Road safety situation of courier and take-out food delivery electric bike riders: a cross-sectional study in one municipality in China

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Research article

Keywords: Injury, Electric-bike, Traffic violation behaviors, Courier, Take-out food deliveryman

Posted Date: June 9th, 2020

DOI: https://doi.org/10.21203/rs.3.rs-31421/v1

Abstract

Background To observe road traffic violation behaviors among courier and take-out food delivery electric bike rider and to characterize road traffic injuries occurred in this occupational population.

Methods A cross-sectional field study including roadside observational data collection and face-to-face interviews was conducted by retrospective response through street intercept.

Results 600 target populations were observed, and 480 were interviewed. The rate of over speed was 91.3%, and windshield use during winter was 91.2%. Traffic rule violations included riding in the motor vehicle lane (32.8%), not waiting behind the white line at a red light (23.3%), and using a cell phone when riding (21.2%). Helmet use was significantly more common in daytime than night (P=0.028). About 46% rode e-bike more than 8 hours per day. 76% of interviewees had suffered a traffic crash. About 14% crashes happened in motor-vehicle lanes and 8% in sidewalks. A logistic regression analysis indicated that compared with uninjured riders, injured riders showed significantly greater odds ratios of unsafe behaviors for running red lights (OR=1.75), and a protective effect for wearing a helmet (OR=0.56).

Discussion Road safety issues need to be addressed through establishment or improvement of e-bike legislation in this vulnerable occupational group.

Background

In recent years, with the increasing popularity and use of smart phones, electronic commerce has boomed and matured in China. As a result, the online shopping and take-out food delivery service industry in China has developed at an amazing speed [1].According to the “China Internet network development state statistic report” issued by the China Internet network information center (CNNIC) in Beijing, as of June 2017, the total number of online shoppers in China reached 514 million, an increase of 10.2% compared to the end of 2016. The number of shoppers using mobile phones has reached 480 million, and the number is still increasing. In China, except for some state-owned express delivery enterprises (EMS) and foreign investment express enterprises (UPS, FedEx) who drive motor vehicles as the main transport method [1], most private courier and delivery enterprises use electric bikes (e-bikes) as the main mode of transportation within urban areas.

E-bikes have become the most popular transportation mode among the Chinese population in recent years. The production of e-bikes increased nearly exponentially, from 58 000 in 1998, to 21 million in 2008 [2] to 120 million in 2011 in China [3]. Meanwhile, the number of crashes and deaths related to e-bikes increases each year. The rate of nonfatal injuries related to e-bikes increased almost four-fold, and the mortality rate increased six-fold, from 2004 to 2010 [2]. The Ministry of Public Security recently announced that, during the five years from 2013 to 2017, a total of 56 thousand people were killed or injured in crashes involving e-bikes in China, resulting in 8431 deaths, 63 thousand injuries, and 11.1 million direct property losses. China is clearly facing new public health challenges arising from e-bike-use.

Non-motor vehicle riders are vulnerable road users, and courier and take-out food delivery e-bike riders may be among the most vulnerable people in this group. Express and take-out food delivery is a recent development in China. In China, workers in this industry don’t need a lot of education and receive lower income, as well as weaker road safety awareness. Due to fierce competition, express delivery services require their employees to serve their customers in a very short specified time. As a result, these delivery workers are in much more of a hurry than the typical E-bike riders, and may have a higher incidence of crashes as a result. Traffic violations are particularly common among e-bike riders in this industry.

Despite the apparent risks to this vulnerable group, our understanding of unsafe behaviors and injury experience among these workers in this emerging industry is very inadequate. Using a combination of observations and interviews, this study conducted a field investigation to better understand the behaviors and direct and indirect burden of road traffic injuries among delivery workers who ride e-bikes.

Method

Study Setting

As one of the four municipalities of China, Tianjin is in the northeast of China with a resident population of approximately 15.6 million and population density of 1300 per square kilometer in 2016[4]. Tianjin has become the largest e-bike production and sales base in China.

