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The effect of new safety helmet legislation on bicycle accidents in young children - 1993

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Abstract

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NOTES.

(1) This report is disseminated in the interests of information exchange.
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BICYCLE ACCIDENTS IN YOUNG CHILDREN.

THE EFFECTS OF NEW SAFETY HELMET LEGISLATION.

A report for the Federal Office of Road Safety.

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September, 1993

ABSTRACT

A study of 813 child bicycle injury presentations at Brisbane's hospitals between April 1991 and June 1992 inclusive. A self-administered questionnaire completed by the caregiver of any child 14 years and under, who presented to the Accident and Emergency Department of five of Brisbane's major hospitals. This requested demographic details, accident, injury, safety helmet ownership and wearing details. It also requested information about parent's educational level and whether the helmet slipped or came off during the accident. Injury details were supplemented by one of the authors. The findings included an age range of 1-14 years. Fifty-seven percent of the parents had received more than 12 years education, 11 percent 12 years of education and 32 percent had received 10 of education or less. The numbers of accidents "on road" and "off road" were very similar, although with increasing age, an increase in number of children were involved in "on road" accidents. Eighty-six percent of children had no contact with a moving object and 59 percent of children described the accident cause as "faulty riding". The majority of injuries suffered were to limbs, but 315 facial and 97 injuries to the head occurred as well. Sixty-six children suffered concussion.

Eighty-four percent of children owned a helmet: 46.5 percent of them were wearing one at the time of the accident. None of the children who were wearing a helmet at the time of the accident suffered a serious head injury. Case control analysis showed that the risk of concussion is six times higher in non-helmet wearing riders.

Conclusions: Children are having bicycle accidents at "on road" and "off road" sites. Safety helmets protect against serious head injury in the accidents young children are having.

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A seeding grant from the Federal Office of Road Safety made this study possible.

We acknowledge the assistance of the staff of all of the participating hospitals. In particular the Accident and Emergency Department staff of the Royal Children's Hospital and the Mater Misericordiae Children's Hospital who saw the majority of the children. Without their help data collection could not have been undertaken.

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Ms. Diana Battistutta provided humane statistical advice and computing skills throughout the project from design to analysis.

SUMMARY

Bicycle related injury is a major cause of morbidity and hospitalisation among young children. This study examines the accident and injury profiles of all children who had bicycle accidents, presenting to public hospitals in Brisbane and environs for a 14 month period.

The period of the study coincided with the introduction of mandatory wearing of safety helmets for bicyclists in Queensland.

Eight hundred and thirteen children attended hospitals for treatment, of whom 127 were admitted. The most common injuries were to the limbs; however, 102 children suffered injuries to the head and 66 children suffered concussion.

The accidents occurred on the roads and at "off road" locations. One hundred and thirty nine children less than 10 years of age were injured in road accidents. This reemphasises the vulnerability of children on the public roads.

Sixty percent of the riders claimed "faulty riding" to be the main cause of the accident. Fewer than five percent of the accidents were attributed to driver error. The most common scenario was for a boy of 11 to 14 years of age to fall from his bike in a single bicycle accident.

Of those injured following the introduction of legislation, 80 percent claimed to own a helmet, although only 43 percent said they were wearing it at the time of the accident. Thirty children said that their helmets slipped at some time during the accident, 20 said that it came off and 14 said that the buckle was not done up at the time. Not all of the children whose buckle was undone stated that their helmet slipped or came off (Table X and XI).

Accidents which happened off the road, arose on cycle paths, shopping centres, parks, paddocks, and backyards. Percentage differences between these sites were not measured.

The injuries to the head were included in those covered by International Classification of Diseases No. 9 (ICD) Nos. 801-804 inclusive and 850-854 inclusive. One in three injuries were to the head and face. They were also divided into concussion: defined as any loss of consciousness and any other injury to the head as listed in the questionnaire (Appendix A) and included in the aforementioned ICD codes. Sixty-six children in this study suffered concussion and 4 had a Glasgow Coma Score (GCS) of less than 8. Five of these remained below 8, 24 hours later, signifying a very serious head injury.

This study has shown that the risk of suffering concussion was six times greater for children not wearing a helmet for those wearing one (Table XII).

ABSTRACT

A study of 813 child bicycle injury presentations at Brisbane's hospitals between April 1991 and June 1992 inclusive. A self-administered questionnaire completed by the caregiver of any child 14 years and under, who presented to the Accident and Emergency Department of five of Brisbane's major hospitals. This requested demographic details, accident, injury, safety helmet ownership and wearing details. It also requested information about parent's educational level and whether the helmet slipped or came off during the accident. Injury details were supplemented by one of the authors. The findings included an age range of 1-14 years. Fifty-seven percent of the parents had received more than 12 years education, 11 percent 12 years of education and 32 percent had received 10 of education or less. The numbers of accidents "on road" and "off road" were very similar, although with increasing age, an increase in number of children were involved in "on road" accidents. Eighty-six percent of children had no contact with a moving object and 59 percent of children described the accident cause as "faulty riding". The majority of injuries suffered were to limbs, but 315 facial and 97 injuries to the head occurred as well. Sixty-six children suffered concussion.

Eighty-four percent of children owned a helmet: 46.5 percent of them were wearing one at the time of the accident. None of the children who were wearing a helmet at the time of the accident suffered a serious head injury. Case control analysis showed that the risk of concussion is six times higher in non-helmet wearing riders.

Conclusions: Children are having bicycle accidents at "on road" and "off road" sites. Safety helmets protect against serious head injury in the accidents young children are having.

The three extra tables are at the end of the document on un-numbered pages.

Tables X, XI, XII.

INTRODUCTION

Children are the most frequent victims of bicycling accidents (Weiss B, 1986). Serious head injury has been the most common reason reported for hospital admissions and cause of death following cycling accidents in the very young (Bergman A, Rivara F, Richards D and Rogers L, 1990; Nixon J, Clacher R, Pearn J, and Corcoran A, 1987; O'Rourke NA, Costello F, Yelland JDN and Stuart G, 1987; Mellion M, 1991). Cycle helmets have been suggested as one means of reducing this risk (Sacks J, Holmgreen P, Smith S and Sosin M, 1991).

The protective capability of bicycle helmets has been demonstrated in multiple studies (Thompson R, Rivara F, Thompson D, 1989; Mills NJ, 1990). However, detailed causes of accidents and in depth injury documentation have not previously been undertaken in Australia. Bicycle related injuries in Australia constitute one of the highest percentages of presentation to Accident and Emergency Departments (Armson CJ and Pollard C, 1986). This is particularly true of children's hospitals (V.I.S.S. 1991).

Legislation was introduced in Queensland, Australia in July 1991, making it compulsory for a helmet to be worn while cycling. This study has been undertaken to investigate the causes of accidents and the injuries involved in bicycle accidents. We have been able to compare the injuries sustained with details of helmet type and wearing behaviour. The effectiveness of helmet wearing within the first year of operation of the legislation was also studied.

LITERATURE REVIEW

One of the earliest Australian studies of bicycle related injuries in children was from Sydney (Gonski L, Southcombe W and Cohen D, 1979). This study showed that of 312 bicycle accident cases, 50% involved young children aged between 5 and 9 years. Bouvier (1984) undertook a study of social and preventive aspects of bicycle accidents in childhood and concluded that the three "E's" of accident prevention - engineering, enforcement and education, were the "keys" to investigating contributing factors to bicycle trauma. Since that time there have been a number of Australian studies concerning children and bicycle safety (Armson CJ and Pollard C, 1986; Wood T and Milne P, 1988; Nixon J, Clacher R, Pearn J and Corcoran A, 1987; O'Rourke NA, Costello F, Yelland JDN and Stuart G, 1987).

In 1991 the Victorian Injury Surveillance System (VISS) showed that bicycles or their accessories ranked highest among products involved in child injury.

A New South Wales study (MacFarlane JP, Jones JE and Lawson JS, 1982) showed that the number of bicycle injuries was increasing. The authors recommended that bicycle traffic should be separated from vehicular, that children under the age of 10 years should not be allowed to ride on public roads and that training in road proficiency should be directed at children.

