

COMPARATIVE STUDY OF ROAD TRAFFIC ACCIDENTS CAUSED BY MOTORCYCLES BEFORE AND AFTER THE LAGOS STATE NEW TRAFFIC LAWS.

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Abstract

Background: Road traffic accidents are among the commonest causes of death and disability worldwide with a high burden of these accidents occurring in developing nations. In Nigeria, Lagos State has one of the highest rates of accidents contributing significantly to the burden of death and disability among motorcyclists in the country. With the high frequency, mortality rates and morbidity associated with motorcycle related road traffic accidents in Lagos, there arose a need for an intervention (traffic laws) and a need to assess the impact of traffic laws in reducing the frequency of road traffic accidents in the state.

Objectives: To compare the frequencies, morbidity patterns and associated mortality of motorcycle-related road traffic accidents before and after the Lagos State new traffic law.

Materials and Methods: A comparative cross-sectional study design in which a total of 202 case notes were retrieved by systematic sampling. Data gathered included age, sex, occupation of the patients, mode of involvement, use of safety devices e.g. helmet use, nature of their injuries and death during or after the accident if any.

Results: It was found that more males were affected representing 58.56% pre-law, while more females were affected post-law representing 51.56%. Before the ban, six deaths representing 5.41% occurred as compared with no death after the ban. The most common part of the body involved was the lower limb region; 76.58% and 68.13% pre-law and post-law respectively. The most common upper limb fracture was the radial bone fracture; 36.59% pre-law and 25.71% post-law. Upper limb dislocation was found in 36.59% of the respondents, pre-law and 31.43% of the respondents, post-law. The most common lower limb fracture was that of tibia and fibula which accounted for 35.29% pre-law and 41.94% post-law. Lower limb dislocation was found in 2.35% of the respondents, pre-law and 1.61% of the respondents, post-law.

Conclusion: This study suggests that the impact of the law is promising as there has been a marked reduction in motorcycle related road traffic accidents, hence the need for continued enforcement by road traffic agencies and compliance from road users.

Keywords: Road traffic accidents, Motorcycles, Pedestrians, Pre-law, Post-law.

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INTRODUCTION

Road traffic accidents are among the commonest causes of death and disability worldwide with a high burden of these accidents occurring in developing nations. RTAs rank ninth globally among the leading causes of disability-adjusted life

years lost. It has been predicted that by 2020, Road Traffic Accidents will rank as high as third among causes of disability-adjusted life years lost.¹

In many developing countries, motorcycle is the most common transportation vehicle as it is useful

in navigating their poor terrains and also serves as a source of income.² A Vietnam study in an attempt to measure the impact of a national helmet law showed that in one out of the 63 Vietnamese provinces wearing of helmets in riders increased from 27% pre-law to 99% post-law, and also, there was an increase in the use of helmets amongst passengers from 21% pre-law to 99% post-law. It was also observed that the risk of head injuries decreased by 16% and the risk of death decreased by 18% after the first three months of the law's introduction. At the end of one year, it was reported that 1557 lives were saved and 2495 serious injuries prevented as compared to the same time frame pre-law.³

In Nigeria, Lagos State has one of the highest rates of accidents contributing significantly to the burden of death and disability among motorcyclists in the country. With the high frequency of motorcycle related road traffic accidents, and associated rates of mortality and morbidity in Lagos, there arose a need for an intervention (traffic laws) and a need to assess the impact of traffic laws in reducing the frequency of road traffic accidents in the state.⁴

In August 2012, the Lagos State Governor signed the Lagos state road traffic bill into law. The law is expected to stop the menace caused by motorcycles and improve traffic situation in the state. The law included among many others the ban of motorcycles and tricycles on major bridges, expressways and major roads, and mandatory use of a standard protective crash helmet by rider and passenger. Violation of this laws attracted strict penalty which could either be a fine, imprisonment with community service or both.⁵ This study aims to compare the frequency of road traffic accidents caused by motorcycles, the morbidity patterns and the associated mortality in Lagos state before and after the new Lagos state traffic law was enforced.

