Evidence-Based Medicine Study between Bicycle Helmet and Head injury

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Abstract

Introduction: Taiwan has successfully passed the motorcycle helmet law in June, 1997. The head injury rate reduced by 30% after the implementation of law, but the head injury rate of bicycle is increase by 15% proportionately, especially for non-helmet users. It is very important to have the bicycle helmet law to protect teenagers fromsevere head injury, because it can decrease Years of Potential Life Lost(YPLL) significantly. Methods: We used case control study to analysis the study, and the result of GCS to discriminate the severity of head injury. In this study, hospital trauma registry was used for analysis to investigate the trauma patients at six hospitals in Taiwan area from February 2 to November 30, 2001. Telephone interviews were made to confirm whether the injury was caused by bicycle accident, and further to complete the insufficient information. We use frequency and Pearson Chi-Square to test for univariable. For multivariable, we use multiple logistic regression to examine the association between severity and related confounders. Results: According to trauma registered data, there were 608 hospitalized patients injured in bicycle related injury, and 600 patients were interviewed. Furthermore, in the logistic regression model, "Male"(odds ratio = 2.13, confidence interval = 1.95-4.38), "Without helmet "(odds ratio=9.34, confidence interval=1.51-62.86), "Helmet is unqualified" (odds ratio = 2.65, confidence interval = 1.23-3.18) and "brakes failure"(odds ratio = 3.08,confidence interval = 2.23- 4.26) had head injury. Furthermore, non-helmet will had serious head injury(odds ratio=4.42, confidence interval = 1.33-65.14) helmet and their severity of head injury in bicycle accident had also been proved significantly lower. Discussion: The benefit of helmet is proved in our study. If the bicycle helmet law is implemented, it will significantly reduced the severity of head injury. Besides, gender, helmet quality and status of bicycle need to be to considered in preventing bicycle related head injury.

Introduction

Bicycling is a worldwide activity. In both developed and developing countries it serves as an important means of transportation as well as an enjoyable recreational activity for both adults and children. Thus, injuries related to bicycling are relatively common among then head injuries account for one third of the visits to emergency departments, and up to two thirds of hospitalisations, and three quarters of deaths(1). Head injuries also carry a substantial risk of long term disability. Therefore, preventing head injuries from bicycling is important.

In June 1997, motorcycle helmet law has been successfully passed by the Legislative Yuan of Taiwan. The head injury rate decreased by 30% after the implementation of this law, As for non-helmet user, head injury rate disproportionately increased 15% in bike injury, especially for non-helmet users.

Safety helmets for bicycling have been available for at least 20 years. Although randomised controlled trials have become the gold standard for providing evidence of the effectiveness of clinical interventions, these trials are not feasible in this aspect. Given that the rate of head injury is about 20 injuries per 100,000 people, a randomised controlled trial would need to recruit hundred-thousands of people(2). Evidence for the effectiveness of helmets to prevent head injury has come from two other types of studies: case control studies, in which the proportion of cyclists wearing helmets with head injuries is compared with those without head injuries, and ecological studies examining changes in the rate of head injury over time among populations wearing helmets and those without. The strongest evidence for the effectiveness of helmets comes from case-control studies; this design is one of the cornerstones of modern epidemiology. A systematic review of five case-control studies, published at the Cochrane Library, found that helmets could reduce the risk by 63-88% for head, and brain injury among cyclists of all ages(1). Four of the studies controlled for a series of important covariates(3–6). helmets seemed to be equally effective in reducing injuries in crashes involving motor vehicles and in accidents associated with falls and other etiologies. Cook

