Original Article

A Comparison Study of Conjunctiva Disorders in Technical and Administrative Sawmill Workers in Nigeria

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Abstract

Background: **Workers in the sawmilling industry are at risk of various ocular hazards as a direct result of the sawmilling processes. The aim of this study was to determine the pattern of conjunctival disorders between technical and administrative sawmill workers in Benin, Nigeria.**

Methods: **A cross-sectional study was performed on sawmill workers in Benin, Nigeria, between January and May 2009, with the aid of pre-tested questionnaires. Ocular examination was performed on all subjects. Data obtained were recorded and analysed using SPSS version 13.**

Results**: A total of 553 sawmill workers were studied, among whom 449 (81.2%) and 104 (18.8%) were technical and administrative workers, respectively. There were 496 (89.7%) males and 57 (10.3%) females. The age range was 15–80 years, with a mean of 38.9 years (SD 12.8). Pingueculum was found in 127 (23%) workers, among whom 122 (27.2%) were technical workers and 5 (4.8%) were administrative workers. Pterygium was present in 65 (11.8%) workers, among whom 64 (14.3%) were technical workers and 1 (1%) was an administrative worker. Seven (1.6%) technical workers used protective eyewear; 2 (0.4%) wore this protective eyewear regularly.**

Conclusion**: Technical sawmill workers are at risk of developing conjunctival disorders, which result from chronic ocular irritation. This can be prevented by the provision of protective eye devices in the workplace.**

Keywords: *air pollutants, conjunctival diseases, eye protective devices, occupational exposure, ophthalmology, pterygium*

Introduction

A sawmill is a facility where logs of timber are cut into boards. The sawmilling process involves logging, which is the process of felling trees; this is followed by log bucking, which involves cutting them to length. The logs are then transported to the sawmills, where they are further processed (1,2). Removal of bark from a log, or debarking, is then done either mechanically or hydraulically. The processes involved in sawmilling put the workers at potential risk of health conditions such as asthma, dermatitis, and hearing defects (2–5). These workers are also at risk of various ocular disorders.

Debarking operations expose the workers to airborne soil as well as pathogenic fungi and bacteria that could be present on the wood. This could result in ocular infections, such as bacterial conjunctivitis, keratitis, and orbital cellulitis, if there is a penetrating injury. This could be both sight- and life-threatening. Cartwright et al. (6) reported that there was a high risk of infection following injuries from organic or vegetal foreign bodies, such as wood. In the process of sawing wood, sawdust composed of fine particles of wood is released into the atmosphere. These particles are detrimental to ocular health, causing chronic ocular irritation, and can result in conditions such as pterygium and pingueculum (7). Exposure to wood dust during the sawmilling process may also cause exposure to the volatile components of wood, such as monoterpenes, aldehydes, and ketones. This could lead to both acute and chronic ocular irritations, with resultant chronic conjunctivitis. Sawmill workers usually have symptoms of tearing, redness, and itchiness of the eyes (2). Allergic conjunctivitis can be caused by naturally occurring chemicals, such as plicatic acid, which are present in some wood species. For example, the wood of western red cedar is known to cause ocular allergies, dermatitis, and bronchial symptoms because of its plicatic acid content (2).

Most of the tree species processed in Nigeria are highly allergenic (8). Ahman et al. (9) noted many woods contain chemicals that can irritate the eyes, nose, or throat. They also explained that some of these effects could be caused by

molds growing on the wood and not always by the wood dust itself. These mold spores become airborne when wood chips are moved, lumber is trimmed, or bark is stripped (2,9). Fungicides, such as azaconazole and chlorophenate, are sometimes applied to wood to prevent the growth of fungi if the logs will be stored for a long time before further processing (2). Treatment with insecticides and wood preservatives, such as pentachlorophenol and creosote, is sometimes used to protect the wood surface from mechanical wear or weathering (2). These fungicides as well as wood preservatives could result in chemical conjunctivitis upon accidental entry to the eye (2). These processes potentially put the sawmill worker at risk for ocular irritation, allergic reactions, ocular injury, and even severe ocular infections, which could result in blindness (2,7).

