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Factors affecting morbidity and mortality from road traffic accidents: A Nigerian peri-urban study

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Summary

Road traffic census was taken along major roads linking Ilorin, Nigeria, with the north, east, south and north-west at different times on three randomly selected days per month during 16 months of 1982 and 1983. Road physical characteristics thought to affect safe and free traffic flow were also documented along the same roads.

Trauma patients at the University of Ilorin Teaching Hospital were prospectively studied between 1983 and 1984. Of 715 road traffic accident (RTA) victims 78.6% were males, 48% suffered multiple injuries while 43.7% were managed non-operatively. Seventy-nine patients (11.0%) died. Of 10 variables analysed, outcome was significantly affected by non-operative management ($P < 0.01$) while patients' primary admission versus referral status was of borderline significance ($P = 0.05$). In addition to these indices of trauma severity, high truck-trailer traffic and high frequency of narrow bridges, bends and vehicle wrecks per kilometer of road were associated with high RTA rates.

Resume

Un recensement du taux de la circulation sur les principales routes qui relient Ilorin, (au Nigéria) avec le Nord, l'Est, le Sud et le Nord-Est a été effectué à trois reprises trois jours par mois; les jours étant sélectionnés au hasard pendant les 16 mois de années 1982 et 1983. Les caractéristiques physiques routières qui, estimons-nous, seraient susceptibles d'avoir des effets sur la libre circulation ont été également documentées sur les mêmes routes.

Les malades de trauma au Centre Hospitalier Universitaire d'Ilorin ont été étudiés en perspective entre les années 1983 et 1984. Parmi les 715 les victimes d'accident d'auto-route, 78,6% étaient du sexe masculin dont 48% qui avaient des lésions multiples alors que 43,7% ont été traités sans avoir recours à l'opération chirurgicale. Soixante et onze malades c'est-à-dire 11% sont morts. Sur 10 variables, le résultat analysé a été influencé de facon importante par la non-intervention d'opération chirurgicale ($P < 0,01$) alors que l'admission primaire des malades vis à vis du statut de référence n'avait qu'une importance moyenne ($P = 0,05$). En plus de ces indices de trauma sévère, la circulation fréquente des poids lourds et le nombre important par kilomètre de ponts étroits, de virages et de ruines de véhicules accidentés ont été associés aux taux élevés d'accidents d'auto-route en dehors de la ville.

Introduction

Road traffic accidents (RTAs) are the commonest cause of trauma in most reported series[1,2]. Control measures are based on epidemiological principles, the application of which varies according to national, regional and local peculiarities. This paper presents an attempt to relate environmental and clinical factors which affect RTA morbidity and mortality in Ilorin, Nigeria, and its environs.

Patients, materials and methods

Between 1982 and 1983 environmental factors that were thought to pose a risk of causing accidents were documented as follows:

Road traffic census to and from Ilorin along the four major roads linking Ilorin with the north, east, south and north-west was taken for 10-30 minutes on each occasion during different hours of each census day which was divided into six 4-hour periods. Census was taken on three randomly selected days per month using random sample numbers for selection.

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Road physical characteristics which were thought capable of rendering driving unsafe (such as major bends, valleys and hills obscuring on-coming vehicles, distracting vehicle wrecks near the road, junctions and intersections with minor and seasonal roads, and count of narrow bridges and culverts) were documented. These road features were not documented in residential areas of towns and villages and all counts were commenced from fixed points approximately 5 to 7 kilometres (about 4 miles) from the central city point.

Between 1983 and 1984 all trauma patients admitted to the University of Ilorin Teaching Hospital (UITH), Ilorin, Kwara State of Nigeria, were followed up by the author. Documentation on each patient included personal details of patient and details of accidents, initial and final diagnoses, patient management and its outcome. The data were then coded and fed into the Data General Eclipse C/150 Minicomputer at the University of Ilorin Computer Centre for analysis.

Results

Clinical analysis

RTA constituted 74.2% of 964 overall trauma patients managed in 1983 and 1984. The age range was 6 months to 80 years with peak incidence in the 18 to 30-year age group. There were 562 male patients (78.6%) and 153 females (21.4%). Of the 715 RTA patients 632 (88.4%) were primarily admitted while 83 (11.6%) were referred. Records showed respectively that 424 (59.3%), 147 (20.6%) and 126 (17.6%) of the patients were drawn from the capital city Ilorin, outside the city but in Kwara State and out of State. Residential addresses were not documented in 18 patients (2.5%).

