ORIGINAL ARTICLE

The Epidemiology of Paediatric Hand Injuries Treated in Emergency Departments in Foshan City, South China

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ABSTRACT

Objective: *The objective of the study was to investigate the epidemiology of paediatric hand injuries treated in emergency departments (EDs) in Foshan City, as well as to supply data for the development of preventive strategies in South China and similar developing areas.*

Methods: *From July 2010 to June 2011, a multicentre study was prospectively designed and conducted in five large hospital EDs in Foshan. An anonymous questionnaire was specially designed for data collection.*

Results: *A total of 317 (95.48%) subjects with paediatric hand injuries completed questionnaires within the one-year study period. Most subjects were injured at home or work (40.69% vs 36.60%). The majority of paediatric hand injuries occurred in daily activities (164, 51.74%) or were caused by crushing (144, 45.43%). There were significant statistical differences among age groups and places of occurrence ($p < 0.05$). Most subjects got their fingers injured (174, 54.89%). About 116 (36.59%) subjects were injured while at work and 106 (91.38%) subjects had medical insurance. About 59 (50.86%) subjects had < 0.5 year of job tenure. However, only less than half of the subjects (46.55%) had the related experience of safety training. Upon the occurrence of hand injuries, the subjects had been working for 4.49 ± 3.05 hours without rest. Among them, 19 (5.99%) subjects were younger than 16 years old and should not be employed, according to the Chinese labour law.*

Conclusions: *Epidemiology data enhance our knowledge of paediatric hand injuries and facilitate prevention and treatment in the future, thus reducing loss of hand function as well as psychological and economic burden.*

Keywords: Emergency department, epidemiology, hand injury, paediatric

La Epidemiología de las Lesiones de Mano Pediátricas Tratadas en Departamentos de Emergencia en la Ciudad de Foshan, al Sur de China

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RESUMEN

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Objetivo: *El objetivo del estudio fue investigar la epidemiología de las lesiones de mano pediátricas tratadas en departamentos de emergencias (DE) en la ciudad de Foshan, así como suministrar datos para el desarrollo de estrategias preventivas en el sur de China y áreas de desarrollo similar.*

Métodos: *De julio de 2010 a junio de 2011 de junio, se diseñó y realizó prospectivamente un estudio multicéntrico en cinco DE hospitalarios mayores de Foshan. Un cuestionario anónimo fue especialmente diseñado para la recolección de datos.*

Resultados: *Un total de 317 (95.48%) sujetos con lesiones de mano pediátricas completaron cuestionarios dentro del período de estudio de un año. La mayoría de los sujetos recibieron lesiones en el hogar o en el trabajo (40.69% vs 36.60%). La mayoría de las lesiones de mano pediátricas ocurrieron en actividades diarias (164, 51.74%) o fueron causadas por aplastamiento (144, 45.43%). Hubo diferencias estadísticas significativas entre los grupos por edad y los lugares de ocurrencia ($p < 0.05$). La mayoría de los sujetos se lesionaron los dedos (174, 54.89%). Alrededor de 116 (36.59%) sujetos resultaron heridos durante el trabajo y 106 (91.38%) sujetos tenían seguro médico. Alrededor de 59 (50.86%) sujetos tenían < 0.5 año de permanencia en el empleo. Sin embargo, sólo menos de la mitad de los sujetos (46.55%) tenían experiencia en relación con entrenamiento de seguridad. Cuando ocurrieron las lesiones en las manos, los sujetos habían estado trabajando por 4.49 ± 3.05 horas sin descanso. Entre ellos, 19 (5.99%) sujetos tenían menos de 16 años de edad, y no debían estar empleados de acuerdo con las leyes laborales en China.*

Conclusiones: *Los datos epidemiológicos mejoran nuestro conocimiento sobre las lesiones de mano pediátricas, y facilitan la prevención y el tratamiento futuros, reduciendo así la pérdida de la función de la mano y la consiguiente carga psicológica y económica.*

Palabras clave: Departamento de emergencias, epidemiología, lesión de la mano, pediátrica

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INTRODUCTION

Hand injuries are a major cause of morbidity and expense, both in China and the rest of the world (1–6). Severe hand injuries can lead to permanent loss of function and psychological and economic burden (7). The annual rates of hand injuries in the Netherlands and Denmark are as high as 1.8% and 2.6%, respectively (8). There are 663 hand fractures per 100 000 children, aged 10 to 16 years old in England (9). In the United States of America, studies have shown from 382 to 464 paediatric patients being treated for hand injuries annually in each urban emergency department [ED] (7).

