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Research Article

A Fifteen Years Retrospective Study of Spinal Cord Injury in South-Eastern Nigeria

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Abstract

Spinal cord injury (SCI) is an insult to the spinal cord resulting in change, either temporary or permanent in its normal motor, sensory or autonomic function. However, literature has been mute on prevalence, pattern and mechanism of spinal cord injury (SCI) in South-Eastern Nigeria unlike the many papers on pattern of spinal cord injury. The purpose of this study was to establish the prevalence of SCI with a view of contributing to the emerging National data on the rising prevalence of this injury and to highlight the deficiencies in our country and suggest ways of improving them. This retrospective review of 263 case files, was conducted at four hospitals in South-Eastern Nigeria, from 1st January, 2001 to 31st December, 2015. A total of 263 cases of spinal cord injury over the 15-year period were studied. There were 209 (79.5%) males and 54 (20.5%) females. Road traffic accident accounted for 135 (51.3%), whereas fall accounted for 89 (33.8%). Thoracic spine was affected in 132 (83.3%) of patients. The peak age of occurrence was at 21 - 30 years (94) (35.7%). A total of 147 (55.9%) of the injuries were of ASIA (American Spinal Injury Association) A. There was a significant association between sex difference and mechanism of injury (P = 0.001). The prevalence rate was 31.8%. Spinal injuries in South-Eastern Nigeria occurred mostly in young adult males affecting mainly the thoracic spine. Road traffic-related incidents were the leading mechanism.

Keywords: *Prevalence; Mechanism; Pattern; Spinal Cord Injury*

Introduction

Spinal cord injury (SCI) is an insult to the spinal cord resulting in change, either temporary or permanently in its normal motor, sensory or autonomic function [1]. Spinal cord injuries account for significant proportion of musculoskeletal injuries worldwide [2]. When the spinal cord is injured, the results can be devastating and may lead to death or long-term disability; these injuries can be life changing, because unlike many other tissues, the spinal cord has poor intrinsic regenerative capacity [3,4] and once damage is done, it is usually permanent. Spinal cord injury is associated with permanent disability and decreased life expectancy [5].

The vertebrae most frequently involved in SCI are 5th, 6th, 7th cervical vertebrae (C5-C7), the 12th thoracic vertebrae (T12), and the 1st lumbar vertebrae (L1) (Heckey, 2003). These vertebrae are most susceptible because there is greater range of motion in the vertebrae column in these areas [6].

Prevalence is the proportion of a population living with a disease at a particular time [7]. Cripps., *et al.* [8] reported the global prevalence of spinal cord injury to be between 236 and 1,009 per million, a figure similar to that estimated by Blumer and Quine (1995) (110

- 1,120 per million) (Price., *et al.* 1994; Thurman., *et al.* 1994). Almost 200,000 people in the United States live each day with a disability from SCI, and an estimated 12,000 to 14,000 new injuries occur every year (Mendel., *et al*. 2005). Cripps., *et al.* [8] reported that no published data on prevalence of SCI exists for Africa or South America. Regarding the gender of SCI victims, traumatic SCI is more prevalent in males than females (Sekhon., *et al.* 2001). SCI occur more often in males (82%) than in females (18%) [9]. Ihegihu., *et al.* [2], reported that thirty of the patients (88.2%) were males, while four (11.8%) were females. It is recommended that in future studies, age at the time of SCI should be reported [10].

Investigating the epidemiological pattern of SCI is the first step in planning for preventive strategies [11]. SCI can be divided into two types- Complete and Incomplete injury. Definition of complete and incomplete SCI are based on the ASIA definition with sacral-sparing, Complete - Absence of sensory and motor functions in the lowest sacral segments. Incomplete - Preservation of sensory or motor function below the level of injury, including the lowest sacral segments [12]. Damage to the spinal cord results in paralysis (quadriplegia if the injury is in the cervical region, or paraplegia if the injury is in the thoracic, lumbar, or sacral region) Herbert (2008). Rahimi-Movaghar., *et al*. (2013), reported that complete SCIs were more common than incomplete injuries (complete SCI: 56.5%; 95% Cl: 47.6 - 65.3; incomplete SCI: 43.0%; 95% Cl: 34.1 - 52.0) while paraplegia was found to be more common than tetraplegia (paraplegia: 58.7%; 95% Cl: 51.1 - 60.0; tetraplegia: 40.6%; 95% Cl: 33.3 - 48.0). He noted that cervical SCI causes tetraplegia and T1-L1 SCI causes paraplegia. Ihegihu., *et al.* [2], reported that the most common level of injury was of the thoracic spine, 17 patients (50%); followed by the lumbar spine 11 patients (32.4%); and cervical spine six (17.6%) patients. Okonkwo., *et al.* reported that forty patients were classified as being affected by ASIA grade A injury, whereas 45 patients had various ASIA grades of incomplete injury.

In a spinal cord injury (SCI), the structures and functions of the spinal cord are damaged by trauma, inflammation, tumors, or other causes, resulting in dysfunction of motion, feeling, sphincters and autonomic nerves below the damaged plane hence, based on their etiology. SCIs can be divided into two different groups: Traumatic spinal cord injury (TSCI) and Non-Traumatic spinal cord injury (NTSCI), (O'Connor, 2002). Stoke (2004) noted that non-traumatic cases includes: developmental anomalies (e.g. spinal bifida) and congenital anomalies (e.g. angiomatous malformation); inflammation (e.g. multiple sclerosis, ischaemia) pressure on the cord due to expanding lesions (e.g. abscess or tumor extrinsic or intrinsic to the spinal cord). Stoke (2004) also noted that spinal cord damage can result from trauma (84% of cases) or non-traumatic cases (16%). Rahimi-Movahgar., *et al*. 2013 reported that, Motor vehicle collisions (MVCs) were found to be the leading causative mechanism in 41.4% of patients while a fall was identified as the mechanism of the injury in 34.9%. Likewise, the World Health Organization predicts that there will be a major increase in motor vehicle crashes in coming decades if preventative measures are not taken. Many developing countries do not have defined programs to prevent MVCs therefore, the incidence of MVCs in SCI is high (Rahimi-Movaghar, 2010). Okonkwo., *et al.* (2013) reported that Motor vehicle accident (47, 55.3%) was the frequent cause of SCI. He also noted that falls from palm trees (3.5%) were markedly reduced from what they were inferred to be (40.2%) from a similar study in Southeast, Nigeria in 1988. Ihegihu., *et al.* [2] reported that most of the spinal cord injuries, 64.7% were as a result of a fall from a height.