Because of their convenience, speed, ease of use, and relatively low price, e-bikes have become popular and are now extensively used. E-bikes are treated as the primary mode of transportation by both ordinary residents and courier and take-out food delivery workers in Tianjin and other large and medium-sized cities all over China. However, e-bike traffic violation behaviors in courier and take-out food delivery workers appear to be quite common. These behaviors are likely taken in order to save time and deliver more orders, but may lead to serious road traffic injury. Given that little is known about the road traffic injury situation of this occupational population, we conducted a program, supported by the Global Road Safety Program, which aimed to evaluate and reduce e-bike injuries and promote social concerns about e-bike. As part of this program, we conducted a cross-sectional study in Tianjin.

Measurements

Our study was divided into 2 components. The first was a roadside observation of e-bike rider behaviors, and the second was a field survey using rider interviews. All of six urban districts of Tianjin were included. The participants were informed about the purpose of the study before they answered the questionnaire. Both observation record and investigation were anonymous.

Observations

One arterial road and one sub-arterial road were selected for observations in each district. Investigators were trained by designer in order to ensure standards of observation uniform. One hundred courier and food delivery worker e-bike riders were observed by trained investigators standing on the roadside in each district. Observers identified courier and food delivery e-bike riders by their work clothes with different food delivery company logos. The observers did not intervene or disturb the e-bike riders in any way. The speed of the observed e-bike riders was assessed visually by experienced observers; the designed speed limit of e-bikes in China is 20 km/h. Observed rider behaviors were recorded using a checklist. These included five traffic violation behaviors (riding in the incorrect direction for the lane, running a red light, not waiting behind the white line at a red light, and using a cell phone when riding), and three protective behaviors (using a windshield during winter, wearing a helmet, having reflectors on the e-bike, and using a light on the e-bike). Both daytime (11:00-14:00) and night (18:00-20:00) were included. Observations took place on two workdays and two weekends. The average temperature all day was 3℃ to 13 ℃ during the observation period.

Survey

Eighty courier and take-out food delivery e-bike riders were intercepted in each district and offered the opportunity to be interviewed. The respondents provided basic information and specific crash information (Table 1). The survey was anonymous. The severity of traffic crash injuries was divided into 4 categories: uninjured, light, medium and serious. “Light” refers to superficial and slight injury, “medium” refers to fracture or suture injury, “severe” refers to emergency or immediate surgery. Finally, the participants’ attitude towards special e-bike management regulations were also enquired .

Statistical Analysis

All analysis was performed with the SPSS statistical package, version 24.0. Pearson Chi-square tests were used to analyze frequency data, and independent sample t-tests were used to assess quantitative data. Odds ratios for risk of being injured

were estimated for specific traffic violation and protective behaviors using logistic regression. A *P* value less than 0.05 was regarded as statistically significant.

Results

Six hundred courier and take-out food delivery worker e-bike riders were observed, and 480 were interviewed as part of our study.

Observations

The rates of observed road traffic violation behaviors were very high (Table 2). More than 90% of observations documented speeds more than 20km/h). Windshield usage (quilt) was approximately 91%. Nearly 33% of observations documented riders riding in the motor vehicle lane while e-bike riders did not wait behind the white line at red lights and used cell phones when riding in more than 20% of observations. Helmet use was not optimal; in the daytime, 73% of riders were wearing helmets, while only about 65% were at night. This difference between daytime and nighttime helmet usage was statistically significant (P=0.028).

Surveys

Among 480 survey respondents, 432 were male (90.0%) and 48 were female (10.0%). Two hundred seventy participants were take-out food delivery workers (56.3%), and 210 were couriers (43.8%). Among the interviewees, 103 (21.5%) were Tianjin urban household registration, 91 (19.0%) were Tianjin rural household registration, and 286 (59.6%) were other provincial household registration (i.e., floating population). The average employment time was 17.9±15.0 months (range 1 to 84 months) and the average number of working days per week was 6.3±0.8 day. Of the 480 interviewees, 411 (85.6%) worked more than 6 day every week, and 233 (46.5%) rode more than 8 h per day; the average riding duration per day was 7.2±2.2 h (range 2h to 13h).

