Traumatic Brain Injury in the Accident and Emergency Department of a Tertiary Hospital in Nigeria

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Background: Traumatic brain injury is a major public health problem in Nigeria, as it could be associated with long term and life long deficits. Unlike other parts of the world, in our country, motorcycles are possibly the main cause of this injury. Unfortunately, we do not have a national epidemiological data base yet. This study was aimed at defining the peculiar demographic and associated risk factors in traumatic brain injury among our patients, as part of a multi-institutional data pool for a future meta-analysis to generate the national data base.
Methods: This was a 24-month retrospective study of all head injury patients who met the criteria for traumatic brain injury in the Accident and Emergency Department of a tertiary health institution. Data were collected from the emergency cards and case notes, then collated and analyzed using the descriptive statistics on SPSS 13, with the *p* value taken as <0.05.
Results: A total of 9,444 patients were attended to during the 24 months; 510 (5.4%) of them met the inclusion criteria for the study. This translated to a presentation rate of 5.3 cases per week and an incidence rate of 2,710 per 100,000 per year. Males accounted for 404 (79.2%) of the cases. The peak age incidence (31.2%) was in the >20 – 30 year age group. Traders constituted the highest occupational group 125 (24.5%). Most (58.8%) of the cases resulted from motorcycle accident. There were 28 deaths giving a mortality rate of 5.5% or 148 deaths per 100,000 per year.
Conclusion: The risk factors were the male gender, motorcycle riding, illiteracy, trading, extremes of age and active daytime period of 12:01 – 18:00hours. The incidence rate was much higher than in the developed countries, but could reduce with the use of crash helmets, seat belts, speed limits and safety/protective vehicular devices, with better road rehabilitation.

Introduction

Head Injury is a general term used to describe any trauma to the head but most especially with involvement of the brain[1]. It could be strictly defined as trauma to the brain and/or its coverings due to an externally applied mechanical force. In essence, its functional significance becomes manifest when there is an accompanying cranial neural injury, and this becomes known as traumatic brain injury (TBI), a term used specifically to describe affectation of intracranial contents with its potential likelihood of significant functional deficits. The enormity of the problem of head injury goes beyond the hospital treatment because there could arise long term or lifelong complications affecting thought processes, language, emotions, sensation and communication, that may necessitate different forms of support services for the injured[2]. Locomotion, memory and post-traumatic seizures could also become a problem

In United States (US), the incidence of head injury at the Emergency Department was recently reported to be 394 per 100,000 people, male: female ratio was 1.8:1 and mortality rate 19.3 per 100,000 people[3]. The leading causes of TBI were reported as fall (28%), motor vehicular traffic crash (20%), assault (11%) and others (41%). The highest incidence of motor vehicular traffic crash was found in the 15 – 19 year group, while fall was the leading aetiology in the 0 – 4 and >75 year groups[4].

Another study done in a United Kingdom (UK) population on the attendance rate of head injury at an Emergency Department showed that head injury constituted 3.4% of the total attendance and the incidence was 453 per 100,000. Nearly 11% were moderate to severe head injury, implying that mild head injury (89.1%) was the most common type. Males were found to be at a higher risk for moderate to severe head injury than females[5]. Thus, even in the regulated systems of the developed countries, head injury is still of special public health concern.

The work done by Adeolu, *et al,* on aetiology of head injury in South West Nigeria involving 1541 patients that presented at the Accident and Emergency Department, showed that motor vehicular accident (MVA) - both passenger and pedestrian, and fall were the leading aetiological factors, accounting for 73.4% and 16.4%, respectively[6]. The aetiological dominance of MVA is consistent with other regional studies, and the study also showed a higher incidence of head injury in the 21 – 30 (23.3%) and 1 – 10 (20.8%) year groups, respectively[7,8,9]. Fall was the dominant aetiological factor in the first decade of life, raising concerns about surveillance and supervision of the paediatric age group; while road traffic accident (RTA), was the most common in the third decade.

Solagberu, *et al,* reported that the greater proportion of MVA involved motorcyclists (riders and passengers). This contributed greatly to their cohort because of the reported increase in motorcycle units on Nigerian roads[10]. Some other studies have implicated motorcycle use as a major contributor to head injury incidence in developing countries[11,12]. With the financial incapacity to buy the more modern vehicles with protective devices and safety gadgets, the lack of strict traffic regulations and the poor network of roads in various stages of dilapidation, the reasons for this situation in developing countries would not be far fetched.