The Federal Department of Road Safety (F.R.S.) in its report Fatal Crash Types - 1988 (Attewell RG and Dowse MJ, 1992) found that of all bicycle related fatalities in 1988, 3% wore helmets and 47% of cyclists killed died of head injuries. In 1988 Wood and Milne reported that, in Victoria, head injuries constituted 33% of reported bicycle related injuries and 80% of fatalities.

Blunt and penetrating force injuries to the brain constitute an enormous public health problem. If a child or young adult survives a moderate or severe brain injury, there is a strong likelihood of a lifetime of physical and mental impairment as well as the economic and social impact on the family (Kraus T, Rock A and Hemyari P, 1990; Harris BH, Schwartzberg SD, Seman T and Hermann C, 1989; Nakayama D, Gardner MJ and Rogers KD, 1990; Wesson DE, Scorpio LJ, Kenny BD, Chipman ML, Netley CT and Hu X, 1992). Those studies which have examined head injury and bicycle accidents are of particular interest for this present study.

In 1982 and 1985, studies comparing head injury predominance between pedal and motor cyclists (McDermott FT and Klug GL, 1982; McDermott FT and Klug GL, 1985) showed that head injuries occurred more frequently in accidents involving pedal cyclists and that these head injuries per se, were more severe than those seen in motor cyclists. The authors stated that the differences were in part due to the significantly lower use of protective helmets among pedal cyclists at that time. In 1989 Cass and Gray (Cass DT and Gray AJ, 1989) undertook a three year prospective study to examine the range of injuries from bicycle accidents, particularly the severe ones. They found that head injuries predominated in the seriously injured and that none of the seriously or fatally injured cyclists wore a helmet. O'Rourke and Costello in 1987 (O'Rourke NA, Costello F, et al, 1987) noted that bicycle related trauma constituted more than 20% of injured children admitted to Brisbane hospitals with head injuries. They considered that the incentive to wear protective helmets would come from a combination of legislative enforcement, acceptable helmet design and energetic promotion.

In his article on traffic safety education, Johnston concluded that "evaluation of current prevention strategies must become more scientific, as the literature on effectiveness is confusing." (Johnston IR, 1992)

Wood and Milne, studied the effect of promotion of helmet use in Victoria. They stated that this had resulted in significant increases in the wearing rates of approved bicycle helmets. They also noted a corresponding reduction in the rate of head injuries among bicycle accident victims (Wood T and Milne P, 1988).

Helmet wearing among young children increased markedly following the introduction of legislation to that effect. The Queensland Department of Transport, in a review of helmet wearing rates, found a 46% wearing rate in primary school children prior to the introduction of legislation and an 80% rate immediately afterwards (Dix W and Dreves M, 1992). The increases however, were not as dramatic among teenagers who are at greater risk of a serious injury. (Friede AM, Azzara CV Gallagher SS, Guyer B 1985.)

Campaigns to voluntarily increase cycle helmet wearing have been undertaken in a number of centres. The Seattle Children's Bicycle Helmet Campaign resulted in an

increased helmet usage rate among school-aged children of 11% compared with a rise of only 1-3% in a community where no helmet campaign was conducted. (Bergman AB, Rivara FP, Richards DD and Rogers LW, 1990).

Road trauma is a major public health problem in all motorised societies (Trinca GW, 1992). Similarly, there is considerable debate as to the effectiveness of current safety education programs and, in an era when public expenditure is influenced by the results of cost-benefit analyses, education programs are under increasing challenge. The incidence of bicycle related injuries in the U.S.A. has been described in three recent publications (Thompson D, Thompson R and Rivara F, 1990; Sacks J, Holmgreen PN, Smith S and Sosin D, 1991; NISS Data 1987). Overall injury rates for all ages in Seattle, Washington, were 163 per 100,000 for all injuries and 42 per 100,000 for head injuries. Individuals between 5 and 9 years of age were at highest risk for head injuries and those between 10 and 14 years had the highest total injury rate. Between 1984 and 1988 Sacks et al (1991) found that bicycling accounted for 2,985 head injury deaths (62% of all bicycling fatalities), 41% of head injury fatalities and, 76% of head injuries occurred among children less than 15 years of age. Data from the National Electronic Injury Surveillance System in 1987 noted that more than half of the bicycle related injuries occurred in the 5-14 year age group (NEISS, 1987). Comparison with accidents due to other causes showed the numbers of bicycle injuries in children in Britain to be fewer than pedestrian (Illingworth C, Noble D, Kemn I, Roche C and Pascoe J, 1981; Joly MF, Foggin P and Pless IB, 1991), but the severity of injury was often similar. Earlier Australian studies have shown that 65-75% of all bicycle accidents involved children between 7 and 17 years of age (Armson CJ and Pollard CW, 1986). The Victorian Injury Surveillance System in 1991 found bicycles to constitute the most common cause of child injury as well as causing the highest number of admissions to hospital. The Department of Transport in its analysis of the 1988 fatality file (Attewell RG and Dowse MJ, 1992) showed that in the same age group the under 13 age range of cyclists were more likely to be injured than that age range amongst pedestrians. The main causes of death were head and multiple injuries.

Multiple trauma has been defined as substantial injury to more than one organ system, or life threatening injury to a single system. (Bushore M, 1988). The recognised standards for describing injuries are the Abbreviated Injury Score and its derivative, the Injury Severity Score (Baker SP, O'Neill B, Haddon W Jr, Long WB, 1974), which classify injuries according to the anatomical site and severity. As neither is used clinically, the Paediatric Trauma Score (PTS) (Tepas JJ III et al, 1987) and the Revised Trauma Score are used in the field or emergency department to predict injury severity. The PTS has a range from -6 to +12, where a higher score represents a less severe injury. The PTS provides a quick assessment scheme for paediatric triage and potential morbidity. The PTS was calculated on all patients in this study who were admitted to hospital. Table I outlines the factors taken into account to determine the Paediatric Trauma Score.

TABLE I: The Paediatric Trauma Score. A score of +2, +1 or -1 is given for each variable listed. The scores are then added to produce a range of -6 to +12.

	PAEDIATRIC TRAUMA SCORE		
VARIABLE	+2	+1	-1
WEIGHT (KG)	>20	10 - 20	<10
AIRWAY	NORMAL	MAINTAINED	UNMAINTAINED
SYSTOLIC BP	>90	50 - 90	<50
NEUROLOGIC STATUS	AWAKE	OBTUNDED OR ANY L.O.C.	COMATOSE
OPEN WOUND	NONE	MINOR	MAJOR
SKELETAL TRAUMA	NONE	CLOSED	OPEN OR MULTIPLE

A complete section of the questionnaire used in this survey was devoted to collecting detailed data about injury to the head and face (Appendix A).

As head injury is a common cause of morbidity and mortality in bicycle riders, the other predictor of outcome used in assessment of the patients admitted to hospital was the Glasgow Coma Score. Children have relatively fewer intra-cranial mass lesions but relatively more intra-cranial hypertension than adults. The tendency to have diffuse brain swelling puts children at increased risk of secondary brain injury and all children with a GCS of 12 or less require special monitoring of their neurologic status. Those with a score of 8 or less need intensive care (Jaffe D, Wesson D, 1991).

A retrospective study of an adult and paediatric population demonstrated that a good recovery was seen in 99% of patients with a GCS of between 13 and 15. This fell to 71% of the patients with a GCS of between 9 to 12. Of those having a GCS of less than 9, 41% died and 17% had a poor recovery (Pal J, Brown R, and Fleizer D, 1979). In this present study a GCS was undertaken as soon as possible after arrival at hospital and 24 hours later. The children's modification of the Glasgow Coma Scale was used with those children who did not yet talk. Table II shows the variables used to determine the Glasgow Coma Scale.

TABLE II: The Glasgow Coma Scale is derived from an assessment of three areas of neurological functioning.