Alcohol consumption were documented in only 6 patients (two passengers and four drivers) who were inebriated on admission or admitted having been drinking. Majority of the rest denied any alcohol intake.

Vehicles involved in RTA were clearly documented for only 207 patients (29%). The motorcycle was identified in 74 cases (35.7%) while the pedal cycle was the least frequent 1.4% (3 patients). The rest in descending order were non-commecial private and public cars 46 (22.2%), taxis 41 (19.8%), commercial and private buses 20 (9.7%) tractors, lorries, trucks 12 (5.8%), truck-trailers and trains 11 (5.3%).

The roads on which RTAs involving the 715 patients were identified in 401 cases (56.1%) as follows: city roads 149 (37.2%), northern road 122 (30.4%), eastern road 82 (20.4%), southern road 42 (10.5%) and north-western road 6 (1.5%).

The status of patients as vehicle operators and cyclists, passengers and pedestrians was complete in 679 patients (95%) as follows: passengers 426 (62.7%), drivers/operators 145 (21.4%), pedestrians 108 (15.9%).

Table 1 shows organs, systems and body parts injured. Just over half, 372 patients (52%), suffered major single injuries while 343 (48%) sustained multiple trauma. Radiographs were positive in 467 patients (65.3%), negative in 104 (14.5%), not yet done and/or requested in 138 (19.3%) while there was no information in 6 patients (0.8%).

Table 1: Localization of injuries from RTA

Organs/Systems	No.	%
Lower extremity	253	35.4
Brain	142	19.9
Chest/CVS	127	17.8
Upper extremity/shoulder	60	8.4
Other Head/Neck	53	7.4
Spinal column	28	3.9
Pelvis/Hip	22	3.1
*Abdomen GIT 11 GUT 5	16	2.2
**Others	14	1.9
TOTAL	715	100.0

* Gastrointestinal tract, genitourinary tract with retroperitoneum

** Lacerations, contusions, abrasions, burns

Table 2: Outcome of management of RTA victims

	Male		Female		Total		Dry Season*		Wet Season*		Total	
	No.	%	No	%	No	%	No	%	No	%	No	%
Alive	475	84.5	130	85.0	605	84.6	280	86.2	325	83.3	605	84.6
Dead	64	11.5	15	9.8	79	11.0	36	11.2	43	11.0	79	11.0
Unstated	23	4.1	8	5.2	31	4.3	9	2.8	22	5.6	31	4.3
Total	562	100.0	153	100.0	715	100.0	325	100.0	390	100.0	715	100.0

* Dry Season: October to March; Wet Season: April to September

At final disposition, patients management was non-operative in 312 patients (43.7%), involved minor operations in 326 patients (45.6%) and major operations in 77 patients (10.8%). Anaesthesia required for these modes of management was as follows: general anaesthesia 135 (18.9%), local and spinal anaesthesia and digital block 221 (30.9%), no specific anaesthesia 359 (50.2%). Analgesia was used following usual clinical indications for all patients groups.

Table 2 expresses outcome of management according to the sex of injured patients and seasonal distribution of RTAs. The dry season (generally mid-October to mid-April) and wet season (generally mid-April to mid-October) have been approximated to last from October to March and April to September for ease of analysis.

Of 547 patients whose admission-discharge dates were documented, 332 patients (60.7%) were admitted for up to 14 days while the remaining 215 patients were admitted for 15 to 120 days. On the other hand 69 deaths occurred within seven days of admission while only 5 (6.3%) deaths occurred after two weeks of admission to hospital. Most chronic injuries affected cranium, long bones and spine.

Injury-treatment intervals were as follows: 583 patients (81.5%) were admitted on the day of RTA, 100 (14.0%) from 24 hours to three months, 10 (1.4%) more than three months post-injury while 22 patients (3.1%) did not have complete data.

The following chi-square, degrees of freedom and probability values were calculated for outcome of management related to 10 variables for 964 trauma victims: age (subdivided into eight groups): X^2 = 16.984, 14*df* P = 0.26;
sex: X^2 = 1.701, 2*df*, P = 0.43; seasons: X^2 = 4.568, 2*df*, P = 0.10;
residential address: X^2 = 6.954, 6*df*, P = 0.33;
RTA type: X^2 = 5.724, 8*df*, P = 0.68;
roads of RTA: X^2 = 12.523, 12*df*, P = 0.40;
operator and passengers status of patients: X^2 = 1.483, 4*df*, P = 0.83;
injury-treatment interval: X^2 = 11.102, 10*df*, P = 0.35;
source of patients by primary admission or referral: X^2 = 5.949, 2*df*, P = 0.05;
operative or non-operative treatment: X^2 = 14.607, 4*df*, P = 0.006.