Nigeria lacks a national epidemiological data base on head injury[6]. This indeed makes it very difficult to appreciate the scale, determinants and distribution of the problem, and as such, makes an effective intervention, even more difficult. The lack of data also impedes the development of evidence-based strategies for prevention of this injury and the objective assessment of the success of any injury reduction intervention put in place. In the US and Italy, the implementation of helmet–use laws for motorcyclists reduced the incidence of head injury associated with motorcycle crash to significantly lower rates by 1975 – 1986[13,14]. This assessment was only possible because of the availability of epidemiological data pre- and post-intervention.

Against this backdrop, therefore, it would be pertinent in Nigeria to generate epidemiological data on head injury and its sub-types which would logically contribute towards the objective evaluation of the enormity of this problem. Such data on the distribution, pattern and determinants of injury would inform the options to be used in the effective control of this preventable epidemic. Our focus in this study was on the incidence, age, gender, aetiologic factors, injury patterns, time of injury and occupational distribution of head trauma cases diagnosed with brain injury that presented in the Accident and Emergency Department of Nnamdi Azikiwe University Teaching Hospital [NAUTH] Nnewi, Anambra State, Nigeria from January 2007 to December 2008. Since most previous local studies in the country were geographically restricted, we hope that, somehow, these segmented studies could be meta-analyzed as a multi-institutional study pool to generate representative national figures and over time, provide the country with her national epidemiological data base on the various facets of head injury.

The aim of this study was to define the peculiar demographic and associated risk factors in traumatic brain injury among head injury patients presenting at our Accident and Emergency Department in Nnewi over 24 months, as part of the multi-institutional data pool for a future meta-analysis for the generation of a national data base on head injury presenting under emergency situations in Nigeria.

Patients and Methods

This was a retrospective study of some demographic variables in all the patients that presented at the Accident and Emergency Department of Nnamdi Azikiwe University Teaching Hospital, Nnewi, Nigeria with traumatic brain injury from January 1, 2007 to December 31, 2008. Nnewi is a small scale industrial and commercial but rural town with different forms of transportation, mainly motorcycles and motor vehicles.

Ours is a tertiary health institution that serves as a referral centre for neurosurgical diseases for most States in the South East and South South Zones of Nigeria. Demographic data on age, sex, occupation, Glasgow Consciousness Score (GCS) at presentation, aetiology of injury, type of head injury, time of injury, mode of presentation, and clinical status of the patient at the time of referral to another centre, transfer to the ward, or home discharge from the Accident and Emergency Department, were collected, collated and analyzed.

Inclusion criteria were essentially all age groups, all genders, history of trauma with clinical evidence of brain involvement exhibiting features of TBI – seizures, affectation of the level of consciousness, amnesia, vomiting, brain evisceration and clinical findings of cranial neurological deficits including hemispheric cerebral deficits. All patients that presented with extracranial head injury without features of neural involvement were excluded. The ages were grouped into nine, each spanning a decade. The aetiological factors were broadly classified into motorcycle accident, motor vehicular accident, falls and assault. The data were then analyzed using descriptive statistics on SPSS version 13. The p value was <0.05.

Results

A total of 9,444 patients attended the Accident and Emergency Department during the 24 months study period.

Table 1. Age group distribution of the patients

Age (years)	Frequency	%
0 -10	62	12.2
>10-20	65	12.7
>20-30	159	31.2
>30-40	97	19.0
>40-50	50	9.8
>50-60	32	6.3
>60-70	29	5.7
>70-80	9	1.8
>80-90	7	1.4

Table 2. Occupational Distribution.

Occupation	Frequency (Total no = 510)	% (100)
Commercial motorcyclists	120	23.5
Civil Servants	22	4.3
Traders	125	24.5
Students	71	13.9
Others	168	32.9
No Record	4	0.8

Of these, 510 (5.4%) met the inclusion criteria for traumatic brain injury and were recruited in the study. This translated into a presentation rate of 21.3 cases per month or 5.3 cases per week with an incidence rate of 2,710 per 100,000 per year. Most of them were graded using the Glasgow Consciousness Scale, as mild (GCS 13-15); Moderate (GCS 9-12); Severe (GCS 3-8). (Figure 1).

