

INTERNATIONAL SURGERY

Causes of hand injuries in a developing country

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Background: In emerging economies such as Nigeria, trauma and hand injuries in particular are on the rise. The aim of this study was to document the causes of hand injuries in Nigeria.

Methods: This was a prospective study conducted between Aug. 1, 2006, and July 31, 2007. We obtained objective information about patient demographic data, occupation, dominant and injured hand, and place and cause of injury. We assessed injury severity using the Hand Injury Severity Score (HISS).

Results: A total of 74 patients with hand injuries were included. The male:female ratio was 1.8:1, and the average age was 26.9 years. Most patients were right-hand dominant, and 56.8% of injuries affected the dominant hand. Engineers and technicians represented 27% of patients with hand injuries, which was the largest group encountered during the study. Most cases occurred because of road traffic injuries, followed by machine injuries. Injuries commonly occurred at the work place and on the road. In total, 57.1% of patients with mechanical injuries were admitted to hospital. The majority received minor surgical treatment, and 16.2% had a digit amputated. The average HISS was 54.35. In total, 64.8% of the injuries were classified as minor or moderate. Sixty percent of admissions were patients with a HISS of severe or major injury.

Conclusion: Hand injury in this part of the world is commonly due to road traffic collisions and machine accidents, and the injuries are usually severe. Hand injuries are commonly seen among technicians and civil or public servants; these people constitute the economic work force.

Contexte : Dans les pays émergents, comme au Nigeria, par exemple, le nombre de traumatismes, et de blessures à la main en particulier, augmente. Le but de la présente étude était de documenter les causes des blessures à la main au Nigeria.

Méthodes : Il s'agit d'une étude prospective réalisée entre le 1er août 2006 et le 31 juillet 2007. Nous avons obtenu des données objectives sur les caractéristiques démographiques des patients, leur occupation, leur main dominante et leur main blessée, ainsi que le lieu et la cause de leur blessure. Nous avons évalué la gravité des blessures à l'aide de l'indice de gravité des blessures à la main HISS (Hand Injury Severity Score).

Résultats : L'étude a regroupé en tout 74 patients victimes de blessures à la main. Le rapport hommes:femmes était de 1,8:1 et l'âge moyen était de 26,9 ans. Pour la plupart des patients, la main droite était la main dominante et 56,8 % des blessures affectaient cette main. Les ingénieurs et les techniciens représentaient 27 % des patients blessés à la main et formaient le groupe le plus nombreux parmi les blessés au cours de cette étude. La plupart des blessures sont survenues lors d'accidents de la route, suivis des accidents de nature mécanique. Ces blessures sont souvent survenues au travail ou sur la route. En tout, 57,1 % des patients victimes de blessures mécaniques ont été hospitalisés. La majorité d'entre eux ont subi un traitement chirurgical mineur et 16,2 % ont dû se faire amputer un doigt. Le score HISS moyen était de 54,35. En tout, 64,8 % des blessures ont été jugées mineures ou modérées. Soixante pour cent des hospitalisations concernaient des patients dont le score HISS correspondait à des blessures graves ou majeures.

Conclusion : Les blessures à la main dans cette région du monde sont souvent causées par des accidents de la route ou des accidents impliquant de la machinerie, et les blessures sont généralement graves. Les blessures à la main s'observent souvent chez des techniciens ou des fonctionnaires; or, ces gens représentent le moteur de l'économie.

Hand injuries constitute a major proportion of injuries seen in many hospitals worldwide.¹ The occurrence is on the rise, especially because there is a general increase in violence and injuries in emerging economies such as Nigeria.²

Injuries to the hand are often neglected, especially when they occur in combination with injuries to other parts of the body. Hand injuries occur mainly among young adults.^{1,3} Many of these injuries affect the dominant hand,^{4,5} thereby impeding patients' ability to work or cope with their social obligations.^{1,6} Hand injuries mainly occur on the road, in the work place and at home.^{1,3,5,7} Often great social and economic losses are encountered because of these injuries.⁶ Severe hand injuries are usually due to gunshot or machine injuries and often require admission and surgical intervention.^{1,5} A large proportion are minor injuries.³ The severity of a hand injury can be readily assessed by use of the Hand Injury Severity Score (HISS) developed by Campbell and Kay.⁸

Because surgical intervention looks to evidence-based practice to improve patient care, it is important to determine the causes of hand injuries in this environment. This study was geared toward reducing the incidence and severity of hand injuries in our society.