THE GLASGOW COMA SCALE	
VARIABLE	**SCORE**
OPENING OF THE EYES	
SPONTANEOUSLY	4
TO SPEECH	3
TO PAIN	2
NONE	1
BEST VERBAL RESPONSE	
ORIENTATED	5
CONFUSED	4
INAPPROPRIATE WORDS	3
INCOMPREHENSIBLE SOUNDS	2
NONE	1
BEST MOTOR RESPONSE	
SPONTANEOUS (OBEDIENCE TO COMMANDS)	6
LOCALIZATION OF PAIN	5
WITHDRAWAL	4
ABNORMAL FLEXION TO PAIN	3
ABNORMAL EXTENSION TO PAIN	2
NONE	1

"Inexperience and misuse" were the most common causes of bicycle accidents reported by Gonski L, Southcombe W and Cohen D in 1979. A more recent study showed that the majority of bicycle accidents were the cyclists' fault (Simpson A and Mineiro J, 1992) due to age, inexperience and involvement with a vehicle, which led to greater injury severity. A number of other studies reported that accidents involving bicycle riders and motorised vehicles resulted in more serious injuries to the cyclists (Selbst S, Alexander M and Ruddy R, 1987; Kraus J, Fife D and Conroy C, 1986).

Contusions, sprains and fractures, in cycling, most commonly occur to the upper limbs (Mellion MB, 1991; Tucci J and Barone J, 1988) but abrasions, lacerations and bruises have been reported to be the most prevalent injuries.

Abdominal, perineal and genital injuries have been reported in bicycle accident victims, the former often presenting as delayed acute trauma with grave sequelae (Rohatgi M and Gupta DK, 1987; Sparnon AC and Ford WD,1986).

Most facial injuries have consisted of abrasions and contusions but a good helmet has been reported to offer partial protection from facial injuries. (Worrell J, 1987; Thompson D, Thompson R, Rivara F, Wolf M, 1990). The most recent literature concerning detail of maxillo-facial injuries sustained in bicycle accidents dates from 1986 (Lindqvist C, Sorsa S, Hyrkas T and Santavirta S, 1986). Of 93 patients, 65% suffered mandibular fractures, 35% mid-face and 5% fractures in both middle and lower thirds of face. Condylar fractures were by far the most common of the mandibular fractures and the majority of middle third fractures were zygomatic. Head injury was the most commonly associated injury.

The range of injuries which occurred due to bicycle accidents was extensive but head injuries were common and accounted for most of the fatal accidents (Mellion 1991; McCarthy 1991; Fife D, Davis J, Tate L, Wells J, Mohan D and Williams A, 1983; Nixon J, Clacher R, Pearn J and Corcoran A, 1987; Cass DT and Gray AJ, 1989; Cohen D, 1986).

The effectiveness of safety helmets in reducing head injuries in bicycle riders has been reported in U.S.A. (Thompson R, Rivara F and Thompson D, 1989; Wasserman R, Waller J, Monty M, Emery A and Robinson D, 1988; Wasserman R and Buccini R, 1990; Spaite DW, Murphy M, Criss E, and Valenzuela T and Meislin H, 1991) and in Australia (Dorsch M, Woodward A, Somers R, 1987; Williams M, 1991; McDermott FT, 1992), however only one of these studies involved a case control design. (Thompson R, Rivara F and Thompson D, 1989). This study produced compelling evidence of the effectiveness of bicycle helmets in reducing the risk of head and brain injury in cyclists.

There were, in January 1993, approximately 140 different helmets which conformed to the Australian Standard AS2063.2 or AS2063 (Standards Australia, Quality Assurance Services.) They fell into three basic types: those with a hard shell which was bulky and relatively heavy; those which consisted of a moulded expanded polystyrene foam with a lycra cover and those with a mini-shell which had a thin, hard outer layer (Mellion MB, 1991).

Two American standards have been used to rate bicycle helmets - the American National Standards Institute (ANSI) and the Snell Memorial Foundation, which was a more stringent standard because of a higher testing impact (Mellion M, 1991; Gisolfi CV, Rohlfe DP, Navarude SN, 1988). To date, there have been no detailed Australian investigations of injury types in cyclists, neither have these been related to helmet wearing or to helmet design. The most recent literature pertaining to bicycle safety helmet design discussed measurements of energy absorption in frontal and side impacts. (Mills NJ, 1990). Mills concluded that "a helmet of a recognised standard provides

valuable protection from the majority of accidents, but it cannot protect the head in a high velocity direct impact". Similarly, Williams in Australia, assessed the current tests used for "standards approval" and suggested that hard shell helmets provided the best all round performance (Williams, 1990).

METHODS

Any child aged 14 years or less, who suffered an injury as a result of riding a two-wheeled bicycle was eligible for entry into the study. The study was undertaken at the two major children's hospitals in Brisbane, the Royal Children's Hospital, the Mater Misericordiae Children's Hospital and three other major hospitals, the QEII, Logan and Redlands Hospitals. The study period covered 14 months between May 1st, 1991 and June 30th, 1992. Data collection included two months preceding the implementation of compulsory cycle helmet wearing in Queensland.

A questionnaire was given to an adult accompanying the injured child to hospital. In most cases, this occurred immediately on arrival of the child at the Accident and Emergency Department. Consent to be included in the study was obtained from all parents or guardians. Children were excluded from the study if they were pedestrians who were hit by bicycles, or if their injury occurred when they were not riding the bicycle. A number of children who had injured hands when undertaking repairs were excluded. Two children who happened to be riding bicycles when bitten by spiders were also excluded. These were treated only for spider bite on arrival to hospital.

Data collected included details about the child (sex, date of birth), suburb, details about the accident, the injuries sustained and details of the parent's occupation and employment.

ACCIDENT

Details collected about the accident included the cause(s) (faulty bike, faulty riding, faulty driving of another vehicle and faulty road conditions); whether contact was made with a moving or stationary object and details about the surface on to which the child fell. Other questions about the accident included whether the child was a pillion passenger on the bicycle, whether the bicycle needed repairs after the accident and whether it was raining at the time of injury.

INJURY

Details of the injuries sustained and the cause of the main injury were answered on the initial questionnaire and were checked, using medical records by one of the investigators (C.A.) to ensure accuracy. Patients were also asked whether they struck their head or sustained any dental trauma. Every child admitted to hospital as a result of injuries involving a bicycle was seen by one of the investigators (C.A.). Further details about the injuries of these children were recorded. These included: the Paediatric Trauma Score (Tepas JJ, Mollit DL, Talbert JL and Bryant M, 1987), the Glasgow Coma Score

(Teasdale G and Jennett B, 1974) and details of skull, scalp and facial injuries. Cranial and facial fractures were documented in detail, as was dental injury.

Head injuries were defined, by the medical staff, as concussion (any loss of consciousness), injury to the forehead, scalp, skull base or vault, or brain stem or recorded as "other injury to the head".

A multi variate analysis was undertaken of head injuries and helmet wearing. Adjustments were included for the confounding effects of age group, sex, hospital, main cause of the accident and its severity based on the repair needs of the bike.

Communication was maintained with the Institute of Forensic Pathology (City Morgue) in order to document any fatalities. Two deaths of child bicyclists occurred during the period of this study; however, only one of them attended hospital and therefore details were documented of this fatality.

HELMETS

Data concerning helmets was also collected. The children were asked whether they were wearing a helmet at the time of injury, whether they owned a helmet and the length of time they had owned it. Using a pictorial portfolio of helmets, children or parents identified the type of helmet which had been worn. It was also ascertained whether the buckle had been done up and whether the helmet came off or slipped at any time during the accident.

CHECKING METHODS

The importance of thoroughness in collecting data was emphasised to all personnel involved. At the two children's hospitals, where the majority of cases presented, a daily check of triage books and patient presentation lists was undertaken. Extensive use was made of the Queensland Injury Surveillance and Prevention Project (QISPP) data for checking purposes. QISPP collects injury data from all hospitals in this study except the Royal Children's. At the Royal Children's Hospital, bicycle related incidents were highlighted in the triage book as a means of checking that all cases were documented.

Admissions to hospital and inter-hospital transfers were checked by daily visits or telephone calls to the wards and through the computerised hospital admissions records.

Children less than 15 years of age who were admitted to an adult hospital were traced through admission registers and were included in the study.

Adults accompanying patients were given a questionnaire on presentation to hospital. Incomplete questionnaires were supplemented with data from QISPP forms and telephone interviews. The reliability of the information collected by this method was checked by one of the investigators (C.A.). At the beginning of the study, test interviews were conducted by phone, with 30 respondents who had already completed questionnaires in

hospital, within three weeks, prior to the follow up call. A new form was filled in at the time of the telephone interview. Both the original and the follow up interview were analysed for consistency and errors were found in 0.3% of items.