Epidemiology provides estimates of disease frequency, including regional and temporal variations, which are essential for research, establishment of public health policy and planning strategies of the healthcare system. Epidemiology of traumatic condition is essential for the development of targeted injury prevention strategies. To improve injury management, it is necessary to quantify the prevalence and pattern of SCI to better understand the mechanism and rates of occurrence and delineate ways of prevention. However, this knowledge will enable health care systems to implement preventative strategies and allocate resources appropriate for the injury management.

Due to the lack of registries in developing countries, an accurate estimation of the incidence and epidemiological patterns of SCI in the majority of developing countries is not feasible therefore; there is a need for large national epidemiological surveys in developing countries assessing the incidence, prevalence and etiology of SCI (Rahimi-Movaghar, 2013). Cripps., *et al.* [8], reported that no published data on prevalence of SCI exists for Africa or South America. There is no established national spinal cord injury registry in Nigeria, although several researches have been carried out in different parts of the country [13].

Ihegihu., *et al*. [2], reported that most of the SCI is as a result of fall from a height, hence could have been prevented if, better climbing tools were used. Many developing countries do not have defined programs to prevent Motor vehicle collisions (MVCs) therefore, the incidence of MVCs in SCI is high (Rahimi-Movaghar, 2010). However, the researchers have not come across studies that have focused on the prevalence, pattern and mechanism of spinal cord injury from South-Eastern Nigeria. There is always high prevalence of spinal cord injury secondary to reckless driving, and poor climbing tools. Therefore, the outcome of this study is extrapolated to give insight to the causes of spinal cord injury. This knowledge will enable health care systems to implement preventative strategies and allocate resources appropriate for the injury management. The result of this study might also provide physiotherapy practice and other health care givers with a basis for health education on spinal cord injury.

Methodology

This study is a retrospective study. The research population comprised of patients with spinal cord injury who were previously admitted into the following selected hospitals in South-Eastern Nigeria:

1. Nnamdi Azikiwe University Teaching Hospital, Nnewi, Anambra State.
2. National Orthopaedic Hospital, Enugu State.
3. Federal medical Centre, Abakaliki, Ebonyi state.
4. Federal Medical Centre, Umuahia, Abia State.

The sample for this study comprised of traumatic and non-traumatic spinal cord injured patients (males and females) from selected hospitals mentioned above from South-Eastern Nigeria. The sampling technique was a purposive sampling technique. This was a retrospective study to estimate the prevalence of spinal cord injury therefore, sample size for calculating qualitative variable was used as:

$$\text{Sample size} = \frac{Z_{1-\alpha/2}{}^2 P(1-P)}{d^2}$$

where, $Z_{1-\alpha/2}$ = Standard normal variate (at 5% type 1 error ($P < 0.05$) it is 1.96 and at 1% type 1 error ($P < 0.01$) it is 2.58). As in majority of studies, P values are considered significant below 0.05 hence, 1.96 is used in formula.

P = Expected proportion in population based on previous studies or pilot studies.

d = Absolute error or precision (has to be decided by the researcher).

Therefore, the researcher assumed according to the previously published studies, the actual number of spinal cord injured patients may not be more than 5%.

The researcher calculated this sample size with precision/absolute error of 5% and at type 1 of 5%.

$$\text{Therefore, sample size} = \frac{1.96^2 \times 0.05(1 - 0.05)}{0.05^2} = 73$$

Hence, the researchers were meant to take at least 73 case files however, the researchers finally used 263 case files.

Subject Description

This included case files of subjects who were previously diagnosed of spinal cord injury (from 1st January, 2001 to 31st December, 2015) and treated in the aforementioned hospitals in the South-Eastern Nigeria.

Inclusion Criteria and Exclusion Criteria

General inclusion criteria

Patients' case notes (males and females) with traumatic or non-traumatic spinal cord injury (from 1st January, 2001 through 31st December, 2015) with completed Data, seen in the following hospitals:

1. Nnamdi Azikiwe University teaching Hospital, Nnewi, Anambra State.
2. National Orthopaedic Hospital, Enugu, Enugu State.
3. Federal medical Centre, Abakaliki, Ebonyi state.
4. Federal Medical Centre, Umuahia, Abia State, was reviewed.

General Exclusion Criteria

Case files with incomplete Data were excluded.

Research Instruments

Already completed case files of spinal cord injury patients with x-ray or MRI report by a medical doctor.

Procedure for Data Collection

A letter was collected from the Department of Medical Rehabilitation and Physiotherapy. The letter was given to the following hospitals:

1. Nnamdi Azikiwe University teaching Hospital, Nnewi, Anambra State.
2. National Orthopaedic Hospital, Park lane, Enugu State.
3. Federal medical Centre, Abakaliki, Ebonyi state and
4. Federal Medical Centre, Umuahia, Abia State, for permission on data collections.

Copies of the proposal were submitted to the Research and Ethics Committee of each of the hospitals mentioned above. Ethical approval was sought and obtained from the Ethical Review Committee of each of the selected hospitals before the commencement of the study.

The procedure for the data collection was explained to each of the hospitals. After obtaining ethical approval from the Research and Ethics Committee, it was later submitted to the HOD, Medical Record of each hospital.

The HOD directed the researchers to the male and female orthopedic wards to submit a copy of the Ethical Approval to the Matrons in charge. Each Matron handed over their ward register to the researchers. The researchers reviewed them and copied out the hospital numbers of patients who were diagnosed of spinal cord injury and submitted back to the HOD, medical record for retrieval. The following data below was sought and obtained from the folders:

1. Demographic data of the patients such as age, sex, address and occupation.
2. The Mechanism and onset of injury as it was written in the history of presenting complaint.
3. The level and pattern of injury, as it is reported by the doctor who reviewed the case.
4. ASIA-classification of spinal cord injury (A: No motor and sensory function, B: sensory function only, C: Some sensory and not useful motor function less than grade 3 oxford muscle power grading, D: Sensory and useful motor function greater grade 3 oxford muscle power grading, E: Normal function).

The statistics of spinal cases seen in the hospitals from 1st January, 2001 to 31st December, 2015 was sought and obtained from each of the Medical Record Departments as this was used in calculating the prevalence rate.

