Statistical Analysis of Bicyclist Accident in Changsha of China and Hannover of Germany

Jikuang Yang[1], Dietmar Otte[2], Chunyu Kong[1], Guoyong Gu[1]

[1]Research Center of Vehicle and Traffic Safety
State Key Lab of Advanced Design and Manufacture for Vehicle Body, Hunan University, China
[2]*Accident Research Unit, Hannover Medical University, Germany*

ABSTRACT

The bicyclist accidents were analyzed to get better understanding of the occurrences and frequency of the accidents, injury distributions, as well as correlation of injury severity/outcomes with engineering and human factors in two different countries of China and Germany.

The accident cases that occurred from 2001 to 2006 were collected from IVAC database in Changsha and GIDAS database in Hannover. Based on specified sampling criteria, 1,570 bicyclist cases were selected from IVAC database in Changsha, and 1806 cases were collected from Hannover, documented in GIDAS database. Statistical analyses were carried out by using these selected data. The results from the statistical analysis are presented and discussed in this study.

1 INTRODUCTION

Bicyclists represent a population with high risk of traffic injuries since they are unprotected in vehicle collisions, and they are one of the most vulnerable road users in city traffic. At present there are more than 500 million bicycles in China. It is a country reserved the largest number of bicycles over the world. In recent two decades, with a rapid increasing of the vehicle fleet on the road in China, there is also a great increasing of the vehicle traffic accidents. Each year the total number of the road vehicle traffic fatalities becomes highest in the world. In 2005, 98,738 road users were killed and 469,911 were injured in vehicle traffic accidents. Of which there are 11,407 bicyclist fatalities accounted for 11.55% of total reported traffic fatalities, and 51,302 injured accounted for10.92% of reported traffic injuries [1]. The bicyclist accidents were identified as a vital issue in urban traffic safety and therefore a high priority should be given to this road user group in research of safe urban transportation.

In urban area of Changsha, bicyclists are frequently involved in vehicle accidents. The objective of this study is to identify the occurrence and type of the traumatic injuries of the bicyclists in vehicle collisions, and to investigate the correlation of traffic injuries with human factor and engineering, environment factors, by using valid and reliable materials collected from traffic administration authorities and local hospital. For this purpose, the bicyclist accident cases were collected from Changsha, China, and also cases collected from Hannover, Germany, based on same sampling criteria. The knowledge from the study is a prerequisite for developing guidelines to improve safety of the bicyclists. The study is presenting the benefit of existing in-depth-research and using the data in common approaches.

2 METHOD AND MATERIALS

2.1 Accident data collection

The vehicle-to-bicyclist accident cases from the IVAC database and GIDAS database were collected based on the following standards: (1) the accident occurred during the period from 2001 to 2006, and (2) the bicyclist accidents occurred in the urban area.

2.1.1 Accident data from police sector in Changsha

Changsha is the capital city of the Hunan province located in middle of China, with a population 2,060,000 (6,133,000 including residents in suburb) and registered vehicles 452,809 in 2006. The bicyclist accident cases registered during 2001-01-01 to 2006-12-31 in Changsha were used in this study.

An analysis on police documentations for bicyclist accidents from 2001 to 2006 was carried out, and the **1570** cases were collected for a statistical study of bicyclist accidents in Changsha, with information about location and type of an accident, accident vehicle, involved road users, as well as road environment etc. The three levels of victim's injuries were registered as minor, serious or fatal injury.

Furthermore, an in-depth investigation of bicyclist accidents have been carried out by a team in cooperation between researchers from Hunan University, local police sector, and medical first aid. The accident data was collected and documented from on-site and retrospective investigations in Changsha urban area with detailed information about bicyclist victims on age, gender, height/weight, injuries, speed determination and details of the accident cars as well as the accident scene.

2.1.2 GIDAS accident data from Hannover Medical University

In the area of Hannover nearly 1000 accidents with injured person are collected there annually in a continued and representative way. These accident cases were documented in the accident database GIDAS (German In-Depth Accident Study) by Accident Research Unit at Medical University of Hanover. The **1806** bicyclist accident cases were collected from GIDAS database for the accident occurred from 2001 to 2006.

The collected cases in the GIDAS database contain very detailed information about bicyclist victims on age, gender, height/weight, injuries, speed determination and details of the accident cars as well as the accident scene.

2.2 Statistical analysis of bicyclist accidents

A study of vehicle-to-bicyclist accidents was conducted by using the collected **1,570** bicyclist accident cases from Changsha, China and **1,806** bicyclist accident cases collected from the accident database GIDAS. First, a general statistical analysis was carried out using the accident cases in terms of involvement of accident vehicle, accident scenarios, injury distributions, injury patterns, and injury severity etc. Secondly, a comparison was carried out in terms of statues of bicyclist accidents in both Changsha and Hannover urban areas. The factors influenced the injury outcomes were proposed and discussed in terms of vehicle transport environment and road users. The results were discussed with regard to accident data collection, accident sampling and injury distributions etc.

3 RESULTS AND ANALYSIS

The results from statistical analysis based on the collected bicyclist accident cases are presented for the frequency of bicyclist accidents, injuries, and injury severities with respect to the different factors.

