

Bicycle-related injuries: a local scene

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To determine the profile of bicycle injury and possible risk factors for severe injuries, we studied patients with bicycle-related accidents attending the Accident and Emergency Department of North District Hospital between 1 May 1999 to 31 October 1999. Of the 424 patients, 52 (12.3%) were admitted and one (0.24%) died. Comparing to those not admitted, significantly more of the admitted cases suffered from major injuries, rode on rainy days and involved in collision with motor vehicles. A total of 160 patients (37.8%) had documented head injuries. However the extremely low utilisation rates of helmet at the time of injury implied that action should be taken in this direction to reduce bicycle-related morbidity and mortality. (*Hong Kong j.emerg.med.* 2001;8:78-83)

Keywords: Cycling, head injuries, head protective devices

Introduction

Cycling is increasing in popularity in Hong Kong. Hiring bicycles for leisure is relatively inexpensive and accessible. Throngs of enjoying cyclists are common scenes on fine days, particularly in the New Territories. In many housing estates throughout Hong Kong, large numbers of bicycles are stored in car-park areas suggesting that people may own their bicycles for various reasons. In recent years, the number of bicycle accidents in Hong Kong has been rising. According to the data published by the Road Safety & Standards Division of the Transport Department of Hong Kong,¹ there were 837 bicycle accidents in 1998 and 1252 in 1999 – an almost 50% increase. Most accidents occurred in the New Territories and most of the injured were youngsters aged 19 or below.² Most of the injuries were minor and self-limiting. Central nervous system injuries represented the most significant cause of fatality or disability.³⁻⁶ Data in United States on bicycle injuries

showed that 76% of head injuries and 41% of head injury deaths occurred in children below 15 years of age.⁶ Despite the fact that head injuries are common and frequently severe, Centres for Disease Control and Prevention in United States showed that less than 20% of riders wear a helmet, all or most of the time.⁷ Besides, younger children who are passengers on bikes are also injured when their feet are trapped in wheel.⁸

The aims of the survey were to provide a profile of bicycle injury seen in the district and to analyse possible risk factors and economic implications in terms of medical care provisions. This baseline information might be helpful in setting bicycle safety programs and helmet campaigns for the community in future.

Subjects and methods

This was a prospective survey. For a 6-month period from 1 May 1999 to 31 October 1999, data were collected from all patients who attended the Accident and Emergency Department (A&E) of North District Hospital as a result of a bicycle accident.

The information collected included age, sex, place of accident, weather condition, purpose of cycling (work-related, transport, recreation, or sports),

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nature of accident (collision with a motor vehicle, other bicycles or a stationary object, fall from the bicycle or foot trapped in the wheel). We also recorded the use of helmet at the time of accident, the site and seriousness of the injuries sustained and the medical care provided in the A&E Department.

Each patient was triaged and categorised at the triage station of our department on arrival. The categorisation of patients was in accordance with the Triage Guidelines, 1999 Edition set by the Coordinating Committee (Accident and Emergency Services), Hospital Authority of Hong Kong.⁹ Based on the patient's complaints, anatomical and physiological parameters, they were divided into five categories. Category I was critical; category II was emergency; category III was urgent; category IV was semi-urgent and category V was non-urgent. Priority for consultation was assigned according to the patient's condition, which in essence implied the severity of the injury or disease. Patients admitted to hospital were followed up with reviews of hospital records and recording the types of investigation performed and length of stay.

Injury differences between the admitted and the discharged cases were compared and analysed with the chi-square test, using the Statistical Program for Social Science, version 8.0 of SPSS Inc.

Results

Demographic data

There were 424 bicycle injuries seen in the A&E Department during the 6-month period.

The mean age was 32 years (age range 9 months to 74 years). Two hundred and five (48.4%) of the injuries occurred in children below 15 years old. Eight injured patients were above 65 years old. The age distribution is shown in Figure 1. The male to female ratio was 2.4:1(300:124).

Mechanism and site of injury (Figure 2)

Most of the injuries were caused by fall from bicycle (276% or 65.2%). Twenty-four (5.7%) were due to collision with motor vehicle and another twenty-four were caused by bicycle-bicycle collisions. A group of patients (43% or 10.2%) were injured as passengers when their feet were trapped by the wheels.