RESULTS

Eight hundred and thirteen children presented to the hospitals included in the study between 1st May, 1991 and 30th June 1992. These comprised 607 (74.7%) boys and 206 girls.

The Mater Misericordiae Children's Hospital received the largest number of these children. The catchment area of the southside of Brisbane covers a larger population than the northern region of the city.

The distribution of ages of the children is shown in Figure 1. The ages ranged from 1 year to 14 years 11 months with a mean age of 9.6 years (standard deviation 3.2) and a modal age of 12 years.

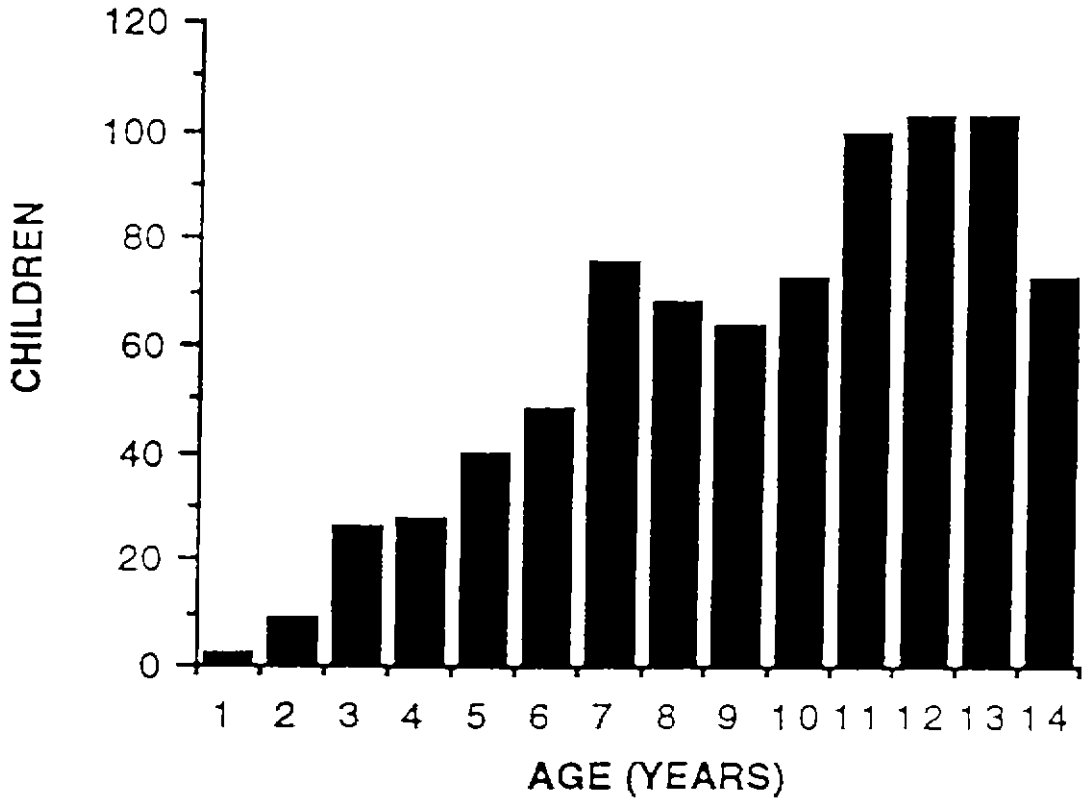

FIGURE 1: The age distribution of 813 children attending hospital for bicycle related injuries in Brisbane, Queensland over a fourteen month period.

The highest level of education achieved by either parent, (or guardian) of the child is shown in Table III.

TABLE III: The level of education achieved by the parents of 394 children attending hospital with bicycle related injuries.

EDUCATION LEVEL	NUMBER	PERCENT
10 YEARS OR LESS	126	32.0
12 YEARS	45	11.4
MORE THAN 12 YEARS	223	56.6

Children were more likely to be injured in a bicycle related incident in summer than in winter and were most likely to be injured between 3 and 6 pm (42%). A further 24% were injured between midday and 3.00pm. Inclement weather does not appear to have played a role in the accidents reported here. Three percent of those cases where data was available occurred when it had been raining.

Equal numbers of bicycle incidents reported in this study occurred on and off the road. Some of the "off road" incidents occurred on private property, including the backyard and indoors. Others occurred on cycle paths, footpaths in shopping centres and in parks. Mandatory wearing of safety helmets applies only when cycling on the road, or the cycle-path. The results of this study suggest that children are as vulnerable to injury from incidents occurring at "off road" locations as well as on the road.

TABLE IV: Site of the accident for 787 child cyclists injured between April 1991 and June 1992 in Brisbane.

AGE (YEARS)	0-4 YRS		5-9 YRS		10-14 YRS		
	N	%	N	%	N	%	TOTAL
ON ROAD	17	27.0	122	43.0	258	58.9	397
"OFF ROAD"	46	73.0	162	57.0	182	41.4	390

Table IV also shows an increase in the likelihood of injury with increasing age, in a bicycle accident on the road. Children in the 10-14 year age group were more likely to be injured on the road while children in the 0-4 year age group were more likely to be injured "off road". However, 31 percent of children in the latter group were involved in an accident on the road.

TABLE V: Moving objects in contact with child victims when the main cause was faulty riding compared to other causes.

	FAULTY RIDING		OTHER CAUSES		
	N	%	N	%	TOTAL
CAR	35	4.7	7	12.5	42
M/CYCLE	1	0.1	1	1.8	2
TRUCK	3	0.4	2	3.6	5
BICYCLE	44	6.0	3	5.4	47
PEDEST'N	3	0.4	1	1.8	4
ANIMAL	3	0.4	0	0.0	3
OTHER	8	1.1	1	1.8	9
NO CONTACT	642	86.9	41	73.2	683
TOTAL	739	100.0	56	100.0	795

Fourteen percent of the patients in this study had contact with a moving object (Table V). These included motor vehicle, motor cycle or truck (6.2%) and another bicycle (5.9%). Collision with pedestrians and animals together comprised less than one percent of patients. Eighty-six percent of children had no contact with a moving object.

Six percent of children were "doubling" or riding pillion at the time of the accident.

The main causes of accidents, according to respondents, are shown in Table VI. Fifty-nine percent involved faulty riding, 9% were said to involve a faulty bicycle, 6.6% the road conditions, 8% avoiding something and only 4.4% described as faulty driving of another vehicle. At interview it became obvious that the parent or guardian very commonly answered faulty riding as a cause of the accident while the child was more likely to specify one of the other reasons. The other causes documented included holes in the road, avoiding rocks, stunt riding, trying to get off a bike that was too big and trying to jump a fence. One child noted that he was avoiding an ant-heap and another fell asleep at the handlebars!

TABLE VI: Main causes of 813 bicycle accidents. There was more than one definable cause in more than 50 incidents.

CAUSE	NUMBER	PERCENT
FAULTY RIDING	511	59.2
FAULTY BICYCLE	78	9.0
ROAD CONDITIONS	57	6.6
FAULTY DRIVING	38	4.4
AVOIDING SOMETHING	72	8.3
CAUSE UNKNOWN	35	4.2
OTHER	72	8.3
TOTAL	863	100.0

Where a child was injured primarily against a stationary object, 30% came into contact with the road. Twenty four percent of the children were injured against the kerb or gutter. "Other" stationary objects included drains, trees, other bikes, traffic islands, ditches and a skateboard bowl.

Fifty-seven percent of the respondents fell onto a paved surface while 18% fell onto gravel and dirt surfaces and 13% fell onto grass. Most injuries were caused by the surface on which the child fell.

Table VII shows the characteristics of the injuries sustained. The type of injury suffered was initially classified using the Injury Surveillance Information System. Seventy percent were injuries to soft tissue, 23% involved bone, tendon or joint and 7% were concussion or dental injuries.

TABLE VII: Type of injuries sustained to 813 child bicycle riders.