Males constituted 404 (79.2%) and females were 106 (20.8%) of patients. The age distribution is summarized in Table 1. The highest incidence of 159 (31.2%) in the >20 – 30 year age group, followed by the >30 – 40 year age group with 97 (19%). The ≤40 year age groups constituted a cumulative proportion of 383 (75.1%), of all the cases.

Tabulated for individual occupations, traders had the highest number with 125 (24.5%) cases, followed by commercial motorcyclists 120 (23.5%), and civil servants 22 (4.3%) were the least affected (Table 2). Data on the occupation of 4 of the cases were missing, whereas 168 (32.9%) cases were in the extremes of age e.g. pre-school and those already retired from service/jobs, and did not belong to any of the listed occupations.

It was also noted that the most common cause of traumatic brain injury was motorcycle accident 300 (58.8%), followed by motor vehicular accident 112 (22%), fall 61 (12%) and assault 37 (7.3%), (Figures 2 and 7). Motorcycle accident was found to be the leading aetiologic factor of injury in males and at all periods in the day (Figures 3 and 7), females 39 (7.6%) were more affected by fall than males 22(4.3%), but there was an equal gender distribution for assaults, while children, the elderly and traders appear to be more susceptible to assault (Figures 3 and 5).

Table 3. Outcome of injury at the Accident and Emergency Department

	Outcome	Frequency	%
	Discharged from A/E	58	11.4
	Transferred to ward	418	82.0
	Dead	28	5.5
	Referred	6	1.2
	Total	**510**	**100**

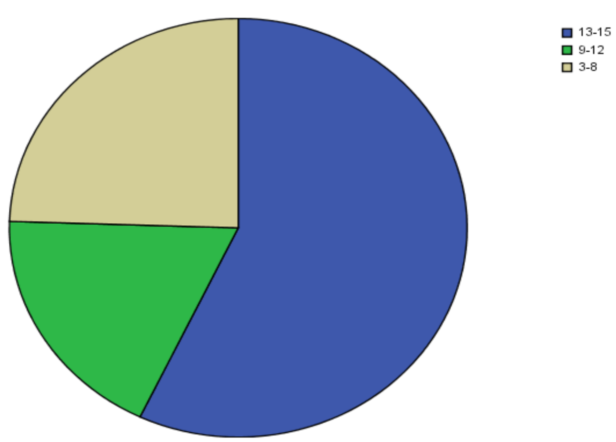

Figure 1. Severity of Injury by GCS
KEY: GCS 13-15 = Mild; 9-12 = Moderate; 3-8 = Severe