METHODS

We performed a prospective study from Aug. 1, 2006, to July 31, 2007. All patients with hand injuries who presented to the National Hospital, the main tertiary health facility in the Nigerian capital of Abuja, were evaluated. We excluded patients who did not complete their treatment in this hospital or whose forms were incomplete.

On-call surgeons saw the patients in the accident and emergency unit or surgical clinic. The emergency department doctors or surgical residents obtained objective information from the patients and filled it into a form designed for this study. The information obtained included demographic data, occupation, dominant and injured hand, and place and cause of injury. Workplace hand injury included those occurring in offices, farms and factories as well as in vehicular collisions involving commercial drivers. The duration of injury and the components of the hand involved were obtained from the operation notes. We studied the area that extends from the distal end of the carpal bones to the tip of the fingers (zones 1–3; Fig. 1). We did not include wrist and forearm (zones 4 and 5) injuries. Other types of injuries and duration of hospital stay were also recorded.

We assessed injury severity by use of HISS. This is an objective assessment of the integument, skeletal, motor and neural components of the hand. The injured components are described for each ray. Each digit and its corresponding metacarpal bone was given a numerical score, which varied according to the degree of functional importance of the digit. The thumb was given a weighted score of 6, the

long and ring fingers were given weighted scores of 3, and the index and little finger were each given a weighted score of 2. Palmar surface injuries were given double the score of extensor surface injuries.^{5,8} Four grades of increasing severity of hand injury are described: minor (HISS score < 20), moderate (score 21–50), severe (score 51–100) and major (score > 100). Data collation and analysis were compiled using SPSS version 11.0.

RESULTS

During the study period, 1096 cases of trauma were seen in the accident and emergency unit; of these, 80 were hand injuries. We included 74 patients and excluded 6. Of the included patients, 48 (64.9%) were men and 26 (35.1%) were women. The percentage of hand injuries out of the total number of trauma patients was 7.2%. The ratio of men to women was 1.8:1, and the mean age was 26.9 (range 2–51) years. In total, 66 patients (89.2%) were right-handed and 8 (10.8%) were left-handed. Injury to the right hand occurred in 34 (45.9%) patients, and injury to the left hand was seen in 32 (43.2%) patients. Injury to both hands was noted in 8 (10.8%) patients. The dominant hand was injured in 42 (56.8%) cases. Injury involving only the hand occurred in 52 (70.3%) patients and combined hand and other system injury occurred in 29.7% of cases.

Engineers and technicians were most often affected (20 patients [27%]). This was followed by civil or public servants (18 patients [24.3%]). Eight of the patients (10.8%) were toddlers or security operatives (Table 1). Overall, 60% of the engineers and technicians were injured by a machine accident, whereas 100% of the security operatives'

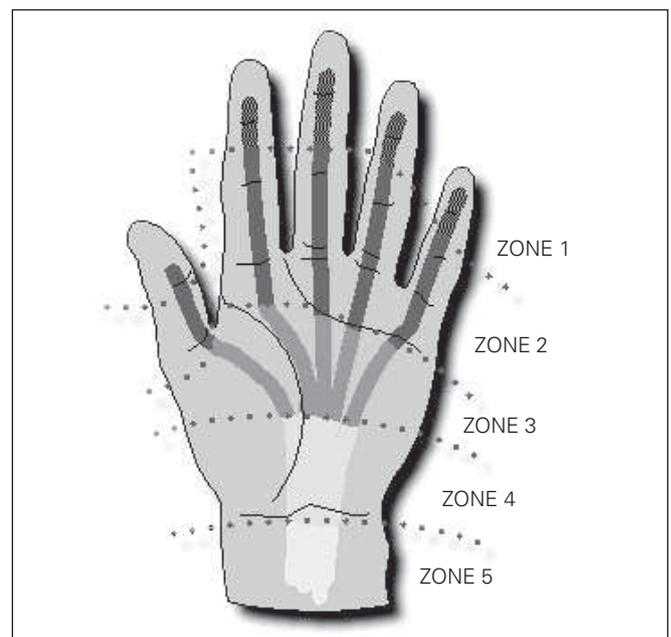


Fig. 1. Zones of the hand.

injuries were due to gunshot. Most of the civil and public servants were injured during motor vehicle collisions (55%) (Table 1).