Though hand injuries are a global burden, there are no authoritative prevention guidelines, and little research about the epidemiology of paediatric hand injuries have been done in China or other developing areas. Understanding the epidemiology of paediatric hand injuries is important for the development of effective prevention strategies. Here, we conducted a prospective study to identify the epidemiology of paediatric hand injuries treated in emergency departments (EDs) in Foshan City, as well as to supply data for the development of preventive strategies in South China and similar developing areas.

SUBJECTS AND METHOD

Foshan City is located in the mid-south of Guangdong Province, South China. It governs five districts, namely, Chancheng District, Nanhai District, Shunde District, Gaoming District and Sanshui District. The city covers a total area of 3848.49 km^2 and has a population of over 5.923 million, including 3.611 million registered permanent residents. There are five large hospital EDs in every district (Chancheng District Foshan Hospital of Traditional Chinese Medicine (TCM), Nanhai District TCM Hospital, Shunde District Longjiang Hospital, Gaoming District People's Hospital and Sanshui District People's Hospital, respectively). These hospitals assess approximately 80 000 patients per year in each ED. A multicentre study was prospectively designed and conducted in these five large hospital EDs from July 2010 to June 2011.

Patient selection

All children, aged younger than 18 years with at least one or more of the following types of injury to the fingers, hand or wrist, were included: laceration, crush, avulsion, puncture, fracture, contusion, amputation, or dislocation. Informed, verbal consent was obtained

for the eligible subjects and their guardians when they attended the ED. The subjects and their guardians who agreed to participate in the study provided the related information to the investigators.

Exclusion criteria

Subjects or their guardians who: (1) were combined (SOMETHING SEEMS MISSING) other fatal polytrauma; (2) refused emergency doctors' advice; (3) left the ED against medical advice, were excluded from the study.

Data collection

An anonymous questionnaire (Appendix 1) was specially designed to collect the data, including the background demographic data, detailed exposure information, assessments of hand injuries and insurance status. If the hand injuries occurred at work, the occupational information was recorded, including the training record, mechanism of injury, average wage, and so on. Twenty non-medical investigators received a six-hour course of investigation training. Then, the investigators asked the subjects and their guardians the questions according to the questionnaire in the ED. They also assisted them in completing the questionnaire which was written in Chinese in order to avoid unnecessary semantic misunderstanding.

Ethics approval

The study was approved by the Ethics Committee of Foshan Hospital of Traditional Chinese Medicine and all aspects of the study complied with the Declaration of Helsinki. The Ethics Committee of Foshan Hospital of Traditional Chinese Medicine specifically approved with no requirement of written, informed consent because patients' records and information were going to be analysed, anonymously.

Statistical analyses

Data were entered into a Microsoft Excel database and analysed by using SPSS 13.0 (SPSS, Chicago, Illinois, USA). With descriptive statistics, numerical variables were expressed as mean ± standard deviation (SD), while categorical variables were expressed as frequency (n) and percentage (%). Categorical variables were compared using Chi-square. Differences were considered statistically significant at a level of $p < 0.05$.

RESULTS

Demographics

In this study, a total of 332 Chinese subjects with paediatric hand injuries were assessed by emergency physicians in EDs, and 317 (95.48%) of them met the study inclusion criteria (mean age 11.09 ± 5.95 years, range 0.75–17 years, 73.82% male). They were divided into groups according to gender, age group, handedness, medical insurance status, disposition, and so on. About 126 (39.75%) subjects were aged between 16 and 17 years old. There were 298 (94.00%) subjects who had medical insurance. When paediatric hand injury occurred, 195 (61.52%) subjects arrived at the ED, 30 minutes after onset of injury and 166 (52.36%) subjects met the (SOMETHING SEEMS MISSING) indication for emergency hand surgery on admission (Table 1).