Method of Data Analysis

Descriptive statistics of frequency, mean, Bar chart, prevalence rate and inferential statistic of chi-square were used to analyze the data after collection. Alpha level was set at 0.05. Prevalence rate was calculated as follows:

$$\text{Prevalence} = \frac{\text{case}}{\text{Persons at risk}} \text{ X } 100$$

Results

Profile of Participants

Two hundred and sixty-three case files with complete data were reviewed (209 males and 54 females) as shown in table 1. A majority of them fell between the age ranges of 21 - 30 years (35.5%), followed by 31 - 40 years (24.0%), with the least age range 0 - 10 years (0.8%), 41 - 50 years (20.5%), 51 - 60 years (9.9%), above 60 years (5.3%), 11 - 20 years (3.8%). See table 1 and figure 1. A majority of the patients were traders and farmers (26.2%), followed by students (12.2%) with the least being footballers (0.8%), carpenter (1.9%), cyclists (10.3%), civil servant (6.8%), mason/laborer (4.9%), artisan (4.9%), and driver (5.6%) (See table 1 and figure 2). Majority of the patients were residents of urban areas (62.0%), while some were residents of rural areas (38.0%) (See table 1 and figure 3).

Profile	Frequency (N)	Percentage (%)
Sex		
Male	209	79.5
Female	54	20.5
Age range		
0-10	2	0.8
20-Nov	10	3.8
21-30	94	35.7
31-40	63	24
41-50	54	20.5
51-60	26	9.9
> 60	14	5.3
Occupation		
Trader	69	26.2
Farmer	69	26.2
Carpenter	5	1.9
Cyclist	27	10.3
Civil servant	18	6.8
Student	32	12.2
Mason/laborer	13	4.9
Artisan	13	4.9
Footballer	2	0.8
Driver	15	5.7
Address		
Urban	163	62
Rural	100	38

Table 1: *Distribution of patients' profiles.*

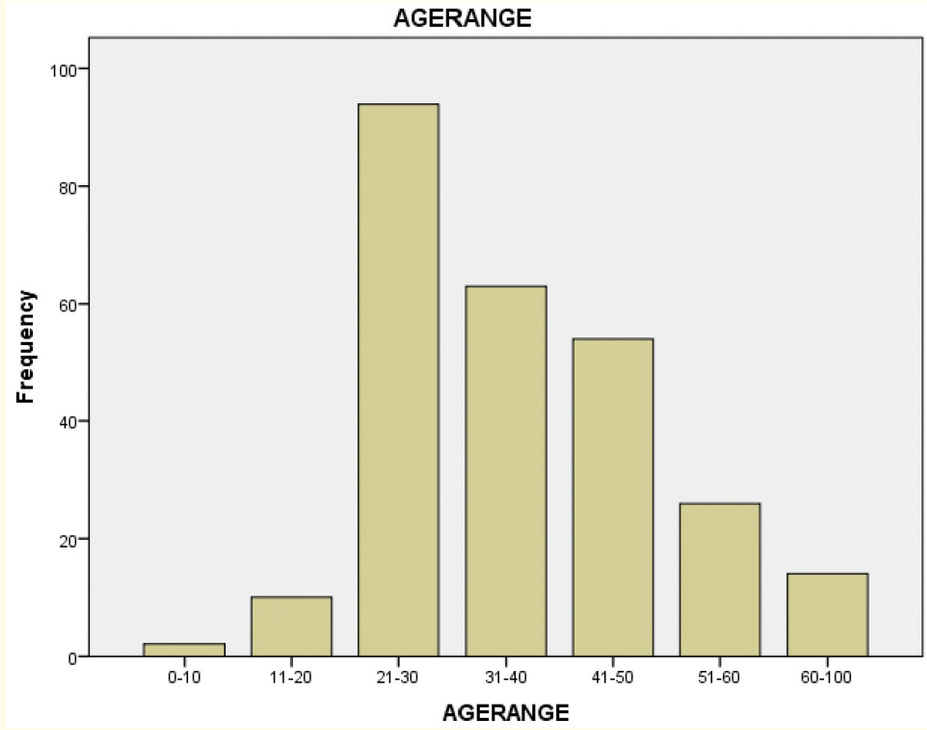

Figure 1: *Bar Chart Representing Percentage Influence of Age range on Spinal Cord Injured Patients.*

Key: Y: Frequency; X: Age Range

Figure 2: *Bar Chart Representing Frequency of Occupation of Spinal cord Injured Patients.*

Key: Y: Frequency; X: Occupation

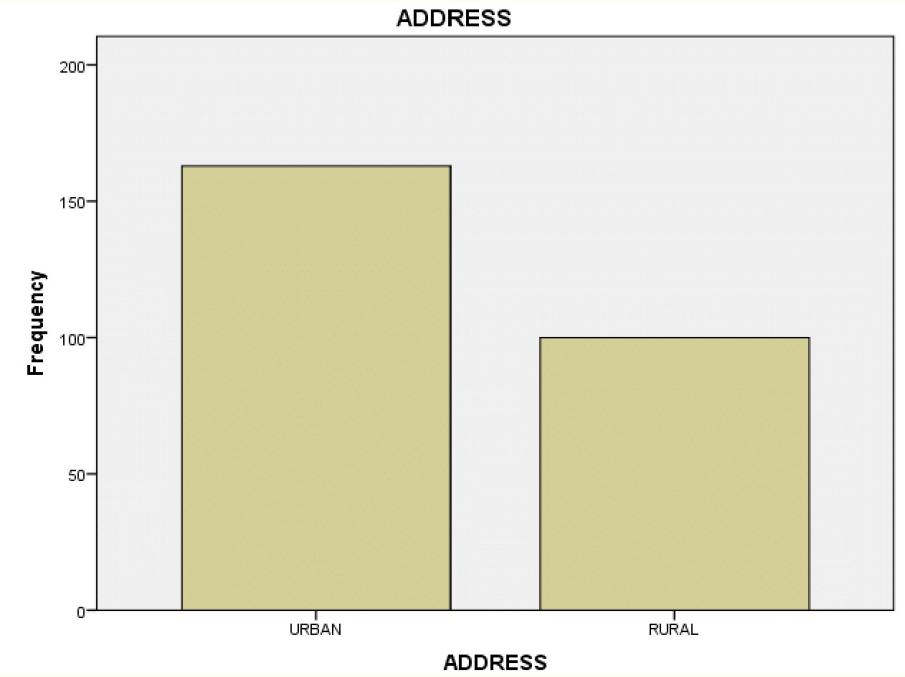

Figure 3: *Bar Char Representing Percentage of Influence of residence on Spinal Cord Injured Patients.*