The majority of injuries occurred during motor vehicle collisions (22 patients [29.7%]), followed by machine injuries (14 patients [18.9%]). In addition, 4 patients sustained burns (5.4%), and 4 patients sustained ring entrapment injury; none of them experienced vascular complication as a result of prompt release of the ring (Table 1). The average duration from time of injury to time of release of the ring was 5.7 hours. Other causes of injury include gunshot, glass cut, fall and assault.

A substantial proportion of injuries occurred on the road (22 patients [29.7%]) in motor vehicle collisions with no record of pedestrian involvement. The same number of injuries occurred in the workplace (22 patients [29.7%]). Home injuries were seen in 20 patients (27%). In total, 72% of work place injuries occurred among technicians. Public servants made up 45% of professionals who sustained their injury on the road way. Injuries to toddlers all occurred at home (Table 2).

Injuries in the work place were largely due to machine accidents (64%). A major proportion (40%) of injuries sustained at home were due to a glass or knife cut. Of the motor vehicle accidents, 100% occurred on the road (Table 3).

A total of 30 (40.5%) patients were admitted to hospital. The mean time between injury and admission was 23.3 hours. The average time between injury and admission for machine injury was 4.8 hours. In addition, 12 patients (54.5%) with injuries from a motor vehicle collision were admitted, and 8 patients (57.1%) with mechanical injuries were admitted. All 8 patients with gunshot injuries were admitted. Two patients with burns were admitted to hospital; none of the other patients were admitted.

The hand is divided into zones of flexor tendons. Thirty-four (45.9%) patients sustained injury within zone 3. There were 18 patients (24.3%) injured in zone 2. There were 6 (8.1%) injuries to zone 1. There were 15 (21.5%) injuries that affected more than 1 zone. All gunshot injuries were in zone 3 (Fig. 2). Burn injuries affected all zones. Ring entrapment injury occurred only in zone 2.

Various forms of treatment were given. Minor treatment included wound dressing and suturing of minor lacerations under local anesthesia, all of which were performed in the minor trauma operating room (34 patients [45.9%]). Surgical repair, involving tendon repairs and skin grafting accounted for 10 injuries (13.5%). Twelve patients (16.2%) had amputation or refashioning of amputation stumps. Twenty-four patients (32.4%) had bony injuries that required open or closed internal fixation.

Table 1. Distribution of hand injuries by profession

Cause of injury	Profession; no. (%) of patients						
	Business/ trade	Engineering/ technician	Public service	Security operative	Scholar	Mandatory youth service	Toddler
Motor vehicle	4 (50.0)		10 (55.6)		6 (42.9)	2 (33.3)	
Gunshot	2 (25.0)	2 (10.0)		4 (100.0)			
Glass cut		2 (10.0)	4 (22.2)				2 (50)
Machine	2 (25.0)	12 (60.0)					
Burns		2 (10.0)					2 (50)
Ring entrapment		2 (10.0)				2 (33.3)	
Fall			2 (11.1)		8 (57.1)	2 (33.3)	
Assault			2 (11.1)				
Total	8 (10.8)	20 (27.0)	18 (24.3)	4 (5.4)	14 (18.9)	6 (8.1)	4 (5.4)

Table 2. Relation between profession and place of injury

Profession	Place; no. (%) of injuries				
	Workplace	Home	Road	School	Public place
Business	2 (9.1)	2 (10.0)	4 (18.2)		
Technician	16 (72.7)	4 (20.0)			
Public service		6 (30.0)	10 (45.5)		2 (100.0)
Security operative	4 (18.2)				
Scholar			6 (27.3)	8 (100.0)	
Mandatory youth service		4 (20.0)	2 (9.1)		
Toddler		4 (20.0)			
Total	22 (29.7)	20 (27.0)	22 (29.7)	8 (10.8)	2 (2.7)

