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Evaluation of pedestrian road traffic maxillofacial injuries in a Nigerian tertiary hospital

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Abstract

Background: Walking is the most basic form of mobility and forms an important part of daily activities; however, walking could often be associated with risks. This is more so when pedestrians share a common space with motorized vehicles especially in developing countries. Despite the frequency of road traffic crashes (RTC) related pedestrian injuries in many developing countries, there is a dearth of documentation of maxillofacial injuries in victims of pedestrian road traffic crashes. The aim of this study was to determine the causes, frequency, pattern, severity, concomitant injuries and outcome of pedestrian maxillofacial injuries observed at a tertiary trauma centre in Nigeria.

Method: Pedestrian victims of RTC were prospectively recruited from among all maxillofacial trauma patients seen at the Accident and Emergency department and the Department of Oral and Maxillofacial Surgery of the University College Hospital, Ibadan between April 2011 and November 2011. Ethical approval was obtained from the UI/UCH Joint Ethics Review Board before the commencement of the study and informed consent was obtained from participants. Patients' demography, the crash events, types of maxillofacial injuries, and concomitant injuries were recorded. Severity of maxillofacial injury was estimated based on the Maxillofacial Injury Severity Scale (MFISS).

Results: Forty-six participants (22.9% of all victims of road traffic crashes seen within the study period) were victims of pedestrian RTC. Pedestrian RTC occurred in all age groups with almost 40% of the victims in their 1st and 2nd decades of life. The most severe MFISS was observed in the 21 – 30 year age group while the least severe injury observed was in the 71 – 80 years age group. Thirty participants (65.2%) were hit by a car or minibus while fourteen (30.4%) were knocked down by a motorcycle. Two (4.4%) were hit by a truck. Soft tissue injury was the most common maxillofacial injury and head injury was the commonest concomitant injury observed. The median MFISS score of victims of motorcycle was 4.0 while the median scores for victims of car/minibus pedestrian RTC was 9.0. The most severe maxillofacial injury was seen in victim of car/minibus pedestrian crashes. Seventeen percent (8) of the victims had a fatal outcome.

Conclusion: Pedestrian RTC resulting in maxillofacial injuries are common in the studied environment. It is particularly common among the 11 -20 year age group and victims are usually hit by cars/minibuses. These injuries are often severe and fatal outcome is not infrequent. Therefore, definitive preventive measures are imperative.

Keywords: *Road traffic crashes (RTC), pedestrians, maxillofacial injuries, severity.*

Résumé

Contexte: La marche est la forme la plus élémentaire de mobilité et constitue une partie importante des activités quotidiennes; cependant, la marche pourrait souvent être associée à des risques. Ceci est d'autant plus lorsque les piétons partagent un espace commun avec des véhicules automatisés en particulier dans les pays en voie de développement. Malgré la fréquence des blessures liées aux accidents de la circulation routière (ACR) parmi les piétons dans de nombreux pays en voie de développement, il ya un manque de documentation des blessures maxillo-faciale chez les piétons victimes des mésaventures routières. Le but de cette étude était de déterminer les causes, fréquence, motif, gravité des blessures concomitantes et les résultats des lésions maxillo-faciales parmi les piétons observées dans un centre de traumatologie tertiaire au Nigeria.

Méthode: Les piétons, victimes d'ACR, ont été prospectivement recrutés parmi tous les patients victimes du traumatisme maxillo-facial vu au département d'Accident du d'Urgence et au département de Chirurgie Buccale et Maxillo-faciale du au Collège Hospitalier Universitaire, Ibadan Avril 2011 et Novembre 2011. La ratification éthique a été obtenue du Comité d'éthique commun UI/UCH avant

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le début de l'étude et le consentement informé a été obtenu des participants. La démographie des patients, les événements d'accident, les types de blessures maxillo-faciales et les blessures concomitantes ont été enregistrés. La gravité des blessures maxillo-faciale a été estimée sur la base de l'échelle de sévérité de blessure maxillo-faciale (MFISS).