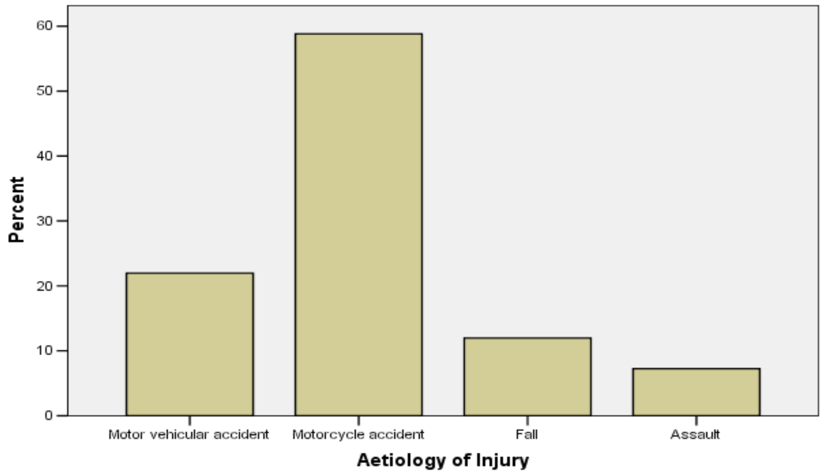

Figure 2. Causes of Head injury

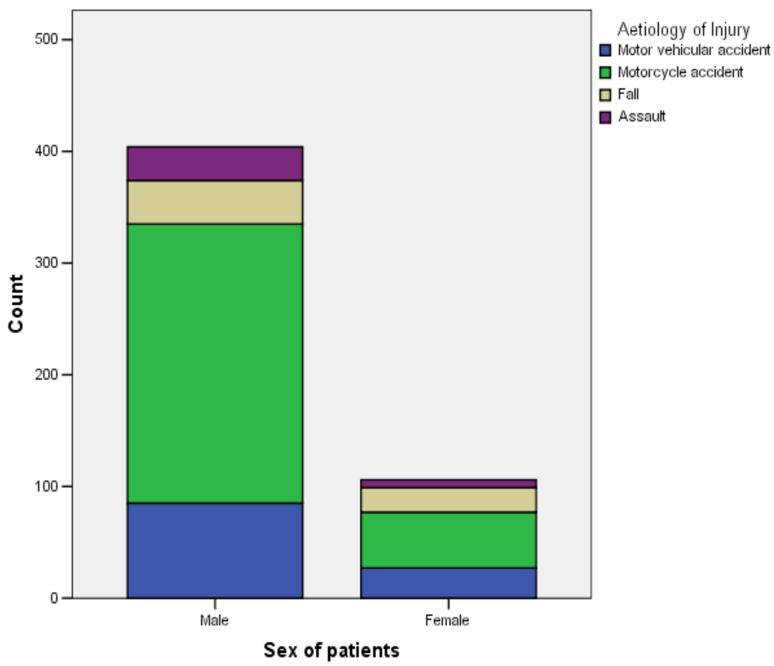

Figure 3. Distribution of Causes by Sex

More than half of the cases presented to the department direct from the accident scene 294 (57.6%), while the rest were referrals from other (primary, secondary and tertiary) health institutions in the South South and South East Zones of the country. The hours of 12:01 – 18:00 recorded the highest incidents of injury 265 (52%), and cumulatively more than 85.1% of all injuries occurred during the busy hours of daytime (6.01 – 18.00 hours). The least incidence was recorded between 0.01 – 6.00 hours, (Figures 6 and 7).

The number of cases discharged home was 58 (11.4%) and those transferred to the wards for definitive care were 418 (82%) (Table3). Thus, about four traumatic brain injury patients were admitted into the wards weekly from the department, and the reasons for the admission were primarily the brain injury and/or other associated systemic injuries. Referrals to other centres for logistic and technical reasons in the hospital accounted for 1.2%. Mortality rate was 28 (5.5%), representing 148 per 100,000 per year (Table 3).

