

Work-Related Traumatic Injury in the Paper-Producing Industry in Nigeria: A Case Study of the Nigerian Newsprint Manufacturing Company Limited, Oku-Iboku, Akwa Ibom State

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Abstract

Introduction: This research aimed to determine the characteristics of work-related traumatic injuries in a paper-producing company over a 12-month period, as a case study of the traumatic injury picture in the industry in Nigeria.

Materials and Methods: This was a longitudinal descriptive study using a structured questionnaire to collect information from permanent employees of the Nigerian Newsprint Manufacturing Company Limited, upon presentation to the Company Medical Service. The identification number of each affected employee was noted. All traumatic injuries sustained by employees while on duty were examined, classified and coded following the World Health Organisation's guidelines. Data gathered were analysed using tables and percentages. The chi-square test was employed in the comparison of the burden of injury in the two major divisions of the Company with the level of statistical significance set at 0.05.

Results: Affected workers were all males with a mean age of 32.14±3.23 years. The Crude Incidence rate of severe injury for the whole Company was 50.7 injuries per 1000 employees, and the Specific Incidence rate for the producing divisions of the Company was 71.7 injuries per 1000 employees. The majority of cases were superficial traumatic injuries (65.1%) requiring only first-aid care and the leading cause of severe injury in forest work was "struck by falling object" (22.86%), while "contact with powered hand tool", the chainsaw (15.50%) was commonest equipment in causation of severe traumatic injury. The burden of Injury in the Forestry division was statistically significant over that in Operations division of the Company ($p < 0.05$).

Conclusion: This study recommends the opening of a National work-related Injury register in Nigeria, for the ease of tracking such injuries in workplaces in the country. Family Physicians are enjoined to work together with the few occupational health physicians to strengthen industrial safety in the emerging factories nationally.

Keywords: Work related traumatic injury; The chain-saw; Paper-producing industry; Forestry work; Family physicians

Abbreviations:

CIR: Crude Incidence Rate; ICD-10: International Statistical Classification of Diseases and Related Health Problems, tenth edition; ILO: International Labour Organization; IR: Incidence Rate; NNMC: Nigerian Newsprint Manufacturing Company Limited; SIR: Specific Incidence Rate; WONCA: World Organization of Family Doctors (formerly known as: World Organization of National Academies and Academic Associations of General Practitioners and Family Physicians)

Introduction

The International Labour Organisation (ILO, 2014), estimated the global number of deaths arising from work (including fatal injuries

and diseases) to stand at 2.3 million people annually [1]. In the same report, it was indicated that about 860,000 workplace accidents occur daily the world over. An earlier report (2011) had pointed out that 321,000 deaths occur in the workplace and 317 million workers sustain nonfatal injuries at work globally every year [2]. Forestry work (along with agriculture and fishing) has been classified among the most hazardous occupations by many researchers [3,4]. Taken side by side, the enormity of the problem of work-related injuries with respect to manufacturing industries could also be imagined by studying the chart of nineteen work settings, provided by the United States Bureau of Labour Statistics on non-fatal occupational injuries, in which the incidence of occupational injuries in manufacturing industry (457.2 injuries/1000workers) is preceded only by that of Health care and social assistance (585.0 injuries/1000 workers) [5]. Wherever comparative statistics are available, the picture remains serious concerning both forestry work and paper-production [6,7].

In Nigeria, government effort in checking accidental morbidity and mortality in the workplace had been expressed by the issuance of a decree in 1987 [8] and updating of the same through an Act in 2004 [9], stipulating the operational conditions of industries in relation to their employees. Factory-based data have the special advantage of being more certain, as the problems from which the data are generated can easily be traced to their roots.

The Nigerian Newsprint Manufacturing Company Limited (NNMC), Oku-Iboku, was founded in January 1975 and commissioned on July 17, 1986 with an installed capacity of 100metric tonnes of newsprint production per year, as the second paper-producing company in the country. As of today, there is hardly any documented study on how accidents occur in the paper-producing industry in Nigeria. The main aim of this research therefore, was to study the characteristics of traumatic injuries at work in the NNMC, with the specific objectives of determining:

- The incidence of work-related traumatic injury in the Company,
- The nature (type)
- The cause of the injury, and as well
- The more injury prone of the two producing Divisions in the Nigerian Newsprint Manufacturing Company Limited, Oku-Iboku, Akwa Ibom State of Nigeria, as a case study of the traumatic injury picture in the paper-producing industry in the country.