MATERIALS AND METHODS

National Orthopaedic Hospital, Igbobi, Lagos (NOHIL) was founded in 1945. It is the premiere orthopaedic hospital in Nigeria. It is a centre of

excellence in the provision of comprehensive health care and training in orthopaedic, plastic and trauma surgery. It is one of the tertiary hospitals popular in the management of accidents and emergency victims.⁶ Average number of registered patients per week is 194, average number of registered patients per month is 840 patients. There was a total of 592 motorcycle related accident cases registered from August 2011- July 2012 and a total of 482 accidents from September 2012 - August 2013. The Accident and Emergency unit of NOHIL delivers 24 hours intensive emergency services to accident and emergency victims.

A comparative cross-sectional study design was used to compare motorcycle related morbidity and mortality that occurred over a two-year period (pre law and post law). The study was carried out in NOHIL on patients' records involved in any motorcycle related accident and excluded records of all patients admitted in August 2012, non-motorcycle related accidents, and accidents that occurred outside Lagos. The sample size formula: $N = (z_a + z_b)^2 (p_1q_1 + p_2q_2) / (p_1 - p_2)^2$ for comparative study was used to estimate the 165-minimum number of case notes to be retrieved. However, 202 case notes were retrieved. A total of 1074 motorcycle related road traffic accidents occurred between August 2011 and August 2013, with 592 accidents occurring between August 2011 and July 2012 (pre-law) and 482 accidents occurring between September 2012 and August 2013 (post-law). Proportionate sample size pre-law was 111 and post-law was 91. Sampling interval for both pre-law and post-law was one in every five case notes. Each case note was selected using systematic random sampling. Data gathered included age, sex, occupation of the patients, mode of involvement e.g. nature of their injuries, the use of safety devices and death during or after the accident if any.

DATA ANALYSIS

Data were analysed electronically using GraphPad Prism. Frequencies, means and standard deviations were generated for relevant variables. The Chi-squared test and Fisher's exact test and Paired T-

test were used to compare proportions and mean differences. All analyses were done with a confidence interval of 95%, and at <0.05 level of significance.

RESULTS

Socio-demographic characteristics

A total of 9451 road traffic accident victims were admitted to the emergency department of National Orthopaedic Hospital Igbobi between August 2011 and July 2012 (pre-law) out of which only 592 (6.26%) were motorcycle related as compared with total of 10773 road traffic accidents admitted between September 2012 and August 2013 (post-law) of which only 482 (4.47%) were motorcycle related. Data on two hundred and two patients were obtained (Pre-law:111, Post-law: 91). Most of the respondents, pre-law were in the 30 – 39 age group representing 32.43%.

Most respondents, post-law were in the 20 – 29 age groups representing 32.97%. More males were affected (56.56%) pre-law while more females (51.56%) were affected post-law. Most (71.17%) of the respondents involved in a motorcycle related accident were married, and 8.83% were single before the law. Most (68.13%) of the respondents were married while 31.87% were single post-law. The most commonly involved occupation was skilled non manual workers; 18.92% pre-law compared to students being most commonly involved; 25.27% post-law.

More Christians were involved in motorcycle related accidents in both years represented by 72.07% pre-law and 70.33% post-law. Prior to the law, passengers and pedestrians represented by 40.91% respectively were most involved in these accidents compared with just the passengers alone represented by 59.55% after the ban. There was a statistically significant reduction in motorcycle incidence amongst pedestrians and riders, post-law ($t=2.31$, $p\text{-value}=0.023$; $t=1.99$, $p\text{-value}=0.049$ respectively). 30.84% of the respondents were found to take alcohol before the ban and 30.0% were found to take alcohol after the ban. Before the ban six deaths represented by 5.41% occurred as

compared with no death after the ban and this was also statistically significant ($t=2.51$, $p\text{-value}=0.014$).

Morbidity Patterns of Injuries

The commonest body region involved is the lower limb region represented by 76.58% pre-law as compared with 68.13% post-law. Superficial bruises were found in 99.10% of the respondents, pre-law as compared to 100% of the respondents, post-law. Most common upper limb injury subcategory was the upper limb swelling represented by 85.37% pre-law and 82.86% post-law.