Road traffic census

The third randomly sampled day for February, 1983 was the 30th day which fell on 2 March, 1983 and therefore became the fourth sampling day for that month. In order to compensate for the dearth of Mondays and Tuesdays among the randomly selected census days eight more days spread over the dry and wet season months of January, February, April, October and November were added to the list. Traffic census was therefore taken in 236 sampling periods on 59 days in the 16-month period of study. The four-hour time periods of the day during which census was taken was distributed as follows through periods one to six beginning from midnight; 6, 23^1/2, 42^1/2, 19^1/2, 88^1/2, and 55^1/2. Thus the least number of times that traffic census was taken was between midnight and 4 a.m. (6 times) while census was most frequently taken between 4 and 8 p.m. (88^1/2 times). The halves indicate census time overlapping two consecutive sampling periods.

The 59 census days were distributed as follows from Monday to Sunday: 4, 9, 10, 8, 9, 7 and 12. The 236 census sampling periods were spread over 16 months beginning with September 1982 and ending in December 1983 as follows: 16, 16, 28, 16, 20, 8, 16, 12, 8, 16, 12, 12, 12, 20, 16 and 8.

The traffic volume expressed as number of

different vehicles and cycles moving to and from Ilorin past each census point is shown in Figure 1. The north-west road traffic was generally the lowest all round except for pedal cycles while the east road was plied most heavily by private cars in contradistinction to truck- trailers which were most frequent to essentially the same degree on the north-and-south-bound roads.

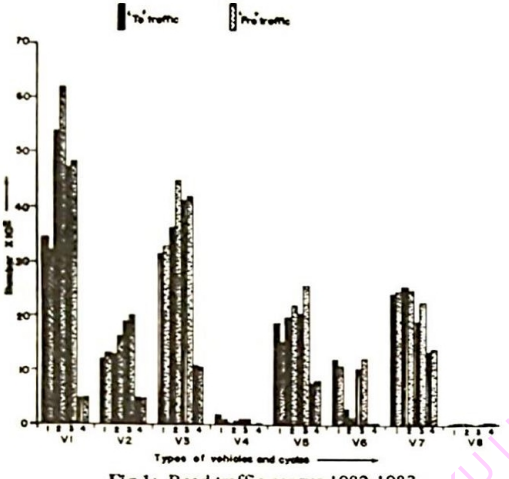

Fig 1: Road traffic census 1982-1983

V1 - Privte Cars
V2 - Taxis
V3 - Minibuses
V4 - Other buses
V5 - Trucks, Tractors & Lorries
V6 - Truck-trailers
V7 - Motorcycles
V8 - Pedal cycles

Road physical characteristics

The total number, and the number per kilometer, of each of the road physical characteristics studied are shown in Table 3. Narrow bridges and culverts were defined as those not as wide as two road lanes and therefore could not accommodate safely two vehicles moving in opposite directions on a single carriage way. The least winding road was the south-bound road while the north and east roads were essentially similar. The most even terrain was recorded along the north-west road as regards hills and valleys masking on-coming vehicles. The Ilorin-east road was the most undulating in these respects. The Ilorin-north road was the most littered with vehicle wrecks adjacent to the road, especially the heavy truck-trailers. However, very old wrecks were also documented frequently along the east and south roads in contrast to a low count on the north-west road. Road junctions and intersections were least visible along the north road while they were most frequent for the north-west road. Narrow bridges and culverts were least numerous along the east-bound road and most numerous along the north-west road.

Discussion

Clinical and road environmental features

It has been suggested that a synchronized study of damaged vehicles and clinical analysis of injured vehicle occupants is more useful than either study alone[3]. Forces producing specific types of trauma and the mechanisms of injury have been studied infrequently[3-6]. In the developing countries of Africa while the multi-disciplinary nature of trauma is well recognised[7], especially little or no co-operative studies are available. This paper attempts to relate clinical and environmental factors thought to influence RTA morbidity and mortality in Ilorin and environs.