Background

Modern paper-manufacturing in Nigeria was conceived in the late 1960s with the Nigeria Paper Mill at Jebba in the North-Western geographical region of Nigeria as the first to be established in 1969 [10], seconded by the NNMC. The third Federal Government owned paper-producing company: the Iwopin Pulp and Paper Company, was founded in 1976 for the production of fine writing, printing and cultural papers [10]. Family physicians and general practitioners contribute significantly to the management of a high patient flow in these occupational settings generally in Nigeria in the face of a palpable dearth of occupational medicine specialists in the country. This situation is in tandem with the position of Murtagh (2011) in his presentation of the Wess Fabb Oration at the 18th Asia Pacific Regional Conference (2011) of the World Organization of Family Doctors (WONCA) which was held at Cebu, The Philippines, with the theme: "Paradigms of Family Medicine: Bridging Old Traditions with New Concepts" [11]. One of the empowering highlights of that Oration, to all Family Physicians with the natural desire to offer unbridled service to all those in need and undertake necessary research, was the statement that: "Family medicine/general practice" is the "foundation stone of health service" in any community [11]. Consequently, undertaking research in an industrial setting must also be an acceptable expectation of the Family physician, especially where occupational medicine specialists are not available.

Paper-manufacturing process

Wood is the basic material from which paper is produced. The processes involved may be mechanical, semi-chemical or chemical. At Oku-Iboku, mechanical and semi-chemical processes were combined. Paper production requires enormous volumes of fresh water. The NNMC enjoyed the positional advantage of being located on the bank of the Cross River as it flows past Itu to empty into the Atlantic Ocean at Oron in Akwa Ibom State – one of the States in the Niger Delta

territory of Nigeria. The NNMC also enjoyed the easy accessibility position of lying on the perfectly motor-able Calabar-Itu road that links up with Uyo - the State capital, and Aba - one of the chief commercial cities in the neighbouring Abia State of Nigeria.

Wood (*gmelina arborea*) for the production of newsprint by the NNMC was supplied by the Forestry Division of the Company as *gmelina* logs, to the Wood-yard at the Mill site in Oku-Iboku, where they were stacked for use by the Operations Division of the Company. Carry-lifts delivered the logs to conveyor belts which took them to chippers. The logs were thoroughly washed with large volumes of water while on the transmission belt. In the chippers, the logs were reduced to chips washed again and passed to a large silo for storage, from where it would be conveyed to the Pulp Mill in measured quantities determined by the Mill operators. In the Pulp mill, the chips were steamed in large vessels at a temperature of 100°C and a pressure of 62 bars and impregnated with sodium sulphite to soften the wood. The softened wood was next reduced to an aqueous solution of fine fibres called "short fibre wood pulp" and passed through other refining processes involving washing with water to remove the liquor earlier impregnated into the wood; and bleaching with hydrogen peroxide and sodium hydroxide. The short fibre wood pulp was then stored in a post-refining chest.

Imported long fibre kraft pulp was sludged in a pulper and mixed with the short fibre wood pulp derived from the *gmelina*. No additives were introduced to the pulp mixture, as *gmelina* is rich in ash and dust but the pulp mixture was passed to the paper machine and spread out on a sheet of fine-mesh machine wire by computer. Water was drained by gravity. The web so produced was passed between heated cylinders to complete its drying. These processes terminated with the production of newsprint which was now wound on a steel spool and passed on to the slitter winders on the paper machine for cutting and trimming. Thereafter, the newsprint was wound on to hard cores, labelled and passed to the warehouse ready for sale.

The toxic chemical effluent derived from these processes was passed through underground gutters and large pipes to a toxic treatment lagoon where the waste treatment was carried out mechanically, the water in it rendered safe, before it was passed into the Cross River. The entire process of newsprint production at Oku-Iboku was highly mechanized and this reduced appreciably the work that had to be done manually.

The NNMC ran aground but a new Company {Oku-Iboku Pulp and Paper-Producing Company (OKIPP)} is now preparing grounds for the revamping of paper-production in the same site and it is of scientific necessity to have a document on work-related traumatic injury, from a study already conducted, to guide the new Managers of the System and similar outfits in sub-Saharan Africa.