The most common fracture was the radial bone fracture represented by 36.59% pre-law compared to 25.71% post-law. Upper limb dislocation was found in 36.59% of the respondents, pre-law compared to 31.43% of the respondents, post-law. There was a statistically significant reduction in the incidence of fractured humerus, fractured hand bones, fractured radius and fractured ulna bones post-law ($t=3.42$, $p\text{-value}=0.001$; $t=4.93$, $p\text{-value}<0.001$; $t=3.74$, $p\text{-value}<0.001$; $t=2.62$, $p\text{-value}=0.010$ respectively). There was also a statistically significant increase in soft tissue injury and upper limb swelling ($t=-5.50$, $p\text{-value}<0.001$; $t=-6.22$, $p\text{-value}<0.001$).

There was a statistically significant decrease in lower limb soft tissue injury post-law ($t=2.93$, $p\text{-value}=0.004$). Most common lower limb injury subcategory was the lower limb swelling represented by 89.41% pre-law and 98.39% post-law. There was a statistically significant decrease in the incidence of lower limb swelling ($t=2.09$, $p\text{-value}=0.039$). The most common lower limb fracture was that of tibia and fibular represented by 35.29% pre-law compared to 41.94% post-law, but there was no statistically significant difference in the incidence post-law ($t=0.31$, $p\text{-value}=0.759$). Lower limb dislocation was found in 2.35% of the respondents, pre-law as compared to 1.61% of the respondents, post-law. There was also a statistically significant increase in the incidence of fractured ankle post-law ($t<-3.48$, $p\text{-value}=0.001$). Knee fracture and

ligament sprain also showed a statistically significant reduction post-law ($t=2.28$, p -value=0.025; $t=3.27$, p -value=0.001 respectively).

In the pre-law period, there was a statistically significant association between the ages and their mode of involvement (p -value=0.000) but there was no statistically significant associations post-law between ages and their mode of involvement. There was a statistically significant association between sex, occupation and the mode of involvement (p -value= 0.001f and 0.010f

respectively) pre-law but there was no statistically significant association between sex, occupation and their mode of involvement post-law. There was a statistically significant reduction in the number of accident cases recorded in the month of December following the enactment of traffic laws ($t(90) = 2.182$, p value: <0.05). However, there was no statistically significant change in accidents cases/month in the other month.

Table 1: Socio-demographic characteristics of respondents

Variable	Pre-law N=111 Frequency (%)	Post-law N=91 Frequency (%)	Chi-square	p-value
Age (in years)			4.06	0.044*
10-19	7(6.31)	8(8.79)		
20-29	25(22.52)	30(32.97)		
30-39	36(32.43)	19(20.88)		
40-49	15(13.51)	15(16.48)		
50-59	13(11.71)	11(12.09)		
>60	15(13.51)	8(8.79)		
Sex			2.76	0.097
Male	65(58.56)	44(48.35)		
Female	46(41.44)	47(51.65)		
Marital status			0.92	0.338
Married	79(71.17)	62(68.13)		
Single	32(28.83)	29(31.87)		
Occupation			0.57	0.452f
Professionals	18(16.22)	5(5.49)		
Skilled manual	20(18.02)	12(13.19)		
Students	17(15.32)	23(25.27)		
Unemployed	14(12.61)	6(6.59)		
Unskilled Manual	8(7.21)	15(16.48)		
Religion			0.05	0.826f
Islam	28(25.23)	23(25.27)		
Traditional	3(2.70)	4(4.40)		
Christian	80(72.07)	64(70.33)		

*statistically significant, f=fishers exact

Table 2: Type of accident, mode of involvement, associated factor and fatality.

Variable	Pre-law N=111 Frequency (%)	Post-law N=91 Frequency (%)	t-value	p-value
Mode of involvement				
Passenger	45(40.54)	53(58.24)	-0.79	0.433
Pedestrian	46(41.44)	29(31.87)	2.31	0.023*
Rider	20(18.02)	9(9.81)	1.99	0.049*
Alcohol intake				
Yes	34(30.63)	27(29.67)	1.35	0.181
No	77(69.37)	64(70.33)	2.75	0.007*
Death				
Yes	6(5.41)	0(0.00)	2.51	0.014*
No	105(94.59)	91(100.00)	3.95	<0.001*

*statistically significant

Table 3: Categories of respondent's injuries.

