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Does Weather Conditions Influence the Epidemiology of Paediatric Orthopedic Trauma in Southern Nigeria?

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Authors' contributions

This work was carried out in collaboration among all authors. Author JEA designed the study and wrote the first draft of the manuscript. Authors IEA and EOO wrote the protocol and managed the statistical analysis with review. Authors COA and OAL managed literature searches and proof reading. Authors BJA and OOA managed the literature searches, proof reading and review. All authors read and approved the final manuscript.

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ABSTRACT

Introduction: Trauma is a major cause of morbidity and mortality worldwide in the paediatric age group. It is a global problem of public health significance. The aim of this study is to describe the influence of weather on the pattern of paediatric orthopedic trauma in Southern Nigeria.
Methods: Trauma victims below the age of 18 years who presented in the accident and emergency department of University of Calabar Teaching Hospital and National Orthopedic Hospital, Enugu over a period of 12 months were enrolled in the study. A total of two hundred and twelve patients were included in the study.
Results: There were 129 male patients in the study which represented approximately 61% of the

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participants. The mean age of study participants was 97.28±57.88 months, with a range of (4-216) months. A greater proportion of study participants, 86(42.6%) were in primary school. Falls constituted approximately 54% of the cause of injury followed by domestic causes which made up 29.1%. Most injuries (58%) occurred in the home settings followed by roadways or playfields (29%). Injury occurred more in the evenings (36.5%), during dry seasons (75.3%), and the second term of the academic session (50.8%). The mean pediatric trauma score was 5.36 and 99.4% of the victims had mild Glasgow coma score. About 71% of these trauma victims were brought directly to the tertiary health facility, 73.1% completed treatment and were discharged, but five patients (2.4%) died during the study period.

Conclusion: Paediatric orthopedic trauma occurs mostly during the dry season due to evening falls at home. Most injuries are severe but do not involve loss of consciousness.

Keywords: Paediatric trauma; paediatric trauma score; cause of injury; time of injury; Nigeria.

1. INTRODUCTION

Worldwide, trauma is the leading cause of morbidity and mortality in children after the first birthday. It has been recognized as major problem of global public health concern in the last decade. The World Health Organization (WHO) acknowledges trauma to be a global epidemic. The highest burden of injury is seen in low and middle income countries (LMICs) where 95% of all childhood injury deaths occur [1,2]. Amongst childhood injuries, 90% are unintentionally sustained while 10% are related to violence and maltreatment. These unintentional injuries, though largely preventable, are of greater health burden to children through the course of their lives [3-5]. The increased vulnerability of children to injuries may be due to their small physical stature-; their physiological and mental immaturity which limits perception of danger-; their penchant to explore and experiment within their environments [2,6]. There is documented evidence that mechanisms of injury differs with age and are more diverse in males [2,7].

Injury-related childhood disability-adjusted life-years (DALYs) are highest in Sub-Saharan Africa and Southeast Asia [2,8]. However, in Nigeria, little attention has been given to trauma or injuries because the Health community gives priority to infectious diseases and other diseases of poverty. Therefore, there is paucity of data on traumatic injury in Nigeria. Few studies focusing on paediatric trauma reveals higher prevalence in males compared to females of all age groups. In North-Eastern (NE) Nigeria, falls (17.5%) were the leading cause of trauma followed by burns (13.7%) [9]. In North-Western (NW) Nigeria the distributions of common causes of injury were: road traffic accident (RTA), (35.5%), burns (26.8%) and falls (16.6%) [10]. In South-Western (SW) Nigeria falls (37.7%) were the leading cause of trauma followed by RTA (32.8%) and burns (8.2%). Most injuries occur at home (41.1%), on roads (36.3%) and in schools (14.6%) [11]. Socioeconomic status, sociopolitical awareness and ethnicity are factors which have been reported to influence the occurrence and outcome of traumatic injury in Nigeria [11,12]. In South Eastern (SE) Nigeria, RTA (50.2%) was the leading cause of trauma followed by falls (27.6%). Most of the injuries occur at home (66.1%) and are commonly sustained during the weekdays (60.8%) [13]. Epidemiological studies are essential for better planning and development of treatment and prevention strategies.

In South-south (SS) Nigeria there is paucity of epidemiological data on pediatric trauma. To the best of our knowledge, no Nigerian study has been published on the influence of weather conditions and weekdays on paediatric injury, but, this study seeks to bridge the information gap and provide descriptive data on pediatric orthopedic trauma in South-south and South-eastern geo-political zones of Nigeria. This will contribute to the trauma registry.