Materials and Methods

This longitudinal morbidity study covered a period of twelve calendar months and involved all 1,579 permanent employees of the NNMC. One thousand, one hundred and sixteen of the employees (1,116) were in two producing divisions (Operations and Forestry Divisions) of the Company. The remaining workers were in four supporting divisions: General Manager's Office, Human Resources, Commercial and Finance Divisions. Casual (temporary) employees, as well as expatriate employees were excluded from the study as they did not constitute a steady workforce, their influx or exit being determined by the business cycle up-or-down swings in the Company.

Information on occurrence and distribution of injuries according to nature (type) and cause were collected daily using interviewer administered structured questionnaire on traumatic injuries. The questionnaire was divided into sections to explore the objectives of the study. Prior to commencement of study, the questionnaire was pre-tested in the study environment for one week to determine the workers' understanding, acceptance, clarity and logistic challenges. To further ascertain the validity of this instrument, a test-retest reliability (intra-observer reliability) among 20 factory workers in the same environment was conducted. This was done by administering the questionnaire to the same group of workers on two different occasions (2 weeks apart). Scores obtained were computed for agreement and consistency using Pearson's correlation statistics. A correlation coefficient of 0.8 was obtained indicating adequate reliability and validity of the test instrument. Two Company doctors (one of the two being the principal investigator in this report) and four Company Nurses who had received training for the purpose were involved in collating the data. Information was entered onto the pre-structured data sheet designed for the study. Data were collected at the factory site Medical Centre and at the First-Aid post located in the forest zone of the Company. Precision and identification were ensured by using each employee's identification number.

All traumatic injuries sustained at work were examined, classified and coded according to the International Statistical Classification of Diseases and Related Health Problems, tenth edition (ICD-10) [12]. All information gathered were entered into a flow chart and analysed, using percentages, frequencies, and chi-square statistics, with the level of statistical significance set at $p < 0.05$.

Working definition

Work-related traumatic injury: For the purpose of this study, this was considered as sudden damage to any anatomical part of the body, by any external cause and arising in the course of the performance of an employee's assigned duty. All damages incurred while travelling to and from the duty post and cumulative trauma disorders like low back pain [13] and carpal tunnel syndrome, were excluded, as well as all occupational diseases. This working definition has been found to be a modification of the Occupational Safety and Health Administration's definition of work-related accidental injury which indicates that "an injury or illness is considered" by that Office to be work-related: "if an event or exposure in the work environment either caused or contributed to the resulting condition or significantly aggravated a pre-existing condition" [5].

Primary medical care of the subjects: Following the sustaining of the injuries, the subjects were offered immediate clinical care upon arrival and presentation at the factory site clinic at Oku-Iboku, as well as at the First-Aid post at Awi in the Forestry Division's base, respectively.

Treatment consisted mainly of cleaning of the wounds with antiseptic solution and painting with tincture of iodine for the minor abrasions. Suturing was offered after necessary toileting for the deep wounds. Antibiotic coverage with Ampicloxacillin Igm statim and 500mg every six hours for five days was given to those with deep lacerations after suturing and wound dressing. Antibiotic cover was also given to the patient with crush injury of the thumb (Table 2 below), after debridement, suturing and wound dressing. Analgesic use ranged from codeine through the non-steroidal anti-inflammatory drugs like diclofenac sodium, diclofenac diethylammonium (all to be

taken with food) to acetaminophen. All subjects with open wounds had booster doses of tetanus toxoid.

Ethical consideration

Ethical approval for this study to be conducted and reported on was obtained from the relevant authorities in the Company.

(Unit in Years)	Forestry N = 98 Freq. (%)	Operations N=100 Freq. (%)	Total N=198 Freq. (%)
Age			
≤ 24	2(2.06)	14(14.00)	16(8.08)
25 – 29	28(28.57)	30(30.00)	58(29.29)
30 – 34	30(30.61)	25(25.00)	55(27.70)
35– 39	21(21.42)	16(16.00)	37(18.69)
≥40	17(17.34)	15(15.00)	32(16.16)
Total	98(100.00)	100(100.00)	198(100.00)
Mean (SD)	33.24±3.27	31.4±3.24	32.14±3.23
Duration on job			
≤ 1	5(5.26)	18(18.00)	23(11.62)
2	18(18.36)	9(9.00)	27(13.64)
3	38(38.78)	14(14.00)	52(26.26)
4	37(37.76)	59(59.00)	96(48.48)
Total	98(100.00)	100(100.00)	198(100.00)
Staff Cadre			
Junior	96(97.96)	100(0)	196(98.99)
Senior	2(2.04)	0(0)	2(1.01)
Total	98(100.00)	100(100.00)	198(100.00)