Table 1: General characteristics of the subjects with paediatric hand injuries

Characteristics	n (%)
Gender	
Male	234 (73.82)
Female	83 (26.18)
Age group	
0–5 year	85 (26.81)
6–10 year	46 (14.51)
11–15 year	60 (18.93)
16–17 year	126 (39.75)
Social security	
Medical insurance	298 (94.00)
None	18 (5.68)
Other	1 (0.32)
Education level	
Illiterate	20 (6.31)
Primary school	157 (49.53)
Secondary school	140 (44.16)
Post-secondary and above	0 (0.00)
Handedness	
Right	302 (95.27)
Left	13 (4.10)
Both	2 (0.63)
Interval from the injury onset to ED arrival	
< 30 minute	195 (61.52)
30–60 minutes	59 (18.61)
60–120 minutes	24 (7.57)
> 120 minute	39 (12.30)
Disposition	
Treatment and release	139 (43.85)
Admission	166 (52.36)
Transfer to another hospital	9 (2.84)
Discharge against medical advice	3 (0.95)
Total	317 (100.00)

Characteristics of injuries

Most subjects were injured at home or work (40.69% *vs* 36.60%). The majority of paediatric hand injuries occurred in daily activities (164, 51.74%) and 144 (45.43%) subjects' injuries were caused by crushing. Only eight (2.52%) subjects were injured by traffic accidents.

Table 2: Characteristics of the injuries

Characteristics	n (%)
Place of injury (n = 317)	
Work	116 (36.59)
Home	129 (40.70)
Street or road	26 (8.20)
Sports venue	9 (2.84)
Other	37 (11.67)
Cause of injury (n = 317)	
Injury by traffic accident	8 (2.52)
Injury by daily activity	164 (51.74)
Injury by other people	8 (2.52)
Self-injury	10 (3.16)
Occupational injury	116 (36.59)
Other	11 (3.47)
Mechanism of injury (n = 317)	
Crushing	144 (45.43)
Cutting	32 (10.09)
Laceration	42 (13.25)
Contusion	48 (15.14)
Other specified (puncture, tearing, strains, sprains, burning, sawing, fall)	34 (10.73)
Other unspecified	17 (5.36)
Injury site (n = 317)	
Wrist	67 (21.13)
Hand	62 (19.56)
Finger	174 (54.89)
Multiple	14 (4.42)
Injury finger (n = 183)	
Thumb	45 (24.59)
Index	48 (26.23)
Long	31 (16.94)
Ring	14 (7.65)
Little	7 (3.83)
Multiple	38 (20.76)
Injury hand (n = 317)	
Right	174 (54.89)
Left	139 (43.85)
Both	4 (1.26)

Most subjects got their fingers injured (174, 54.89%). The thumb and index fingers were more prone to be injured, especially on the right hand. The injured sites were associated with gender or age differences, but to place of occurrence ($p > 0.05$). There were significant differences between age groups and the place of occurrence ($p < 0.05$). In the 16–17-year age group, 97 (76.98%) subjects' hand injuries occurred at work. In other age groups, most injuries occurred at home (Tables 2, 3, 4).

The epidemiology of occupational hand injuries in children

In this study, 116 (36.59%) subjects were injured at work (mean age 16.31 ± 0.87 years, range 14–17 years, 80.17% male). However, 19 (5.99%) subjects, aged younger than 16 years, got occupational hand injuries (mean age 14.68 ± 0.48 years, range 14–15 years, 73.68% male). Children below age 16 years are not allowed to be employed, according to the Chinese labour laws.

Among these 116 subjects, about 106 (91.38%) subjects had medical insurance and 59 (50.86%) subjects had < 0.5 years of job tenure. However, only less than

Table 3: Comparison of injury sites with regard to gender, age groups and place of injury

Variable	Injury site				*p*-value
	Wrist n = 67 n (%)	Hand n = 62 n (%)	Finger n = 174 n (%)	Multiple n = 14 n (%)	
Gender					
Male	51 (21.79)	43 (18.38)	127 (54.27)	13 (5.56)	0.319
Female	16 (19.28)	19 (22.89)	47 (56.63)	1 (1.20)	
Age group					
0–5 year	15 (17.65)	22 (25.88)	47 (55.29)	1 (1.18)	
6–10 year	11 (23.91)	10 (21.74)	24 (52.17)	1 (2.18)	0.159
11–15 year	18 (30.00)	8 (13.33)	32 (53.34)	2 (3.33)	
16–17 year	23 (18.25)	22 (17.46)	71 (56.35)	10 (7.94)	
Place of injury					
Work	20 (17.24)	17 (14.66)	72 (62.07)	7 (6.03)	
Home	28 (21.71)	32 (24.80)	67 (51.94)	2 (1.55)	
Street or road	13 (50.00)	1 (3.85)	11 (42.30)	1 (3.85)	0.003
Sports venue	1 (11.11)	2 (22.22)	6 (66.67)	0 (0.00)	
Other	5 (13.51)	10 (27.03)	18 (48.65)	4 (10.81)	