Résultats: Quarante-six participants (22,9% de toutes les victimes d'accidents de la circulation routière vus pendant la période de l'étude) ont été victimes d'ACR des piétons. L'ACR parmi les Piéton s'est produit dans tous les groupes d'âge avec près de 40% des victimes dans leur 1ère et 2ème décennies de vie. Le plus sévère MFISS a été observé dans le groupe d'âge de 21 - 30 ans tandis que le moins sévère a été la dans le groupe d'âge de 71 - 80 ans. Trente participants (65,2%) ont été cognés par une voiture ou un minibus tandis que quatorze (30,4%) ont été renversés par une moto. Deux (4,4%) ont été cognés par un camion. Les blessures de tissus douces étaient les blessures maxillo-faciales les plus fréquentes et le traumatisme crânien a été la blessure concomitante fréquente observée. Le score médian de MFISS des victimes de la moto était de 4,0 tandis que les scores médians pour les piétons victimes d'ACR par la voiture / minibus était de 9,0. La blessure la plus grave maxillo-faciale a été vu dans les piétons victime de collisions avec voiture / minibus. Dix-sept pour cent (8) des victimes avaient une issue fatale.

Conclusion: L'ACR parmi les piétons entraînant des blessures maxillo-faciales sont fréquentes dans l'environnement étudié. Il est particulièrement fréquent chez le groupe d'âge 11 -20 ans et les victimes sont habituellement cognés par des voitures / minibus. Ces blessures sont souvent graves et le décès n'est pas rare. Par conséquent, des mesures définitives préventives sont impératives.

Mots-clés: *accidents de la circulation routière (ACR), piétons, blessures maxillo-faciale, sévérité.*

Introduction

Walking is the most basic form of mobility and forms an important part of daily activities. It is inexpensive, emission-free, requires no fossil fuel. It offers significant health benefits and for those without substantial mobility impairment, is accessible regardless of economic consideration [1]. However, walking could often also be associated with risks. This is so when pedestrians share a common space with motorized vehicles especially in developing countries. The vulnerability of pedestrians in traffic crashes is well documented [2–7]. Such crashes may result in maxillofacial injuries solely or in combination with other injuries[8,9]. In many regions and especially in developing countries, road traffic crash has remained the commonest cause of maxillofacial injuries [8–14]. The majority of patients are involved in crashes while driving an automobile or riding a motorcycle or bicycle, or as passengers of these vehicles. However, many patients are involved in vehicle-pedestrian crashes. Despite the frequency of road traffic crashes (RTC) related pedestrian injuries in many developing countries, there is a dearth of documentation of maxillofacial injuries in victims of pedestrian road traffic crashes. The aim of this study was to determine the patterns of pedestrian maxillofacial injuries observed at a tertiary trauma centre in Nigeria.

Methods

Pedestrian victims of RTC were prospectively recruited from among all maxillofacial trauma patients received at the Accident and Emergency department and the Department of Oral and Maxillofacial Surgery of the University College Hospital, Ibadan between April 2011 and November 2011. Victims of RTC that refuse to participate in the study or that died before adequate examination could be carried out were excluded from the study. Ethical approval was obtained from the UI/UCH Joint Ethic Review Board before the commencement of the study and an informed consent was obtained from participants.Patients' demography, the crash events, types of maxillofacial injuries, and concomitant injuries were recorded. Severity of maxillofacial injury was estimated based on the Maxillofacial Injury Severity Scale (MFISS)[15]. Data was processed using IBM SPSS Statistics version 20.0.

Results

There were 201 RTC victims with maxillofacial injuries of which 22.9% (24 males and 22 females) were pedestrians. Maxillofacial injuries resulting from pedestrian RTC occurred in all age groups with over 51% of RTC victims in age group of 1 – 20 and 83% of those above 60 years being victims of pedestrian RTC with the mean age of 29.9 $\pm$ 20.4 years. About 40% of the victims of pedestrian road traffic crashes were in their 1st and 2nd decades of life and were mainly students (Table 1). The highest MFISS score was observed in the 11 – 20 years age group while the least score was seen in the 71 – 80 years age group (Table 2). Hits by car/minibus (30, 65.2%) and motorcycle (14, 30.4%) were most prevalent (Figure 1). Over ninety seven percent of crashes occurred in intra-city locations (Table 3) with 52.2% occurring in the single carriage roads, 32.6% and 15.2% occurring on dual carriage lanes and expressways respectively (Table 4). Majority of the vehicles (33, 71.7%) involved in the crashes were deployed for commercial purposes with almost all

Table 1: Age, gender and occupations of victims of pedestrian RTC

Age group	Gender			Occupational status				
	Male	Female	Total	Student/ unemployed	Vehicle driver/ rider	Unskilled / Junior worker	Skilled worker	Total
1-10	3	5	8	8	0	0	0	8
11-20	5	5	10	9	0	1	0	10
21-30	5	3	8	3	2	0	3	8
31-40	4	4	8	0	3	4	1	8
41-50	2	2	4	0	2	2	0	4
51-60	1	2	3	1	2	0	0	3
61-70	3	1	4	2	0	1	1	4
71-80	1	0	1	1	0	0	1	1
Total	24	22	46	23	9	8	6	46

Table 2: Age distribution of participants and severity of maxillofacial injuries.