INJURY TYPE	NUMBER	PERCENT
SOFT TISSUE	943	69.6
BONE-TENDON-JOINT	317	23.4
CONCUSSION & DENTAL	94	6.9
OTHER	1	0.1
TOTAL	1355	100.0

Facial injuries were divided into those occurring to the upper or the lower face. The lower face incorporated the dental-bearing areas. The classification was the same as that used by Thompson and Rivara (1991), and was chosen to further examine the protective effect of bicycle safety helmets.

Table VIII shows that the majority of injuries were to the limb; 34% to arms and 26% to legs. There were 315 (23.7%) facial injuries, 97 (7.3%) head injuries and 104 (8.8%) injuries to the trunk and digestive tract.

Table VIII: Body parts injured in 813 child cyclists over a 14 month period from April 1991.

BODY PART	NUMBER	PERCENT
ARM	455	34.2
LEG	349	26.2
FACE	315	23.7
HEAD	97	7.3
TRUNK	80	6.0
DIGESTIVE TRACT	23	1.7
NECK	8	0.6
OTHER	3	0.3
TOTAL	1330	100.0

Sixty percent of injuries were caused by the surface upon which the children fell, 26% were caused by impact with another object and 7% by impact with another vehicle before landing.

One hundred and two children suffered injuries to the head and 67 children suffered facial injuries with no concurrent head injury. Sixty six children suffered concussion. It is of note that 294 children commented that they had hit their head during the accident. Concussion for the purposes of this study was defined as any loss of consciousness. General head injuries were 2.6 times higher than among non-helmet wearers (95% Cl; 1.5, 4.6). For concussion specifically, the risk was 6.0 times higher (2.3, 16.0) among non-helmet wearers than among helmet wearers. This translates to a protective effect of helmets of 0.4 (0.2, 0.7) for general head injuries and of 0.2 (0.1, 0.4) for concussion.

TABLE IX: Helmet wearing and helmet characteristics among 671 children injured in the first year of mandatory helmet wearing in Queensland (July 1,1991 to June 30, 1992).

	YES		NO			
	N	%	N	%	N	%
WEARING HELMET	301	46.5	347	53.5	648	100
BUCKLE DONE UP	234	94.4	14	5.7	248	100
HELMET SLIPPED	28	13.0	187	87.0	215	100
HELMET CAME OFF	16	7.2	207	92.8	223	100

Table IX shows the extent of helmet wearing in the group of children who were injured during the first twelve months of mandatory helmet wearing in Queensland. Eighty-four percent of the children interviewed owned a helmet, although only 46.5% of them said they were wearing a helmet at the time of the accident. The proportion of children wearing helmets remained constant between hospitals. Overall 46.5 percent of children wearing helmets compares with rates observed by Queensland Transport researchers of 84.6 percent at primary schools and 38.3 percent at secondary schools giving an overall rate of 61.5 percent for a September,1991 survey.

The helmet came off the child in 16 (2.8%) of cases and in 28 (5%) it slipped. Fourteen (4.7%) of children who were wearing helmets, in this study, reported that the buckle was not done up at the time of the accident. Twenty-four helmets apparently being worn correctly were reported to have slipped during the accident. A high proportion of children (84%) claimed to have owned a helmet. Sixty-eight percent of these were owned prior to the introduction of the legislation.

One indicator of severity of the incident was the extent of damage to the bicycle. The bike was considered to be beyond repair following the accident in 15 (2.6%) of cases and in need of repair in 144 (24.8%).

The Paediatric Trauma Score (PTS) was used to estimate the severity of the injury for children admitted to hospital.

One hundred and twenty seven children were admitted to hospital and PTS scores were recorded. Twenty-nine (22.8%) had a trauma score equal to, or less than eight, which is considered a severe enough injury to necessitate transfer of the child to a major trauma centre. A further 58 (45.6%) children had trauma scores of 9 and 10. Thus 68.4% of the admitted children had injuries which could be considered serious. The most severe of these were skull injury and compound fractures of limbs. Abdominal trauma alone, did not initially present as a potentially life threatening or even severe injury, using the PTS. However, there were 13 cases of major abdominal injury. Some of these cases

took up to 48 hours to reveal their severity. These included pancreatic and hepatic damage as well as intestinal perforations.

The Glasgow Coma Scale (GCS) range was from 5 to 15. A score of 15 represents normal neurological status. Sixty six children in this study suffered concussion and therefore sustained some injury to the brain. Concussion was defined as any loss of consciousness. Four children had a GCS of less than 8 which indicated a severe head injury. A GCS of less than 8 (depending on the time spent unconscious) carries a 70% chance of long term neurological deficit.

DISCUSSION

An unexpected finding of this survey was the high proportion of bicycle trauma that occurred at sites other than the road. As the age of the children increased so did the likelihood of their being injured in a bicycle accident on a public road. However, the rate of exposure of children to a potential bicycle accident is unknown for both road and "off road". The authors know of no way of estimating or postulating this.

The majority (59%) of children injured in bicycle related accidents "fell off" their bike with no apparent contributing factor other than faulty riding. The most common scenario was for a boy of 11 to 13 years to fall from his bike in a single vehicle accident, to a paved surface. There was an equal chance that the paved surface was on a public roadway or in a driveway or bicycle path.

While the age distribution of the children was similar to that described in other studies, 31 percent of the children aged 4 years and less were involved in accidents on a public road. The use of public roads by children less than 10 years of age has been criticised previously (Nixon, J et al, 1987). This present study highlights the vulnerability of very young children, reiterates the need to separate child cyclists and vehicular traffic and demonstrates the need for education in cycling proficiency for children.

Helmets worn by the children in this study have been found to have a protective effect against head injury in general and concussion in particular. This was ascertained by case control analysis of the children presenting to the Mater Misericordiae Children's and the Royal Children's Hospital, as these are the tertiary referral centres for Brisbane. These data are presented in Table X. The effect of the legislation was to increase the wearing rate at least among those children coming to hospital. The doubling of the proportion of children wearing a helmet in the period following the introduction of the legislation occurred in spite of a breach of the legislation incurring no fine.

More children suffered injury to the limbs than to any other body part. These are rarely life-threatening injuries although they carry some significant, short term morbidity.

This study showed that many more children owned helmets than were wearing them at the time of injury. Some helmets slipped or came off at the time of the accident. Whether this indicates a design problem in the helmet or the strap or incorrect fitting or use by the

wearers was unknown. Twenty-four apparently "done up" helmets slipped during the accident.

One in three injuries were to the head and face, including 66 cases of concussion. The long term sequelae of even a minor head injury are serious and often disabling. Prevention of head injuries should therefore, remain a high priority for road safety as well as other safety organisations. The data collected in this study indicated a strong protective effect for head injury in bicycle riders wearing safety helmets. Injuries to the head were 2.5 fold higher among non-helmet wearers than among helmet wearers. For brain injuries specifically, the risk was 5.8 fold higher among non-helmet wearers than among helmet wearers. This study confirms the continued benefit of bicycle helmet wearing. However it is also relevant, that few of these were high velocity vehicular accidents. Therefore, approved bicycle helmets are able to protect against major head injury in the types of accidents suffered by the 0-14 year age group.

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TABLE X: Helmet wearing.

		No. of Subjects	Percentage
Own a helmet	Yes	519	80.2
	No	128	19.8
	missing data	166	-
Median months (range) owned helmet prior 01-07-91	17.0 (1,103)		
Wearing helmet at time of accident	Yes	335	42.7
	No	450	57.3
	missing data	28	-
Helmet came off	Yes	20	2.8
	No	232	33.0
	Not applicable	450	64.1
	missing data	111	-
Helmet slipped	Yes	30	4.3
	No	210	30.3
	Not applicable	454	65.4
	missing data	119	-
Buckle done up	Yes	234	33.4
	No	14	2.0
	Not applicable	452	64.6
	missing data	113	-

TABLE XI: Proportion of head injuries before and after legislation on helmet use.

	Before 01-07-91		**From 01-07-91**	
	Total Subjects	% with head injury	Total subjects	% with head injury
Owned a helmet				
yes	70	10.0	449	8.3
no	43	16.3	85	18.8
Wearing helmet				
yes	34	5.9	301	6.3
no	103	11.7	347	14.4
Helmet came off				
yes	4	0.0	16	18.8
no	25	8.0	207	5.3
Helmet slipped				
yes	4	25.0	26	11.5
no	23	4.3	187	4.3
Buckle done up				
yes	22	9.1	212	6.6
no	3	0.0	11	0.0

TABLE XII: Characteristics of helmet usage.