A total of 160 patients (37.8%) sustained head injuries either as an isolated injury or as part of multiple traumas. The types of injury included facial and scalp laceration, abrasions and bruises, skull fractures, extracranial and intracranial haemorrhages. The remaining were injuries to the extremities (36.8%), chest (1.4%) and abdomen (1.2%). A total of 210 (49.6%) patients had injuries

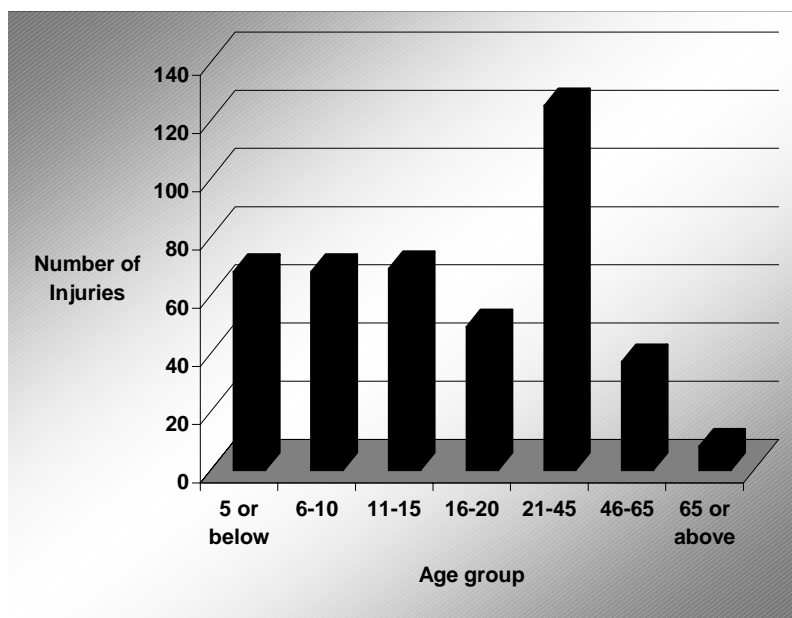


Figure 1. Age distribution.

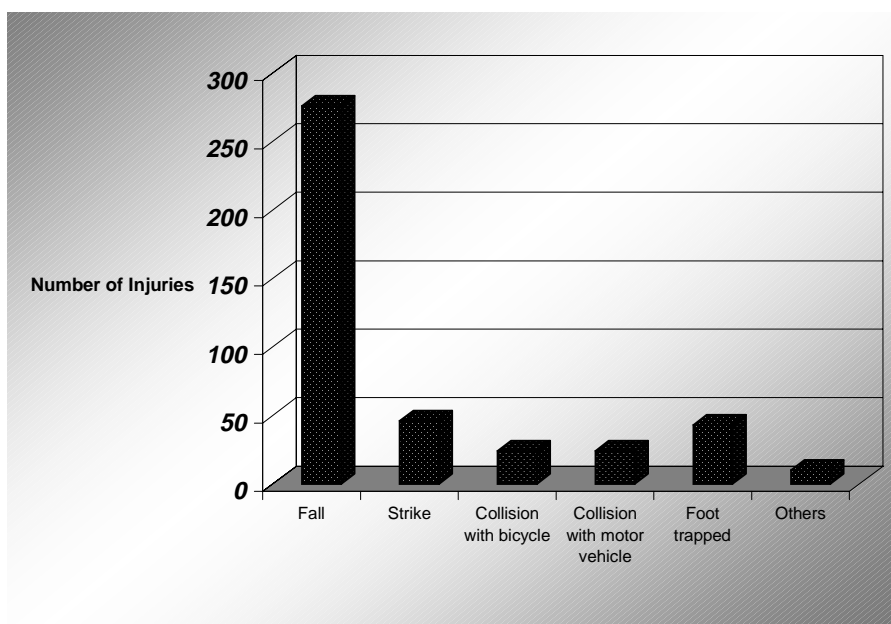


Figure 2. Mechanism of injury.

to more than one site with 113 of them involving the head and neck regions.

Outcomes of injury

Most injuries (374% or 88.2%) were minor and self-limited and 316 (74.5%) were discharged with no follow-up. Fifty-one (12%) were discharged from A&E department with follow-up or referral to specialist for reassessment. Fifty-two (12.3%) were admitted and one patient died at the emergency department, resulting in a mortality rate of 0.2%. The dead patient did not wear a helmet at the time of accident. The bicycle had a head-on collision with a bus. The patient was ejected from the bicycle. He suffered multi-organ injuries involving skull fracture, multiple rib fractures with severe chest and abdominal contusion.