Table 3. Relation between place of injury and cause

Cause of injury	Place; no. (%) of injuries				
	Workplace	Home	Road	School	Public place
Motor vehicle			22 (100.0)		
Gunshot	6 (27.3)	2 (10.0)			
Glass cut		8 (40.0)			
Machine	14 (64.3)				
Burns	2 (9.1)	2 (10.0)			
Ring entrapment		4 (20.0)			
Fall		2 (10.0)		8 (100.0)	2 (100.0)
Assault		2 (10.0)			
Total	22 (100.0)	20 (100.0)	22 (100.0)	8 (100.0)	2 (100.0)

The mean HISS was 54.35 (median 40.00, standard deviation [SD] 53.97, range 5–216, 25th–75th percentile 11–72). Minor and moderate injuries comprised 64.8% (48 patients) of injuries, whereas severe and major injuries made up the remaining 35.2% (Table 4). In addition, 60% of admissions were classified as severe or major by HISS. None of the patients with minor injury were admitted to hospital. Twelve patients with moderate injury (40%), 12 patients with severe injury (40%) and 6 patients with major injury (20%) were admitted to hospital.

DISCUSSION

The hand is a very intricate and important tool used for daily living activities. In the developing world, it establishes the individual in society, allowing them to meet social and economic responsibilities. It is therefore important to understand the causes of injury to this part of the body to minimize the occurrence of injury and to forestall poor treatment outcomes that may result in dramatic reduction in quality of life. In this study, young adults were most commonly affected. This finding is consistent with other series in which the average age was less than 30 years.^{1,3,6,7} However, studies in areas with considerable postproductive populations show a slightly higher average age group of 40 years. Most studies show a male predominance, with a male-to-female ratio of 4:1.^{1,7,9} In our series, we had a higher incidence of injury among men, but with a smaller margin of 2:1. This may be because of the fact that the study was carried out in a predominantly working class population in which both sexes have equal labour opportunities.

The report of hand injuries by Beaton and colleagues⁴ showed results similar to ours, where right-hand injuries

were more common than left-hand injuries. Similar to other studies, 56.8% of our patients sustained an injury to their dominant hand. These studies reported more than 50% of injuries to the dominant hand.^{1,3} However, Mink and colleagues¹⁰ observed dominant-hand injuries in about 37% of their sample. In this study, 30% had a hand injury in combination with other injuries, which was in dramatic contrast with another study in which 4% had combined injuries.¹¹ In our study, about 10% sustained injury to both hands. A 2% rate of injury to both hands has previously been reported.¹

Trybus and colleagues¹ performed a study in an industrial city in Poland in which about 50% of workers with a hand injury were manual workers. However, in our study, semiskilled workers such as technicians and public servants constituted more than half of all patients with hand injuries. This underscores the important fact that more than 50% of people who sustain hand injuries in our environment are in the work force. It is pertinent to observe that in many studies undertaken in industrialized nations, machine injury is the most common cause of hand injury.^{1,7} In our environment, motor vehicle collision was the most common cause of hand injury followed by machine injury. This may be because of the fact that this study was carried out in an environment with fewer industries and a high rate of vehicular collisions. We also observed that more than half of the engineers and technicians had injuries sustained from machine accidents. The civil and public servants had most of their injuries from motor vehicle collisions; this is probably explained by the fact that these professionals are regular commuters.

An appreciable number of our patients (10.8%) sustained their injuries from gunshot incidents. This was not the finding of other investigators, who rarely reported gunshot injuries to the hand.^{1,5,7} The rising level of violence and banditry in Abuja may provide insight into this observation. As a capital city, Abuja is experiencing overwhelming urbanization, which has resulted in increased crime. All injuries sustained by security operatives were due to gunshots. This is most probably the result of careless handling of firearms resulting in injuries to one's self or an unintended target. We also observed that all of the gunshot injuries occurred at a work place and involved mainly zone 3.