	Controls Number (%)	Head injuries Number (%)	Brain injury Number (%)
Owned a helmet			
yes	200 (77)	69 (71)	25 (66)
no	60 (23)	28 (29)	13 (34)
		p = 0.259	p = 0.136
Wearing helmet at time of accident			
yes	126 (47)	31 (32)	8 (20)
no	140 (53)	67 (68)	31 (80)
		p = 0.007	p = 0.002

* significance of x^2 test statistic for the association between each variable and case-control status

INFORMATION AND CONSENT FORM

PROJECT TITLE:- BICYCLE ACCIDENTS IN YOUNG CHILDREN

EXPLANATION AND AIMS

We are medical researchers based at the Royal Children's Hospital, the University of Queensland and the Mater Misericordiae Children's Hospital. We are conducting research on the types of injuries sustained by young children who ride bicycles. (Two wheeled, non-motorised push bikes). We have particular interest in what protection safety helmets give. Our long term aim is to prevent bicycle related injuries in children by advising the public about factors leading to these injuries and by better design of safety helmets. We need to know more about each incident and in particular whether a safety helmet was worn and what model. Your child is eligible to take part in our study and therefore to help us take steps to reduce such injuries in the future.

WHAT IS INVOLVED

Entry into the project involves a brief interview / questionnaire for a parent. The questionnaire seeks information about you and your family, as well as details about the accident. If a significant injury necessitates hospital admission, one of us will briefly examine your child at a suitable time afterward.

Taking part in this research project is voluntary. Absolute confidentiality is guaranteed for all information received.

The investigators responsible for this research are:-

Dr Caroline Acton	07 - 253 7777	Dr Steve Thomas	07 - 253 6201
Dr Rob Pitt	07 - 840 8323	Dr Ron Clark	07 - 253 7857
Dr Jim Nixon	07 - 365 5322		

Please feel free to contact them at any time.

CONSENT

I ..... hereby consent to the participation of my child in the aforementioned study.

Signature. .....

Date. ..... CODE .....
MCH 1, RCH 2, QE2 3, L 4.

SECTION 3

CHARACTERISTICS OF THE ACCIDENT

In this section we would like you to describe how the accident happened.
Please circle the appropriate response or responses, one or more is possible.

WHAT WERE THE EVENTS INVOLVED IN THE ACCIDENT?

1. Was the main cause of the accident?

Faulty bike	1
Faulty riding	2
Faulty driving of another vehicle	3
Faulty road conditions eg. potholes	4
Avoiding something	5
Unknown	6
Other, please specify	7

2. Did the accident involve contact with a moving object at any stage?

NO contact with a moving object	1
A car	2
A motorbike	3
A truck	4
Another bicycle	5
A pedestrian	6
An animal	7
Other, please specify	8

3. Did the accident involve contact with any of the following at any stage?

A stationary vehicle	1
A post or fence	2
The kerb or gutter	3
The road	4
Other stationary object (specify)	5
None of the above	6

4. What surface did your child fall on to?

Paved road surface (concrete, asphalt)	1
Gravel surface	2
Dirt	3
Grass surface	4
Other please specify	5

5. Was your child a passenger on the bike (a pillion)?

Yes	1
No	2

6. Will the bicycle need repairs to make it safe to ride again?

Yes	1
No	2
Beyond repair	3

7. Was it raining at the time of the accident?

Yes	1
No	2

SECTION 4

CHARACTERISTICS OF THE INJURY

1. Was the major injury caused by?

Impact with another vehicle PRIOR to landing	1
Impact with another vehicle AFTER landing	2
The surface on which the child fell	3
Impact with another object eg. fence, lamp post, kerb, gutter	4
Don't know / not sure	5

2. Please describe in your own words the main injury or injuries sustained.

.....

.....

.....

3. Did your child damage any teeth in the accident?

Yes	1
No	2

4. If yes, were any teeth

Loosened	1
Broken	2
Knocked out	3
Not applicable	4

5. Did your child strike their head in the accident?

Yes	1
No	2

SECTION 5

CHARACTERISTICS OF THE HELMET

1. Does your child own a bicycle helmet? If NO go to section 6.

   Yes 1
   No 2

2. How long has your child owned a bicycle helmet?
   Years / Months ___Y ___M

3. Would you look at the chart and indicate which number corresponds to the type used by your child. _____

4. If not on the chart please insert the makers name.....

5. Was your child wearing a helmet at the time of the accident?

   Yes 1
   No 2

6. If your child was wearing a helmet, did it come off during the accident?

   Yes 1
   No 2
   Not applicable 3

7. Did it slip?

   Yes 1
   No 2

8. Was the helmet buckle done up?

   Yes 1
   No 2
   Not Applicable 3

SECTION 6

GENERAL INFORMATION

In this section we would like to have some background information about parents/partner. Please could one of you answer this section. Under each topic given below, write the number which best describes each of your education occupation etc.

NOTE: We use the word "partner" to cover both marriage and defacto partners.

Please record who is answering this section (Circle a number):

Mother or female partner (1) Father or male partner (2) Other (3)
please specify.....

EDUCATION

Please put the number of your response in the appropriate box.

D1 Highest educational level completed or currently undertaking.

	Male partner	Female partner
(1) Did not complete grade 10		
(2) Did complete grade 10		
(3) Did complete grade 12		
(4) Technical or Teachers' College		
(5) University degree		
(6) Apprenticeship, diploma etc		

EMPLOYMENT

Please put the number of your response in the appropriate box

		Male partner	Female partner
D4	(1) Student		
	(2) Unemployed		
	(3) Part-time		
	(4) Homemaker		
	(5) Full-time		
	(6) Retired		
	(7) Other category		

OCCUPATION

D5 What has been your usual and regular lifetime occupation?
Please be specific. For example: "Administrative service officer 5 in the Public Service" or "Truck Driver with own trucking business".

Male partner _____

Female partner _____

QUEENSLAND INJURY SURVEILLANCE & PREVENTION PROJECT

For all injuries and poisonings

Complete only for FIRST attendance of a particular episode.

HOSPITAL_____

TRIAGE_____

Date: Time: am/pm

WAS THIS PATIENT **TRANSFERRED FROM** ANOTHER HOSPITAL? ..... YES NO

***IF YES**, which hospital_____

AFFIX PATIENT LABEL TO BOTH COPIES

U.R. NUMBER_____ REG. NUMBER_____

SURNAME_____

Given names_____

Address_____

_____ Postcode_____

Telephone_____Home _____Work

Date of Birth_____

Sex_____ Religion_____

Occupation_____

SECTION 1:

1. **When did the injury occur? Date** _____ **Time** _____ AM PM

2. **Where did the injury occur?** For example at home in the bathroom, at Mansfield High School oval, on Ipswich Road, at Apex Industries tooling department, etc

_____

3. **What was the injured person doing at the time he/she was injured?** For example: washing up, playing football, driving a car, making a steel pipe, etc.

_____

4. **Was he/she injured on the job? .....Please tick one** YES NO

   ***IF YES,** i) Does the injured person plan to claim worker's compensation? . . . . . YES NO

   ii) What is the injured person's occupation _____

   iii) In what sort of business is he/she employed? _____

5. **What went wrong?**
   For example: Fell from a tree, lost control of bicycle, spilt coffee, car collided with bus, dropped steel pipe, etc

_____

6. **What actually caused the injury?** For example: landed on concrete, caught hand in lathe, thrown against windscreen, swallowed digoxin pills, etc

_____

7. **Was the injured person using any safety equipment?** For example seatbelt, motorcycle helmet, bike helmet, hard hat, safety glasses, etc. . . . . YES NO

   ***IF YES**, please specify:_____

8. **Was a specific product or article involved?** For example Ricardo 10- speed bike, Black & Decker circular saw model 139, Dettol (small bottle), etc. . . . . YES NO

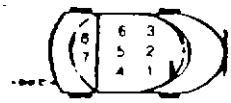
   ***IF YES**, please specify. Include brand name and model, if known

_____

9. **Was a motor vehicle involved? .....** YES NO

   ***IF YES**, please specify make/model/year of vehicle _____

   What seat did the injured person occupy? ....