The outcomes of patients under each category were summarised in Table 1. Of the 53 major cases (the

admitted cases and the fatal case), 33 (62.3%) belonged to categories I, II and III. Twenty (37.7%) belonged to categories IV and V. The admitted and fatal cases were associated with significantly higher categories (62.3% vs 37.7%, $p < 0.001$, Table 1) which reflected on the severity of injury.

Thirteen out of 47 patients riding on rainy days were admitted. On the other hand, 40 out of 377 patients riding on dry days were admitted. Admission rates for rainy and dry days were statistically significantly. (27.7% vs 10.6%, $p < 0.001$, Table 2).

Of the 52 patients admitted, 33 patients (63.5%) cycled on main roads at the time of accident. Twenty-six patients (50%) cycled mainly for the purpose of transport. For the eight patients above 65 years old, five cycled as means of transport and one for working purpose.

Table 1. Outcomes of patients by triage category.

Triage category	Target waiting time	Dead	Admitted	Not admitted	Total
Critical (I)	0 minutes	1	3	0	4
Emergency (II)	15 minutes	0	9	1	10
Urgent (III)	30 minutes	0	20	50	70
Semi-urgent (IV)	90 minutes	0	20	309	329
Non-urgent (V)	180 minutes	0	0	11	11
Total		1	52	371	424

Table 2. Outcomes of patients under different weather conditions.

	Admitted + Dead	Not admitted	Total
Dry days	40 (10.6%)	337 (89.4%)	377 (100%)
Rainy days	13 (27.7%)	34 (72.3%)	47 (100%)
Total	53	371	424

Nine out of the 24 patients colliding with motor vehicles were admitted. Only 44 out of the remaining 400 patients were admitted due to other reasons. Collision with motor vehicles had significantly increased admission rate (37.5% vs 11%, $p < 0.001$, Table 3). Nearly half (45.3%) of the 53 admitted patients had head and neck injuries in single or as combination with other injuries.

Provision of medical care

The majority (240 or 57%) required only simple wound dressing while 71 (17%) required wound suturing. Close reduction and/or Plaster of Paris (POP) fixation were performed in 26 (6%) of the patients and 58 (14%) required some oral analgesia only. The remaining 29 patients (6%) received intravenous fluid administration or intramuscular analgesia. One patient received cardiopulmonary resuscitation, which was unsuccessful.

For those admitted, the mean hospital stay was 6.6 days, ranging from 7.3 hours to 49.2 days. The majority (34% or 65.4%) had simple treatment (splint, POP, close reduction, chest drainage) while (16% or 30.8%) had more special treatment (open reduction, arthroplasty). The hospital records of two patients could not be found. A total of 8 CAT scan and 2 MRI were done.

Discussion

Our data provided a profile of the bicycle injury in the local community. It was consistent with overseas data¹⁰⁻¹³ that school-age children (5-15 years old) were disproportionately involved in bicycle injuries. They

accounted for up to 50% of all the bicycle injuries. The preponderance of males in our study was also consistent with the other studies. For age below 5 years old, male to female ratio was 1.6:1. The ratio rose to 4:1 for ages 16-204. The prevalence of injury in males was due largely but not entirely to the fact that they cycled more.¹⁴

Similar to that reported in other studies, head and neck trauma represented the most significant cause of injuries.³⁻⁶ In our survey, it contributed to more than one-third of the total injuries and half of the hospitalisation. However, another striking finding in our survey was that less than 5% of patients used helmet at the time of injury. This extremely low helmet usage rate was also consistent with that reported in other countries.⁷

Properly fitted bicycle helmets are very effective in reducing and preventing all forms and severity of skull/brain injury. Helmets owe their energy-absorbing qualities primarily to their compressible polystyrene liners. Thompson in Seattle,³ using a population-based control study demonstrated that helmet effectively decreased head injury by 85% and brain injury by 88%. This, together with McDermott's population-based study in Melbourne,¹⁵ provided data that demonstrated the effectiveness of helmets for cyclists of all ages. Besides, helmets were shown to have equal protection value in accidents involving motor vehicles and other types of accidents.

Barriers to helmet use include cost, wearability of bicycle helmets, and a lack of knowledge regarding helmet effectiveness.¹⁶ In addition, some school-age

Table 3. Outcomes of patients with different mechanisms of injury.