Among the 480 interviewees, 367 (76.46%) had suffered a traffic crash. The number of crashes they suffered ranges from 1 to 9, and the average number was 1.9±1.2 times. Courier delivery workers had fewer crashes than take-away delivery workers (1.7±1.1 vs. 2.1±1.3, respectively); this difference was statistically significant (P=0.001). Among the 367 (76.5%) participants who suffered crashes, 129 (35.1%) were riding in the wrong direction when the crash happened.

Table 3 shows information about injured riders' behaviors related to the worst traffic crash during their career. Courier and take-out food delivery worker e-bike riders most often crashed into other e-bikes (25.6% of crashes), followed by pedestrians (24.5%), bicycles (24.0%), and motor vehicles (16.6%). In terms of crash location, the majority of crashes occurred at an intersection (44.7%) or a non-motor vehicle lane (33.2%). A total of 22.1% of crashes occurred at locations where e-bike riding is prohibited.

Table 3 shows the severity of the reported injuries from the worst traffic crashes. Riders in 193 of the 367 crashes (52.6%) crashes were "uninjured", 148 (40.3%) were "light" injuries, 24 (6.5%) were "medium," and 2 (0.5%) were "serious." Fig 1 shows that lower limbs (17.2%) and upper limbs (16.9%) are the most common injury parts in all (n=367).

Table 4 shows the incidence rate of riding behaviors and OR (and 95% CI) between injured and uninjured courier and take-out food delivery worker e-bike riders who had crashes (n=367). Compared with uninjured e-bike riders, injured riders showed greater ORs for violation behaviors, such as riding in the incorrect lane direction (OR=1.26, 95% CI 0.82 to 1.94), running a red light (OR=1.75, 95% CI 1.01 to 3.06), and riding in a motor vehicle lane (OR=1.73, 95% CI 0.75 to 3.96). Odds ratios of injury increased with increasing speed, though the ORs were not statistically significant in all speed categories. Speeds less than 15 km/hour and wearing a helmet were associated with reduced ORs for injury, though only the OR for wearing a helmet was statistically protective, significantly.

In terms of the burden among injured E-bike riders (n=174), 28.7% (n=50) missed work because of the injury. The average number of days off for the 50 workers who missed work was 7.1±7.1 days.

Finally, when riders were asked about their attitudes toward e-bike special management regulations, 50.8% of the 480 surveyed riders (n=244) were very supportive, 32.1% (n=154) were supportive, 16.3% (n=78) did not care, 0.8% (n=4) were opposed.

Discussion

According to the World Health Organization, road traffic injury were responsible for approximately 12% of deaths worldwide in 2012[9]. Road traffic injuries (RTIs) have also become the leading cause of injury-related death, and a primary cause of disability in China[10](Xie et al.2016). E-bike crashes emerged as a major public health threat not only in China but also in other countries[6](Yuan et al.2017)[13]. In 2011, 120 million E-bikes were registered in China[11](Du et al.2013); this accounts for up to 90% of the global market[11](Du et al.2013), and the number of registered bikes in China and elsewhere continues to increase. Consequently, e-bike-related deaths increased almost seven times between 2004 (589 deaths) and 2010 (4029 deaths), while bicycle-related deaths decreased by a factor of three during the same period[12](Jie Yang). The number of road traffic injury involving casualties caused by e-bikes is increasing 8.6% annually, and the number of e-bike deaths has been increasing 13.5% annually. In China, bicycle use is changing into e-bike use. In the cities of China, most of the courier and take-out food delivery workers e-bike riders are migrants. The industry also has a high turnover of workers.

Our survey results indicated that the average employment time of the interviewees was 17.9 months. However, 76.5% of them had suffered traffic crashes during this short employment time. More than 85% of e-bike rider worked more than 6 days per week, with an average riding time of 7 hours per day, and a maximum time of 13 hours. Due to the long riding time and exposure on the road, these occupational populations have a very high risk of road traffic injury. Their work is high-intensity, mobile, and has a low educational need and low income. Therefore, these workers may be considered exceptionally vulnerable road users.