Nigeria is endowed with a good reserve of wood (8). Depending on the climate of the region and the size of the mill, sawing operations may be performed outdoors or indoors (2). In Nigeria, most of the sawmilling processes are performed outdoors. Workers in outdoor sawmills are at added risk of chronic exposure to ultraviolet radiation (290–400 nm), as are other outdoor workers (10). Thus, they are at risk of developing ocular disorders, such as pterygium, pingueculum, dry eyes, senile cataract, and age-related macular degeneration (11,12). Those in the tropics have a greater risk because of the hot, dry, sawdust-filled environment. Hence, it is necessary to protect the eyes by wearing large goggles with side shields. These workers are also at risk of bacterial and fungal ocular and orbital infections (6).

Certain types of occupational diseases are particular to various occupations, for example, miners' nystagmus and glass-blowers' cataract (13). Ocular hazards in industries are preventable if adequate precautionary measures are taken (14). The aim of this study is to compare the pattern of conjunctival disorders between technical and administrative sawmill workers in Nigeria and offer appropriate recommendations.

Subjects and Methods

A comparative cross-sectional study between technical and administrative sawmill workers was carried out in Benin, Nigeria, between January and May 2009. A list of all sawmills in Benin, Nigeria, and their various locations were obtained from the Forestry Division, State Ministry of Agriculture. The Ethics and Research Committee as well as the Health Department of the University of Benin Teaching Hospital, Nigeria, granted approval to conduct this study. Informed consent was obtained from all participants.

Participants were the technical and administrative sawmill workers. Administrative workers were those involved in the payment of salaries, clerical work, and sales transactions. Technical workers included sawyers who fell trees, converters who transport the logs from the forest for processing, jack men who roll the logs from the field onto the various machines, machine operators, wood loaders who transfer the finished products for sale onto vehicles and sawdust packers who are involved in evacuating the sawdust generated, and clearing up bark.

Pre-tested questionnaires designed for the study were administered. Assessment of visual acuity (VA) for each eye was done using Snellen's chart, which was placed at a distance of 6 m outdoors. Aided and unaided VA was carried out where applicable. For individuals whose VA was less than 6/6, pinhole VA was done to exclude the presence of refractive errors. Near vision was assessed with the Roman tests. Further ocular examination was performed on site in improvised areas with some shade. All examinations were performed during the daytime by the first author. Anterior segment examination was done with a pen torch and a portable hand-held slit lamp bio-microscope (Scan Optics, EU).

A diagnosis of pterygium was made in the presence of a wedge-shaped fibrovascular subepithelial ingrowth of degenerative bulbar conjunctival tissue over the limbus onto the cornea. Allergic conjunctivitis was diagnosed in the presence of itching, redness, stringy mucoid discharge, or palpebral or limbal papillae on the conjunctiva. Bacterial conjunctivitis was diagnosed clinically in the presence of an acute onset of purulent discharge with conjunctival hyperaemia without a history of decreased vision (15).

Results

There were 62 registered sawmills of which 38 were operating during the period of the study. No randomisation was done; all of the workers were included in the study except those who declined. Out of 602 sawmill workers, 553 agreed to participate: 449 (93.3%) out of 481 technical workers and 104 (86.0%) out of 121 administrative sawmill workers. The response rate was 91.9%. Those who were unwilling to participate felt the study would interrupt and delay the completion of their tasks for the day. There were 496 (89.7%) males and 57 (10.3%) females, with a male to

female ratio of 8.7:1. The technical workers had a male to female ratio of 12.6:1, whereas for administrative workers, 3.3:1. All of the workers were Nigerians.

The age distribution of the sawmill workers is shown in Table 1. The age range was between 15 and 80 years, with a mean age of 38.9 years (SD 12.8). The mean age of the technical workers (38.2 years, SD 12.7) was significantly higher ($P = 0.015$) than the mean age of the administrative workers (41.6 years, SD 12.8).

The ocular symptoms in sawmill workers are presented in Table 2. Out of 378 sawmill workers who had ocular disorders, 235 (62.8%) workers complained of having symptoms; some had multiple symptoms. Symptoms such as tearing, itching, foreign body sensation, and photophobia were more common in the technical workers. The type and prevalence of conjunctival disorders seen in sawmill workers are shown in Table 3. Pingueculum was the most common disorder, present in 127 (23.0%) workers. Ninety-eight (25.3%) sawmill workers had multiple ocular problems.