Table 4: Comparison of place of injury according to age group

Age group	Place of injury					*p*-value
	Work n = 116 n (%)	Home n = 129 n (%)	Street or road n = 26 n (%)	Sports venue n = 9 n (%)	Other n = 37 n (%)	
0–5 year	0 (0.00)	66 (77.65)	9 (10.59)	1 (1.17)	9 (10.59)	
6–10 year	0 (0.00)	25 (54.35)	8 (17.39)	4 (8.70)	9 (19.56)	< 0.001
11–15 year	19 (31.67)	26 (43.33)	4 (6.67)	0 (0.00)	11 (18.33)	
16–17 year	97 (76.98)	12 (9.52)	5 (3.97)	4 (3.18)	8 (6.35)	

half of the subjects (46.55%) had the related experience of safety training. Regarding the educational levels, the majority graduated from secondary schools (93, 80.17%). The majority received an annual wage from $2000 to $4000 (99, 85.35%). Most subjects worked at private enterprises (110, 94.84%). The subjects had received about 44.50 ± 27.59 hours of safety training before manipulation and they had 0.99 ± 1.65 years of working experience on average. When hand injury occurred, they had been working for 4.49 ± 3.05 hours without rest (Table 5).

Table 5: General characteristic of occupational hand injuries in children

Characteristics	n (%)
Gender	
Male	93 (80.17)
Female	23 (19.83)
Age group (years)	
14–15 year	19 (16.38)
16–17 year	97 (83.62)
Social security	
Medical insurance	106 (91.38)
None	10 (8.62)
Job category	
Metal machinery	41 (35.35)
Food handling	11 (9.48)
Maintenance/repair	12 (10.35)
Wood work	2 (1.72)
Construction	2 (1.72)
Textile	16 (13.79)
Printing	3 (2.59)
Others	29 (25.00)
Job tenure	
< 0.5 year	59 (50.86)
0.5–1 year	34 (29.31)
> 1 year	23 (19.83)
Experience of safety training	
Yes	54 (46.55)
No	62 (53.45)
Education level	
Illiterate	7 (6.03)
Primary school	16 (13.80)
Secondary school	93 (80.17)
Post-secondary and above	0 (0.00)
Annual wage	
< $2000	9 (7.76)
$2000–$3000	51 (43.97)
$3000–$4000	48 (41.38)
$4000–$6000	7 (6.03)
> $6000	1 (0.86)
The nature of enterprise	
Private enterprises	110 (94.84)
State-owned enterprise	2 (1.72)
Foreign-funded enterprise	1 (0.86)
Joint venture	2 (1.72)
Collective enterprise	1 (0.86)
Interval from the injury onset to ED arrival	
< 30 minute	72 (62.07)
30–60 minutes	22 (18.96)
60–120 minutes	8 (6.90)
> 120 minute	14 (12.07)
Disposition	
Treatment and release	35 (30.17)
Admission	73 (62.93)
Transfer to another hospital	5 (4.31)
Discharge against medical advice	3 (2.59)
Total	**116 (100.00)**

DISCUSSION

To the best of our knowledge, this is the first study to describe the epidemiology of paediatric hand injuries in South China. At present, there is no authoritative guideline on the prevention of hand injuries in China (6). Therefore, our study provides useful information for the development of strategies to help reduce the risks of paediatric hand injuries. The social and economic impact of hand injuries on the society highlights the importance of prevention of these injuries.

Several studies have reported the epidemiology and prevention of paediatric hand injuries in the developed countries. For example, in Turkey, hand injuries occur mostly in male children, the most frequent type of injury is accidental domestic injury of the wrist flexor tendon caused by broken glass fragments and the most frequently injured digit is the fourth (10). In Spain, children at age 6 to 14 years are more likely to sustain hand injuries while playing sports than at home (11). In Britain, fractures to the hand among children in the sports scene, specifically ball games, occur more frequently than at home (12). In Scotland and Sweden, jamming is the most common mechanism of finger injury in paediatric populations and safety measures specific to this mechanism of injury were suggested (13, 14).

In our study, hand injuries occurred mostly in male children, and the most frequent type of injury was crushing caused by daily activities at home and work. Few subjects sustained hand injuries while playing sports, which was inconsistent with most other research in Western developed countries. As is well known, China is a developing country and many children are forced by their poor families to drop out of school and earn money. We noticed that 116 (36.59%) subjects got occupational hand injuries in this study. The proportion of occupational hand injuries was larger in South China than in the western countries. Among them, 19 (5.99%) subjects were below age 16 who should not be employed,

according to the Chinese labour law. Luckily, most subjects have medical insurance which is guaranteed, and supported by the government ensuring adequate medical treatments.