	Admitted + Dead	Not admitted	Total
Collision with motor vehicle	9 (37.5%)	15 (62.5%)	24 (100%)
Others	44 (11%)	356 (89%)	400 (100%)
Total	53	371	424

children believe that wearing a helmet will result in derision by their peers.¹⁷ Approaches to overcoming some of the barriers to helmet use include community-based teaching programs, and bicycle-helmet legislation. The Hong Kong Government is now planning to legislate the mandatory wearing of bicycle helmets for all cyclists.

Orthopaedic injuries were also common in our study. The lower extremities were involved more than the upper extremities. Injuries ranged from minor abrasions to major long bone fractures. The use of wristguards, knee and elbow pads may help to reduce the severity of injury.

As expected, involvement in motor vehicle crashes was associated with more severe injuries. In our survey, motor vehicle crashes accounted for only 5.7% of all bicycle injuries, but 38% of them were hospitalised. This reflected the greater severity of injury – a common finding in other studies.¹⁸⁻²⁰ Only 1 out of the 136 children of less than 10 years old was injured in bicycle-motor crashes. This was also in agreement with other reports.^{21,22} Children younger than 10 years old cycled primarily on sidewalks or playgrounds resulting in less traffic injuries. Among the elementary school children, overseas report indicated that "off-road" cycling injuries outnumbered traffic-related accidents by 9 to 1. As children get older, they venture more frequently into road traffic, resulting in more crashes involving motor vehicles. On the other hand, interestingly, a fair proportion of older people is now using bicycle as a means of transport in North District, which reflects our local scene in Hong Kong.

The above information highlights the need to separate cyclists from other traffic, either by cycling tracks or bicycle lanes away from main roads. In Hong Kong, the majority of cycling tracks and bicycle lanes are in the New Territories. An extension of these facilities to areas with heavy traffic may help to create a safer riding environment for cyclists of all ages.

The age at which children should be allowed to ride bikes at the road is a question analogous to the question of when children should be allowed to cross the street unsupervised. It does not depend solely on age but rather on the conditions of the child

(maturity and temperament) and the road (volume and speed of traffic). Children must be able to control the bicycle, to understand and follow rules of the road, and to exercise good judgement. Parents should provide a substantial period of adult-supervised road riding. Only with practice and demonstrated competence should children be allowed to ride in more challenging traffic.

Another interesting finding is that a significant proportion of children less than 5 years old (51.5%) were injured as rear-mounted passengers with feet trapped in the wheel. In some developing countries, like Sangli, Maharashtra and India, it was found that amputation of the toes by unguarded chains was the most common non-crash cycling injury.⁸ This injury occurred in children who were riding as passengers on the rear carrier. Parents should be advised of these problems and should ride with caution. Children should only be carried in well-designed rear-mounted seats and wear helmets. Seats should be securely mounted over the rear wheel and have a spoke guard to prevent hands and feet from being caught in the wheel. Seats should also have a high back and a shoulder harness and lap belt that will support a sleeping child. Children who cannot cooperate and sit still should not be passengers. Parents riding bicycles with passengers should confine their bike riding to low-traffic areas with reasonable speeds. Children should never be left alone in a bike carrier.

Some experts advocate the use of bike trailers to carry a young child as a passenger. There are at least two theoretic advantages. Firstly, they do not make the bike unstable from being top-heavy. Secondly, they attach by a point pivot joint so that the child is not thrown if the bike tips over. However, trailers should not be used in the road as they are low and may not be seen by motorists. Passengers in trailers must also wear helmets.

The major limitation of the survey was the inability to collect data from all other hospitals in Hong Kong. Hence, mortality and mobility might be underestimated. There was no follow-up information for patients after discharge from hospital. Information on further admission or rehabilitation, long term complications like seizures and residual deformities were not available. Thus our results

might underestimate the seriousness of the injuries and the related economic implications in terms of medical care provisions. However, as limitations are inherent in any survey and most of our results are consistent with other overseas reports, we believe the survey do reflect a local scene of bicycle-related injuries in Hong Kong.

Conclusion

Our injury data provide a profile of bicycle injuries in the Northern District of New Territories. Based on the above findings, continual efforts with education and legislation of helmet use to reduce the morbidity and mortality caused by bicycle-related crashes is necessary. It is also apparent from our data that instruction should be given to parents in the safe-riding skills when carrying children as rear-mounted passenger. With the increasing awareness of the magnitude of the problem, a lower injury rate can hopefully be achieved in the near future.

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