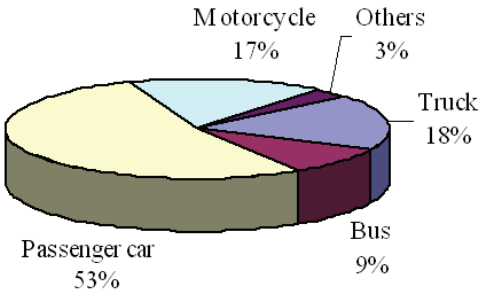
3.1 Analysis of involvement of vehicles

The distribution of vehicle types in bicyclist accidents in Changsha is presented in Table 1 with 1646 involved vehicles. The passenger cars participated in 53% of the bicyclist accidents, motorcycles and trucks participated in about 17% and 18% bicyclist accidents. In Hannover the passenger cars accounted for 64% of reported bicyclist accidents, which indicated the passenger cars are involved more frequently in bicyclist accidents in Hannover (Figure 1).

Table 1: Distribution of vehicle type in bicyclist accidents

Vehicle	Changsha, China		Hannover, Germany	
	AF*	RF*	AF	RF
Truck	295	**17.92**	95	5.26
Bus	152	9.23	27	1.5
Passenger car	875	**53.16**	1157	**64.06**
Motorcycle	274	**16.65**	20	1.11
bicycle			223	**12.35**
pedestrian			59	3.27
None			223	**12.35**
Others	50	3.04	2	0.11
Total	1646	100	1806	100

* AF=Absolute Frequency, RF=Relative Frequency



(a) (b)

Figure 1. Distribution of vehicle type for bicyclist accidents in (a) Changsha and (b) Hannover.

3.2 Injury severity

There are 1594 casualties in total of 1,570 vehicle to bicyclist accidents collected in Changsha. Among those casualties, 9.2% bicyclists were killed, 10.7% bicyclists were serious injured, 76.5% were slightly injured, and 3.6% bicyclists had no injuries (Table 2). In Hannover, the relative frequency 0.83% of the bicyclist fatalities is much lower than that from Changsha. The relative frequency of the slightly injured bicyclists is the quite the same in both Changsha and Hannover.

Table 2 Proportions of bicyclist injury severity

Value label	Changsha China		Hannover Germany	
	Absolute Frequency	Relative Frequency(%)	Absolute Frequency	Relative Frequency(%)
Fatalities	**146**	**9.2**	**15**	**0.83**
Seriously injured	171	10.7	318	17.61
Slightly injured	**1219**	**76.5**	**1345**	**74.47**
No injuries	58	3.6	128	7.09
Total	1594	100	1806	100

3.3 Age and Gender

Table 3 shows that in the bicyclist accidents, male had a higher rate for the gender distribution in Changsha: male 67.2%, and female 32.8%. In the bicyclist accidents, bicyclists ranged from 36-40 years old have a high percentage compared with other age

groups. Small children (0-10) and old people (61-100) were not so often involved in the bicyclist accidents. The gender distribution for the bicyclist accidents in Hannover: male 57.1%, and female 42.9%. The distributions of relative frequency by the age are quite the same in both Changsha and Hannover.

Table 3: The distribution of bicyclist accident frequency by age and gender

Age	Changsha, China						Hannover, Germany					
	Male		Female		Total		Male		Female		Total	
	AF*	RF* (%)	AF	RF (%)	AF	RF (%)	AF	RF (%)	AF	RF (%)	AF	RF (%)
0-5	4	0.4	1	0.2	5	0.3	11	1.00	13	1.90	24	1.40
6-10	10	1.1	4	0.9	14	0.9	39	3.70	21	3.00	60	3.40
11-15	**76**	**8.3**	**54**	**12.1**	**130**	**8.2**	**99**	**9.40**	**63**	**8.10**	**162**	**8.80**
16-20	78	8.5	60	13.4	138	8.7	77	7.60	61	8.40	138	7.90
21-25	61	6.7	25	5.6	86	5.4	55	5.40	71	9.90	126	7.30
26-30	61	6.7	41	9.2	102	6.4	70	6.80	60	8.40	130	7.50
31-35	66	7.2	47	10.5	113	7.1	88	8.70	40	5.40	128	7.30
36-40	**108**	**11.8**	**78**	**17.4**	**186**	**11.7**	**98**	**9.60**	**69**	**9.10**	**167**	**9.30**
41-45	75	8.2	44	9.8	119	7.5	87	8.60	52	6.80	139	7.80
46-50	99	10.8	56	12.5	155	9.7	67	6.90	42	5.40	109	6.30
51-55	89	9.7	20	4.5	109	6.8	52	5.10	38	4.40	90	4.80
56-60	63	6.9	11	2.5	74	4.6	65	6.40	36	4.40	101	5.50
61-65	46	5.0	4	0.9	50	3.1	62	5.90	51	6.10	113	6.00
66-70	45	4.9	1	0.2	46	2.9	56	5.20	36	4.40	94	5.00
71-75	23	2.5	1	0.2	24	1.5	46	4.10	43	5.50	89	4.60
76-80	10	1.1	—	0.0	10	0.6	24	2.20	41	4.90	65	3.40
81-85	2	0.2	1	0.2	3	0.2	14	1.20	14	1.50	28	1.30
86-90	—	—	—	—	—	—	3	0.30	3	0.40	6	0.30
91-95	—	—	—	—	—	—	—	—	—	—	—	—
96-100	—	—	—	—	—	—	—	—	—	—	—	—
Unknown	—	—	—	—	230	14.4	19	2.00	14	1.90	33+6	2.20
Total	916	100	448	100	**1594**	100.0	1032	100	768	100	**1806**	100