Table 1: Demographic Profile of the Subjects with work-related traumatic injuries in NNMC over the 12 months of the study

Results

Two hundred and fifty eight (258) traumatic injuries were recorded during the study period among employees of the two producing divisions of the company. The overall Crude Incidence Rate (CIR) of work-related traumatic injury was 163.4 injuries per 1000 workers for the total workforce and the Specific Incidence Rate (SIR) for the two producing divisions was 231.2 injuries per 1000 workers (for Forestry and Operations Divisions).

Out of the 258 traumatic injuries sustained at work, 80 were severe (that is, earned each affected employee three or more working days of sick-leave) by the Nigerian Factory Decree [8,9]. This gave a CIR of 50.7 traumatic injuries per 1000 workers for severe injury for the whole Company and a SIR of 71.7 traumatic injuries per 1000 workers for the two producing divisions of the NNMC. Males were the only

ones affected, as the producing Divisions were predominantly masculine in employee position. Table 1 shows the demographic profile of the subjects with traumatic injuries at work. The mean age of all affected workers was 32.14 ± 3.23 years. The youngest subject in Forestry Division was aged 23 years and served in the Forestry automobile maintenance workshop. He presented with foreign body in the right conjunctiva that he suffered while at work. Two of the youngest subjects in Operations were each aged 21 years – one, a tester in the Mill Laboratory was hit by the sharp edge of paper and sustained a deep wound on the right index finger, while the second, was a machine helper in the Finishing department who sustained a puncture injury from his equipment. In the Mill Operations, subjects with the longest period in service were the most affected (4years). In the Forestry Division, however, those worst affected had three years' experience on the job. Only two senior staff suffered traumatic injury during the entire study period. Both were in Forestry Division – a Logging supervisor was hit by log in the forest and sustained superficial bruises. The second was a civil engineer in Afforestation department who sustained puncture wound at his left hand with his work equipment.

Table 2 shows the distribution of traumatic injury according to the nature (type) of injury. The highest frequency was seen with superficial traumatic injury (65.1%). Out of these: 'wrist, hand and fingers' was the worst affected (22.5% of all traumatic injuries and 34.5% among superficial injuries). Also, among superficial injuries, the 'head' came second (11.6% for all traumatic injuries and 17.9% in this category). Open wound (27.1%) came next to superficial injury in overall frequency. Interestingly, 'wrist, hand and fingers' was still the highest affected, contributing 10.9% to the overall traumatic injury picture (and 40% in this category). Open wound involving the 'head' (7.8% of all traumatic injury) was second again to: 'wrist, hand and fingers'. Internal injury, though very low in frequency (0.8%), was fatal in one instance, when a driver slipped and fell off a forest truck while trying to tie logs on to the truck for transportation to the factory site. He was struck by the falling logs on his abdomen and he sustained intra-abdominal injury with extensive intra-peritoneal hemorrhage from splenic rupture. This proved fatal despite prompt hospital referral and care. The second subject with 'Internal injury' was struck by falling branch of *gmelina* felled by self. He was brought to the First-aid post but walked into the facility by himself and gave a history of brief (about ten seconds) loss of consciousness. His colleagues admitted that he fell as he was being struck down but jumped up immediately by self. He was transferred to the Factory site facility, admitted and monitored for forty-eight hours with no negative findings. A skull X-ray which was requested for, was taken in one of the retained hospitals and had no signs of internal injury. The x-ray was preserved for record purposes. The subject returned to work after 48 hours. Crush injury was the least frequent (0.4%). The left thumb of a machine operator was crushed following the snapping of a crane wire in the Company's wood-yard.

Table 3 shows the causes of the injuries. In both producing Divisions, 'contact with non-powered hand tools' (32.17%) was most frequent, followed by 'struck with projectile or falling objects' (22.86%). Though coming second in frequency, the two subjects with 'Internal injury', out of which one was fatal, were victims of this causal agent. Injury caused by powered hand tool - the chain-saw (15.2%) came third.