Observations

A few other studies have assessed riding behaviors and attitudes among e-bike riders. In Denmark, riding style and e-bike attitude played a crucial role in both perceived safety and involvement in safety critical incidents[7](Haustein et al.2016). In the Netherlands, e-bike users were also more likely to be involved in a crash[8](Schepers et al.2014). This phenomenon is even more prominent in China. Unsafe riding practices such as speeding, road rule violations and lack of helmet use have previously been shown to be commonplace among e-bikers in China[12].

In this study, we found that traffic violation behaviors in courier and take-out food delivery worker e- bike riders are much more pronounced than in the general public. The occurrence rate of over speed was 91.3%, followed by riding in motor vehicle lanes and not waiting behind the white line at a red light. Driving in the incorrect lane direction, running a red light, and using a cell phone were less common, but still occurred in roughly 20% of observations. The traffic violation behaviors of this occupational population are much more serious than an observational study in Suzhou, China, which showed 70.9% exceeded the designed speed limit of 20 km/h, and that 38.3% did not comply with the road rules when entering intersections[12].

With regard to helmet use, the overall rate of helmet use was 68.83% in courier and take-out food delivery workers. The rate of helmet use at night (64.5%) was lower than daytime (73.0%), and this difference was statistically significant. Helmet use is even worse among non-commercial e-bike riders. Jie Yang reported only 2.2% of riders wore helmets among resident e-bike riders in Suzhou[12]. The relatively higher helmet use among riders observed in this study maybe be due to employer regulations on wearing helmets. If true, this would suggest that industry or company regulations may be effective at

regulating the behavior of courier and take-out food delivery riders. Therefore, in the absence of a national or local law concerning e-bikes, industry regulations need to be established and strengthened.

This study was conducted in the late autumn and early winter, during which time the average temperature was 3℃ to 13 ℃. This allowed for assessment of windshield use, which was seen in 91.2% of observations. Wind shields are often installed to reduce exposure to wind and associated wind chill in the cold northern area of China, such as in Tianjin city. However, this is an unsafe practice when operating an e-bike, because of some of the wind shields have integrated gloves and kneepads, and some windshields also cover riders' upper bodies. Wind shield use is dangerous to e-bike riders, as the shield will interfere with the handlebars during sharp turns, and may become loose and require reattachment while riding. The windshield can also interfere with the rider's ability to support the bike with two feet on the ground. Therefore, we suggest that installing wind shields on e-bikes should be prohibited by local or national regulations.

Surveys

Road safety consciousness and self-protection awareness appeared to be weak among courier and take-out food delivery workers riding e-bikes, and crashes and injuries were common. We found that courier and take-away delivery workers riding e-bikes most commonly crashed into other e-bikes, pedestrians, and bicycle riders. More than three-quarters of crashes occurred in intersections or in non-motor vehicle lanes. Traffic violation behaviors of e-bike riders were commonplace, and these violations appear to be more common than those among non-commercial e-bike riders. Although riding in motor vehicle lanes and on sidewalks are traffic violation behaviors [13], almost 14% of crashes happened in motor vehicle lanes, and 8% on sidewalks, in our study.

Pedestrians, cyclists, and e-bike riders are the most disadvantaged road users[16](Nantulya 2003). In low- and middle-income countries, they are the main road users and the main injury group in traffic crash[17](Duan et al. 2010),[18](Nantulya and Reich 2002). However, our investigation indicated that e-bike riders frequently do not comply with traffic rules. If e-bikers ride in their own non- motor vehicle lane, e-bike crashes happen on sidewalks and in motor vehicle lanes would be reduced. Similarly, e-bike crashes in intersections should be reduced by e-bike riders choosing to obey traffic lights, and collisions in non-motor vehicle lanes can be reduced by avoiding speeding.