* AF=Absolute Frequency, RF=Relative Frequency

3.4 Age and Injury Severity

Table 4 shows the distribution of injury severity by different age groups. It indicates that bicyclists of age groups 11-20 and 36-50 had a larger fatality rate than other age groups of bicyclists. The zero fatality rate of age group 86-100 years old is due to the scarce of the accident data of this age group (only 1 case). The frequency of injury severity vs the age in Changsha is similar with the status in Hannover.

Table 4: Age vs Injury severity

Age	Changsha, China										Hannover, Germany									
	Total		Injury severity								Total		Injury severity							
			Fatalities		Seriously injured		Slightly injured		No injuries				Fatalities		Seriously injured		Slightly injured		No injuries	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
0-5	5	0.3	0	0.0	0	0.0	5	0.4	0	0.0	24	1.4	—	—	4	1.2	15	1.2	5	3.9
6-10	14	0.9	2	1.4	1	0.6	11	0.9	0	0.0	60	3.4	—	—	11	3.7	45	3.4	4	3.4
11-15	**130**	8.2	8	5.5	20	11.7	95	7.8	7	12.1	**162**	8.8	—	—	34	10.4	112	8.3	16	12.7
16-20	**138**	8.7	1	0.7	10	5.8	117	9.6	10	17.2	**138**	7.9	1	—	15	4.2	108	8.1	14	10.6
21-25	86	5.4	1	0.7	7	4.1	75	6.2	3	5.2	126	7.3	—	2.5	12	4.1	104	7.7	10	7.4
26-30	102	6.4	9	6.2	8	4.7	80	6.6	5	8.6	130	7.5	—	—	13	3.6	108	8.0	9	6.7
31-35	113	7.1	11	7.5	8	4.7	89	7.3	5	8.6	128	7.3	2	—	23	8.2	92	7.0	11	8.6
36-40	**186**	11.7	15	10.3	32	18.7	128	10.5	11	19.0	**167**	9.3	1	11.4	26	7.2	131	9.8	9	6.9
41-45	119	7.5	13	8.9	18	10.5	86	7.1	2	3.4	**139**	7.8	1	6.4	20	6.7	106	7.8	12	9.2
46-50	**155**	9.7	15	10.3	17	9.9	119	9.8	4	6.9	109	6.3	—	4.3	16	6.2	91	6.8	2	1.6
51-55	109	6.8	13	8.9	9	5.3	86	7.1	1	1.7	90	4.8	1	—	18	5.0	65	4.7	6	5.0
56-60	74	4.6	11	7.5	14	8.2	49	4.0	0	0.0	101	5.5	1	3.4	18	5.3	77	5.7	5	4.0
61-65	50	3.1	10	6.8	8	4.7	31	2.5	1	1.7	113	6.0	1	7.4	29	9.3	82	6.1	1	0.8
66-70	46	2.9	9	6.2	3	1.8	34	2.8	0	0.0	94	5.0	2	4.4	21	6.8	67	4.9	4	3.4
71-75	24	1.5	3	2.1	4	2.3	16	1.3	1	1.7	89	4.6	3	11.9	26	8.4	58	4.3	2	1.7
76-80	10	0.6	4	2.7	—	—	6	0.5	—	—	65	3.4	1	35.5	17	5.2	43	3.2	4	2.9
81-85	3	0.2	—	—	—	—	3	0.2	—	—	28	1.3	1	6.9	12	3.6	15	1.2	—	—
86-90	—	—	—	—	—	—	—	—	—	—	6	0.3	—	5.9	2	0.8	4	0.3	—	—
91-95	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
96-100	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
unknown	230	14.4	21	14.4	12	7.0	189	15.5	8	13.8	37	2.2	—	—	1	0.3	22	1.6	14	11.2
total	**1594**	100	146	100	171	100	1219	100	58	100	**1806**	100	15	100	318	100	1345	100	128	100

3.5 Date and Time of the Accident

Table 5 shows that bicyclist accidents occurred most frequently from August to November in Changsha. This could be due to that it is the season good for people to travel by bicycles in Changsha. In Hannover the bicyclist accidents occurred more often in the summer.