*Categories	Pre-law (n=111) Frequency (%)	Post-law (n=91) Frequency (%)	t-value	p-value
Superficial bruises	110(99.10)	91(100.00)	4.77	<0.001*
Upper limb injuries	41(36.94)	35(38.46)	0.85	0.399
Lower limb injuries	85(76.58)	62(68.13)	3.52	0.001*
Head injuries	12(10.81)	10(10.99)	-3.30	0.001*
Abdominal injuries	5(4.50)	2(2.20)	3.94	<0.001*
Chest injuries	8(7.21)	1(1.10)	3.11	0.002*
Pelvic injuries	1(0.90)	1(1.10)	4.91	<0.001*

*statistically significant

Table 4: Subcategories of upper limb injuries.

*Upper limb injuries	Pre-law (n=41) Frequency (%)	Post-law (n=35) Frequency (%)	t-value	p-value
Upper limb dislocation	15(36.59)	11(31.43)	0.94	0.348
Fractured humerus	7(17.07)	2(5.71)	3.42	0.001*
Fractured radius	15(36.59)	9(25.71)	2.62	0.010*
Fractured hand bones	2(4.89)	4(11.43)	4.93	<0.001*
Ligament sprain	10(24.39)	2(5.71)	2.23	0.280
Fractured ulna	5(12.20)	2(5.71)	3.74	<0.001*
Upper limb swelling	35(85.37)	29(82.86)	-6.22	<0.001
Soft tissue injury	31(75.61)	24(68.57)	-5.50	<0.001

*statistically significant

Table 5: Subcategories of lower limb injuries.

*Lower limb injuries	Pre-law(n=85) Frequency (%)	Post-law (n=62) Frequency (%)	t-value	p-value
Soft tissue injury	72(84.71)	51(82.26)	2.93	0.004*
Swelling	76(89.41)	61(98.39)	2.09	0.039*
Dislocation	2(2.35)	1(1.61)	-1.00	0.319
Fractured femur	20(23.53)	19(30.65)	-4.76	<0.001
Fractured tibia and fibula	30(35.29)	26(41.94)	0.31	0.759
Fractured ankle	7(8.24)	11(17.74)	-3.48	0.001*
Fractured foot	8(9.41)	5(8.06)	-16.95	<0.001
Knee fracture	5(5.88)	3(4.84)	2.28	0.025*
Ligament sprain	6(7.06)	2(3.23)	3.27	0.001*

*statistically significant

Table 6: Association between respondents' socio-demographic characteristics and their mode of involvement in the accidents.

Variable	Pre-law Mode of involvement			Post-law Mode of involvement		
	Passenger	Pedestrian	Rider	Passenger	Pedestrian	Rider
Age						
<30 years	11 (35.48)	9 (29.03)	11 (35.48)	22 (61.11)	10 (27.78)	4 (11.11)
30-49 years	30 (58.82)	15 (29.41)	6 (11.76)	23 (67.65)	9 (26.47)	2 (5.88)
≥50 years	4 (14.29)	21 (75.00)	3 (10.71)	8 (42.11)	10 (52.63)	1 (5.26)
Total	45 (40.91)	45 (40.91)	20 (18.18)	53 (59.55)	29 (32.58)	7 (7.87)
	X² = 26.93 df = 4 P = 0.000*f			X² = 5.30 df = 4 P = 0.258f		
Sex						
Female	20 (43.48)	25 (54.35)	1 (2.17)	28 (62.22)	16 (35.56)	1 (2.22)
Male	25 (39.06)	20 (31.25)	19 (29.69)	25 (56.82)	13 (29.55)	6 (13.64)
Total	45 (40.91)	45 (40.91)	20 (18.18)	53 (59.55)	29 (32.58)	7 (7.87)
	X² = 14.81 df = 2 P = 0.001*f			X² = 4.09 df = 2 P = 0.130f		
Marital status						
Married	31 (39.74)	36 (46.15)	11 (14.10)	37 (59.68)	20 (32.26)	5 (8.06)
Single	13 (43.33)	8 (26.67)	9 (30.00)	15 (60.00)	8 (32.00)	2 (8.00)
Total	44 (40.74)	44 (40.74)	20 (18.52)	52 (59.77)	28 (32.18)	7 (8.05)
	X² = 4.50 df = 2 p = 0.082			X² = 0.11 df = 2 P = 0.948f		
Occupation						
Non professional	26 (41.94)	20 (32.26)	16 (25.81)	33 (58.93)	17 (30.36)	6 (10.71)
Professional	8 (47.06)	7 (41.18)	2 (11.76)	2 (40.00)	3 (60.00)	0 (0.00)
Student	9 (52.94)	6 (35.29)	2 (11.76)	16 (76.19)	4 (19.05)	1 (4.76)
Unemployed	2 (14.29)	12 (85.71)	0 (0.00)	1 (16.67)	5 (83.33)	0 (0.00)
Total	45 (40.91)	45 (40.91)	20 (18.18)	52 (59.09)	29 (32.95)	7 (7.95)
	X² = 16.80 df = 6 p = 0.010*f			X² = 12.11 df = 6 P = 0.060		