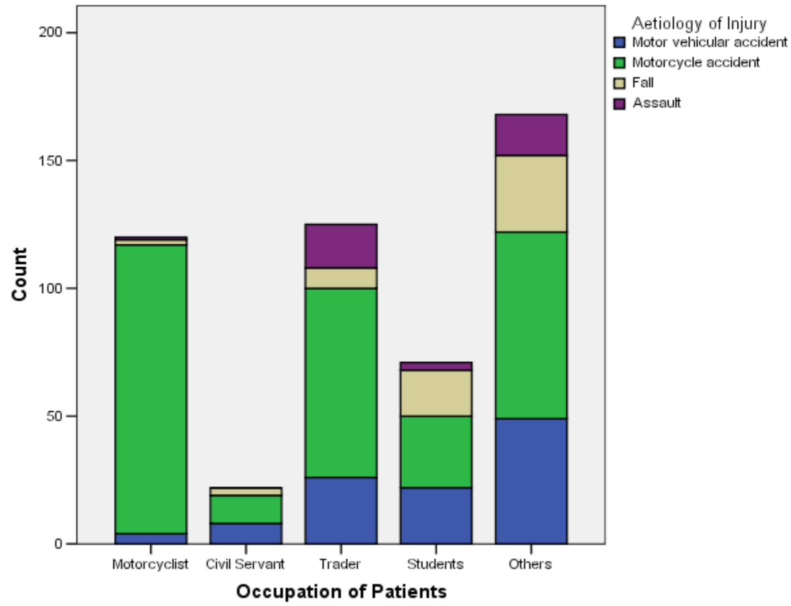

Figure 4. Distribution of Causes by Occupation

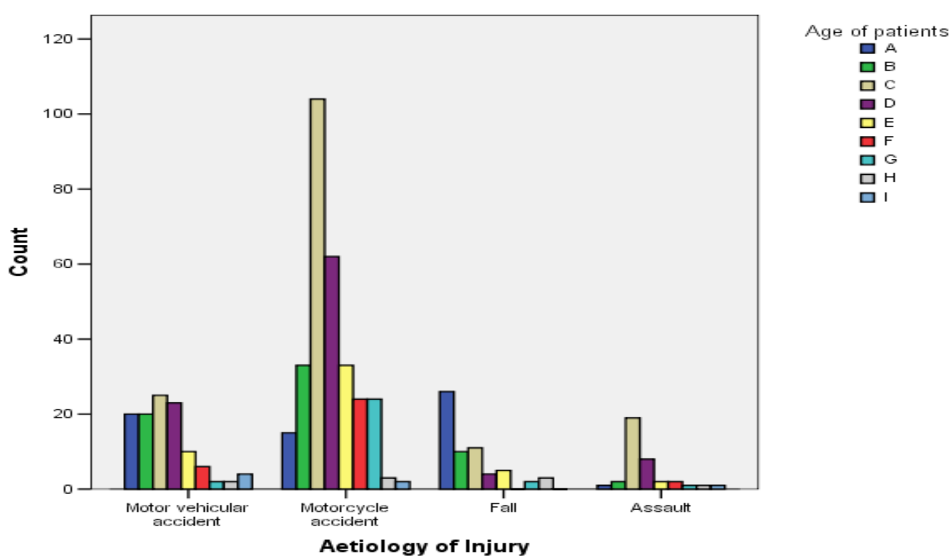

Figure 5: Histogram showing distribution of aetiology of injury according to age groups

KEY: A (0 -10yrs), B (>10-20yrs),C (>20-30yrs), D(>30-40yrs), E(>40-50yrs), F(>50-60yrs), G(>60-70yrs),H(>70-80yrs), I(>80-90yrs)

