Traffic Safety Basic Facts. Available online at: http://ec.europa.eu/transport/road_safety/specialist/statistics/care_reports_graphics/index_en.htm, 2010.

Transport Analysis a). Road traffic injuries 2010. :2011:15 . Available online at: http://www.trafa.se/Statistik/Vagtrafik/Vagtrafikskador/, 2011.

Transport Analysis b). Persons hospitalized due to road traffic accidents 2010. :2011:23 Available online at: http://www.trafa.se/Statistik/Vagtrafik/Vagtrafikskador/, 2011.

Wang Y, Nihan N L. Estimating the risk of collisions between bicycles and motor vehicles at signalized intersections. Accident Analysis and Prevention 36: 313-321, 2004.

Wachtel A, Lewiston D. Risk factors for bicycle-motor vehicle collisions at intersections. ITE Journal, Institute of Transportation Engineers, September, 1994.

Veisten K, Sælenminde K, Alvær K, Bjørnskau T, Elvik R, Schistad T, Ytterstad B. Total costs of bicycle injuries in Norway: Correcting injury figures and indicating data needs. Accident Analysis and Prevention 39: 1162-1169, 2007.

WHO. Global status report on road safety: time for action. Geneva, World Health Organisation. Available online at: http://www.who.int/violence_injury_prevention/road_safety_status/2009/en/, 2009.