Table 5: Month of the year

Month	Changsha, China		Hannover, Germany	
	AF*	RF*(%)	AF	RF(%)
January	121	7.71	58	3.21
February	123	7.83	76	4.21
March	124	7.90	116	6.42
April	113	7.20	130	7.2
May	119	7.58	**236**	13.07
June	111	7.07	**204**	11.3
July	102	6.50	**193**	10.69
August	134	8.54	**218**	12.07
September	**177**	11.27	210	11.63
October	**160**	10.19	147	8.14
November	**171**	10.89	126	6.98
December	115	7.32	92	5.09
Total	1570	100	1806	100

* AF=Absolute Frequency, RF=Relative Frequency

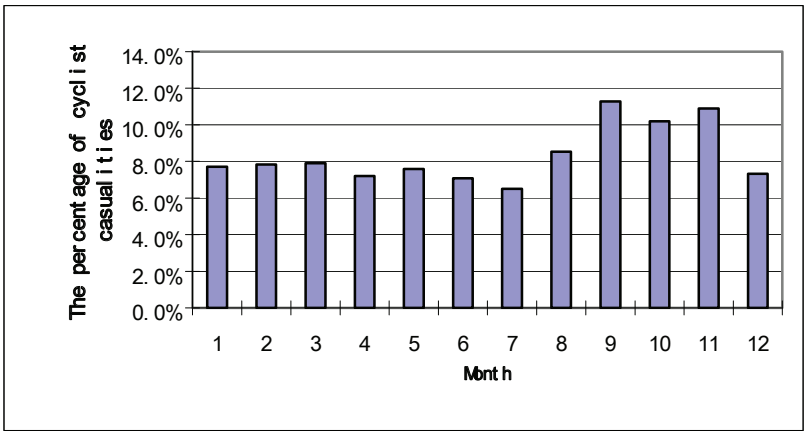


Figure 2 Accident frequency in month of the year in Changsha,

Table 6 and Figure 3 show that the bicyclist accidents occured most frequently in the morning and afternoon. The frequency of the accidents has two peaks: 7:00-9:00 AM and 5:00-7:00 PM when most people were traveling to work or home during the time period. The similar frequency of bicyclist accidents could be observed for accident data from Hannover.

Table 6 Time of the day

Time	Changsha, China		Hannover, Germany	
	AF*	RF*(%)	AF	RF(%)
00:00-00:59	44	2.80	16	0.89
01:00-01:59	20	1.27	3	0.17
02:00-02:59	10	0.64	2	0.11
03:00-03:59	4	0.25	3	0.17
04:00-04:59	9	0.57	3	0.17
05:00-05:59	19	1.21	7	0.39
06:00-06:59	60	3.82	33	1.83
07:00-07:59	**140**	**8.92**	**111**	**6.15**
08:00-08:59	98	6.24	93	5.15
09:00-09:59	78	4.97	105	5.81
10:00-10:59	89	5.67	127	7.03
11:00-11:59	95	6.05	124	6.87
12:00-12:59	72	4.59	142	7.86
13:00-13:59	83	5.29	121	6.7
14:00-14:59	88	5.61	134	7.42
15:00-15:59	71	4.52	**154**	8.53
16:00-16:59	92	5.86	133	7.36
17:00-17:59	**105**	**6.69**	**146**	**8.08**
18:00-18:59	**103**	**6.56**	**139**	**7.7**
19:00-19:59	68	4.33	73	4.04
20:00-20:59	83	5.29	54	2.99
21:00-21:59	78	4.97	39	2.16
22:00-22:59	32	2.04	22	1.22
23:00-23:59	29	1.85	22	1.22
Unknown	103	6.56	1806	100
Total	1570	100	16	0.89

* AF=Absolute Frequency, RF=Relative Frequency

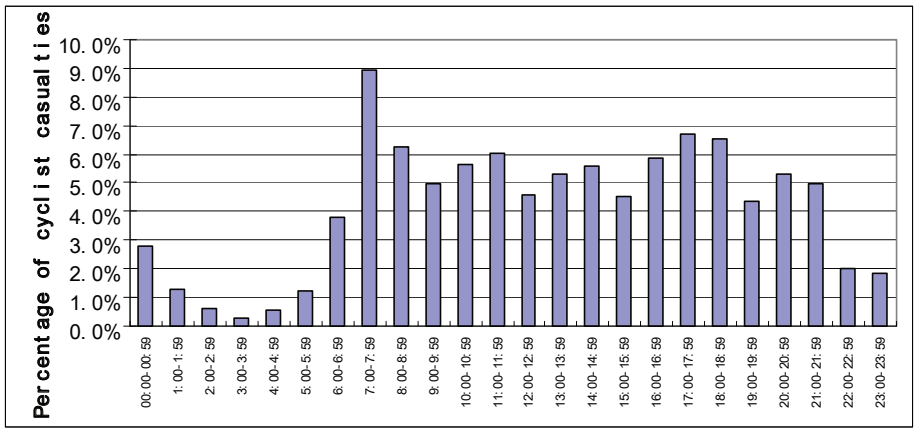


Figure 3 Time of the day

3.6 Light Conditions

Table 7 and Figure 4 show that most bicyclist accidents occurred while the light condition was good either during the daylight or had the street light on during darkness.