Age group (in years)	MFISS Score				Total	Median MFISS Score
	1-10	11-20	21-30	>30		
0-10	4	4	0	0	8	7.0
11-20	6	3	0	1	10	7.0
21-30	3	1	4	0	8	20.5
31-40	5	2	1	0	8	6.0
41-50	4	0	0	0	4	3.0
51-60	1	1	0	1	3	12.0
61-70	4	0	0	0	4	6.5
71-80	1	0	0	0	1	2.0
Total	28	11	5	2	46	7.0

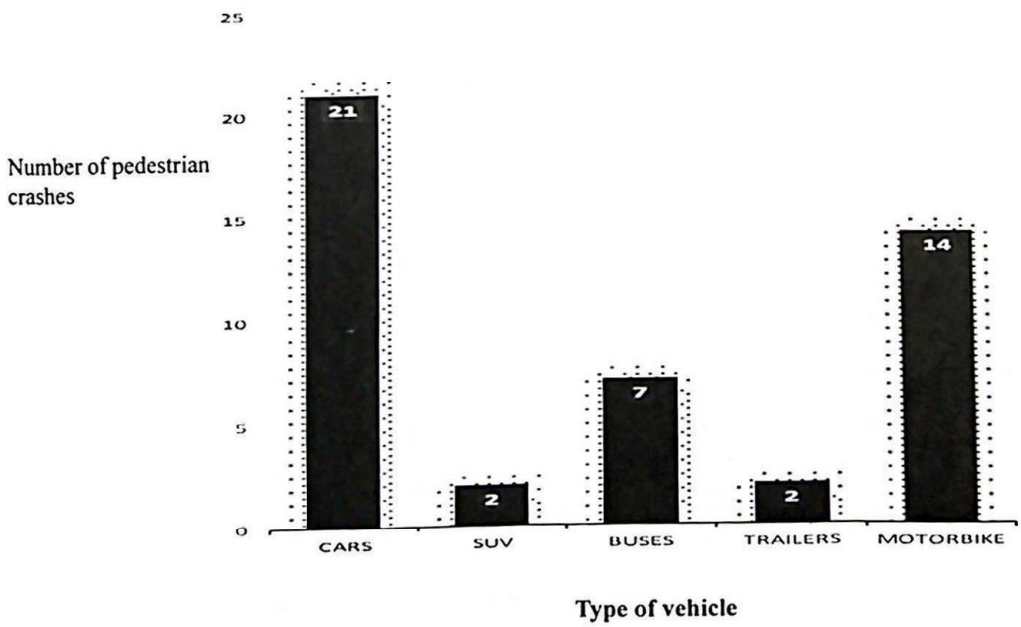

Fig. 1: Vehicle type involved in pedestrian road traffic crashes

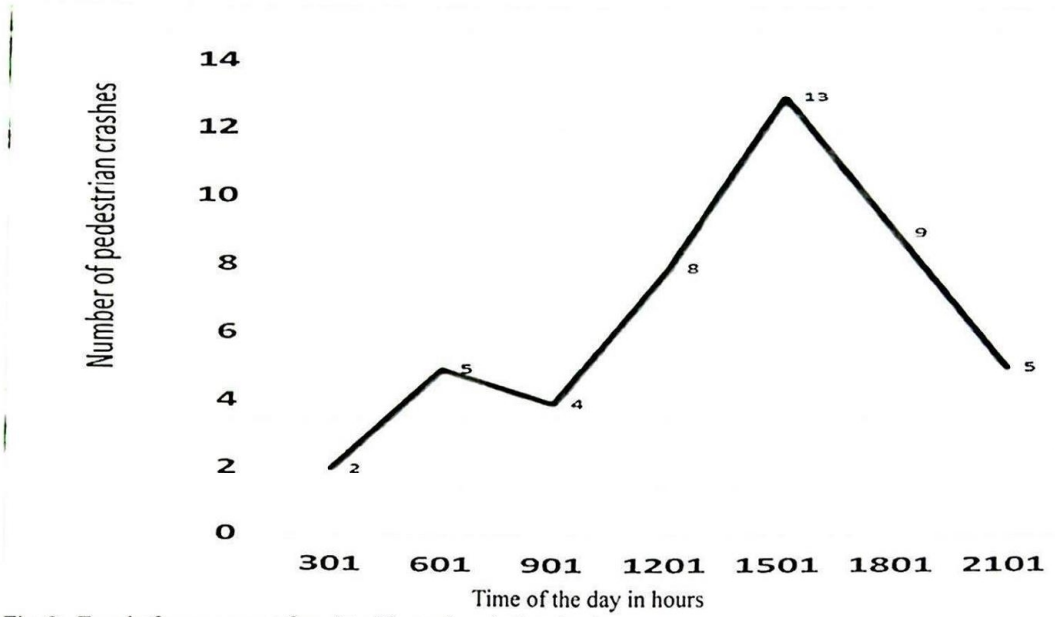

Fig. 2: Trend of occurrence of road traffic crashes during the day.

Table 3: Vehicle ownership and locations where crashes occurred.

Vehicle ownership	Ibadan metropolis	Outside Ibadan but in Oyo State	Outside Oyo State but in South West Nigeria	Others	
Private	12	0	1	0	13
Commercial	29	1	2	1	33
Total	41	1	3	1	46

Table 4: Road design and location of crashes.

Location of road	Road design			Total
	Single lane	Dual carriage way	Express way	
Intra city	25	15	5	45
Inter city	0	0	1	1
Total	25	15	6	46

Table 5: Maxillofacial injuries sustained by victims of pedestrian road traffic crashes.

Maxillofacial injuries	n (%)
Soft tissue injuries	23 (50.0)
Mandibular fractures	8 (17.4)
Le Fort fractures	6 (13.0)
Zygomatic fractures	4 (8.7)
Multiple facial fractures	5 (10.9)
Total	46(100.0)

Table 6: Concomitant injuries sustained by victims of pedestrian road traffic crashes.

Concomitant injuries	n (%)
Head injuries	12 (66.7)
Abdominal injuries	2 (11.1)
Orthopaedic injuries	3 (16.7)
Major integument injuries	1 (5.5)
Total	18 (100)

of the crashes (41, 89.1%) occurring within the metropolis (Table 3). About seventy four percent (34) of the injuries occurred between 12 noon and 12 midnight while 26.1% occurred between 12 midnight and 12 noon (Figure 2). Half of the patients presented

with purely facial soft tissue injuries while fracture of the mandible was the commonest maxillofacial fracture seen (Table 5). Eighteen participants (39.1%) presented with concormitant injuries, Head injury was the commonest concomitant injury seen and was present in 12 patients. Five patients sustained severe head injury (Table 