f=Fischer's exact, *statistically significant

Table 9: Comparison between monthly accident cases recorded pre- and post-law.

PRE-LAW – POST-LAW	Mean	SD	t-value	df	p-value
JANUARY	0.066	0.416	1.511	90	0.134
FEBUARY	-0.055	0.45	-1.149	90	0.254
MARCH	-0.033	0.379	-0.831	90	0.408
APRIL	0.033	0.407	0.773	90	0.442
MAY	0.044	0.419	1.000	90	0.320
JUNE	-0.033	0.348	-0.904	90	0.369
JULY	0.000	0.365	0.000	90	1.000
AUGUST	-0.044	0.392	-1.070	90	0.288
SEPTEMBER	-0.055	0.376	-1.394	90	0.167
OCTOBER	-0.011	0.380	-0.276	90	0.783
NOVEMBER	0.000	0.394	0.000	90	1.000
DECEMBER	0.088	0.384	2.182	90	0.032*

*statistically significant

DISCUSSION

This study showed that the occurrence of motorcycle road traffic accident was higher within the age group of 30 – 39 years before the law. This finding is in agreement with some reports from Mwanza city, Tanzania.⁷ This observation is a reflection of the ages of most commercial vehicle and motor-cycle riders in Lagos. It was also noted that there was a change in the age group mostly affected after the law, as the ages 20 – 29 years recorded the highest amount (32.97%) of occurrences of road traffic accident after the enactment of the law. While this observation may be related to the increased risk-taking and the unskilled level of these young drivers similar to the conclusion of a study done in Bangkok Thailand⁸, it may also be denoting the disregard for laws especially by the young drivers.

A study in Khorasan Razavi Province of Iran also reported a similar higher rate of road traffic accident in people less than 25 years and the study attributed this higher rate to the disregard for 'yield right of way' law.⁹ Studies from South Sudan¹⁰ showed that males are majorly involved in road traffic accident. Even though, these reports were corroborated by the cases recorded in males before the promulgation and enforcement of traffic laws in Lagos, it was reversed after the enactment of the law. Majority of cases

recorded before the law were in males (58.56%) but in females (51.65%) since after the law. These changes can be due to either poor use of helmet by females or by the increased involvement of females in road transport businesses in Lagos either as public bus drivers, 'bus conductors' or as 'Okada' riders.

The involvement of females may be attributable to the high rate of unemployment in the society which in itself may motivate these women to join this sector since it can be a source of income for their family. The recorded cases of road traffic accidents doubled in the unskilled manual labourers from 7.21% to 16.48% after the enactment of the law. This observation can be attributed to the higher socio-economic pressures these categories of people are subjected to due to the high rate of unemployment in Nigeria.