Key: Y: Frequency; X: Residence

Prevalence, Pattern and Mechanism of spinal cord injured patients

The prevalence of spinal cord injury in South-East, Nigeria as obtained from selected hospitals is 31.8% of spinal cases. Generally, Road Traffic Accident (RTA) was the major mechanism of spinal cord injury (51.3%), among them motor vehicle road traffic accident (MVRTA) accounted for 30.0%, motorcycle road traffic accident (MCRTA) accounted for 19.4% and pedestrian road traffic accident (PRTA) accounted for 1.9%, followed by fall (33.8%), with the least mechanism being sport (0.8%), gunshot (3.0%), violence (2.7%), industrial accident (3.4%), NTSCI (4.9%). See table 2 and figure 6. Majority of the pattern of injury were paraplegia (P) (66.2%), followed by quadriplegia (Q) (33.8%). See table 2 and figure 7. Type of injury (American Spinal Injury Association A (ASIA A)) (55.9%) was more common followed by ASIA B (27.0%), ASIA D (12.2%) and ASIA C was the least (4.9%). See table 2 and figure 8. Figure 4 shows that SCI was highest in 2003 followed by 2002 and 2015. SCI was highest from 2001 - 2005 (41.4%), followed by 2011 - 2015 (30.8%) and lowest from 2006 to 2010 as shown in table 2 and figure 9. Level of injury was common at the thoracic area (50.2%), followed by cervical (33.1%) and lumbar (16.7%), see table 2 and figure 5. SCI secondary to MVRTA (79 patients), cervical level was common (64.6%) followed by thoracic level (31.6%). SCI secondary to NTSCI (13 patients), thoracic level accounted for 100%. SCI secondary to fall (89 patients), 58.4% thoracic level was common (58.4%) followed by lumbar level (29.2%), thoracic level (12.4%). SCI secondary to gunshot (8 patients), cervical level was more common (75.0%), thoracic level (25.0%). Out of the total number of the injury due to industrial accident 9 (3.4%), gunshot 8 (3.0%), pedestrian road traffic accident 5 (1.9%) and sports 2 (0.8%), males accounted for all and females accounted for none. Spinal cord injury due to motorcycle road traffic accident was common between the age ranges of 21 - 30 years (62.7%) of patients. About 19.4% of cases seen was due to motorcycle road traffic accident, followed by the age range 31 - 40 years (13.7%), lowest between the age range of 0 - 10 years (0.0%) and 60 - 80 years (0.0%).

	Frequency (N)	Percentage (%)
Mechanism		
RTA	135	5.3
MVRTA	79	30
MCRTA	51	19.4
PRTA	5	1.9
Fall	89	33.3
Gunshot	8	3
Violence	7	2.7
Industrial accident	9	3.4
Sport	2	0.8
NTSCI	13	4.9
Pattern		
P	174	66.2
Q	89	33.8
ASIA		
A	147	55.9
B	71	27
C	13	4.9
D	32	12.2
Level		
Cervical	87	33.1
Thoracic	132	50.2
Lumbar	14	16.7
Onset		
Onset range		
2001 - 2005	109	41.4
2006 - 2010	73	27.8
2011 - 2015	81	30.8

Table 2: *Distribution of Patients on the Categorical Variables.*

Key: *RTA: Road Traffic Accident; MVRTA: Motor vehicle Road Traffic Accident; MCRTA: Motorcycle Road Traffic Accident; PRTA: Pedestrian Road Traffic Accident; NTSCI: Non-Traumatic Spinal Cord Injury; ASIA: American Spinal Injury Association; A: Complete: No sensory or motor function is preserved; B: Incomplete: Sensory, but no motor function is preserved; C: Incomplete: Motor function is preserved but muscle grade less is than 3; D: Incomplete: Motor function is preserved and muscle grade greater than or equal to 3.*

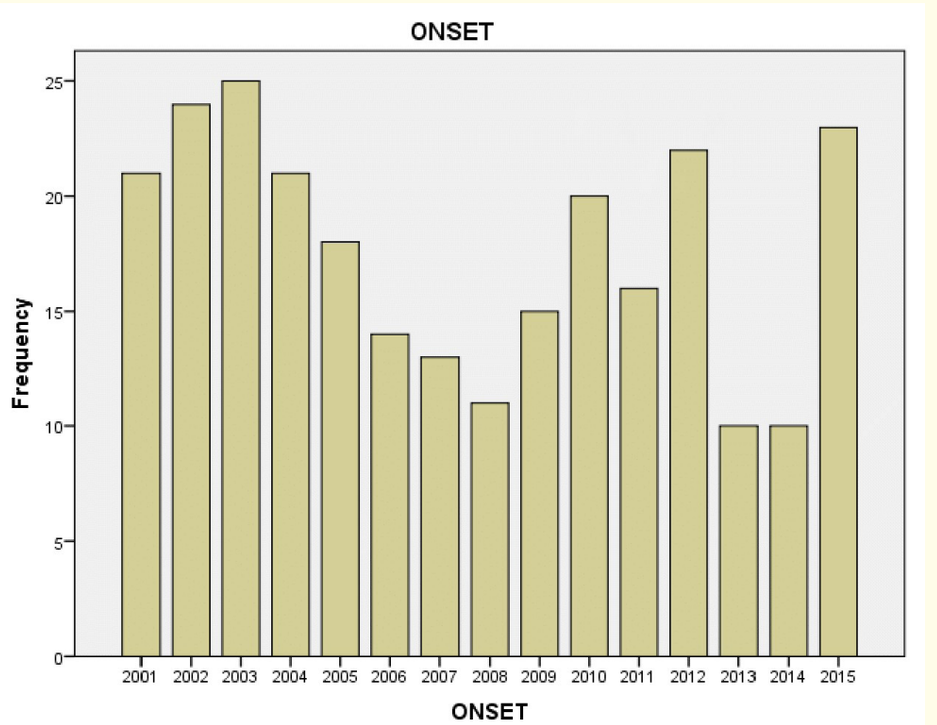

Figure 4: *Bar Chart Representing Percentage Influence of Year on Spinal Cord Injured Patients.*