Injury caused by the chain-saw ranged from fracture of the bones (tibia and fibula) and teeth, to open wounds. A subject who sustained

the fracture of his right ulna and radius was a victim of: "caught, crushed, jammed or pinched in, or, between objects", as a causal factor. This occurred in the Finishing Department when the slitter winder of the paper machine which cuts and trims the paper was at "crawl" (slow motion) and this employee, out of inattention, placed his hand thereon and was caught and pulled in between the rollers. The raising of an alarm for the machine operator to turn it off, along with the fact that the machine was not in full operation, were what reduced his possible calamity to "a mere fracture of the right fore-arm bones".

Nature of Injury (type)	Equivalent ICD-10 Classification	No. of Injury	Percentage/ Proportion
Superficial Injury			
(a) Contusion			
Head	S 00.0, .1	6)	41.1
Eye and Orbit	S 05.0, .1; T15.0,.1	9)	
Thorax, Abdomen & Back	S 20.2; S 30.0, .1	11)	
Shoulder & Forearm	S 40.0; S 50.0, .1	18) 106*	
Wrist, Hand & Fingers	S 60.0,.1,.2	31)	
Thigh and Leg	S 70.1; S80.0,.1	17)	
Ankle and Foot	S 90.0, .1, .3	14)	
(b) Other Superficial Injury			
Head	S 00.3,.5,.7, .8,.9	24)	24.0
Thorax & Abdomen	S 20.3; S30.8	2)62*	
Wrist, Hand & Fingers	S 60.8, .9	27)	
Thigh and Leg	S 70. 9; S 80.8, .9	9)	
Open Wound			
Head	S 01.0,.1,.2,.5,.7	20)	27.1
Abdomen	S 31.1	4)	
Shoulder & Forearm	S 41.0 ;S 51.9	7)	
Wrist, Hand & Fingers	S 61.0, .1,.8,.9	28)70	
Thigh and Leg	S 71.1; S 81.0,.9	5)	
Ankle and Foot	S 91.0,.1,.3	6)	
Fracture			
Teeth	S 02.5	5)	6.6
Shoulder and Forearm	S 42.0,.1; S52.1,.2	5)	
Hand	S62.8	1)	
Multiple Regions of one	T02.3	17	
Lower Limb	S82.3,.4	4)	
Lower Leg		2)	
Internal Injury			
Intracranial Injury	S 06.9	1)2	0.8
Intra-abdominal Injury	S 36.0+	1)	
Crush Injury			
Thumb	S 67.0	1	0.4
Total		258	100.0

Table 2: Distribution of Work-Related Traumatic Injuries according to Nature of Injury in the NNMC over the 12 months of the study

(*Superficial injury: 1(a) plus 1 (b) = 168, (65.1%), +Employee later died of internal hemorrhage from splenic rupture in referral hospital)

Table 4 shows that out of the 98 subjects in Forestry Division who sustained traumatic injury at work, 21 were serious enough to earn the victim three or more days of sick-leave [8,9] and in Operations Division, out of 100 subjects that sustained injuries only 27 were serious. Twelve (57.1%) out of the 21 subjects in Forestry with severe injuries were chainsaw operators. The chain-saw was the one instrument in forest work with the highest causation of severe traumatic injuries. In Operations Divisions, aside from a chainsaw operator who sustained multiple deep lacerations on the head, secondary to chainsaw kick-back in the Wood-yard, a core machine operator's right fore-arm was caught by in-running nip points at the Finishing department and pulled into the rotating rollers of the slitter winder out of inattention, while the machine was on 'crawl' (see below).

Cause of Injury	ICD-10 Coding	Total No. of Injury	Percentage/ Prop
Falls (from same level or heights)	W01, 11, 13, & 19	21	8.14
Struck by thrown, projected, or falling object eg., tree, or, log.	W20	59*	22.86
Striking against or struck by other object	W22	6	2.33
Caught, crushed, jammed or pinched in, or, between objects	W23	7	2.71
Contact with lifting or transmission devices	W24	2	0.78
Cut with knife	W26	22	8.53
Contact with non-powered hand tools e.g., hand-saw, Screw driver	W27	83	32.17
Contact with powered hand tool (chainsaw)	W29	40+	15.5
Explosion or rupture of gas cylinder	W36	3	1.16
Foreign body entering the eye	W44	7	2.71
Foreign body or object entering through skin	W45	6	2.33
Others- plant thorn, bee sting.	W57 W60	2	0.78
Total		258	100

Table 3: Distribution of Work-Related Traumatic Injury according to Cause of injuries in NNMCM over the 12 months of the study (*In one instance, the impact was fatal, + The chain saw caused the highest number of serious injuries in forest work.)