2. METHODS

This study is of descriptive cross sectional design. Data was collected over a 12month period. The study was conducted in two tertiary health facilities located in adjoining geopolitical zones of Nigeria. These were the University of Calabar Teaching Hospital (UCTH) and the National Orthopedic Hospital Enugu (NOHE). The UCTH is an 800 bed multi-specialist hospital including subspecialty in pediatric orthopedic surgery, is located in SS Nigeria. The NOHE is a 350 bed specialty hospital with various sub specialization including trauma and paediatric

orthopedic, it's located in SE zone of the country. Data was collected from these hospitals between 1st December 2017 and 30th November 2018.

2.1 Patient Recruitment and Data Collection

All patients below the age of 18 years who had sustained various types of injuries following traumatic incidences and who presented in the accident and emergency units or outpatient clinics of both institutions were recruited into the study. Informed consent was given by either parents or guardians of the subjects. Data was collected by an interviewer-administered structured questionnaire. The questionnaire consisted of both close – and open – ended questions. The study instrument elicited data on socio-demographic profile (for example educational level and occupation of parents or guardians), injury profile, paediatric trauma score, treatment and treatment outcome. A section of the questionnaire elicited information on seasons (rainy and dry seasons), days of the week, academic term and months of trauma incident. The study investigators and trained research assistant administered the questionnaire to the patients directly or to a proxy (i.e. in situations where the patient is a minor or is speech incapacitated). Two – hundred and twelve subjects who gave consent were enrolled into the study.

2.2 Data Analysis

Data was analyzed using SPSS statistics (version 22; IBM Corp., Armonk, NY, USA). Key variables were summarized as standard deviations, means, frequencies and proportions. . The relationship between injury determinants or covariates and paediatric trauma score was analyzed using the multivariable linear regression. Determinants in this model were sex, educational level, age in months, cause of injury, distribution of injuries according to seasons and time of injury. The inferential analysis was conducted at a 95% confidence level. P-values of ≤ 0.05 were considered statistically significant.

3. RESULTS

Out of the 212 subjects, 129 were males (60.8%). The mean age 97.28±57.88 months and the age range was 4–214 months. Accidental falls were the leading cause of injury (53.9%), followed by domestic injuries (29.1%) and road traffic accident (RTA, 7.9%). Most of the injuries occurred at home (58%) and on roads (29%) (Table 1).

3.1 Time-related Details on Injury Occurrence

Most injuries occur during week-days (53.4%) and in the day time (56.9%). The seasonality of injury occurrence showed higher frequency during the autumn or dry season (75.3%). Analysis of injury frequency by academic term showed that, children are more frequently injured in the second term (50.8%) and the holiday (51.1%) following this academic term. Injury occurrence was highest in the last quarter of the year (39.3%) followed by the first quarter (35%). About 71.3% of the injured children reported to a health facility within 24 hours (Table 2).

Falls and domestic injuries were more common during the dry seasons while motor vehicular accidents were common in the rainy season (Fig. 1).

3.2 Treatment-related Prognostic Details

About 20.4% of the admitted study subjects had packed cell volume ≤30%. All the subjects had fractures but mostly (90.4%) without complications. Overall 73.1% were admitted, successfully treated and discharged. Prior to admissions at the tertiary facility, about 25.9% received first aid in a private hospital and 2.5% had blood transfusion on arrival (Table 3).

The mean pediatric trauma score (PTS) was 5.36±5.00; median score was 5.0-; with a range of 0–11-; and an inter-quartile range (IQR)-: of 4 – 7.

The modified Glasgow coma score (MGCS) for 99.4% of the subjects fell into the mild category.

Mortality occurred in 2.4% of the study subjects.

3.3 Linear Model Coefficients for Covariates of Paediatric Trauma Score

Nether sex, educational level, age, cause and time of injury showed a statistically significant pattern with increased paediatric trauma score. (Table 4).

Table 1. Descriptive data

Parameter	Objectives	Frequency	Percent
Sex	Male	129	60.8
	Female	83	39.2
	Total	**212**	**100**
Age in years	1 - 5	66	32.4
	6 - 10	63	30.9
	11 - 15	59	28.9
	16 - 18	16	7.8
	Total	**204**	**100**
Educational level	Nursery	53	26.2
	Primary	86	42.6
	Secondary	63	31.2
	Total	**202**	**100**
Cause of Injury	Motor vehicle accident	13	7.9
	Tricycle accident	11	6.7
	Bicycle accident	4	2.4
	Falls either from height or ground level	89	53.9
	Domestic injuries or assaults	48	29.1
	Total	**165**	**100**
Place of Injury	Home	120	58.0
	School	21	10.1
	Place of worship	3	1.4
	Market	3	1.4
	Road / fields / walk ways	60	29.0
	Total	**207**	**100**