Based on our study, prevention strategies in children who are younger than 15 years old should focus on the specific consumer products/activities at home that are most frequently associated with injury (*eg*, doors and knives). The law prohibits enterprises employing workers under 16 years old in China. The related health and labour administration departments should improve their supervision and make all enterprises follow the law absolutely.

Meanwhile, children who are above age 15 years should pay more attention to the occupational prevention strategies. Based on our study, we provide four suggestions: Firstly, all Chinese enterprises must provide basic medical insurance for employees according to the national labour law. Secondly, safety training must be compulsory. All workers should undertake some courses of safety training and education frequently. The responsible health and labour administration departments should provide authoritative guidelines about the education, and set-up some risk assessment tools for identification of potential hazards in the workplace. Thirdly, enterprise managers should improve the working environment and make a scientific work-rest schedule, and decrease the chance of making rush production orders. Fourthly, enterprises should be encouraged to improve the technologies and engineering safety devices, and so decrease the risks of occupational trauma.

Nevertheless, our study has some limitations. We investigated the paediatric subjects with hand injuries treated in the EDs, which would underestimate the actual incidence of injuries since some subjects do not present to the EDs. An anonymous questionnaire was specially designed for data collection. The investigators could not recognize the same subjects who returned to the ED due to reoccurrence and these subjects have been re-investigated.

CONCLUSIONS

Epidemiology data enhance our knowledge of paediatric hand injuries and facilitate the prevention and treatment in the future, and thus, reduce loss of hand function as well as psychological and economic burden.

AUTHORS' NOTE

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All authors of this manuscript have no competing interests to declare.

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APPENDIX 1

Acute Traumatic Hand Injuries Questionnaire in Foshan City
Foshan Hospital of Traditional Chinese Medicine (FSTCM)

Name: Gender: Age: Tel:

1. Date of injury: _____
   Day of the week: _____
   Interval from the hand injury onset to ED arrival: _____minute
   Disposition: A. Treatment and release B. Admission
   C. Transfer to another hospital
   D. Discharge against medical advice

( ) 2. Cause of injury:
A. Traffic accident B. Activity of daily life
C. Injury by other people D. Self-injury
E. Occupational injury F. Other

( ) 3. Place of injury:
A. At work B. At home C. On streets or roads
D. Sports venue E. Other

( ) 4. Place of work (District):
A. Chancheng B. Shunde C. Nanhai D. Gaoming
E. Sanshui F. Other

( ) 5. Has the patient taken the treatment in another hospital?
A. Yes B. No

( ) 6. Handedness:
A. Left-hander B. Right-hander C. Both hands

( ) 7. Injury hand:
A. Left B. Right

( ) 8. Type of injury:
A. Crushing B. Cutting C. Laceration
D. Contusion E. Other specified
(puncture, tearing, strains, sprains, burning, sawing, fall)
F. Other unspecified

( ) 9. Injury site:
A. Wrist B. Hand C. Finger (Multiple choice)

( ) 10. Injury finger:
A. Thumb B. Index C. Long D. Ring
E. Little (Multiple choice)

( ) 10. Injury finger:
A. Thumb B. Index C. Long D. Ring E. Little
(Multiple choice)

( ) 11. Education level:
A. Illiterate B. Primary school C. Secondary school
D. Post-secondary and above

( ) 12. Social security:
A. Medical insurance B. None C. Other

( ) 13. If the injury is an occupational hand injury, please choose from these items:

( ) 1) Job category:
A. Metal machinery B. Food handling
C. Maintenance/repair D. Wood work
E. Construction F. Textile
G. Printing H. Other:_____

( ) 2) Cause of injury:
A. Pure accident B. No protection
C. Faulty machine D. Distraction
E. Unfamiliar with machine F. Poor cooperation
G. Fatigue H. No idea (Multiple choice)

( ) 3) Experience of safety training:
A. Yes Safety training ____ hours B. No

( ) 4) When the hand injury occurred, patient had been working ____ hours

( ) 5) Working experience: _____years

( ) 6) Nature of enterprise:
A. Private enterprise B State-owned enterprise
C. Foreign-funded enterprise D. Joint venture
E. Collective enterprise F. Other

( ) 7) Annual wage:
A. <$2,000 B. $2,000-$3,000
C. $3,000-$4,000 D. $4,000-$6,000
E.>$6,000