Table 7: Light conditions duringbicyclist accidents

	Changsha, China		Hannover, Germany	
	AF*	RF*(%)	AF	RF(%)
Daylight	**1117**	**71.15**	**1500**	**83.06**
Darkness-lights on	339	21.59	146	8.08
Darkness-lights off	113	7.20	160	8.86
Total	1570	100	1806	100

* AF=Absolute Frequency, RF=Relative Frequency

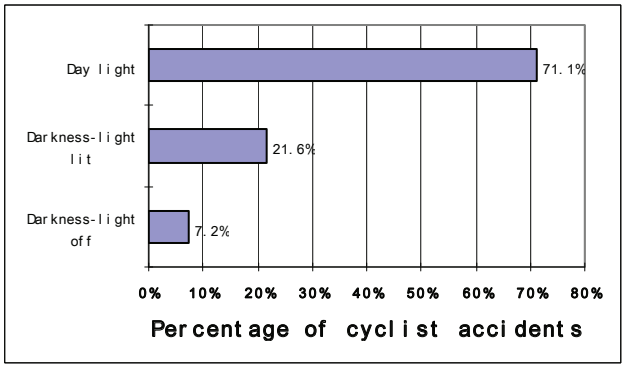


Figure 4 Light conditions during bicyclist accidents in Changsha,

3.7 Weather

Table 8 and Figure 5 show that among all known weather conditions, fine weather was the most representative weather when bicyclist accident happened. The bad weather such as fog and snow only accounted for a small portion (0.6%) of all weather conditions. However, to evaluate the risk of bicyclist accidents under different weather conditions, the distribution of weather condition during period 2001-2006 should be counted.

Table 8 Weather conditions during bicyclist accidents

Month	Changsha, China		Hannover, Germany	
	AF*	RF*(%)	AF	RF(%)
Fine	**965**	**61.46**	**1056**	**58.47**
Cloudy	294	18.73	569	31.51
Rain	295	18.79	161	8.91
Snow	5	0.32	10	0.55
Fog	5	0.32	7	0.39
Others	6	0.38	3	0.17
Total	1570	100	1806	100

* AF=Absolute Frequency, RF=Relative Frequency

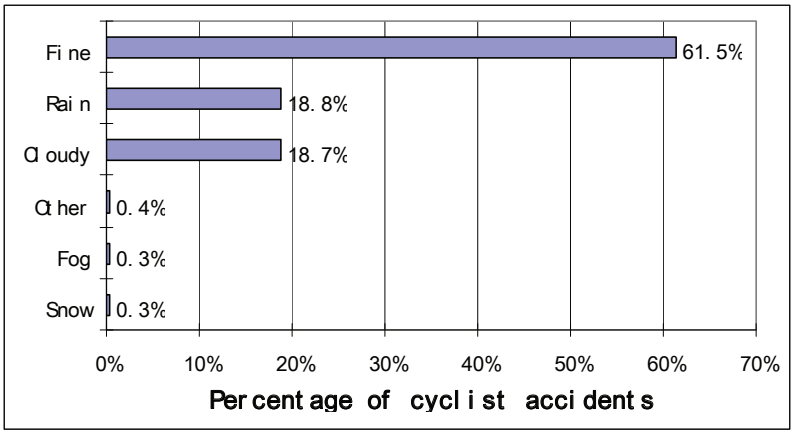


Figure 5 Weather conditions during bicyclist accidents

3.8 Road types

Table 9 and Figure 6 show the distribution of accidents vs road transect in Changsha (2006). The most vehicle-bicycle collisions took place on motor vehicle ways. Bicyclist themselves should more aware of the safety by following the traffic requirement. The distribution of accidents vs road transect in Hannover is quite different from that in Changsha, including the road transect for non-motor vehicle way and bicycle path.

Table 9: The distribution of bicyclist accidents vs road transect

	Changsha, China		Hannover, Germany	
	AF*	RF*(%)	AF	RF(%)
Motor vehicle way	**63**	**65.63**	**545**	**32.67**
Non-motor vehicle way	5	5.21	529	31.71
Mixed way	**22**	**22.92**	**0**	**0**
crosswalk	2	2.08	47	2.82
bicycle path	**0**	**0**	**547**	**32.79**
Others	4	4.17	0	0
Total	96	100	1668	100
Rejected Observations			138	

* AF=Absolute Frequency, RF=Relative Frequency

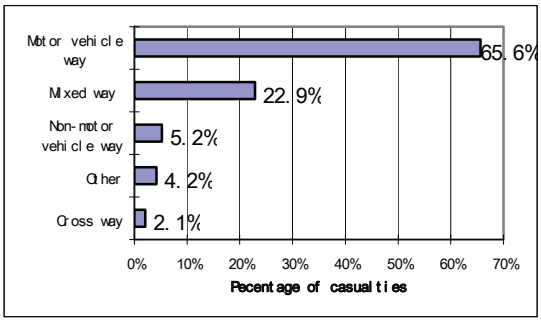


Figure 6. The distribution of bicyclist accidents vs road transect in Changsha,

Table 10 and Figure 7 show that straight road were the predominated road line type for bicyclist accidents in Changsha. While under corner or slope condition, there were much lower frequency of bicyclist accidents. In Hannover, the bicyclist accidents took place more frequently on intersections.