and Shiekh tepoeted this using an ecological time series analysis(7). Examining all admissions to NHS hospitals in England over a four year period, the authors found that head injuries as a proportion of monthly admissions for trauma related to bicycles fell from 40% in 1991-2 to 28% in 1994-5 while total emergency admissions for trauma related to bicycles did not change. These changes showed a consistent year to year trend in which the proportion of head injuries related to trauma from bicycles became lower in each successive year. Changes occurred in all age groups and are ascribed to an increase in the use of helmets. Similar findings from ecological studies have also been reported in the United States, New Zealand, and Australia(8-10). These findings were associated with an increased use of helmets occurring as a result of educational and legislative initiatives. Despite this large body of evidence on the effectiveness of helmets in preventing head injuries in
cyclists and their beneficial effects for populations of cyclists, critics, especially in the United Kingdom, continue to question the usefulness of helmets. Their criticisms fall into two main categories: "risk homeostasis" and lack of adjustment for other confounders. Hillman has argued that while helmets may offer some inherent protection to cyclists there is no overall benefit because cyclists who wear helmets ride in a less cautious manner so that their overall risk of injury is unchanged(11). This theory of risk homeostasis has been discussed for decades, but the evidence that it applies to helmet use and bicycling is non-existent(12). The other criticism is that case control studies on helmets have not adequately controlled for all potential confounders, especially unmeasured factors such as differential risk taking behavior in cases and controls. Adequate adjustment for differences between cases and controls is important for the validity of any case-control study. Four of the five studies in the Cochrane review controlled for potential differences between cases and controls, such as age and severity of the crash(3-6)Crash severity can be used as a proxy for the hypothesised effects of risk taking behaviour. The magnitude of the protective effect of helmets found by these studies (threefold to eightfold) makes it clear that unmeasured confounders cannot explain the differences in the risk of injury between cyclists who wear helmets and those who do not.

Material and Method

The trauma registry is an emergency room based surveillance system(6),hospital is organized and administered by the research group. The companions of the injured patients receive a questionnaire about the injury event, including demographic information, time, location, activities being undertaken preceding the incident, and events that could be the contributing factors to the injury. The attending physician completes a medical questionnaire indicating the nature of the injuries and the affected body part(s). The information is coded by a trained data entry clerk or nurse, based on a detailed manual. We use case control study to analyze efficacy of bicycle helmets, and GCS score to distinguish the severity of head injuries. In this case control study, we used hospital trauma registered system to investigate the traumatic patients from six hospitals in Taiwan from February 2 to November 30, 2001. In the mean time, telephone interviews were made to confirm whether the injury was caused by bicycle accident, and further to complete the insufficient information. We use frequency and Pearson Chi-Square univariable test. For multivariable, we use multiple logistic regression to exam the association between severity and related confunders.

Results

Tables1 shows that men tend to have 50 % more severe head injuries than women. The main age group of head injured patient is 10-19 years old, approximately 45%. Under contain circumstances, cyclists may have severe head injuries: speed-change bicyclists (46%), cyclists without helmets (88.9%), large car accidents (45%), bicycle without reflecting objects (86.2%), cyclists carrying heavy items (73.1%), cycling at high speed (86.2%), brake broken system (64.4%). There is no statistically signification difference between wearing safety equipments and cycle with bells. Table2 of multiple regression shows that the odds ratio in male having severe head injuries is 4.86(confidence intervals between 2.89 and 5.68); in age group 10-19 is 3.85(confidence intervals between 1.68 and 4.55); in speed-change bicycle is 2.89(confidence intervals between 1.48 and 3.13); in cyclists without helmets is 4.64(confidence intervals between 1.38 and 55.68); in bicycles without reflecting objects is 2.64(confidence intervals between 1.38 and 4.58); in cyclists carrying heavy items is 5.26(confidence intervals between 4.23 and 8.98); in cycling at high speed is 2.45(confidence intervals between 1.65 and 2.88); in bicycles with broken brake system is 2.13(confidence intervals between 1.25 and 2.69).

Discussion

Bicycle injuries continue to be a serious public health problem, comprising 20% of all injuries to trauma registry during the study period. The helmet's benefit can be proved from the present study. Speed-change bicycle has been demonstrated to have more severe head injury, this is due to loss of control as has been reported by others(13-14). Thus, specific protection of bicyclists rather than implementation of motor vehicle traffic changes could be the most effective preventive strategy. Although we can not control the type and quality of the helmet, but it is necessary in preventing bicycle related head injury. Besides, comparing what items leads to more severe head injuries would further investigation.

Conclusion

Many bicycle related injuries can be prevented by changing attitudes and knowledge, and head injuries can be more easily prevented by wearing protective helmets. Legislation,(15-16) together with education(17), should significantly reduce the severity of head injury.