Table 3: Road characteristics* affecting safe traffic flow

Road*	Distance	Bends	Valleys	Hills	VWC	JIC	NBC
Jebba (North)	109	(105) 0.963	(40) 0.367	(61) 0.560	(92) 0.844	(30) 0.275	(11) 0.101
Egbe (East)	133	(122) 0.917	(70) 0.526	(58) 0.436	(25) 0.188	(72) 0.541	(2) 0.015
Ogbomoso (South)	53	(5) 0.094	(21) 0.396	(30) 0.566	(19) 0.358	(28) 0.528	(11) 0.208
Igbeti (NW)	55	(38) 0.691	(6) 0.109	(10) 0.182	(2) 0.036	(42) 0.764	(15) 0.273

* All road distances covered are in kilometers from Ilorin
* Recorded respectively as number and number per kilometer
VWC - Vehicle wreckage count
JIC - Junctions and intersections count
NBC - Narrow bridges and culverts count

Our typical RTA victim was a young adult male with 62.7% chance of being a passenger and 63.9% chance of being admitted primarily to our hospital. For social, religious and economic reasons a smaller percentage of our population appears to consume alcohol when compared with what obtains in developed countries. It will require breath or blood alcohol analysis to determine the possible contribution of alcohol consumption to RTAs in our locality in comparison with others[8-9]. However, the low incidence of alcohol consumption in RTA victims has been documented by others[10-11].

Several aspects of our trauma data including type of vehicles involved in RTAs are incomplete as noted by others[10-11]. A national policy on mandatory trauma data reporting using standard accident form will correct this deficiency as has been proved elsewhere[12]. Additionally it will enable a case-to-case analysis relating road environmental features and RTA morbidity and mortality.

RTA involving 149 patients (37.2%) occurred on city roads. In descending order other RTAs occurred on the northern, southern, eastern and north-western road links. The northern road also had the largest number of bends and vehicle wrecks per kilometer of road and intermediate number of narrow bridges and culverts (Table 3). The north and south road links recorded particularly large traffic volumes and similarly conveyed large numbers of truck-trailers in contradistinction to the large east-bound traffic composed mainly of private cars, taxis and mini-buses (Figure 1). The east-bound road also combined a low narrow bridge and culvert count with the largest number of valleys (Table 3). The heavy vehicle traffic volume, high narrow bridge-culvert, vehicle wreckage and road bend counts were associated with higher RTAs and hence higher morbidity and mortality. High traffic census did not necessarily imply high RTA rate, however. Two university convocation days consecutively recorded very high but largely slow traffic volume and only one RTA.

Pedestrians constitute a small but notable 15.9% (108 patients) of RTA patients. Many of these accidents involving pedestrians are preventable.

Only 77 patients (10.8%) required major operations of all types while 326 (45.6%) required minor operations. Of those subjected to operations 221 (30.9%) had local and spinal anaesthesia and digital nerve block which could be administered by the surgeons. These data reflect the severity of traffic trauma and hence degree of morbidity.

Radiographs were economically used, in that only 104 patients (14.5%) have negative radiographs in contrast to lower yield with head injuries recorded by others[13-15]. However, our limited autopsy experience confirmed a considerable false negative rates for spinal and rib fracture radiographs especially in the multiply injured.

There was no significant seasonal difference in mortality. This may be due to cancelling effects of seasonal variations in sunshine hours, comfortable temperature and humidity which are well documented for Ilorin[16].

Road traffic census

RTAs occurred in descending order of frequency on the north, south, north-west and east roads which has some agreement only with the pattern of truck, trailer and commercial vehicle traffic. Private cars appear to be involved in RTA's somewhat less frequently than their traffic volume. More complete data and more extensive patient follow-up would be needed to relate road traffic census and other road characteristics directly to RTA morbidity and mortality.

Road physical characteristics

Accident clusters and vehicle wrecks were most obvious and road bends most frequent on the north-bound road. It needs to be seen to what extent the correction of many of these unfavourable road characteristics will influence RTA morbidity and mortality, especially if speed limits are enforced. These data provide some objective basis on which preventive measures may be taken in cooperation with engineers and civil authorities.

It is general practice to attribute most RTA's to human factors since human behaviour is expected to anticipate and compensatorily adjust to environmental factors that tend to result in RTA. This paper shows that for certain roads, environmental factors are more frequent. Mechanical factors are beyond the scope of the author.

Conclusion

Statistical analysis has shown that indices of trauma severity are associated with higher morbidity as can be expected. Additionally higher RTAs have been documented along the roads having high truck-trailer traffic and high frequency of narrow bridges, bends and vehicle wrecks. A national policy on mandatory

trauma reporting will enhance detailed case-to-case documentation and statistical relationship between environmental factors and RTA morbidity and mortality.

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