The relationship between the nature of the work and the development of pterygium is presented in Table 4. There were 65 (11.8%) workers with pterygium, out of which 64 (11.6%) were technical sawmill workers and 1 (0.2%) was an administrative sawmill worker. A technical sawmill worker was more likely to develop pterygium than an administrative sawmill worker (odds ratio = 2.8, 95% CI = 0.9–4.8). A total of 127 (23.0%) workers had pingueculum, among whom 122 (22.1%) were technical sawmill workers, whereas 5 (0.9%) were administrative sawmill workers (Table 5). There was a significant relationship between the nature of the work and the development of pingueculum. A technical sawmill worker was more likely to develop pingueculum than an administrative sawmill worker (odds ratio = 7.4, 95% CI = 2.9–18.6). Seven (1.6%) of the 449 technical sawmill workers used protective eyewear, whereas 442 (98.4%) did not. Only 2 (0.4%) workers used protective eyewear regularly; the other 5 (1.1%) did not.

Discussion

The response rate among technical workers was higher than that of the administrative workers. This may be due to the direct involvement of technical workers in the sawmilling process and the higher rate of exposure of their eyes to the ocular hazards of the profession, which made them more willing to have their eyes examined. Majority of the subjects are males, especially among the technical workers. This male predominance was also reported in a previous study (16); it is not surprising that more of them are involved in technical tasks because the profession necessitates manual labour, hence the need for more males (2).

Symptoms of ocular irritation, such as tearing, itching, foreign body sensation, and photophobia, were more common in the technical workers than in the administrative workers. A technical worker who was more exposed to the irritant effects of sawdust was more likely to present with the symptoms of ocular irritation.

The most common ocular disorders seen in this study were degenerative conjunctival disorders (pterygium and pingueculum), which were responsible for 34.8% of cases; 23.0% were secondary to pingueculum, whereas pterygium was responsible for 11.8% of cases. A similar

Table 1: Age distribution of sawmill workers

Age	Technical workers		Administrative workers		*P* value
	n	(%)	*n*	(%)	
11–20	29	6.5	5	4.8	0.015[a]
21–30	118	26.3	15	14.4	
31–40	120	26.7	30	28.8	
41–50	104	23.1	25	24.0	
51–60	52	11.6	24	23.1	
61–70	26	5.8	1	1.0	
71–80	0	0.0	4	3.9	

[a] Student's *t* test, $t(551) = 2.430$.

Table 2: Multivariate analysis showing prevalence of ocular symptoms in sawmill workers

Symptom	Technical sawmill workers *n* = 449				Administrative sawmill workers *n* = 104				*P* value
	Yes		No		Yes		No		
Tearing	74	(16.5)	375	(83.5)	7	(6.7)	97	(93.3)	0.009[a]
Itching	35	(7.8)	414	(92.2)	5	(4.8)	99	(95.2)	0.400
Redness	25	(5.6)	424	(94.4)	6	(5.8)	98	(94.2)	0.963
Foreign body sensation	3	(0.7)	446	(99.3)	0	(0.0)	104	(100.0)	1.000
Eye pain/Eye aches	2	(0.4)	447	(99.6)	2	(1.9)	102	(98.1)	0.162
Discharge	13	(2.9)	436	(97.1)	3	(2.9)	101	(97.1)	1.000
Photophobia	6	(1.3)	443	(98.7)	0	(0.0)	104	(100.0)	0.599
Grittiness	7	(1.6)	442	(98.4)	2	(1.9)	102	(98.1)	0.679
Lid Swelling	0	(0.0)	449	(100.0)	1	(1.0)	103	(99.0)	0.100

Data are expressed in number of subjects (percentage). [a] Significant at 95% confidence level with Pearson's chi-square test.

Table 3: Multivariate analysis showing the relationship between conjunctival disorders and nature of work in sawmill workers

Disorder	Technical workers		Administrative workers		Total		*P* value
	n	(%)	*n*	(%)	*n*	(%)	
Pingueculum	122	(27.2)	5	(4.8)	127	(23.0)	<0.001[a]
Pterygium	64	(14.3)	1	(1.0)	65	(11.8)	<0.001[a]
Allergic conjunctivitis	44	(9.8)	7	(6.7)	51	(9.2)	0.330
Bacterial conjunctivitis	21	(4.7)	0	(0.0)	21	(3.8)	0.020[a]

[a] Significant at 95% confidence level with Pearson's chi–square test.