Key: Y: Frequency; X: Years

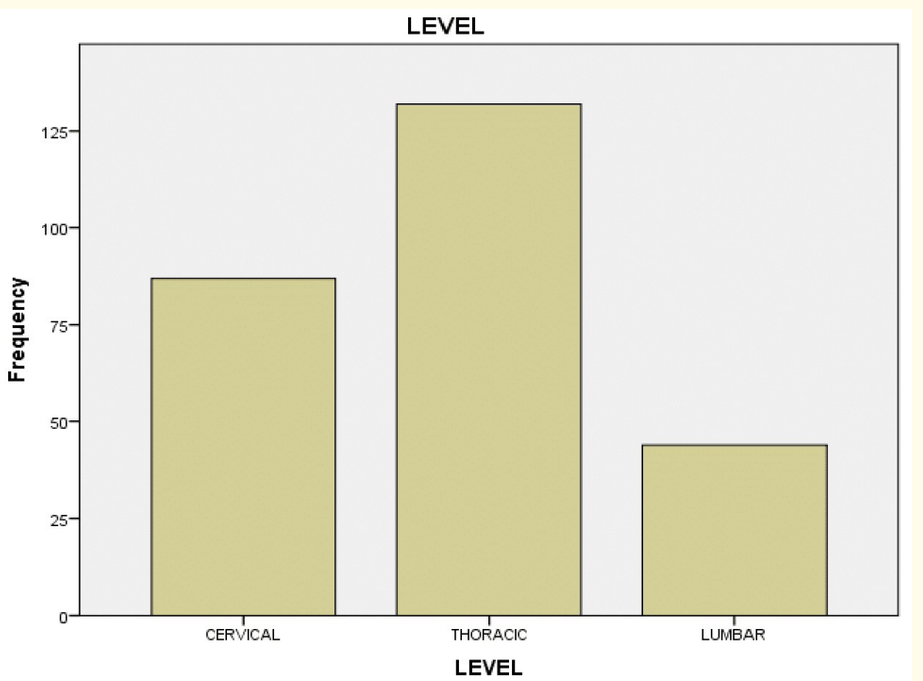

Figure 5: *Bar Chart Representing Percentage Influence of Injury level on Spinal Cord Injured Patients.*

Key: Y: Frequency; X: Level of spinal injury

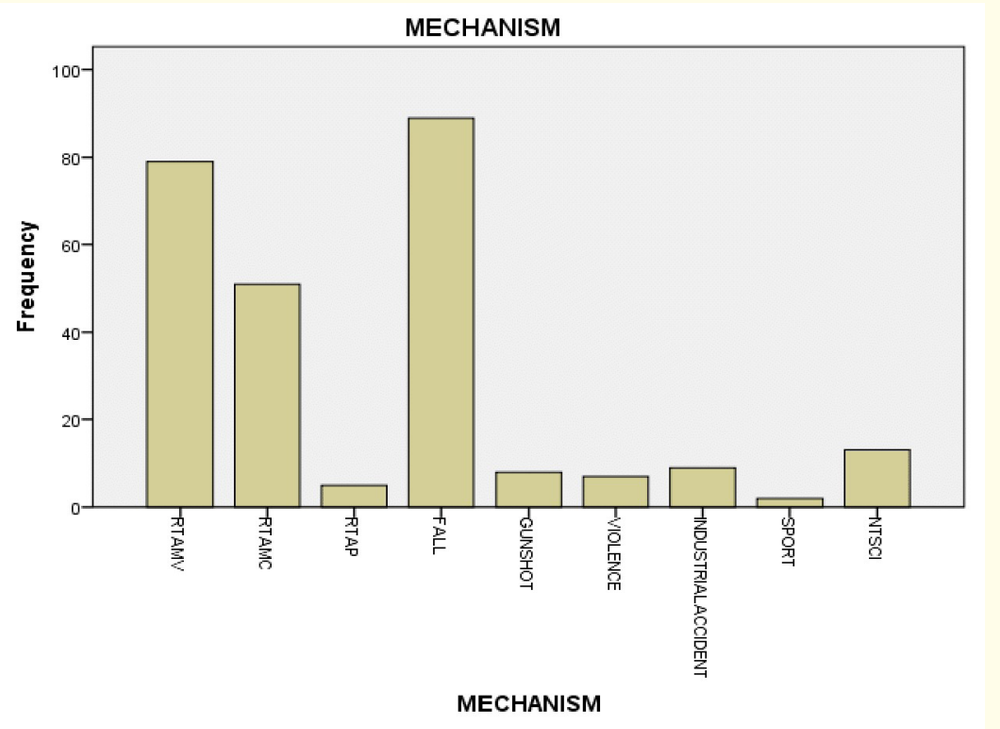

Figure 6: *Bar Chart Representing Frequency of Mechanism of Spinal cord Injury.*
Key: RTA: Road Traffic Accident; MVRTA: Motor vehicle Road Traffic Accident; MCRTA: Motorcycle Road Traffic Accident; PRTA: Pedestrian Road Traffic Accident; NTSCI: Non-Traumatic Spinal cord Injury

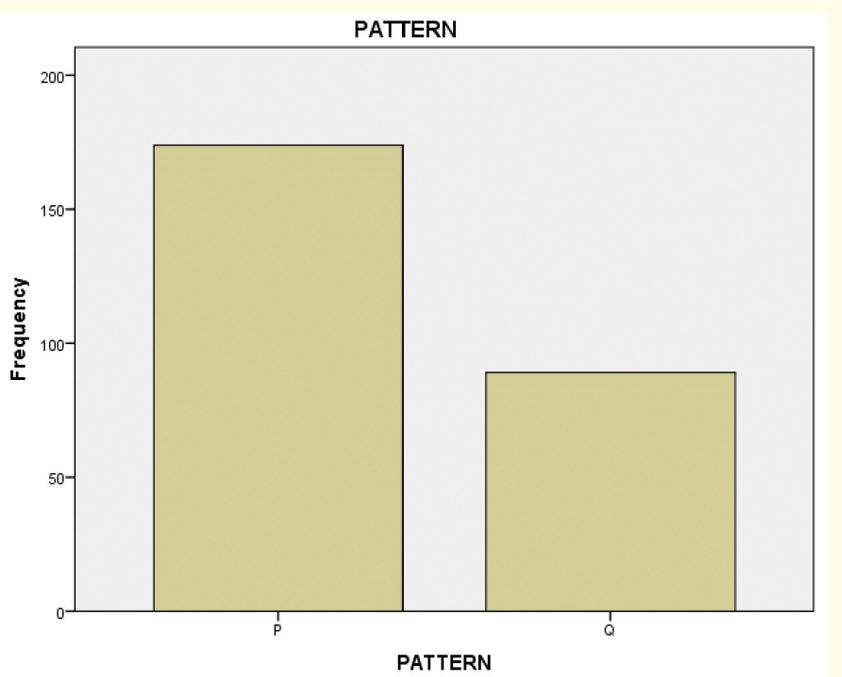

Figure 7: *Bar Chart Representing Percentage Influence of Injury Pattern on Spinal Cord Injured Patients.*