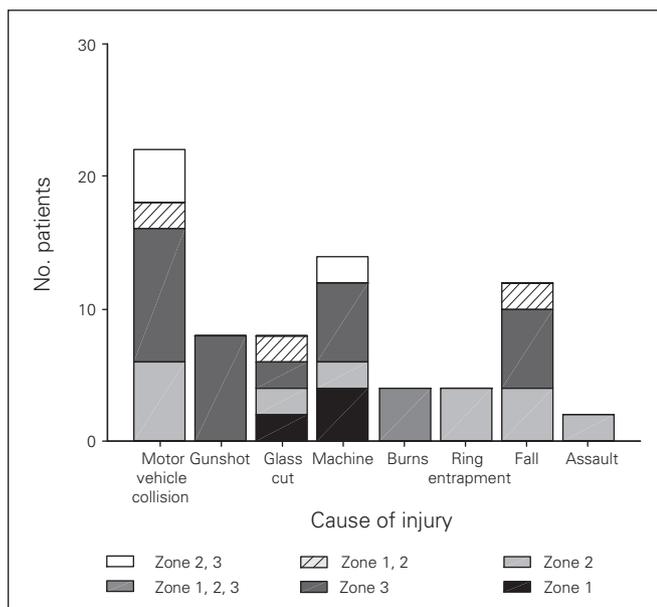


Fig. 2. Relation between cause of injury and zone of the hand.

Grade	HISS	No. (%) of patients
Minor	< 20	20 (27.0)
Moderate	21–50	28 (37.8)
Severe	51–100	14 (18.9)
Major	> 100	12 (16.3)
Total		74 (100.0)

HISS = Hand Injury Severity Score.⁸

In our study, 5% of cases were burn injuries to the hand. A study conducted in Sweden reported a burn rate of 3%.³ Injuries due to ring entrapment were not often reported in other studies; however, about 5% of cases in this series sustained this form of injury and all were female patients. None of the patients had vascular complication as a result of prompt release of the ring, and they did not require admission to hospital. The average duration from time of injury to time of release of the ring was 5.7 hours. Men are more likely to sustain hand injury from violent causes such as traffic accidents, gunshot and machine injuries. Ahmed and Chaka⁷ noted similar findings in a study in Ethiopia. Sports injuries to the hand were not seen in our study; however, a rate of sports-related hand injuries of 31% was reported in a European study.³

In our series, most injuries occurred on the road (29%) and in the workplace (29%); other studies reported more workplace injuries.^{5,7,10} Trybus and colleagues¹ reported that 45% of injuries in their study occurred in the home, followed by 20% in the workplace. These results are similar to those from a study conducted in Finland.¹¹ Some earlier reports showed that home injuries are commonly due to glass or knife cuts.^{1,6,12} This is consistent with our findings. This is probably because most home injuries are minor and are treated at a nearby medical clinic.

In this study, 40.5% of those who sustained a hand injury required admission to hospital. In contrast, a study in Finland, showed that less than 2% of those injured required admission.¹¹ More than 60% of our admissions were because of motor vehicle collision, gunshot or machine injuries.^{1,3,6} This indicates that such injuries increase the chance of hospital admission.^{1,3} The mean time between occurrence of injury and admission was 23.3 hours; this is close to the findings of other surveys.¹ However, it is important to note that patients with machine injuries were brought to the hospital relatively earlier, with an average time between injury and admission of 4.8 hours. This is in contrast to the results of a study conducted in Ethiopia,⁷ in which the average time between mechanical injury and presentation was 8 hours.

Consideration was given to the injury distribution within the zones of the hand. We observed that zone 3 had the highest risk of being injured (45.9%). This is because it is the palmar surface of the hand and is the widest zone, thereby making it the most at risk of injury. Fingertip injuries accounted for almost 8% of cases but were mainly seen in children.¹³ However, 21% of cases involved injury to more than one zone. As in other series, the skeleton and integument were the tissue components most commonly injured.^{5,7} High-energy injuries from gunshots and machinery have a higher risk of involving of all the tissue components and increasing the potential of digit amputation.^{5,7,8,14}

We assessed injury severity using the HISS system developed by Campbell and Kay.⁸ In 1996, these authors performed a retrospective study with 100 cases of hand

injuries. This scoring system has been widely used in most series and has been found to be correlated with the functional outcomes of hand injuries.^{5,10} In a previous study, 110 patients had a mean HISS score of 64, a median of 36 and a 25th–75th percentile of 20–85.¹⁰ When compared with our findings, these values are lower, perhaps because of the smaller number of patients in our study and the lower severity of injury. However, both studies showed that the average HISS score falls within the severe injury grade.