Discussion

The Crude Incidence rate (CIR) of work-related traumatic injury among the employees of NNMCM was 163.4 injuries per 1000 workers. The CIR of severe injury (that is, injury which earned the victim sick-leave of 3 days and above) [8,9] was 50.7 per 1000 workers. Specific rates for the two producing divisions of the Company (Forestry and

Operations Divisions) taken together for all traumatic injury sustained at work and severe traumatic injury were 231.2 and 71.7 per 1000 workers, respectively.

Umeokafor et al. (2014) have decried the scanty nature of factory-based data in this country, with an alarming finding of the total absence of records of reported accidents or diseases in the workplace from the Federal Ministry of Labour and Productivity Inspectorate Division, Abuja, for the years 2005 and 2006 [14]. A review of literature showed a near total absence of material regarding the paper-producing industry in Nigeria. Available reports for other related industrial settings were those conducted on sawmill workers in Nigeria [15,16].

However, in an extensive review conducted by the United States Department of Labor (1993), on selected occupational fatalities related to pulp, paper and paper board Mills, 72 fatalities were reported [17]. In the current report only one fatality (with intra-abdominal injury in Table 2) was recorded and that occurred in the Forestry Division.

	Forestry Division	Operations Division	X2, Critical Z from table= 1.96
(a) Evaluation of all injured subjects			
No. of subjects traumatically injured at work	98	100	Z = 8.2, p<0.05
No. with no traumatic injuries	208	710	
Total staff strength	306	810	
Proportion affected	98/306	100/810	
(b)Evaluation of the seriously injured*			
No. traumatically injured and on sick-leave of ≥ 3days	21	27	Z = 2.8, p<0.05
No. with minor or no traumatic injuries	285	783	
Total staff strength	306	810	
Proportion affected	21/306	27/810	

Table 4: Comparison of burden of Work-related traumatic injury at work in Forestry and Operations Divisions of NNMCM over the 12 months of the study (*Injuries that attracted sick-leave of three days or above [8,9].)

In an earlier review carried out by Kraus (1985) in the United States of America (USA) on the Incidence Rate (IR) of occupational injuries, the incidence rate of work-related traumatic injuries in manufacturing industries was 11.8 per 100 full-time workers [18]. For lumber and wood product workers in the same report, the CIR was 18.4 per 100 full-time workers and this was 20% higher than the overall reported IR. The rates found in the present study for injuries which made the subjects to be placed on three days' of sick-leave and above [8,9], compared favourably with the report of Kraus for lumbar/wood product workers.

More than half of the subjects (57.1%, Table 1) in this study were of the 25 to 34 years' age bracket (25-29 and 30-34 computed years), showing that those mainly affected were young adults (mean age of all

the subjects: 32.14 ± 3.23 years). The involvement of young adult workers in traumatic injuries in this study is in agreement with many reports [4,6,17]. More interesting is an Australian report [19], which indicates that young workers aged under 25 years, experienced 18% level of traumatic injury over and above all other workers aged 25 years and above for the 2009-10 year period of evaluation. However, in the report of Friedman and Forst (2007), on occupational injury surveillance of traumatic injuries in Illinois, USA, the age range of those worst affected was in the middle-age bracket but younger than 55 years [20]. A close look at experience on the job (duration in service), revealed that subjects with 3-4 years' experience in Forestry Division and overwhelmingly those with 4 years' experience in the Mill Operations, were the worst affected. This could have been a result of over-confidence at the job.

Regarding the nature of traumatic injury (Table 2), superficial injuries had the highest frequency (65.1%) and crush injury the least (0.4%), while open wound and fracture were intermediate in frequency. One of the two cases of internal injury was fatal.