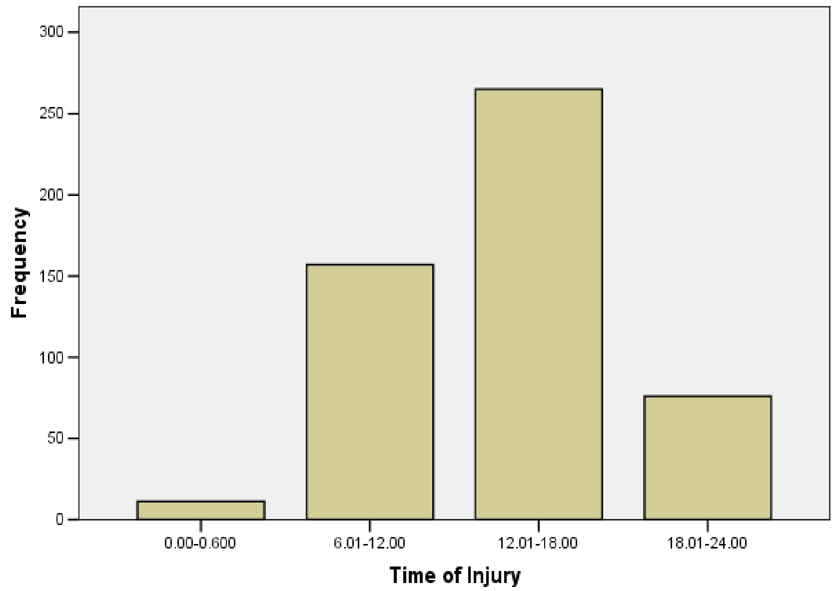

Figure 3. Distribution of causes by Age

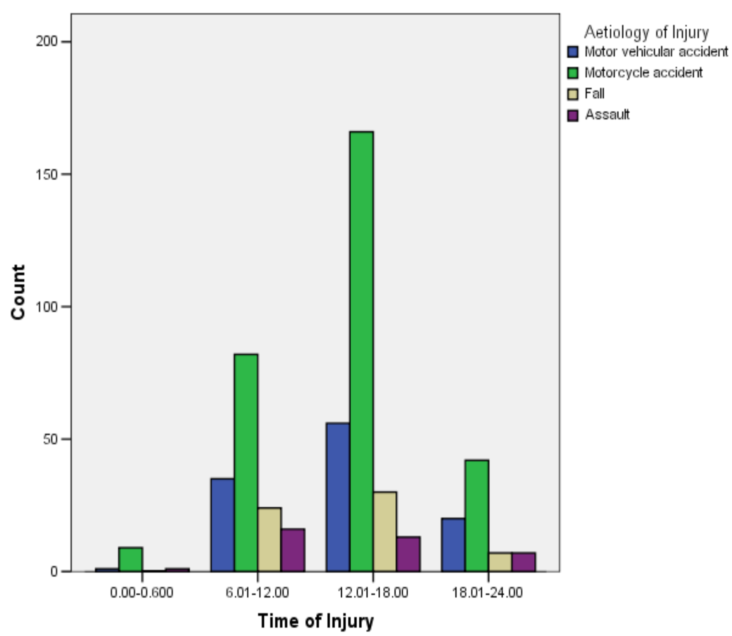

Figure 7. Distribution of Injury by Time of Occurrence.

Figure 8. Traumatic Brain Injury Illustrations
a]. Computerized Tomogram of one of our patients showing a massive right fronto-parietal acute extradural haematoma with significant midline shift
b]. Right frontal comminuted compound depressed skull fracture with evisceration of contused brain tissue in another patient
c]. Penetrating matchet injury lacerating the superior sagittal sinus, with eviscerating lacerated brain tissue in a 12-year old boy.

Discussion

Traumatic brain injury (TBI) constituted an important cause of mortality and morbidity in our environment. In this study, we found an Accident and Emergency Department (A&E) incidence of 2710 per 100,000 per year in our environment, far higher than the A&E figures of 453 and 394 per 100,000 per year for UK and US, respectively[3,5,]. This finding, thereby, stressed the urgency and significance of this preventable killer in our environment, and further highlighted the need for a better intervention protocol if improved outcome would be attained in our part of the world.

The greatest contributor to TBI in our study was road traffic accident (RTA) with the motorcycle being the major contributor to the cohort, a finding that correlated with most local and regional studies in our country[6,10,11,12]. This finding, however, was at variance with the situation in the US where fall was reported as the leading aetiological factor[3,4]. Indeed, the dominance of RTA, precisely from the motorcycle, was a serious indictment on the safety of our roads and conscientiousness of the motorcyclists.

As had been previously reported, even by other local studies, the very active >20 – 30 year male age group was the most commonly affected by TBI, and in our case, mainly from motorcycle accident (x^2 – 112.866, df – 24, p<0.000) [6]. Interestingly, the peak age incidence was lower in the US (15 – 19 years) where majority resulted from vehicular crashes. This difference might suggest that the US youths drive automobiles at an earlier age than our youths, and the high crash rate may thus, be due to the lack of sound judgment on the part of these very young drivers.

Motorcycle accident rate in our series was followed by those of motor vehicular accident, assault and fall. Fall was largely the aetiologic agent in the first decade of life while RTA was essentially the main factor in the rest of the age groups. This finding was at variance with reports in literature which generally record fall (mostly on level ground) as the predominant aetiologic factor in the very young and elderly. It could imply that even in the 9th decade of life, our people are still prone to road mishap. The explanation for this was not very certain but the indiscriminate and improper use of motorcycles as a major mode of transportation in our locality, variously reported, could be a contributing factor, more so since we recorded an outrageously higher incidence rate of RTA compared to domestic accident like fall (80.8% vs. 12%) [6,10,11,12].

While discussing trauma resulting from traffic accidents, the high level of illiteracy and ignorance of traffic laws and road signs found amongst the motorcycle operators were alarming, according to

Adogu and Ilika[15]; in fact, most of the operators had no formal training and licensing before starting to ply the roads. This probably explained the reason for the least affected occupational group being the civil servants who were more likely to have some level of education and awareness of traffic laws and road signs.

Recently, the Federal Government initiated a strict implementation of the helmet-use laws, borrowing from the discovery that this interventional measure helped in reducing the incidence in other countries like US and Italy. It is yet to be seen how this would reduce our local incidence of motorcycle-related road accidents, and it would be well advised to study the impact of this intervention as an epidemiological reference, after a few years of implementation, to assess its effectiveness in our environment[13,14].