Table 10 The distribution of bicyclist accidents vs road line type

	Changsha, China		Hannover, Germany	
	AF*	RF*(%)	AF	RF(%)
straight	**1401**	**89.24**	**545**	**30.18**
slope	88	5.61	40	2.21
intersection	**0**	**0**	**1011**	**55.98**
others	0	0	210	11.63
Corner only	43	2.74	0	0
Corner & Slope	38	2.42	0	0
Total	1570	100	1806	100

* AF=Absolute Frequency, RF=Relative Frequency

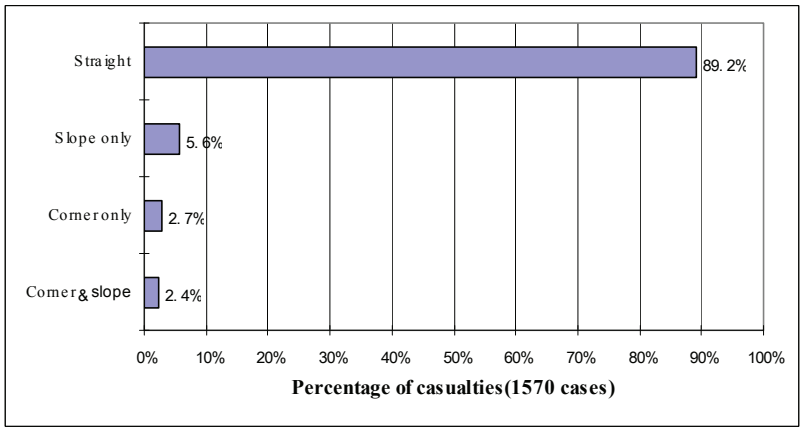


Figure 7 Road line type of bicyclist accidents in Changsha

Table 11 and Figure 8 show that dry road surface were the predominated road condition in reported bicyclist accidents. In Hannover the situation for road surface condition is quite the same as in Changsha, the bad road surface conditions has accounted for a small part of the bicyclist accidents.

Table 11 Road surface conditions of bicyclist accidents

	Changsha, China		Hannover, Germany	
	AF*	RF*(%)	AF	RF(%)
Dry	**1417**	**90.25**	**1546**	**85.6**
Wet	127	8.09	236	13.07
Ice and snow	3	0.19	20	1.11
Bumpy and loblolly	11	0.70	0	0
Unknown	0	0	4	0.22
Other	12	0.76	0	0
Total	1570	100	1806	100

* AF=Absolute Frequency, RF=Relative Frequency

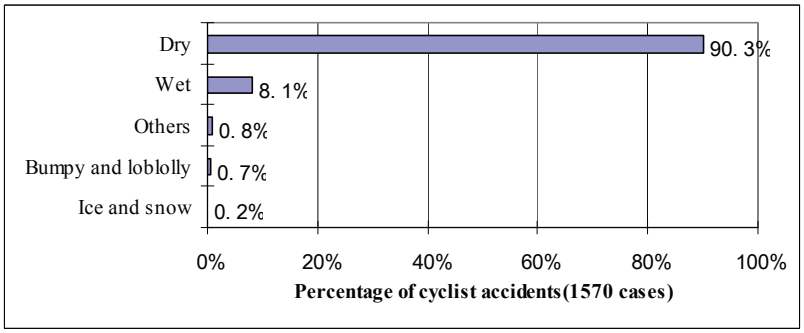


Figure 8 Road surface conditions of bicyclist accidents in Changsha

Table 12 and Figure 9 show that bicyclist accidents took place more frequently in conditions without traffic control and symbol, the rate of accidents was higher than controlled road condition. Road mark and lines showed little function of traffic control for the high rate of bicyclist accidents.

Table 12: Road control conditions in bicyclist accidents

	Changsha, China		Hannover, Germany	
	AF*	RF*(%)	AF	RF(%)
None, no intersection			**1018**	**56.37**
Traffic light	22	1.40	273	15.12
Road signs	**525**	**33.44**	263	14.56
Crosswalk			47	2.6
No road signs			84	4.65
Police	6	0.38		
Police & Traffic light	51	3.25		
Traffic light & signs	117	7.45		
No control	**752**	**47.90**		
Other equipments	51	3.25		
Others	0	0.00	120	6.64
Unknown	46	2.93	1	0.06
Total	1570	100	1806	100

* AF=Absolute Frequency, RF=Relative Frequency

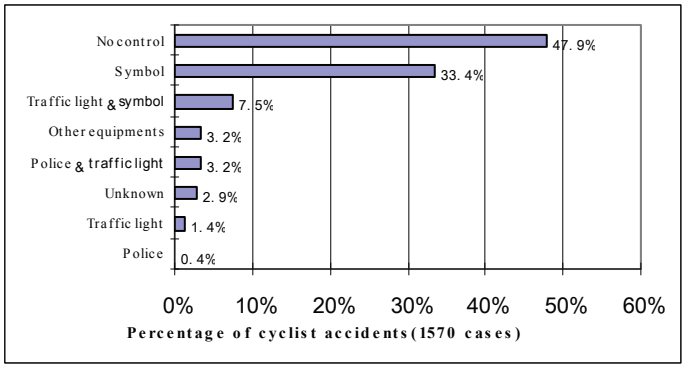


Figure 9 Road control conditions during bicyclist accidents

3.9 Type of Cyclist Accidents

Table 13 and Figure 12 show that the more common types of bicyclist accidents were lateral impact and front impact, in both Changsha and Hannover city area.