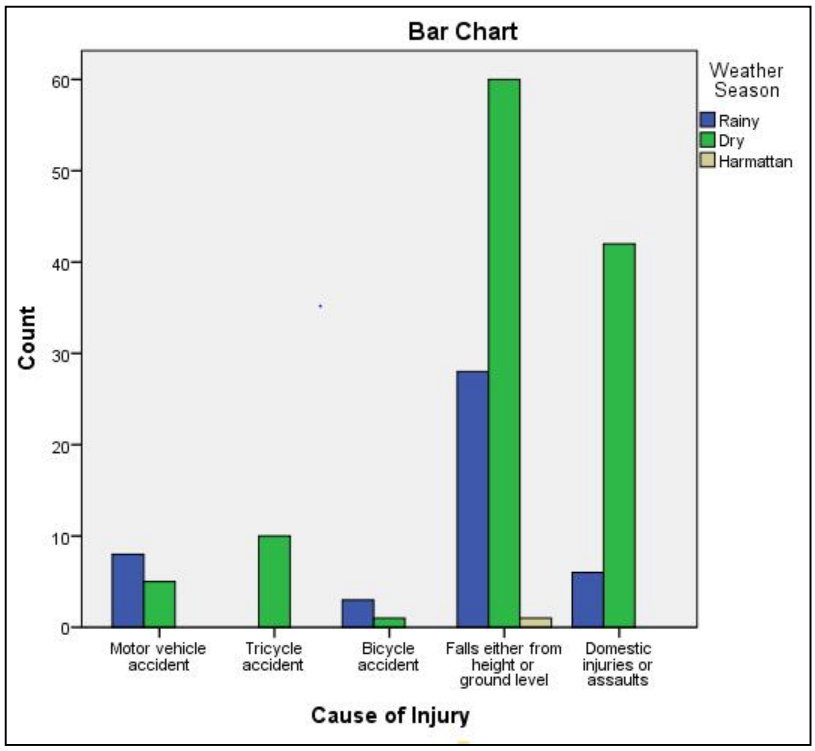

Fig. 1. Shows the distribution of injury mechanisms during seasons

Table 2. Time-related details on injury occurrence

Parameters	Days/time	Frequency	Percent
Weekday of injury	Sun	27	13.2
	Mon	22	10.8
	Tue	28	13.7
	Wed	31	15.2
	Thur	28	13.7
	Fri	33	16.2
	Sat	35	17.2
	Total	**204**	**100**
Time of Injury	Morning	35	25.5
	Afternoon	43	31.4
	Evening	50	36.5
	Night	9	6.6
	Total	**137**	**100**
Duration before presentation	<24hrs	144	71.3
	<10days	46	22.8
	>10days	12	5.9
	Total	**202**	**100**
Weather	Rainy/Spring	52	24.8
	Dry/Winter	158	75.3
	Total	**210**	**100**
School Session	First term	74	41.8
	Second term	90	50.8
	third term	13	7.3
	Total	**177**	**100**
Holidays or vacation	1st term	59	41.8
	2nd term	72	51.1
	3rd term	10	7.1
	Total	**141**	**100**
Quarter of the year	1st qtr	64	35.0
	2nd qtr	17	9.3
	3rd qtr	30	16.4
	4th qtr	72	39.3
	Total	**183**	**100**

4. DISCUSSION

The mean age at presentation in our study was not different from what is reported by other studies [1,2,11]. The slight variations are likely due to the predominant ages of children included in the study.

In our study, males sustained more injuries than females and this tends to increase with increasing age. This finding has been consistently reported in numerous international and local studies [1,6,10,11,13]. This is no doubt due to the fact that boys are more physical and prone to engage in more risky activities in schools and at home. They are more adventurous and thrill seeking. Injuries were proportionally more common in younger age categories.

Our study showed that accidental falls were the leading cause of injury followed by domestic injury then RTA but Adegoke, et al. [11] reports that falls were more common followed by RTA. Bradshaw, et al. 2017 [1] & Mathur, et al. [2] reported equal frequency for falls and RTA. Mungadi, et al. [10], Hyginus, et al. [13] & Sundari, et al. [14] presented contrary findings whereby RTA preceded accidental falls in frequency. This again, may be due to the predominant age groups recruited into the various studies. We found out that most of the injuries occurred mostly at home followed by the roadways or streets. This finding is corroborated by studies within and outside Nigeria [1,10,11,13–15]. Possible explanations may be that home play involves various forms of unstructured and unsupervised activity which can potentially lead to injury.