The most common type of head injury based on severity was the mild type (57.1%), figure 5. Mild head injuries, though predominant as reported from the UK, were still much less than the rate from there (89.1% vs. 57.1%), implying that we had a higher rate of moderate and severe injuries than they did (10.9% vs. 42.9%). The consequence of this was that our TBI would more likely lead to deaths or significant neurological deficits than those in the developed world. This might just be as a result of the higher rate of male incidence of TBI generally, rather than a male gender predilection, ordinarily.

Increased risk of TBI amongst males had been unequivocally demonstrated in all local and international studies[3,4,5]. The only issue was that the male risk in our environment was nearly four times that for females unlike in UK and US where studies reported it as barely twofold. From anecdotal reports, males were the predominant motorcycle/motor vehicular drivers; therefore and in contrast, the females were expectedly less commonly affected by RTA than males. But then, more females (7.6%) were affected by fall than males (4.3%). The reason for this could not be easily adduced, but again might just be a fall out from the larger number of males involved in traffic activities and transportation which far outstripped the incidence from relatively less active duties that culminate in fall. Could it translate that if more females were involved in traffic activities, this trend might be reversed?

Another remarkable observation was that fall occurred most frequently by 12.01 – 18.00 hours, but declined by 18.01 – 24.00 hours, with the lowest incidence by 0.01 – 6.00 hours. This period of lowest incidence, of course, coincided with the period of sleep or least activity, buttressing the fact that all injuries, inclusive of those to the head or brain, were usually activity-driven. The peak time of the injury was 12.01 – 18.00 hours and this reckoned with the level of societal outdoor activities in that period. Most previous studies tended to be silent on this time rhythm.

Also, fall was found to be the most common aetiologic factor in the first decade of life, as in the reports from US for the 0-4year age group. The incidence in this our report was noted to begin rising from the 2nd quarter of the day (6:01 – 12:00), then peaked in the 3rd (12:01 – 18:00), and declined in the fourth quarter (18:01 – 24:00) when most parents would be at home and children would be retiring to bed. Children are known to be inexperienced, curious, adventurous, and sometimes, daring and as such need close supervision both at home and school. By the 3rd quarter of the day, parents and care-givers would themselves be engaged in other activities on their own, thereby depreciating the surveillance over the children. The consequence of this is the peak incidence of fall among the children occurring while playing at home and school, or pedestrian road traffic accident as they walk or hawk on the streets in the most active daytime period in our environment, 12.01 - 18.00 hours.

Expectedly, both the transfers to the ward and incidence of mortality were inversely proportional to the GCS, while discharges from the department and good outcome were directly proportional to GCS; in other words as the GCS increased, survival and discharges home also increased in number.

Of interest was the high mortality rate in the A&E in our study compared to other reports. It should be noted however that, besides the quality of intervention available in our institution, the mortality in TBI could also be related to the interplay between the brain injury, other associated injuries and level of initial care received. A careful audit might be necessary to evaluate the adequacy of the initial management given by the first care-givers vis-à-vis the outcome from TBI. Our study, equally, did not extend to other associated injuries that could have contributed to the mortality rate, and this should also be further explored, subsequently.

Conclusion and Recommendations

In summary, the risk factors for TBI in our environment were the male gender, motorcycle riding, illiteracy, trading, extremes of age, and the active daytime period of 12:01 – 18:00 hours. Mortality and morbidity from TBI in our environment was much higher than those from the developed countries and this was a direct reflection of the much higher severity of our injuries. The corollary to this is that if we made our accidents less tragic and less fatal, we would record more mild injuries and better outcome.

To achieve this corollary, there is need to adopt public health safety measures like the use of crash helmets, seat belts, speed limits, modern safety/protective vehicular devices and better road rehabilitation. These are a completely different prescription from the need for better trauma centres and optimally equipped health facilities; and the two should not be confused, because while the former deals with the risk and prevention of accident and injury, the latter deals with the care of the victims after the injury has occurred. Both measures, nonetheless, would definitely save and preserve the lives of more Nigerians.

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