Table 13 Type of bicyclist accidents

	Changsha, China		Hannover, Germany	
	AF*	RF*(%)	AF	RF(%)
Lateral Impact	**775**	**49.36**	**871**	**48.23**
Front Impact	**379**	**24.14**	**629**	**34.83**
Rear Impact	127	8.09	75	4.15
Scratching	179	11.40		
Fall			103	5.7
Roll over	5	0.32	45	2.49
Others	104	6.62	83	4.6
Unknown	1	0.06		
Total	1570	100	1806	100

* AF=Absolute Frequency, RF=Relative Frequency

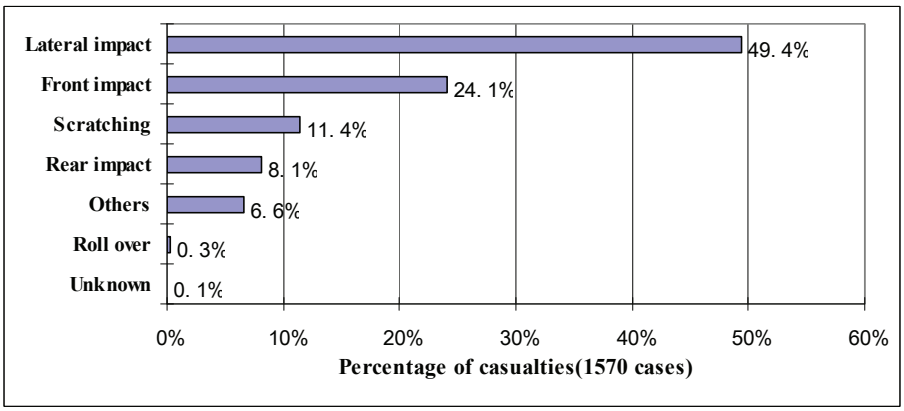


Figure 10 Type of bicyclist collisions

3.10 Distribution of Injuries by Body Regions

Table 14 and Figure 11 show that the head and lower extremities were found to be the most frequently injured. The injury region datum which were used in the figure were all registered in police data, while bicyclist accidents cases with no registered injury regions were ignored.

Table 14: Distribution of injuries by body regions for bicyclist accidents in Changsha

	Changsha, China									
	Not injured		Slight		Serious		Dead		Total	
	AF*	PF*	AF	RF	AF	RF	AF	RF	AF	RF
Head	1391	87.3	**82**	**5.1**	**46**	**2.9**	**75**	**4.7**	1594	100
Neck	1592	99.9	2	0.1					1594	100
Thorax & Back	1569	98.4	15	0.9	8	0.5	2	0.1	1594	100
Up limbs	1531	96.0	56	3.5	7	0.4			1594	100
Waist & Abdomen	1570	98.5	18	1.1	6	0.4			1594	100
pelvis	1592	99.9					2	0.1	1594	100
Low limbs	1366	85.7	**196**	**12.3**	**30**	**1.9**	**2**	**0.1**	1594	100
others	1325	83.1	259	16.2	10	0.6			1594	100

AF=Absolute Frequency, RF=Relative Frequency

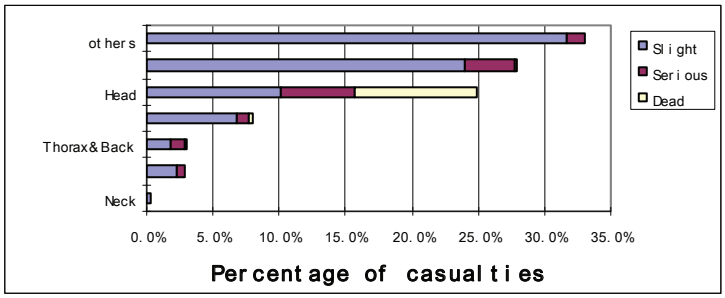


Figure 11. Distribution of injuries by body regions

Table 15 shows that the head and lower extremities were found to be the most frequently injured. The injury region datum which were used in the figure were all registered in police data, while bicyclist accidents cases with no registered injury regions were ignored.

Table 15: Distribution of injuries by body regions for bicyclist accidents in Hannover

	Hannover, Germany											
	Not injured		Slight AIS1		Serious AIS2-4		Dead AIS5-6		Unknown		Total	
	AF	RF	AF	RF	AF	RF	AF	RF	AF	RF	AF	RF
Head	1128	62.5	**516**	**28.6**	**125**	**6.9**	**7**	**0.4**	30	1.7	1806	100
Neck	1723	95.4	68	3.8	2	0.1	1	0.1	12	0.7	1806	100
Thorax & Back	1408	78	307	17	74	4.1	4	0.2	13	0.7	1806	100
Up limbs	1045	57.9	**696**	**38.5**	53	2.9			12	0.7	1806	100
Waist & Abdomen	1711	94.7	70	3.9	6	0.3	1	0.1	18	1	1806	100
pelvis	1581	87.5	198	11	15	0.8			12	0.7	1806	100
Low limbs	829	45.9	**868**	**48.1**	**96**	**5.3**			13	0.7	1806	100

4 DISCUSSIONS

The annually fatalities in the reported accidents of China increased from 49,271 in 1990 to 98,738 in 2005. The vehicle traffic accidents steeply increased in the past decade in China, and traffic injuries are common issue worldwide. The road traffic authority made large efforts to control incidence of the accidents, but the tendency of the accident growth is still a critical issue in China, even though the reported traffic accidents decreased in resent two years.