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Table1 Difference of day-time cyclists' head injuries from February 1st, 2001 to March 1st, 2002

	Severe head injuries (n=90)		Mild head injuries (n=234)		P value#
Character	Number	Percent	Number	ercent	
Sex					
Female	45	(50.0)	147	(63.0)	0.027
Male	45	(50.0)	87	(37.0)	
Age					
0 9	32	(35.7)	91	(38.8)	0.043
10 14	40	(45.0)	97	(41.5)	
15 30	4	(5.2)	12	(5.3)	
30 45	6	(6.5)	24	(9.9)	
≧45	8	(7.6)	10	(4.5)	
Bicycle Type					
Child toy bicycle					
Chile bicycle(with and without aid	5	(5.7)	29	(12.5)	0.040
wheels)	14	(15.5)	38	(16.5)	
Lady bicycle	23	(25.3)	107	(45.8)	
Speed-change bicycle	41	(46.0)	18	(7.3)	
Mountain bicycle	7	(7.6)	42	(17.9)	
Wearing helmets					
Yes	10	(11.1)	10	(4.2)	0.010
No	80	(88.9)	224	(95.8)	
Wearing other safety equipments					
Yes	2	(2.2)	6	(2.7)	0.823
No	88	(87.8)	228	(95.3)	
Accident causing events					
Large car	40	(45.0)	12	(5.3)	0.043
Compact car or taxi	14	(16.5)	29	(12.5)	
Motorcycle	23	(26.3)	38	(16.5)	
Passengers	4	(4.7)	107	(45.8)	
Others	9	(7.6)	48	(19.9)	
Bicycle with reflecting objects					
Yes	12	(13.8)	199	(85.4)	0.004
No	78	(86.2)	35	(14.6)	
Bicycle with bells					
Yes	16	(17.8)	39	(14.6)	0.754
No	74	(82.2)	195	(83.4)	
Carrying items (bags)					
Yes	65	(73.1)	7	(2.9)	0.000
No	25	(26.9)	227	(97.1)	

*data excluding missing value
**more than one injured body parts on the same patient
Chi Square or Fisher' s Exact Test

Table1 Continue

Characters	Severe head injuries (n=90) Number	Percent	Mild head injuries (n=234) Number	Percent	P value#
Cause of accidents					
Negligence (chat with company)	5	(5.2)	73	(31.4)	0.031
At high speed	62	(68.4)	78	(33.3)	
Cycling at reverse direction	23	(26.4)	83	(35.3)	
Mechanical problems					
Loss of control	29	(31.8)	13	(5.9)	0.024
Broken brake system	58	(64.4)	62	(25.9)	
Loosing wheel chain	3	(3.8)	159	(68.2)	

Table2 Risk factors of bicycling injured cases having severe head injuries

Character	Odds ratio	Confidence intervals
Sex		
Female	1.00	
Male	4.86	2.89-5.68
Age group		
0 9	1.00	
10 19	3.85	1.68-4.55
20 30	1.26	0.18-1.59
30 40	0.26	0.15-2.99
≧40	1.65	1.57-2.68
Bicycle type		
Child toy bicycle	1.00	
Chile bicycle(with and without aid wheels)	1.02	0.18-1.58
Lady bicycle	0.56	0.33-1.98
Speed-change bicycle	2.89	1.48-3.13
Mountain bicycle	1.08	0.86-2.36
Wearing helmets		
Yes	1.00	
No	4.64	1.38-55.68
Wearing other safety equipments		
Yes	1.00	
No	1.14	0.38-5.68
Bicycle with reflecting objects		
Yes	1.00	
No	2.64	1.38-4.58
Carrying items (bags)		
Yes	1.00	
No	5.26	4.23-8.98
Cause of accidents		
Negligence(chat with company)	1.00	
At high speed	2.45	1.65-2.88
Cycling at reverse direction	1.66	1.24-1.98
Mechanical problems		
Loss of control	1.00	
Broken brake system	1.21	0.18-2.23
Loosing wheel chain	2.13	1.25-2.69