6). The median MFISS scores in relation to causes were 4.0 for motorcycle and 9.0 for car/minibus. The median hospital stay for participants with purely maxillofacial injuries was four days while those presenting with concomitant injuries had a median hospital stay of 16 days, this difference in duration of hospital stay was statistically significant (p=0.018). Eight patients (17%) had a fatal outcome; all resulting from head injuries.

Discussion

The present study reported that 22.9% of patients presenting with road traffic maxillofacial injuries are victims of pedestrian RTC. This is higher than the earlier reports of 3% by Oji[16], 7.9% by Ugboko *et al.* [9], and 4.5 – 14.4 % reported by Fasola *et al.* [8]. This increasing trend in pedestrian road traffic maxillofacial injuries could be attributed to increasing population (particularly in urban areas due to rural – urban migration), high vehicular traffic, poor mass transit system and poor state of road infrastructure. Pedestrian RTC was commoner in the younger age group who are mainly students and as they usually face the risk of RTC when they have to cross the road on their way to/from school [17].

Some young people are also involved in hawking wares on the major roads. These younger road users are vulnerable because many of them have not mastered the dynamics of the busy urban roads. The other group comprises of the elderly whose reflexes are reduced and are therefore less likely to move swiftly in the face of an impending crash. These vulnerable group are not well educated about the principles of pedestrian road safety. Pedestrian road safety involves the rapid and complex process of identifying safe crossing gaps in traffic, assessing the speed of traffic and assessing acceleration/deceleration [7]. It also includes assessing distance of moving vehicles in at least two directions, judging the speed with which one should cross the street, and recognizing and coping with visual occlusions such as parked cars, bushes, curves, and inclines of the roadway [7].