Key: P: Paraplegia; Q: Quadriplegia

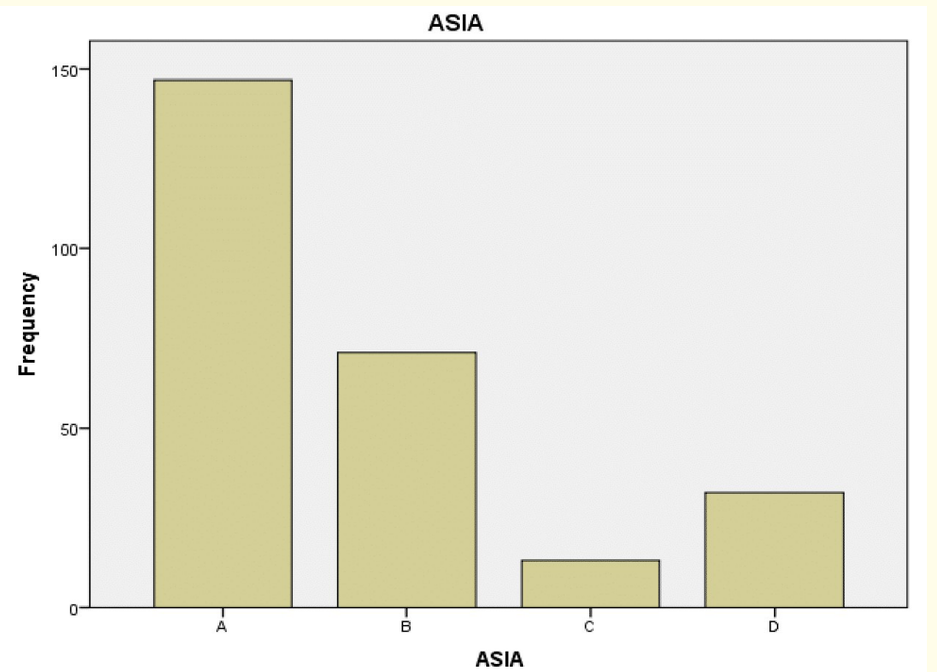

Figure 8: *Bar Chart Representing Percentage Influence of Severity of Injury on Spinal Cord Injured Patients (according to ASIA classification).*

Key: ASIA: American Spinal Injury Association; A: Complete: No sensory or motor function is preserved; B: Incomplete: Sensory, but no motor function is preserved; C: Incomplete: Motor function is preserved but muscle grade less is than 3; D: Incomplete: Motor function is preserved and muscle grade greater than or equal to 3.

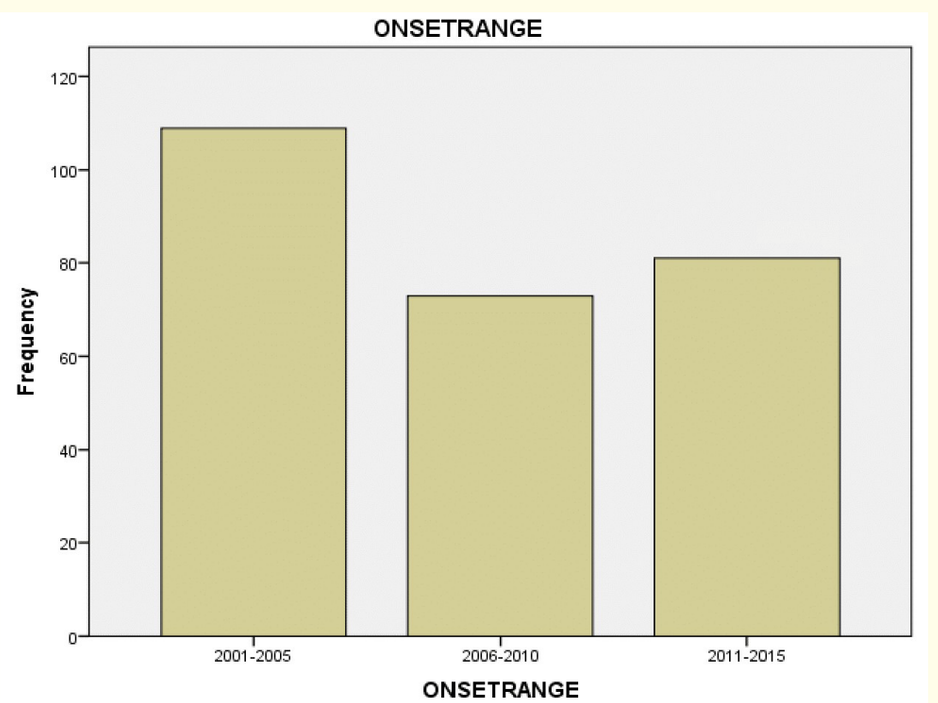

Figure 9: *Bar Chart Representing Percentage Influence of Year range on Spinal Cord Injured Patients.*

Key: Y: Frequency; X: Years in range

Out of the 33.8% spinal cord injury cases caused by falls, patients from rural areas accounted for 94.4% cases while patients from urban areas accounted for 5.6% cases. Whereas, 30.0% of spinal cord injury cases occurred as a result of motor vehicle road traffic accident, patients from urban areas accounted for 98.7% cases while patients from rural areas accounted for 1.3% cases. Falls accounted for 86.5% cases of paraplegia (66.2%) cases seen while motor vehicle road traffic accident accounted for 35.4%. However, motor vehicle road traffic accident accounted for 64.6% out of quadriplegia (33.8%) cases seen while falls accounted for 13.5% cases. Out of fifty-one (19.4%) cases caused by motorcycle road traffic accident, cyclists accounted for twenty-six (51.0%) cases, followed by traders (thirteen (25.5%)) cases while farmers accounted for one (2.0%) case. Meanwhile, eighty-nine (33.8%) cases caused by a fall from a height, farmers accounted for fifty-seven (64.0%), followed by student (nine (10.1%)), traders accounted for three (3.4%), whereas cyclists accounted for zero (0.0%). Also out of thirteen (4.9%) cases caused by NTSCI, farmers accounted for nine (69.2%), traders accounted for one (7.7%) while civil servants accounted for one (7.7%).