10. **In order to prevent future injuries, we are collecting details about particular incidents. If we need to, may we contact you for further information?**

    Signature_____ YES NO

SECTION 2: PLEASE COMPLETE THIS SECTION IF THE INJURED PERSON IS A CHILD

1. **Who was looking after the child at the time of the injury?**
   For example mother, sister, teacher, etc _____

2. **Was the child in sight at the time of injury? .....** YES NO

3. **Mother's occupation** _____ **Father's occupation** _____

ACCIDENT & EMERGENCY INJURY SURVEILLANCE

Doctor Doctor's name (print)

Please note: *It is the doctor's responsibility to check that the form has been filled in as completely as possible. Please supplement the description of injury details where necessary — as much detail as possible.*

Complete only for first attendance of a particular episode

1. NATURE OF THE INJURY

☐☐ SEVEREST
☐☐ SECOND
☐☐ THIRD

SELECT UP TO THREE CODES

systemic and special injury
91 poisonings (thru skin/lungs/mouth etc)
93 asphyxiation or respiratory difficulty
94 electric shock
95 over-exertion, heat/cold stress
96 concussion
97 dental injury
99 no injury detected

soft tissue
01 cut/laceration
02 puncture
03 bite
04 superficial abrasion
05 penetrating wound
06 other wound, incl. amputation
07 haematoma/bruising
08 haemorrhage
09 inflammation/oedema/tenderness
10 burn, *full thickness*
11 burn, *partial thickness*
12 foreign body in soft tissues
13 damage to major blood vessel
14 crushing injury

bone, tendon or joint
20 fracture
21 dislocation
22 sprain/strain

2. BODY PART

☐☐☐ SEVEREST
☐☐☐ SECOND
☐☐☐ THIRD

systemic and special injury
000 defined as in Section 1 at left

head
101 eye
102 ocular adnexum
103 nose
104 mouth *external*, e.g. jaw, lip
105 ear
106 face/cheek/forehead/scalp
107 skull *base*
108 skull *vault*
109 neck, NEC
198 other injury to head

upper extremity
201 clavicle
202 scapula
203 shoulder, NEC
204 humerus
205 upper arm, NEC
206 radius, ulna
207 elbow
208 forearm
209 wrist
210 carpal bone
211 metacarpal bone
212 digit/phalanx
213 hand NEC
298 other injury to upper extremity

lower extremity
301 hip
302 femur
303 upper leg, NEC
304 knee
305 tibia/fibula
306 lower leg, NEC
307 ankle
308 tarsal bone
309 metatarsal bone
310 digit/phalanx
311 foot, NEC
398 other injury to lower extremity

trunk
401 rib(s)
402 sacroiliac joint
403 spine (inc cervical), *excluding cord*
404 pelvis
405 chest, NEC
406 abdomen, NEC
407 upper back, NEC
408 lower back, NEC
409 genitalia
410 heart
498 other injury to trunk

respiratory tract
501 pharynx
502 larynx
503 trachea
504 bronchus
505 lung
598 other injury to respiratory tract

digestive tract
601 mouth *internal*, e.g. gum, palate
602 oesaphagus
603 stomach
604 small bowel
605 colon
606 rectum
607 liver
608 spleen
609 injury to other internal organs
698 other injury to digestive tract

nervous system
701 brain, *not concussion*
702 brain stem
703 cervical spinal cord
704 thoracic spinal cord
705 lumbar spinal cord
706 peripheral nerve
798 other injury to nervous system

3. INTENT OF INJURY

☐ SELECT ONE CODE

0 accidental injury (ie unintentional)
1 intentionally self-inflicted or possibly so
2 victim of assault, or possibly so
3 unknown intent

4. WHAT YOU DID WITH YOUR PATIENT

☐☐ SELECT ONE CODE

01 no treatment
02 treated, no referral
10 treated, A & E review
03 treated, referred to outpatients
04 treated, referred to family doctor
05 treated, other referral
06 short-stay observation in Emergency
07 admitted to hospital
08 transferred to other hospital
09 DOA or died in Emergency

Note: NEC means "not elsewhere classified"

SECTION 7

CLASSIFICATION OF THE INJURY

1. PAEDIATRIC TRAUMA SCORE

P.T.S.	+2	+1	-1
WEIGHT	>20Kg.	10-20Kg.	<10Kg.
AIRWAY	Normal	Oral/Nasal	Intubated, tracheostomy invasive
BLOOD PRESSURE	>90mm Hg.	50-90mm Hg.	<50mm Hg.
LEVEL OF CONSCIOUSNESS	Completely awake	Obtunded or any LOC.	Comatose
OPEN WOUND	None	Minor	Major or penetrating
FRACTURES	None	Closed	Open or multiple #'s.

2. TYPE OF SKULL INJURY

None	1
Closed	2
Crush (Massive destruction of cranium and brain)	3
Penetrating	4

3. TYPE OF SCALP INJURY

None	1
Abrasion	2
Contusion	3
Laceration	4

4. SITE OF SKULL INJURY

None	1
Frontal	2
Occipital	3
Parietal	4
Temporal	5
Basal	6
Undefined	7

SECTION 7

5. TYPE OF CRANIAL FRACTURES

No fracture	1
Linear - no displacement	2
Displaced fracture	3
Depressed fracture	4
Multiple fractures (Two or more)	5

6. GLASGOW COMA SCALE <u>ON ADMISSION</u> _____

<u>AFTER 24 HOURS</u> _____

7. DECEASED

At site	1
On arrival at hospital	2
Subsequently as a result of injury/injuries sustained	3
Not deceased	4

8. FACIAL INJURIES

SKIN

None	1
Abrasion	2
Contusion	3
Laceration - minor <10cm & superficial	4
Laceration - major >10cm	5
Laceration - major & into subcutaneous tissues	6

AVULSION OF SKIN

None	1
Minor <25 cm^2	2
Major >25 cm^2	3

EAR(S) (EXTERNAL AURICLE)

None	1
Abrasion/contusion	2
Laceration	3
Avulsion	4

INTRAORAL

None	1
Laceration/contusion gingiva	2
Laceration/contusion tongue	3
Other intraoral laceration/contusion	4

OTHER

Please specify .....

.....

SECTION 7

9. FACIAL FRACTURES

ALVEOLAR RIDGE

None	1
Without injury to teeth	2
With injury to teeth	3

MANDIBLE

None	1
Closed ie. Ramus/condyle	2
Open/compound (Teeth bearing regions)	3

MAXILLA

None	1
Le Fort 1	2
Le Fort 11	3
Le Fort 111	4
Naso-ethmoid	5

NOSE

None	1
Closed	2
Open/displaced/continued	3

ZYGOMATIC/ORBITAL

None	1
Closed	2
Open/displaced/comminuted	3

10. TEMPEROMANDIBULAR JOINT INJURIES

None	1
Sprain	2
Dislocation	3

Bike Study : General Descriptive Paper
Tables

Table 1. Demographic description of subjects.

		Number of subjects	%
Total		813	100.0
Admitting hospital -	Mater Children's	267	33.1
	Royal Children's	180	22.3
	QE2	93	11.5
	Logan	108	13.4
	Redlands	159	19.7
	missing data	6	-
Agegroup -	0 - 4 years	65	8.0
	5 - 9	296	36.4
	≥ 10	452	55.6
Mean age (sd)	9.6 (3.2)		
Sex -	male	607	74.7
	female	206	25.3
Socioeconomic status -	unpaid work/ <= grade 10	45	8.1
	unpaid work/ to grade 12	7	1.3
	unpaid work/ > grade 12	18	3.2
	paid work/ <= grade 10	185	33.1
	paid work/ to grade 12	47	8.4
	paid work/ > grade 12	257	46.0
	missing data	254	-

Table 2a. Characteristics of the accidents - overall.