More than one third (35.2%) of accidental crash happened when e-bike riders were riding in the incorrect direction of a traffic lane in our study. Rider behavior also plays an important role in injury severity. We observed rider running red lights in nearly 17% of our observations, and this behavior was significantly associated with injury risk when we compared injured (20.7%) and uninjured (12.95%) e-bike riders who had been in a crash. This finding agrees with other research. Du W[11]used a cross-sectional observational study to describe different on-road riding behaviors among E-bikers and reported that 26.6% did not comply with the road rules. The overall prevalence of carrying passengers, riding in a motor vehicle lane, running red lights, riding in opposite directions, mobile phone use, and helmet use were 12.4%, 1.9%, 4.8%,3.4%, 0.4%, and 9.0%, respectively in his study[11]. Analysis has revealed that, in China, over 60 percent of fatal crashes involving 2-wheelers result from traffic rule violations (China Road Traffic Accidents Statistics Report 2004). In our previous study, 132 patients, nearly two thirds of the total, violated traffic rules. E-bikers hospitalized for injuries accounted for 57% of serious non-fatal road traffic injuries and 50% of the direct hospitalization cost for all road crash casualties in a rural hospital in Suzhou[12](Jie Yang).

Wearing a helmet is an effective protective behavior, and the use of a helmet was significantly different between injured (51.7%) and uninjured (65.8%) e-bike riders in our study. Approximately one-third (32.7%) of traffic injuries were e-bike-related in Zhejiang Provincial People's Hospital in China from 2008 to 2011, and the head was the most commonly injured body region (31.1%)[19].Feng Hu reported that injury severity is commonly sustained within crash mode (OR = 11.56) and traffic rule violations (OR = 4.74)[15]. In our study, the main risk factors for injury severity were riding in the incorrect lane direction (OR = 1.26), running a red light (OR = 1.75), riding in a motor vehicle lane (OR = 1.73), and increased riding speed (15–39 km/h, OR = 1.29, ≥ 40 km/h, OR = 4.00). Conversely, helmet use and riding speed ≤ 15 km/h were protective against

serious injury (ORs = 0.56 and 0.78, respectively).The most common injury region was the extremities (99 riders, 48.3%), followed by the head and face (54 riders, 26.3%).

All of these traffic violation behaviors might be particular to workers in the delivery industry. These occupational populations do not possess high education levels and high safety consciousness. In order to save time, courier and delivery e-bike riders often choose the nearest shortcut to reach their destination. In order to collect more orders to earn more money, or to contact customers to confirm the delivery address is accessible, workers often use mobile phone when riding. In our study, 34.6% of interviewees who had a crash were using mobile phone at the time of the crash.

According to the road traffic safety law implemented by the Chinese government, e-bikes are classified as non-motor vehicles[13](Road Traffic Safety Law of the People's Republic of China 2004). In Tianjin, e-bike riders including courier and take-out food delivery workers do not need to pass any driver's license test, and therefore may be not aware of the traffic safety rules; this situation is the same in other cities in China[14](Hu et al.2014).On the other hand, many e-bikes owned by courier and take-out food deliveryman are modified, and may be too heavy or have their speed limiting device removed, both forbidden acts. According to China's criteria, the top speed of e-bikes is about 20 km/h and the vehicle weight is less than 40 kg[12]. Modified e-bikes do not meet these criteria and likely should not be classified as non-motor vehicles. Courier and take-out food delivery e-bike riders are in a more vulnerable position than other non-motor vehicle vulnerable road users, because they are often high-mobility migrants who appear to have lower income, lower education level, high-intensity and fast-paced work requirements, and required fast delivery speed. Therefore, this special industry population needs to be given more attention by both government and society, and traffic laws need to be modified and improved to reduce the crash and injury burden in this group.

Study limitations

The study has several limitations. First, the helmet use rate we observed might be different from that of other seasons due to temperature differences. Second, the speed of observed e-bikes was estimated by well trained and experienced observers, but these observations undoubtedly included error. It would be preferable in future studies to quantify e-bike speeds using measuring instrumentation. Finally, it is possible that some of the e-bike riders' interview responses to the survey were influenced by social desirability bias.