Out of hundred and seventy-four (66.2%) cases seen as paraplegia, farmers accounted for fifty-nine (33.9%) cases while traders accounted for thirty-one (17.8%) cases. whereas, out of eighty-nine (33.8%) cases seen as quadriplegia, traders accounted for thirty-eight (42.7%) cases while farmers accounted for ten (11.2%) cases. Traders accounted for cervical injuries (43.7%), thoracic injuries (20.5%), and lumbar injuries (9.1%), whereas farmers accounted for cervical injuries (10.3%), thoracic injuries (32.6%) and lumbar injuries (38.6%), while civil servants accounted for cervical injuries (13.8%), thoracic injuries (3.8%) and lumbar(2.3%).Cervical level accounted 97.8%% of quadriplegia while thoracic level accounted for 2.2% of quadriplegia, whereas paraplegia was more common in thoracic level (74.7%) followed by lumbar level (25.3%). Out of the two cases that fell between age ranges of 0 - 10 years, paraplegia (100%) was more common, while between the age range (31 - 40), both paraplegia and quadriplegia were almost the same (57.1%) and (42.9%) respectively. Out of thirteen (94.9%) seen as a result of non-traumatic spinal cord injury (NTSCI) cases, one (7.7%) had ASIA A, seven (53.8%) had ASIA B, one (7.7%) had ASIA C while four (30.8%) had ASIA D, whereas, out of seven (2.7%) cases seen due to violence were mostly ASIA A, (ASIA A = 4 (57.1%), ASIA B = 1 (14.3%), ASIA C = 1 (14.3%), and ASIA D = 1 (14.3%).Out of eighty-seven (33.1%) cases with cervical spinal cord injury seen, seventy (80.5%) had ASIA A, nine (10.3%) had ASIA B, five (5.7%) and three (3.4%) had ASIA C, whereas forty-four cases with lumbar spinal cord injury seen, fifteen (34.1%) had ASIA A, thirteen (29.5%) had ASIA B, five (11.4%) had ASIA C, and eleven (25.0%) had ASIA D.

Association between mechanism and level of injury, sex difference, age range of patients, residence of patient, pattern of injury, occupation of patient, type of injury (ASIA)

Mechanism of spinal cord injury showed significant association with level of spinal cord injury ($x^2 = 101.2$, $p = 0.001$), sex difference of patients ($x^2 = 27.9$, $p = 0.001$), age range of patients ($x^2 = 189.5$, $p = 0.001$), residence of patients ($x^2 = 209.9$, $p = 0.001$), pattern of spinal cord injury ($x^2 = 81.1$, $p = 0.001$), occupation of patients ($x^2 = 489.2$, $p = 0.001$), type of injury (ASIA) ($x^2 = 45.6$, $p = 0.005$) as shown in table 3.

Association between pattern of injury and occupation of patient, level of injury, age range of patients, type of injury (ASIA)

Table 3 also shows that pattern of injury associated significantly with occupation of patient ($x^2 = 41.72$, $p = 0.001$), level of injury ($x^2 = 254.2$, $P = 0.001$), age range of patients ($x^2 = 13.55$, $p = 0.04$) and type of injury (ASIA) ($x^2 = 34.6$, $P = 0.001$).

Association between level of injury and occupation of patient, ASIA

Level of injury was significantly associated with occupation of patient ($x^2 = 52.19$, $p = 0.001$), and type of injury (ASIA) ($x^2 = 46.4$, $P = 0.001$) as shown in table 3.

Variables	Chi-Square ($\times^2$)	P-value (p)
Mechanism		
Level of Injury	101.2	0.001**
Sex difference	27.9	0.001**
Age range	189.49	0.001**
Resident of patient	209.9	0.001**
Pattern of Injury	81.1	0.001**
Occupation of patient	489.2	0.001**
ASIA	45.6	0.001**
Pattern		
Occupation of Patient	41.7	0.001**
Level of injury	254.2	0.001**
Age range	13.6	0.04*
ASIA	34.6	0.001**
Level		
Occupation of Patient	52.2	0.001**
ASIA	46.4	0.001**

Table 3: *Associations between different Variables.*

Key: *ASIA: American Spinal Injury Association*

***Indicates high level of significant association.*

Discussion

The aims of this study was to determine the prevalence, mechanism and pattern of spinal cord injury and how these constructs were affected by some selected sociodemographic variables in the South-Eastern, Nigeria. The findings of this study revealed that SCI affected males more than females. This finding agrees with the previous studies relating to prevalence, mechanism and pattern of spinal cord injury by Ihegihu., *et al.* [2] and Obalum., *et al* [13]. This might be due to the type of occupation (e.g. driving, climbing, mason etc.) males are normally engaged in, that predisposes them to high risk of spinal cord injury. The age range with highest occurrence of SCI was the third decade, followed by the fourth and fifth decades. This finding corroborated with the findings of Obalum., *et al.* [13] who noted that SCI affects age range between 21 - 30 years followed by the fourth and fifth decades. This might be due to youthful act like fighting which predisposes young people to gunshot injury, driving on high speed, as majority of these patients within these age ranges were students, cyclists and drivers. Majority of the patients were residents of urban areas. This might be a result of the occupation of patients who were mostly involved, like traders, students, cyclist, civil servants, drivers etc. These people are mostly found in the cities. However, this result contrast with the finding of Ihegihu., *et al*. [2], who noted that most of the patients were residents of rural area.

Farmers and traders were found to be more affected followed by students when occupation of patients was considered. This is similar to the finding of Ihegihu., *et al.* [2], who reported that farmers were more affected followed by petty traders and students. Therefore, this could be as a result of the type of occupation most South-East, Nigerians are engaged in. Most of them are either traders or farmers. As traders, they travels frequently to buy and becomes predisposed to motor vehicle or motorcycle road traffic accidents. However, most patients regarded as farmers in this study were palm wine tappers, palm oil refiners etc., therefore, were used to climbing palm trees and consequently, been predisposed to fall from a height.

The result of this study shows that RTA is the major cause of SCI, followed by fall from a height. This result agrees with the finding obtained by Kawu [14], Nwankwo., *et al.* [15], Umaru., *et al.* (2005), Asiravatham., *et al.* [16] who noted that SCI following RTA is more common. This might be due to frequent motor vehicle and motorcycle accidents joined together and when they occur, it usually involves one or more persons at once while fall can only involve one person per incidence. This result also contradicted with the findings of Dahlberg., *et al.* (2005), Ihegihu., *et al.* [2], who noted that most of the injuries were as a result of a fall from a height followed by RTA.