In a recent evaluation of 140 cases, 52% of injuries were minor, 29% were moderate, 12% were severe and 6% were major.¹⁵ In our series, 27% were classified as minor, 38% were moderate, 19% were severe and 16% were major injuries. Thus, more than 60% of our cases fell within the minor and moderate classification. Other series have also reported that more than 60% of cases are minor or moderate.^{11,15} Furthermore, this study also demonstrated that most (60%) of admissions had a severe or major HISS injury classification.

In conclusion, we have shown that hand injuries constitute a major proportion of trauma emergencies in a developing country and that motor vehicle collisions are the major cause of hand trauma in this environment, unlike in other locations where machine injury is the major cause. It is imperative that education for drivers and other road users coupled with adequate enforcement of traffic regulations to reduce the incidence of hand injury. Although a large percentage of machine injuries are minor, more than half of the people with this type of injury are from the working class and are the driving force of the country's economy. A substantial number of these workers face the risk of losing their employment and having their social status irreparably altered. This, in turn, leads to major economic loss. We also observed that workers who sustained machine injuries usually had severe to major forms of injury, which included amputation of digits. It is therefore recommended that employers and government focus more effort toward worker education, particularly with regards to occupational health and safety. The provision of a safe and work-friendly environment includes training in equipment operation and maintenance and the provision of appropriate protective clothing and safeguarding of machinery. Furthermore, it is essential that policy measures be put in place for insurance and adequate compensation of the hand injury-related disability.

Competing interests: None declared.

Contributors: All authors contributed to study design, data acquisition and analysis, and writing and reviewing the article. All of the authors approved the version submitted for publication.

References

1. Trybus M, Lorkowski J, Brongel L, et al. Causes and consequences of hand injuries. *Am J Surg* 2006;192:52-7.

2. Mock C, Quansah R, Kobusingye O, et al. Trauma care in Africa, the way forward. *African J Trauma* 2004;2:53-8.
3. Rosberg HE, Dahlin LB. Epidemiology of hand injuries in the middle-sized city in Southern Sweden: a retrospective comparison of 1989 and 1997. *Scand J Plast Reconstr Surg Hand Surg* 2004;38:347-55.
4. Beaton AA, William L, Moseley LG. Handedness and hand injuries. *J Hand Surg [Br]* 1994;19:158-61.
5. Saxena P, Cutler L, Feldberg L. Assessment of the severity of hand injuries using "Hand Injury Severity Score" and its correlation with functional outcome. *Injury* 2004;35:511-6.
6. Trybus M, Guzik P. Occupational hand injuries. *Med Pr* 2004;55:341-4.
7. Ahmed E, Chaka T. Prospective study of patients with hand injuries: Tikur Anbessa University Teaching Hospital, Addis Abba. *Ethiop Med J* 2006;44:175-81.
8. Campbell DA, Kay SPJ. The Hand Injury Severity Scoring system. *J Hand Surg Br* 1996;21:295-8.
9. O'Sullivan ME, Colville J. The economic impact of hand injuries. *J Hand Surg Br* 1993;18:395-8.
10. Mink van Der Molen AB, Ettema AM, Hovius SER. Outcome of hand trauma: the Hand Injury Severity Scoring system (HISS) and subsequent impairment and disability. *J Hand Surg Br* 2003;28:295-9.
11. Nieminen S, Nurmi M, Isberg U. Hand injuries in Finland. *Scand J Plast Reconstr Surg* 1981;15:57-60.
12. Ousby J, Wilson DH. 1086 consecutive injuries caused by glass. *Injury* 1982;13:427-30.
13. Ljungberg E, Rosberg HE, Dahlin LB. Hand injuries in young children. *J Hand Surg Br* 2003;28:376-80.
14. Olaitan PB, Jiburum BC. A review of amputation of 106 hand digits. *Nigerian J OrthopTrauma* 2008;7:3-6.
15. Rosberg HE, Carlsson KS, Dahlin LB. Prospective study of patient with injuries to the hand and forearm: cost, function, and general health. *Scand J Plast Reconstr Surg Hand Surg* 2005;39:360-9.

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