Conclusions

Our study suggests that courier and take-out food delivery worker e-bike riders are highly vulnerable road users. Road traffic violation behaviors were very common among the riders we observed and interviewed, and this group also had a heavy burden of associated crashes and injuries.. Riding in the incorrect lane direction, running red lights, riding in motor vehicle lanes, speeding, not using a helmet, and using a cell phone while riding all increase the risk of a traffic crash and resulting injury. Three quarters of the riders interviewed reported having had a traffic injury. More than a quarter of these crashes involved a collision with another E-bike, almost a quarter involved pedestrians, and a quarter involved bicycles. Three quarters of the crashes occurred at an intersection or in a non-motor vehicle lane. Road safety concerns need to be communicated to these employees, and establishment or improvement of E- bike regulations are needed to increase safety in this vulnerable occupational group.

Declarations

Acknowledgments

This project was supported by funds from the International Federation of Red Cross and Red Crescent Societies as the hosting agency of the Global Road Safety Partnership.

Funding

This project was supported by funds of Global Road Safety Partnership (RSGP-0233).

Competing interests

All authors declare that they have no competing interests.

Ethics approval and consent to participate

The study was approved by the institutional ethics committee of Tianjin Centers for Diseases Control and Prevention. The participants were informed about the purpose of the study before they answered the questionnaire.Moreover,both observation record and investigation were anonymous and didn't involve sensitive information.

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Tables

Table 1 Information items collected by anonymous survey

Basic information	Gender, age, specific occupation (courier or food delivery), status of registered residence (Tianjin urban, Tianjin rural, or other provincial), employment duration, and average number of working days per week,previous crashes and injuries resulting from e-bike riding
Specific crash information collected by questions	Whether or not the rider had experienced a crash; the time of the crash(es); specific information about the worst crash, including riding status, crash site, the other party in the crash, injury severity level, injury location, riding behaviors, and protective behaviors. The burden of the traffic injuries was also assessed, including medical cost and lost work time.

Table 2 Incidence rate of riding behavior among courier and take-out food delivery E-bike riders by observation (%)

Behavior		Daytime(n=300)		Night(n=300)		Total(n=600)		Value	P Value
		n	%	n	%	n	%		
Traffic violation	Speed over 20km/h	271	90.3	277	92.3	548	91.3	0.758	0.384
	Riding in incorrect lane direction	50	16.7	52	17.3	102	17.0	0.047	0.828
	Riding in motor vehicle lane	101	33.7	96	32.0	197	32.8	0.189	0.664
	Run a red light	53	17.7	58	19.3	111	18.5	0.276	0.599
	Don’t wait behind the white line at red light	68	22.7	72	24.0	140	23.3	0.149	0.699
	Use cell phone when riding	62	20.7	65	21.7	127	21.2	0.354	0.552
	Use windshield during winter	277	92.3	270	90.0	547	91.2	1.014	0.314
Protective behaviors	Wear helmet *	219	73.0	194	64.7	413	68.8	4.856	0.028*
	Reflectors using	229	76.3	236	78.7	465	77.5	0.468	0.494
	Turn on light during night riding	-	-	248	82.7				

Pearson’s chi-square test, *$P<0.05$

Table 3 Retrospective information of the traffic accident by face-to-face investigation (N=367)

	Right direction (n=238)		Wrong direction (n=129)		Subtotal		Value	P-Value
	n	%	n	%	n	%		
Crashed into							**7.334**	**0.291** [b]
Other e-bike	54	22.7	40	31.0	94	25.6	3.038	0.081 [a]
Pedestrian	55	23.1	35	27.1	90	24.5	0.731	0.392 [a]
Bicycle	59	24.8	29	22.5	88	24.0	0.245	0.621 [a]
Motor vehicles	45	18.9	16	12.4	61	16.6	2.554	0.141 [a]
Motorbike	11	4.6	5	3.9	16	4.4	0.112	1.000 [a]
Other road user	14	4.6	4	3.1	18	4.9	1.388	0.315 [a]
Accident site							**7.842**	**0.049*** [b]
Intersection	118	49.6	46	35.7	164	44.7	6.559	0.010* [a]
Non-motor vehicle lane	74	31.1	48	37.2	122	33.2	1.410	0.235 [a]
Motor vehicle lane	31	13.0	20	15.5	51	13.9	0.430	0.512 [a]
Sidewalk	15	6.3	15	11.6	30	8.2	3.161	0.109 [a]
Injury information							**4.077**	**0.130** [b]
Unhurt	130	54.6	63	48.8	193	52.6	1.123	0.325 [a]
Hurt	108	45.4	66	51.2	174	47.4		
Severity level								
Light	91	38.2	57	44.2	148	40.3	1.231	0.316 [a]
Medium	17	7.1	7	5.4	24	6.5	11.075	0.002 * [a]
Serious	0	0.0	2	1.6	2	0.5	47.377	0.000* [a]