Paraplegia was more common than quadriplegia and this in line with the report by Rahimi-Movaghar., *et al.* (2013), who reported that paraplegia was found to be more common than tetraplegia. This greater number of paraplegic patients compare to quadriplegic patients in this study might be as a result of the greater number of thoracic and lumbar injury level in which most patients had, because thoracic, lumbar and sacral injury causes paraplegia while cervical injury causes quadriplegia (Herbert, 2008).

Complete spinal cord injury (ASIA, A) were more common followed by ASIA B, ASIA D and lastly ASIA C. This result agrees with the findings by Obalum., *et al.* [13], who noted that ASIA A, followed by ASIA B, ASIA D. This might be as a result of the mechanism of the injury. For instant, majority of the patients fell from a height (especially palm tree) and this must have caused a severe damage to spinal cord resulting complete spinal cord injury (ASIA A).

Road traffic accident contributed a lot in the mechanism of spinal cord injury (especially from 2001 - 2005) therefore, high incidence of spinal cord injuries was recorded from 2001 - 2005, this could be as a result of motorcycle activities that were still allowed in the major roads in the South-East Nigeria then, which was later stopped by some governors in some states. This high incidence of motorcycle road traffic accidents is still seen in some cities of the South- East, like Abakaliki, the capital of Ebonyi state where the governor is yet to stop the activities of motorcycles in the city.

Since majority of the mechanism was as a result of fall which normally occur majorly at the thoracic level, thoracic level injuries was often involved and this is in line with the findings by Ihegihu., *et al*. [2] but contradicted with the findings of Kawu [14], who noted that cervical level was often involved.

Thoracic level was more common in falls, because most of them landed with their back, whereas cervical level was more common in RTA, more so, thoracic level was more affected following NTSCI, because tuberculosis normally occur at the thoracic level therefore, there was a significant association between mechanism of spinal cord injury and level of injury.

Pedestrian accident was more common with welders and mechanics who always at the roads side and females are rarely engaged in this type of work and also industrial accident was often seen with laborers who use to carry heavy loads in the company and markets, off course females do not do this type of work too, females are also rarely engaged in sports activities unlike the male counterparts hence, there was significant association between mechanism of spinal cord injury and sex difference of patients.

MCRTA was common between the age range of 21 - 30 years and this is because, youthful age falls between this age bracket where guys like to enter bike to where they are going in order to avoid delay due to hold-up on the roads. In the other hand, between 0 - 10 and 60 - 80 years, people within these age ranges rarely enter bike. Another reason is that, between age ranges (21 - 30 and 31 - 40 years) are mostly the age ranges cyclist people can be found, therefore there was significant association between mechanism of spinal cord injury and age range of patients.

Most people in the urban areas always have occupation that makes them to be entering motor vehicle frequently and become vulnerable to motor vehicle road traffic accident, while those at the rural areas always do jobs that require climbing and become vulnerable to fall from a height, therefore, there was a significant association between mechanism of spinal cord injury and residence of patients. However, there is no literature on this yet.

Those who fell from a height normally fall either with their back or buttocks resulting to either thoracic or lumbar injury hence, having paraplegia while those who had motor vehicle road traffic accident always hit their head on glass or door resulting either head injury or cervical spinal cord injury or both and came down with quadriplegia, if cervical spinal cord injury ensued as it noted that thoracic, lumbar and sacral injury causes paraplegia while cervical injury causes quadriplegia. Therefore, this study revealed that there was a significant association between mechanism of spinal cord injury and pattern of spinal cord injury, however there is no literature that supports this finding yet.

SCI secondary to motorcycle road traffic accident was more common with cyclists and traders compare to farmers because, they are always on bike for their businesses and became predisposed to motorcycle road traffic accident while farmers are rarely on bike for their businesses hence, saving them from the risk of motorcycle road traffic accident. In the other way round, farmers were often involved in falls and NTSCI because, they are always climb trees and became predisposed to the risk of fall. Secondly, farmers must have been more affected with NTSCI (mostly from tuberculosis), because of unhygienic and lack of formal education, this shows that mechanism of spinal cord injury is associated significantly with occupation of patients, no literature to support this.

Paraplegia was often seen in farmers while quadriplegia was more common in traders, this could be as a result that when farmers have spinal cord injury (mostly due to fall from a height), they often have it at either thoracic, lumbar or sacral level hence, resulting paraplegia while if traders have spinal cord injury (mostly due to motor vehicle road traffic accident), they always have it at cervical level hence, resulting quadriplegia and this revealed that, there was a significant association between pattern of SCI and occupation of patients, however, no literature that supported this finding.

Most of the traders and civil servants had spinal cord injury at the cervical level while most of the farmers had this injury at thoracic level; this is because of the type of works they do that predisposed them to the mechanism of this injury, this revealed that, there was a significant association between level of injury and occupation of patients, though there is no literature to support this finding.

Cervical injuries often result to quadriplegia while thoracic and lumbar injuries often results in paraplegia, hence level of injury significantly associated with pattern of injury, no literature supporting this finding.

Some patients between 0 - 10 year's cases seen were a result of spinal bifida which normally occur at the thoracic level hence causing paraplegia, therefore there was significant association between pattern of injury and age range of patients, no literature was used to support this finding.

ASIA B was more common in NTSCI therefore, if spinal cord injury occurs as a result of NTSCI (e.g. tuberculosis, spinal bifida etc.), there is likelihood of having sensation but motor lost, whereas ASIA A was more common in violence and this shows that, if spinal cord injury is caused by violence (e.g. someone hits heavy rod or wood on someone's spine), there is likelihood of having both sensory and motor lost according to its severity, hence there was a significant association between mechanism of SCI and type of injury (ASIA classification), no literature that supported this finding.

ASIA A was more common with cervical injury cases while ASIA B was more common with lumbar injury cases, this shows that if spinal cord injury occurs at the cervical level, there is likelihood that it will result to injury type ASIA A, i.e. it might be very severe while if it occurs at the lumbar level, it can results to injury type ASIA B i.e. it might be less severe, this could be as a result of cervical levels' proximity to the origin of spinal cord (foramen magnum), therefore there was significant association between level of injury and ASIA classification, no literature was found supporting this finding [17-19].

Conclusion

It was concluded that many of the spinal cord injuries in this study could have been prevented, as most were a result of road traffic accident and a fall from a height. Improved traffic safety standards, including road maintenance may have reduced the incidence of spinal cord injuries from road traffic accident. Use of better climbing tools also may reduce the incidence of snapping of the rope used for climbing, the common reason for the falls.

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Conflict of Interest Disclosure

The authors declare that there is no conflict of interest.

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