			Number of subjects	%
Date of accident	-	1991 March	1	0.1
		April	21	2.6
		May	52	6.4
		June	68	8.4
		July	34	4.2
		August	34	4.2
		September	47	5.8
		October	51	6.3
		November	69	8.5
		December	58	7.1
		1992 January	64	7.9
		February	92	11.3
		March	65	8.0
		April	60	7.4
		May	47	5.8
		June	50	6.2
Season	-	Summer	214	26.3
		Autumn	246	30.3
		Winter	186	22.9
		Spring	167	20.5
Time of injury	-	6-9 am	58	7.3
		9am-12pm	95	12.0
		12pm-3pm	189	23.9
		3-6pm	331	41.8
		6pm-6am	118	14.9
		missing data	22	-
Road related	-	No	390	49.6
		Yes	397	50.4
		missing data	26	-
Involved contact with	-	Nil	683	85.9
		Car	42	5.3
		Motorbike	2	.3
		Truck	5	.6
		Another bicycle	47	5.9
		Pedestrian	4	.5
		Animal	3	.4
		Other	9	1.1
		missing data	18	-
Riding pillion	-	Yes	36	6.0
		No	568	94.0
		missing data	209	-
Bicycle needed repair	-	Yes	144	24.8
		No	422	72.6
		Beyond repair	15	2.6
		missing data	232	-
Raining	-	Yes	18	3.6
		No	483	96.4
		missing data	312	-

Table 2b. Main characteristics of the accidents - stratified by agegroup. Missing data excluded.

			0 - 4 years		5 - 9 years		10 - 14 years	
			Number of subjects	%	Number of subjects	%	Number of subjects	%
Date of accident	- 1991	March	0	0.0	0	0.0	1	0.2
		April	2	3.1	5	1.7	14	3.1
		May	6	9.2	16	5.4	30	6.6
		June	7	10.8	19	6.4	42	9.3
		July	2	3.1	16	5.4	16	3.5
		August	2	3.1	14	4.7	18	4.0
		September	1	1.5	22	7.4	24	5.3
		October	3	4.6	14	4.7	34	7.5
		November	3	4.6	25	8.4	41	9.1
		December	12	18.5	22	7.4	24	5.3
	1992	January	2	3.1	25	8.4	37	8.2
		February	7	10.8	42	14.2	43	9.5
		March	5	7.7	19	6.4	41	9.1
		April	4	6.2	16	5.4	40	8.8
		May	3	4.6	19	6.4	25	5.5
		June	6	9.2	22	7,4	22	4.9
Season	-	Summer	21	32.3	89	30.1	104	23.0
		Autumn	20	30.8	75	25.3	151	33.4
		Winter	17	26.2	71	24.0	98	21.7
		Spring	7	10.8	61	20.6	99	21.9
Time of injury	-	6-9 am	2	3.1	19	6.6	37	8.5
		9am-12pm	12	18.5	29	10.0	54	12.4
		12pm-3pm	18	27.7	66	22.8	105	24.0
		3-6pm	26	40.0	131	45.3	174	39.8
		6pm-6am	7	10.8	44	15.2	67	15.3
Road related	-	No	46	73.0	162	57.0	182	41.4
		Yes	17	27.0	122	43.0	258	58.6

Table 3a. Causes of accidents - overall. There may have been several causes for one accident, hence the following are based on number of responses, which may be more than the total number of accidents.

		Number of responses	%
Main cause of accident -	Faulty bicycle	78	9.0
	Faulty riding	511	59.2
	Faulty driving	38	4.4
	Road conditions	57	6.6
	Avoiding something	72	8.3
	Cause unknown	35	4.1
	Other causes	72	8.3
Involved a stationary object -	Vehicle	32	4.0
	Post-fence	40	8.9
	Kerb-gutter	91	11.3
	Road	241	29.9
	Other stationary object	113	14.0
	None of the above	290	35.9
Surface -	Paved	460	57.3
	Gravel	85	10.6
	Dirt	59	7.3
	Grass	105	13.1
	Other	94	11.7

Table 3b. Causes of accidents - stratified by main cause. There may have been several causes for one accident, hence the following are based on number of responses, which may be more than the total number of accidents. Missing data are excluded.

		Faulty riding		Other causes	
		Number of responses	%	Number of responses	%
Involved a stationary object	Vehicle	21	4.3	10	3.3
	Post-fence	24	4.9	14	4.7
	Kerb-gutter	54	11.1	35	11.6
	Road	131	26.9	102	33.9
	Other stationary object	60	12.3	48	45.9
	None of the above	197	40.5	92	30.6
Surface	Paved	266	56.7	188	62.9
	Gravel	40	8.5	41	13.7
	Dirt	42	9.0	16	5.4
	Grass	64	13.6	30	10.0
	Other	57	12.2	24	8.0
Involved contact with	Nil	642	86.9	41	73.2
	Car	35	4.7	7	12.5
	Motorbike	1	0.1	1	1.8
	Truck	3	0.4	2	3.6
	Another bicycle	44	6.0	3	5.4
	Pedestrian	3	0.4	1	1.8
	Animal	3	0.4	0	0.0
	Other	8	1.1	1	1.8
Riding pillion	Yes	33	5.9	3	6.7
	No	526	94.1	42	93.3
Bicycle needed repair	Yes	129	24.0	15	34.1
	No	396	73.7	26	59.1
	Beyond repair	12	2.2	3	6.8
Raining	Yes	16	3.4	2	5.4
	No	448	96.6	35	94.6

Table 4. Characteristics of the injuries. There may have been several injuries, hence the following are based on number of responses, which may be more than the total number of subjects.

			Number of responses	%
Cause of injury	-	Impact w another vehicle prior to landing	60	7.0
		Impact w another vehicle after landing	6	.7
		Surface on which fell	522	60.6
		Impact with another object	224	26.0
		Unknown cause	24	2.8
		? code 6	25	2.9
Type of injury	-	Bone-tendon-joint	317	23.4
		Soft tissue	943	69.6
		Systemic & special	94	6.9
		Other	1	0.1
Body part	-	Face	315	23.7
		Head	97	7.3
		Neck	8	.6
		Upper extremity	455	34.2
		Lower extremity	349	26.2
		Trunk	80	6.0
		Respiratory tract	1	.1
		Digestive tract	23	1.7
		Nervous system	1	.1
		Systemic & special	1	.1
Teeth	-	Loosened	24	3.0
		Broken	20	2.5
		Knocked out	15	1.9
		Not applicable	742	92.6
Head struck	-	Yes	294	46.0
		No	345	54.0
Severity of injury (PTS)	-	≤ 8	33	21.6
		9	29	19.0
		10	45	29.4
		11	35	22.9
		12	11	7.2

Table 5. Helmet wearing.

			Number of subjects	%
Own a helmet	-	Yes	519	80.2
		No	128	19.8
		missing data	166	-
Median months (range) owned helmet prior 01-07-91		17.0 (1,103)		
Wearing helmet at time of accident	-	Yes	335	42.7
		No	450	57.3
		missing data	28	-
Helmet came off	-	Yes	20	2.8
		No	232	33.0
		Not applicable	450	64.1
		missing data	111	-
Helmet slipped	-	Yes	30	4.3
		No	210	30.3
		Not applicable	454	65.4
		missing data	119	-
Buckle done up	-	Yes	234	33.4
		No	14	2.0
		Not applicable	452	64.6
		missing data	113	-

	Total	Head struck	Head not struck
Median PTS (range)	10 (3,12)	10 (3,12)	10 (5,12)
Median Glasgow (range)	15 (5,15)	15 (5,15)	15 (15,15)
Median 4h Glas (range)	15 (3,15)	15 (3,15)	15 (15,15)

Table 6. Proportion of head injuries before and after legislation on helmet use.

	Before 01-07-91		From 01-07-91	
	Total subjects	% with head injury	Total subjects	% with head injury
Owned a helmet				
yes	70	10.0	449	8.3
no	43	16.3	85	18.8
Wearing helmet				
yes	34	5.9	301	6.3
no	103	11.7	347	14.4
Helmet came off				
yes	4	0.0	16	18.8
no	25	8.0	207	5.3
Helmet slipped				
yes	4	25.0	26	11.5
no	23	4.3	187	4.3
Buckle done up				
yes	22	9.1	212	6.6
no	3	0.0	11	0.0