In the year 2006, 2.2 million traffic accidents with altogether 427,000 casualties (fatalities and injuries) occurred in Germany. 77,054 of these (18 %) were bicyclists, of those 486 (0.6 %) were killed, 14,233 (18.4 %) were severely injured and 62,335 (81 %) slightly injured. If the development over the past 15 years is regarded for Germany, then no trend towards a reduction of accidents involving bicyclists can be recognized, as is the case with pedestrians. Thus for the year 1992 altogether 78,695 bicycle accidents occurred and 47,884 accidents involving pedestrians were reported, in 2006 in contrast 82,819 bicyclists were involved in an accident and only 38,917 pedestrians.

Therefore in both countries the accidents with bicyclists have to be recognized. The injury situation related to traffic accidents seems to have different pictures for China and Germany [Kong et al., ESAR2006]. Particularly, the fatalities of vulnerable road users (VRUs) formed a main proportion of all reported fatalities in traffic accidents.

The present study is based upon an analysis of 1570 bicyclist accidents in urban area of Changsha in China and 1806 cases in the area of Hannover in Germany. The evaluation method was described and the available accident data were analyzed. The used samples are acceptable as a preliminary study. The presented methodology for an in comparison of different in-depth accident studies could be used for comparison of the injury risk and injury outcome for different countries. Such methodology can be used for further studies with new collection of accident data in the area and special research issues.

4.1 Involvement of vehicle

The analysis of bicyclist accidents in Changsha indicated that passenger cars, trucks and motorcycles are most frequently involved in vehicle bicyclist accidents compared to Germany where the major collision partner of a bicyclist is a passenger car (64%). In Changsha 53% of the reported bicyclist accidents are respobsible by passenger cars, truck 18%, and motorcycle 17%. Due to the difference of involved vehicles from country to country, the priority of safety countermeasures should be given considering the frequency of involved vehicles.

4.2 Bicyclist injuries

The bicyclist accident is a common problem in both motorized countries and motorizing countries, which occur frequently in city build up area. The combined results of the analysis of the two different areas of China and Germany are shown major resources for further countermeasures on car safety developments.

The injury severity and risk for bicyclists in Germany can be seen as much less danger as in China. As shown in Table 2, the relative frequency of the bicyclist fatalities is 9.2% in Changsha vs 0.8% in Hannover. In Changsha, 50% of the bicyclist fatalities attributed to fatal head injuries (Table 14). One of the possible reasons for the high relative frequency is due to that the bicyclists travel in Changsha without using any helmet.

The gender distribution for the bicyclist accidents In Hannover the male bicyclists accounted for 57.1% of reported bicyclist accidents, and female 42.9%. A higher rate for the gender distribution in Changsha is male 67.2%, and female 32.8%. One of the possible reason for the higher rate is due to that more males travel by bicycles than females do.

The findings of the distribution of bicyclist to different body segments are compared between the results from both institutes. As a common tendency, the head and the lower extremities have been found to be the most frequently injured body regions.

4.3 Needs of bicyclist protection and counter-measures

There is great potential of reduction of the accidents and fatalities in China by enhancing safety consciousness of all road users, improving the traffic administration, and strictly implementing traffic laws.

As findings mentioned above, the high rate of bicyclist fatalities is due to the fatal head injuries, it is therefore important for bicyclist to use helmet for head protection from vehicle collisions.

4.4 Limitations

It is also noticed that the limitations existed in this study. The data sources partly reflects the real situations of bicyclists in traffic accidents in Changsha and Hannover and not in the whole countries of China and Germany. Compared to this the data of GIDAS Hannover are comprehensive and give information on every issue of accident and injury details.

Another problem existed on the police records in Changsha, the provided data on the injury severity, which seldom provided exact details of the locations and extent of the injuries, and it bring up a difficulty to classify the injuries according to the AIS code. This problem can be soöved by further in-depth studies using detailed accident data collected from hospital and police sectors, as well as on-site and retrospective investigations.

5 CONCLUSIONS

Bicyclist accidents represent a group of vulnerable road users with high risk of injuries, therefore a priority should be given to this road user group in research of safe urban transportation.

About two thirds of victims in vehicle-to-bicycle collisions are male bicyclicts.

The head and lower extremity injuries are the predominant types of bicyclist injuries. It is necessary to give the priority of injury prevention to the head and lower extremities.

The head injuries are main responsible for the high relative frequency of bicyclist fatalities. It is vital for bicyclist to use helmet for head protection from vehicle collisions.

It can be seen that the bicyclist accidents and injury outcomes in Changsha are quite different from that in Hannover. The further in-depth study is needed to develop efficient counter-measures for improvement of bicyclist safety.

6 ACKNOWLEDGEMENTS

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