Table 4: Odds ratio analysis of pteryngium among workers

Nature of work	Pteryngium				Total	*P* value
	Present		Absent			
Technical workers	64	(14.3)	385	(85.7)	449	<0.001[a]
Administrative workers	1	(1.0)	103	(99.0)	104	<0.005[b]

Data are expressed in number of subjects (percentage). [a] χ^2 (1) = 14.384. [b] OR = 2.8, 95% CI 0.9–4.8. The Mantel-Haenszel common odds ratio estimate is not normally distributed under the common odds ratio of 1.00 assumption, owing to inadequate counts for sub-cell analysis, thereby showing a high level of imprecision. Hence, the natural log of the estimate was used.

Table 5: Odds ratio analysis of pingueculum among workers

Nature of work	Pingueculum				Total	*P* value
	Present		Absent			
Technical workers	122	(27.2)	327	(72.8)	449	<0.001[a]
Administrative workers	5	(4.8)	99	(95.2)	104	

Data are expressed in number of subjects (percentage). [a] OR = 7.4, 95% CI 2.9–18.6.

Table 6: Odds ratio analysis of allergic conjunctivitis among workers

Nature of work	Allergic conjunctivitis		Total	*P* value
	Present	Absent		
Technical workers	44 (9.8)	405 (90.2)	449	0.333[a]
Administrative workers	7 (6.7)	97 (93.3)	104	

Data are expressed in number of subjects (percentage). [a] OR = 1.5, 95% CI 0.7–3.4.

finding was reported by Omoti et al. (17) in other outdoor workers, with conjunctival disorders having the highest prevalence rate of 30.1%. Pingueculum and pterygium are ocular disorders associated with chronic exposure to ultraviolet radiation (10,18). Other risk factors identified include chronic ocular irritation, dust, windy conditions, and outdoor work (18). There were more cases of pingueculum than pterygium in this study.

The prevalence rates of pterygium in the general population in Nigeria varied from 4% to 9% (19,20). However, in a study that reviewed the risk factors for pterygium and pingueculum, it was reported that sawmill workers and welders have higher prevalence rates of pterygium (10). In the current study, there was a significant difference in the occurrence of both disorders depending on the nature of work, such that a technical worker was more likely to develop pterygium and pingueculum than an administrative worker was. The difference is likely due to the higher outdoor exposure to irritants among the technical workers as compared to the administrative workers.

Allergic conjunctivitis had a prevalence rate of 9.2% among all the workers studied. The prevalence rate was 9.8% and 6.7% in technical and administrative workers, respectively. This may be attributed to the higher exposure to sawdust among the technical workers. However, the difference was not significant. Previously, Omoti et al. (21) reported a high prevalence rate of 23.3% among the industrial workers they studied. This may have resulted from differences in the nature of irritants in these industries. Some wood species, such as *Triplochiton scleroxylon* and *Nauclea diderrichii*, milled in Nigeria are highly allergenic (22). The rubbing of the eyes during itching with hands that are likely not clean due to the working environment may have rendered the technical workers more prone to develop bacterial conjunctivitis.

Only 7 workers used protective eye devices in this study, yielding a compliance rate of 1.6%; 98.4% of the technical workers did not protect their eyes while working. Some of the administrative workers occasionally assisted with minor technical work. Even when they did, none of them protected their eyes. This is similar to findings by Titiyal and Murthy (23) in India, where 96.4% of the workers studied did not use protective eye devices. This level of non-compliance may be attributed to the fact that the workers in this study are in a developing nation, in the North Indian town; thus, the level of compliance with eye safety precautions was low due to insufficient awareness of its usefulness or negligence on the part of the employers. Okoye et al. (16) in Enugu, Nigeria, reported an even lower level of compliance among the sawmill workers studied; none used protective eyewear. This may be due to the smaller sample size.

Conclusion

The most common conjunctival disorders among sawmill workers in Nigeria are pingueculum, pterygium, and allergic conjunctivitis. A technical worker is more likely to have a degenerative disorder (pingueculum or pterygium) than an administrative worker is. This may be due to poor compliance with safety eyewear. There is a need to educate sawmill workers on the necessity to comply with the use of protective eye devices. The government and legislative bodies should enforce laws on the use of protective eye devices and ensure that employers provide the appropriate safety equipment for their workers.