a Compare with different direction in the group

b Compare among groups

* P<0.05

Table 4 incidence of riding behaviors and OR (95%CI) between injured and uninjured courier and food delivery e-bike riders who had accident (n=367)

		Injured(n=174)		Unhurt(n=193)		Subtotal (n=367)		Value	P Value	OR (95%CI)
		n	%	n	%	n	%			
Traffic violation behavior	Riding in incorrect lane direction	66	37.9	63	32.6	129	35.2	1.123	0.289	1.26 (0.82,1.94)
	Using mobile phone	53	30.5	74	38.3	127	34.6	2.512	0.113	0.70 (0.46,1.09)
	Running a red light	36	20.7	25	13.0	61	16.6	3.952	0.047	1.75 (1.01,3.06)
	Riding in motor vehicle lane	15	8.6	10	5.2	25	6.8	1.705	0.192	1.73 (0.75,3.95)
Riding speed	≤15km/h	43	24.7	57	29.5	100	27.3	1.073	0.300	0.78 (0.49,1.24)
	15-39 km/h	109	62.6	109	56.5	218	59.4	1.443	0.230	1.29 (0.85,1.96)
	≥40km/h	7	4.0	2	1.04	9	2.5	3.412	0.065	4.00 (0.82,19.53)
	Unclear	15	8.6	25	13.0	40	10.9	1.769	0.184	0.63 (0.32,1.25)
Protective behaviors	Wear helmet	90	51.7	127	65.8	217	59.1	7.505	0.006	0.56 (0.37,0.86)
	Reflectors using	94	54.0	90	46.6	184	50.1	1.999	0.157	1.35 (0.89,2.03)
	None of above	43	24.7	48	24.9	91	24.8	0.001	0.972	0.99 (0.62,1.59)

Pearson’s chi-square test

Figures

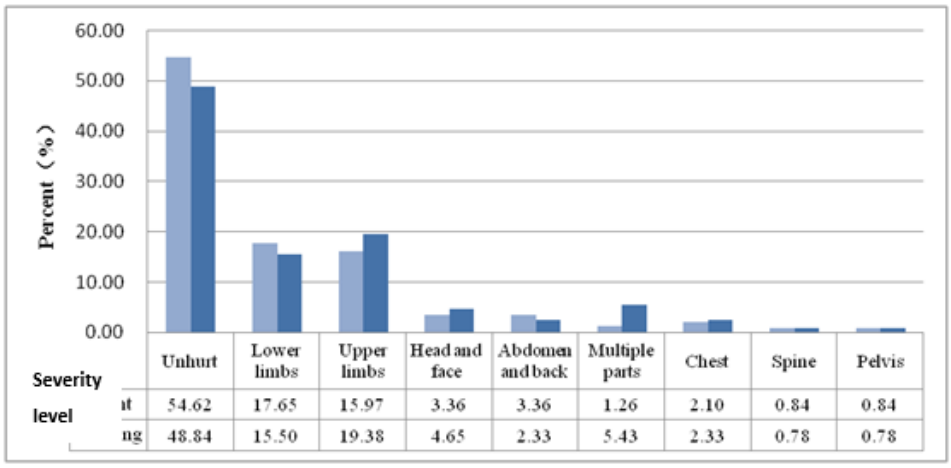

Figure 1

Injury information among e-bike riders riding in right (n=238) and wrong (n=129) direction

Supplementary Files

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- supplementary.doc