Table 3. Treatment-related prognostic details

Parameter	Objectives	Frequency	Percent
PCV	≤30	28	20.4
	>30	109	79.6
		137	100
Complication of fracture	no complication	201	94.8
	complication	6	2.8
	dead	5	2.4
	Total	**212**	**100**
Treatment outcome	Not admitted	46	21.7
	LAMA	5	2.4
	Absconded	1	0.5
	Died	5	2.4
	Discharged	155	73.1
	Total	**212**	**100**
Previous treatment prior to presentation	None	110	57.0
	Private hospital	50	25.9
	General hospital	15	7.8
	Traditional bone Setter	18	9.3
	Total	**193**	**100**
Resuscitation given on arrival	Reassurance and drugs	109	69.4
	fluid and drugs	44	28.0
	Fluid, drugs and blood	4	2.5
	Total	**157**	**100**

Table 4. Linear model coefficients for covariates of pediatric trauma score

Parameter	Categories	B	95% confidence interval		P-value
			Lower bound	Upper bound	
Intercept		5.133	2.094	8.173	0.001
Sex	Female	ref.			0.321
	Male	0.416	-0.412	1.243	
Educational level	Secondary	ref.			0.244
	Primary	-0.748	-2.376	0.880	
	Nursery	-0.083	-2.590	2.423	
Age in months		-0.001	-0.019	0.016	0.862
Cause of injury	Domestic injuries or assault	ref.			0.992
	Falls from height or ground	0.059	-.891	1.008	
	Bicycle accident	0.395	-1.756	2.545	
	Tricycle accident	0.302	-1.194	1.798	
	Motor vehicle accident	0.044	-1.463	1.551	
Time of injury	Night	ref.			0.689
	Afternoon	0.362	-.575	1.298	
	Morning	0.337	-.670	1.344	

In these study injuries occurs mostly during the week-days in contrast to weekends and more frequently in the evenings. Findings from Hyginus, et al. [13] reveal weekday occurrence of injury while studies in Sweden [16], United States [17] & United Kingdom [18] also report frequent occurrence of trauma in the daytime. These studies suggest that clement weather predispose to injury causing activity. The finding that autumn, summer and dry season are associated with increased pediatric injury is supported by studies in UK & USA [18,19]. There is a saying that, "a warm sunny weather may keep the orthopedic surgeon busy" [19] but in our case, 'dry sunny weather and cool evenings are amenable to paediatric trauma presentations'. Our study reveals that more trauma admissions are expected during the dry season especially on Saturdays followed by Fridays then Wednesdays. Livingston, et al. [19] reported

increased presentations from Saturday through Monday in his article where he related these days to seasons. Unlike other Nigerian studies, our study reveals that injuries are commoner in the second term academic session and the holiday preceding it. Our study reveals interesting findings that falls and domestic injuries are common in the dry season and motor vehicular accidents are common in the rainy season. This can be due to the fact that there is increase activities by children during this period, most fruits got ripe at this time and they engage in more outdoor activities including contact sports.

The finding of a relatively low mortality rate in our study was lower than that reported by Adegoke, et al. 2017 [11] (a southwestern Nigerian study) & Sundari, et al. [14] but higher than that reported by Bradshaw, et al. 2017 [1] (a multi-countries / continental study). The explanation may not be unrelated to the PTS, modified GCS and the fact that majority (>70%) were evacuated to a health facility within 24 hrs. Bulut, et al. [20] in his article opined that outcome is improved when trauma subjects are evacuated from trauma scenes to hospitals directly.

This study has an obvious limitation in that was hospital based. A community-based study is without doubt better suited to avoid missed trauma reporting.

5. CONCLUSION

Pediatric Orthopedic trauma occurs mostly during the dry seasons due to accidental falls in the home environment in the evenings. Parents and care-givers should endeavor to endure safe home environments and low-injury risk engagements for their children at home. Items that can specifically engender falls should be minimized in the environment. We found that younger children are more prone to injury. Closer supervision of this demographic both at home and at work is well indicated. We saw a pattern of increased trauma during the dry seasons, especially on Saturdays. Injury surveillance can be increased at this time so that timely response can be offered to victims. Education of road users during both seasons cannot be overemphasized.

CONFERENCE DISCLAIMER

This article was presented at the 40th SICOT Orthopaedic World Congress in Muscat (4th – 7th December, 2019), Oman. Web Link of the conference: http://www.sicot.org/muscat

CONSENT

As per international standard written participant consent has been collected and preserved by the authors.

ETHICAL APPROVAL

Ethical approval for this study was given by the Institutional Research and Ethical Committee in compliance with the Helsinki Declaration regarding studies using human subjects.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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