The pressures can possibly be a factor that forces them to be more involved in commercial motorcycle riding in an attempt to be self-sustaining and in order to get daily allowance that will at least suffice enough to meet their daily needs. However, majority of these people do not have a form of education and perhaps are living without the knowledge of the law as it was the case

in a study done in Ghana¹¹ and similarly, in another study done in Oyo state.¹² Majority of the cases of road traffic accident in this study were noted among the Christians both before (72.07%) and after (70.33%) the enactment of the legislation. This is similar to the reports obtained from a study done in Jos where Christians were more involved in road traffic accidents than other religions.¹³ Their findings in that study was attributed to the higher rate of ethno-religious crisis in that state. However, the incidences of such ethno-religious crisis in Lagos state were substantially lower than that of Plateau state.¹³

Another study in Taiwan showed that about 60% of all driving fatalities involved motorcycles. Consideration of factors behind the high frequency and risk of motorcycle deaths specifically riders age, and non-use of helmet could help the government make informed decisions regarding the development of effective traffic safety measures.¹⁴ The introduction and enforcement of new Lagos traffic laws has shown promising results in terms of reducing the incidences of motorcycle related accidents just as it did in Kwara state after they re-enacted their helmet law in 2006.¹⁵ And in Romagna Italy, their revised Italian mandatory helmet law with police enforcement crashed motorcycle-moped accident by 66%.¹⁶

It was also observed in this study that there was a significant association between age of respondents and the mode of involvement in accidents before the law. As age increased, respondents were more involved as pedestrians while with decreasing age they were involved more as riders/drivers. However, after the law, such association did not exist because different measures such as: enforcing acquisition of driver's licence before driving on major roads, construction, renovation and increased use of overhead bridges to cross roads by pedestrian, and effective management of Lagos traffic lights.

When assessing the morbidity patterns of injuries in Lagos, soft tissue injuries and lower limb

injuries were the most common pre-law (76.58%) and post-law (68.13%). This was also seen in a study done in Buruku, Jos where 73.9% and 62.5% of injuries occurred in the lower limbs, pre-law and post-law respectively.¹³ However in Bangkok Thailand, the commonest region involved was the head region.⁸

The commonest lower limb bone fracture encountered was of the tibia bone pre-law (36.29%) and post-law (41.94%) which was also seen in a study done in Pakistan.¹⁷ When assessing mortality associated with these accidents, it was observed in this study that no death occurred after the enactment of the law compared to six casualties before the law. This could be explained in part by good compliance with the law in the aspect of helmet use for both rider and passenger as the commonest cause of mortality in such accidents is head injuries. This was in contrast to what was seen in Jos where no accidents occurred both before the law and after the law.¹³ However in north-western Tanzania, mortality rate was as high as 16.7%.⁷

It was found in this study that there was a reduction in the frequency of motorcycle related accidents that occurred in the month of December. This was contrary to what was found in another study done in Lagos that recorded increased number of accidents in the month of December.⁴ The finding was attributed to the fact that the month hosts one of the most celebrated festivities (Christmas and New year), that the season usually witnesses increased vehicular movement within and between cities, that motorists are likely to be more tensed, and alcohol impaired drivers are very likely to be among the traffic.⁴ However, since the enactment of the law motorists and commuters exercise care on this roads to avoid being arrested and fined thereby impeding the celebrations of the season.

CONCLUSION

This study suggests that the impact of the law is promising as there has been a marked reduction in

motorcycle related road traffic accidents. Hence the need for continued enforcement by road traffic agencies and compliance from road users. With continuous enforcement we could have long term reduction in the frequency of RTAs and morbidity patterns in the state. As with many issues in the country at the moment, sustainability of policies poses a challenge. But if such law can be well sustained over a ten-year period, there could be a marked reduction in incidence of motorcycle related accidents and associated mortalities.

ETHICAL APPROVAL

Ethical approval was obtained from the Health Research and Ethics Committee of Lagos University Teaching Hospital, Idi-Araba, Lagos and Research and Ethics Committee of National Orthopaedic Hospital, Igbobi, Lagos.

COMPETING INTEREST

The authors declare no competing interests.

AUTHOR'S CONTRIBUTION

All the authors contributed substantially to this study. Surulere MO and Campbell PC contributed to the concepts and design of this study; Surulere MO and Campbell PC contributed to the definition of intellectual content and literature search; Surulere MO and Campbell PC contributed to the data acquisition and collation. All authors have read and agreed to the final version of this manuscript.

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