Contact with non-powered hand tools caused the highest percentage of traumatic injury (32.17%) in the current study. This finding also agrees with the Australian report above [19], in which contact with non-powered hand tools, appliances and manual equipment caused the highest incidence of traumatic work-related injuries. In the present study, the chain-saw (powered hand equipment), caused a very high percentage of severe traumatic injury (15.5%) and 57.1% of all equipment. Lindroos and Burstrom (2010) had also identified the chain-saw as a common cause of harvesting accidents in forestry but had observed further that unsafe work methods were more related to the occurrence of the injury with equipment [4]. In this study, "struck by thrown, projected, or falling object e.g., tree, or, log" presented with the highest cause of severe injuries generally (Table 3). Whereas, "caught, crushed, jammed or pinched in or between objects", had a frequency of 2.71% in injury causation. This represents the contribution of winder and re-winder equipment in the paper mill. The current study is in agreement with the US Department of Labour's report [17] that winder and re-winder equipment have a prominent place in injury causation in paper mills. "Struck by thrown, projected or falling objects" as well as "caught, crushed, jammed or pinched in or between objects" are two main categories of injury causation that can culminate even in fatalities in the paper-producing industry. This position is also corroborated by the US Department of Labor's report [17].

Although the present study, shows that falling objects (branches of falling *gmelina* and logs) caused the severest and most traumatic injury in the entire system (with fatality in one case), it is obvious that the seriousness of injury causation by the paper machine winder and re-winder equipment, is being masked by the inclusion of forestry accidents in this study.

When the burden of injury within the two producing divisions of the NNMC (Forestry and Operations) were compared (Table 4), statistically significant differences were observed both for all traumatic injuries sustained at work and when serious injuries sustained by the subjects were compared ($p < 0.05$). It goes without saying therefore, that even for artificial forests as seen in NNMC, where tree-planting had been properly interspaced from the outset, felling of trees and the general inclement terrain posed by weather, the extraneous noise and dust pollution generated by machines and falling trees, together make forestry a very hazardous occupation over and above many others.

The results of the primary medical care offered were generally satisfactory in each instance. As the Company Medical Service did not have X-ray facility, all subjects with bone fractures were offered first-aid immobilisation together with analgesia and immediately referred to the neighbouring hospitals that were retained by the NNMC to give service to the employees in such situations. A chainsaw operator and a welder suffered dental fractures – the chainsaw operator, secondary to chainsaw kick-back injury as in many other situations, and the welder secondary to an accidental blasting of the oxy-acetylene cylinder. Both were referred for dental attention.

Limitations of the Study

This study did not consider the incidence of work injuries in relation to feeding. The NNMC had an in-built arrangement to cater for the feeding of the workers at a highly subsidized rate, which must have obviated the possibility of work injuries occurring as a result of hunger. However, the possible sedating effect of the full stomach should be evaluated in relation to injury causation.

The relationship to remuneration was equally not explored. Although it was generally upheld that the workers were well paid, a pointed study on the individual thinking of the employees, would have been the only way to unearth some hidden grumbling regarding their pay.

Other risk factors for the occurrence of injuries not explored in this study included: whether the employees were doing jobs they had not been doing before when the injury occurred; operating faulty machinery, operating machinery different from those they normally used in doing their normal work; applying a different approach to a usual work; working hurriedly and working with lower concentration [21]. Inattentiveness though elicited in one instance (the case of the fracture of an employee's radius and ulnar by the slitter winder, was confessed/admitted to by the subject rather than a fall-out of enquiry).

Conclusion and Recommendation

This study provides the first national profile of work-related traumatic injuries in the paper-manufacturing industry in Nigeria. On the whole, the problem of work-related traumatic injury at NNMC Oku Iboku, was low when compared with those of similar industrial settings in developed countries [5-7]. This may have been because the Company never reached 50% of its production capacity (100 metric tonnes) throughout the period of the study. Also, safety measures were always taken very seriously in that Company [22]. The present study, however, underscores the need for:

- The opening of a National Work-related Injury Register to ensure that all injuries suffered at work are properly documented.
- Family Physicians and General Medical Practitioners to be alert in designing Injury Prevention Programmes as they serve in industrial settings in Nigeria and other developing nations with a dearth of Occupational Health Physicians in order to stem the scourge of traumatic Injury at work.
- Policy makers to institute modalities for effectively protecting workers in industrial settings, especially for medium and small scale industries that are known to have minimum or no health care provisions in this country [14]. Similar studies of this nature and many more are needed from developing nations like Nigeria and other countries in sub-Saharan Africa.

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