Almost all pedestrian injuries occurred at intra-city location irrespective of road design and involved commercial vehicles. To ensure pedestrian safety therefore, public transport services should be treated as an integrated part of the urban development [1]. This will support a shift towards higher-density, mixed-use walking and transit- oriented urban environments. It has also been suggested that a "safe system" approach for the design of walking environments should be adopted. The "safe system" approach recognizes that road users make mistakes and requires road design to take account of this to reduce the risk of serious injury[1]. The peak period of incidents coincides with the period that students are returning from school. It is therefore important that "safe systems" and traffic calming zone should be built around schools. Commercial vehicle drivers should also be partnered in aggressive campaign in ensuring a safer road for pedestrians.

Victims of pedestrians RTC had a high incidence of severe maxillofacial injuries. Car–pedestrian collisions often involves two phases. The primary phase consists of the pedestrian's contact with different parts that form the front of the car while the secondary phase is contact with the road surface [18]. Both phases of the collision could result in severe injury due to the unprotected position of the pedestrian at the time of the crash.

Soft tissue injury was the commonest facial injury seen in victims of pedestrian RTC. Majority of the soft tissue repair was done under local anaethesia at the Accident and Emergency unit to avoid delay in treatment which often results in wound infection and poor postoperative aesthetics [19]. The mandible was the most frequently fractured bone, although this is contrary to the findings of Yamamoto *et al.* [20] who reported a higher frequency of midfacial fracture with the zygoma mostly involved. However, several studies in maxillofacial trauma in our environment reported the vulnerability of the mandible in maxillofacial trauma [8,9,21,22]. This discrepancies may be due to differences in study population and setting as Yamamoto *et al.* [20] stated that the finding is inconsistent with previous work done on maxillofacial trauma in the region. Head injuries was the commonest concomitant injuries seen. This could be attributed to the unprotected position of the patient at the time of crash. All the patients with fatal outcome had associated head injury.

Victims of car/minibus pedestrian crashes were more vulnerable to sustain more severe maxillofacial injuries than victims of motorcycle/ pedestrian crashes. The increased severity of injury in this group of patients could be attributed to the higher speed and therefore greater resultant force generated by a car/minibus when compared with a motorcycle. The mortality rate seen in this group is much higher than reported for victims of other RTC. This is similar to the findings of DiMaggio *et al.*

[23]who found a positive relationship between vehicle body type characteristics and injury severity in victims of paediatric pedestrian crashes. Olukoga [24] also reported higher fatal outcome in victim of bus-pedestrian crashes.

About one in five victims of pedestrian RTC with maxillofacial injuries had a fatal outcome. All fatal outcomes were seen in patients with concomitant head injury which is similar to previous reports[7,23–26]. It has been noted that an 80% drop in pedestrian risk of death is achievable by traffic speed reduction from 50 km/h to 30 km/h. Lowering motorised traffic speed is therefore key to improving pedestrian safety. It is important to integrate the needs of pedestrians at the earliest stages of urban planning projects and transport investments. Traffic-calming zones and generalized 30 km/h zones should be enforced in areas with high pedestrian activity.

It was reported that despite the fact that traffic deaths have increased across the globe, from 990,000 in 1990 to nearly 1.2 million in 2002, there has been a marked spatial shift[6]. Fatalities have declined in the developed world due to better vehicle design, improvements in safety standards such as drunk driving enforcement, better traffic management schemes, implementation of road safety programs and associated changes in pedestrian behaviour [6]. However, most developing countries have seen a very sharp increase in road fatalities and injuries. A major reason is rapid motorization without a corresponding increase in road safety [6]. Pedestrian fatalities have continued to increase in developing countries due to ineffective legislations, poor road design, highway crossing, street hawking and roadside trading [27,28]. To stem this trend, it is imperative to introduce high-quality road safety education in schools and local community centres. Also considerations should be made for pedestrians during road design. This should include easy, safe, well-maintained pedestrian access to public transport and city centre destinations, prevention of erection of structures or parking on pedestrian pavements and designated pedestrian crossings [1].

A large scale study involving multicentre data will be required to further characterize pedestrian road traffic maxillofacial injuries to help in understanding mobility behaviour and trends. This will improve our knowledge about walking and help in creating a standardized methodology for measuring, reporting and monitoring pedestrian mobility. This will enhance the formulation of national pedestrian observatories and encourage international comparisons.

Conclusion

Pedestrian RTC resulting in maxillofacial injuries is common in the studied environment. It is particularly common among the 11 -20 year age group and victims are usually hit by cars/minibuses. These injuries are often severe and fatal outcome is not infrequent. Therefore, definitive preventive measures which should include pedestrian safety education, establishment of traffic calming zones and effective public transport system are very important.

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