Authors' Contributions

Conception and design, analysis and interpretation of the data, drafting and final approval of the article, provision of study materials, statistical expertise: IN, OMU
Collection and assembly of the data: IN
Critical revision of the article: IN, OMU, OTE, OAD, AEO

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References

1. Peterson CE. Sawdust trail: Annals of sawmilling and lumber trade from Virginia to Hawaii via Maine, Barbados, Sault Ste. Marie, Manchac and Seattle to the year 1860. *B Assoc Pres Technol*. 1973;**5(2)**: 84–85.
2. Demers P, Teschke K. Lumber industries based on biological resources. In: Stellman JM, editor. *Encyclopaedia of Occupational Health and Safety: Volume 3*. 4th ed. Geneva (CH): International Labour Office; 1998. p. 71.
3. Fatusi A, Erhabor G. Occupational health status of sawmill workers in Nigeria. *J R Soc Health*. 1996;**116(4)**:232–236.
4. Ige OM, Onadeko OB. Respiratory symptoms and ventilatory function of the sawmillers in Ibadan, Nigeria. *Afr J Med Med Sci*. 2000;**29(2)**:101–104.
5. Alwis KU, Mandryk J, Hocking AD. Exposure to biohazards in wood dust: Bacteria, fungi, endotoxins, and (1→3)-beta-D-glucans. *Appl Occup Environ Hyg*. 1999;**14(9)**:598–608.
6. Cartwright MJ, Kurumety UR, Fruel BR. Intraorbital wood foreign body. *Ophthal Plast Reconstr Surg*. 1999;**15(1)**:44–51.
7. Fox LS. Industrial and occupational ophthalmology. In: Fox LS, editor. *Eye hazards*. 1st ed. London (GB): Oxford University Press; 1973. p. 1–58.
8. Keay RWJ. *Trees of Nigeria*. 2nd ed. Oxford (GB): Clarendon Press; 1989.
9. Ahman M, Holmstrom M, Cynkier I, Soderman E. Work related impairment of nasal function in Swedish woodwork teachers. *Occup Environ Med*. 1996;**53(2)**:112–117.
10. Saw S, Tan D. Pterygium: Prevalence, demography and risk factors. *Ophthalmic Epidemiol*. 1999;**6(3)**: 219–228.
11. Threlfall JJ, English DR. Sun exposure and pterygium of the eye: A dose response curve. *Am J Ophthalmol*. 1999;**128(3)**:280–287.
12. Dolin PJ, Johnson GJ. Solar ultraviolet radiation and ocular disease: A review of the epidemiological experimental evidence. *Ophthalmic Epidemiol*. 1994;**1(3)**:155–164.
13. Resnick L. *Eye hazards in industry: The problem of eye accident*. 2nd ed. New York (NY): Columbia University Press; 1941. p. 21-50.
14. Abiose A, Otache MA. Ophthalmic needs of Nigerian factory workers. *J Trop Med Hyg*. 1981;**84(4)**: 161–163.
15. Kanski JJ. *Clinical ophthalmology. A systematic approach*. 6th ed. Philadelphia (PA): Elsevier; 2007.
16. Okoye OI, Umeh RE. Eye health of Industrial workers in Southeastern Nigeria. *West Afr J Med*. 2002;**21(2)**:132–137.
17. Omoti AE, Edema OT, Akinsola FB, Aigbotsua P. Non-traumatic ocular findings in industrial technical workers in Delta State, Nigeria. *Middle East Afr J Ophthalmol*. 2009;**16(1)**:25–28.
18. Mackenzie FD, Hirst LW, Battistutta D, Green A. Risk analysis in the development of pterygia. *Ophthalmology*. 1992;**99(7)**:1056–1060.
19. Ashaye AO. Pterygium in Ibadan. *West Afr J Med*. 1991;**10(3–4)**:232–243.
20. Ukponmwan CU. Recurrent pterygium in Benin City. *Nig Med J*. 1997;**33(1)**:17–18.
21. Omoti AE, Waziri-Erameh JM, Enock ME. Ocular disorders in a petroleum industry in Nigeria. *Eye*. 2008;**22(7)**:925–929.
22. Dutkiewicz J, Skorska C, Dutkiewicz E, Matuszyk A, Krysinska-Traczyk E. Response of sawmill workers to work-related air borne allergens. *Annal Agric Environ Med*. 2001;**8(1)**:81–90.
23. Titiyal JS, Murthy GV. Industrial ocular morbidity in a north Indian town. *Indian J Public Health*. 1998;**42(2)**:29–33.