

Ocular disorders in a petroleum industry in Nigeria

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CLINICAL STUDY

Abstract

Objective To determine the ocular disorders in the petroleum industry in Warri, Nigeria.

Methods A clinic-based prospective study of the pattern of ocular disorders in workers of the Nigerian National Petroleum Corporation in Warri, Delta state of Nigeria was carried out over a 1-year period. Technical and non-technical workers were interviewed and examined using the Snellen's chart, pen-torch, direct ophthalmoscope, slit-lamp biomicroscope, Perkin's hand-held applanation tonometer, and the Kowa automatic visual field plotter where indicated.

Results A total of 154 technical workers comprising 146 males (94.8%) and eight females (5.2%), and 116 non-technical workers comprising 90 males (77.6%) and 26 females (22.4%) were seen. There was no reported case of ocular trauma. Symptoms suggestive of ocular irritation were much more common in technical workers. Allergic conjunctivitis, pterygium, corneal abrasion, and foreign body on the cornea were significantly more common in technical workers $P < 0.0001$.

Conclusions Exposure to irritant chemicals in the petroleum industry makes the technical workers more prone to allergic conjunctivitis, pterygium, corneal abrasion, and foreign body on the cornea. Protection goggles should be provided for all the technical workers.

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Introduction

Ocular hazards occurring in industrial workers may result in visual impairment, suffering, reduced manpower, man hours, and monetary loss. Most of these hazards are preventable if adequate precautionary measures are taken.^{1–4}

To maintain certain standards in terms of health, safety, efficient, and overall productivity in the industries, factories act and decrees were enacted by the Federal Government of Nigeria.⁵ The great increase and diversification of mechanization in industry, with associated increased demand on our social lives result in increased risk and occurrence of all types of trauma especially ocular trauma.

The eyes are exposed to a variety of injurious agents depending on the type of industry. Ocular injury is commonly due to occupational hazards.^{6,7} A study carried out at Wolver-Hampton, a highly industrialized area of the UK showed that 73.8% of all ocular trauma seen over a 10-year period occurred in industries.⁶

A similarly high figure of 71% was reported as early as 1923.⁷ However a much lower figure of 15.4% was reported from a much less industrialized area of Northern Ireland.⁸

There are other sources of industrial ocular hazard, which include exposure to dangerous rays. Acute exposure to ultraviolet radiation results in photokeratitis, which is characterized by pain and grittiness. This may result in decreased corneal sensitivity⁹ and damage to the corneal endothelium.¹⁰ Long-term exposure may be partly responsible for conditions such as pterygia, pingueculae, band-shaped keratopathy, and climatic droplet keratopathy.^{11–13}

Repeated exposure to radiant energy on glass blowers, steel workers, blast furnace attendants, and blacksmiths can result in glassblower cataract.¹⁴ The damage to the lens is a consequence of absorption of direct and indirect infrared radiation.^{14,15}

There are several chemicals used in the refining process in the petroleum industry. Exposure to these chemicals may cause adverse ocular side effects, which may manifest mainly in the technical workers. The aim of this study is to identify the pattern of ocular disorders in workers in the Nigerian National Petroleum Corporation in Warri, Delta state, Nigeria.

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Materials and methods

This is a clinic-based prospective study of technical and non-technical workers of the Nigerian National Petroleum Corporation in Warri, Delta State, Nigeria. Patients attend the eye clinic from several departments of the petroleum industry. The study was conducted between July 2005 and June 2006.

The technical workers and non-technical workers were interviewed and examined by the author when they presented to the eye clinic and the findings in the two groups of workers were compared. All interviews and examinations conducted during the study took place in the consulting room of the eye clinic provided by the management within the main clinic complex. Eye health talk was given at the end of the screening sessions. Provisions were made for personal data, industrial work history, ocular history, and examination findings.

Visual acuity assessment was carried out using Snellen’s literate chart for distance placed at 6 m inside the examination room with adequate illumination. Each eye was tested separately with and without glasses where applicable. The pinhole was used for subjects with distant visual acuity less than 6/6, whereas near visual acuity was tested using Jaegar’s reader’s chart. Those with visual acuity less than 6/6 or had difficulty reading were refracted.

Colour vision was tested using the Ishihara pseudo-isochromatic plates when indicated and findings noted as simply normal or abnormal. External ocular examination was carried out with a pen-touch and slit-lamp biomicroscope. Fluorescein staining of corneal lesions was carried out whenever indicated. Further clinical assessment included direct ophthalmoscopy. Examination under mydriasis was achieved with 2.5% phenylephrine hydrochloride and 0.5% mydriaticum.

Tonometry was performed on subjects who had suspicious or pathologically cupped discs, or who admitted a family history of glaucoma. This was measured using Perkin’s hand-held applanation tonometer after the instillation of amethocaine eye drop and fluorescein dye. Visual field examination was assessed by the Kowa automatic visual field plotter where indicated.

Subjects were informed about the findings and were treated and or given spectacles.

Results

The total number of staff of the Warri zone of the Nigerian National Petroleum Corporation, where this study was conducted was 2147. This was made up of 1482 male subjects (68.17%) and 692 female subjects (31.83%). There were 1062 technical workers (48.85%)

and 1112 non-technical workers (51.15%). Only workers seeking eye care were included in the study. The total number of workers seen was 270 (12.57%). Of these, 154 technical workers comprising 146 male subjects (94.8%) and eight female subjects (5.2%) and 116 non-technical workers comprising of 90 male subjects (77.6%) and 26 female subjects (22.4%) were seen. The age range of the technical workers was 21–60 years with a mean age of 49.6 years (SD ± 8.4). Only 27 patients (17.5%) were below the age of 40 years. Seventy-seven patients (50%) were between 41 and 50 years, whereas 50 patients (32.5%) were between 51 and 60 years. The age range of non-technical workers was 31–60 years with a mean age of 51 years (SD ± 7.2). Ten patients were between 31 and 40 years, 60 patients (51.6%) were between 41 and 50 years, and 45 patients (38.8%) were between 51 and 60 years.

Among the technical workers, three patients (2%) had primary level of education, 51 patients (33.1%) had secondary level of education, and 100 patients (64.9%) had tertiary level of education. Among the non-technical workers, 17 patients had primary education (14.75), 37 patients (31.9%) had secondary education, and 62 patients (53.4%) had tertiary education. Nine technical (5.8%) had been employed for less than 10 years, 61 had been employed between 10 and 20 years whereas 84 (54.6%) had been employed for over 20 years. Three non-technical workers (2.6%) had been employed for less than 10 years, 63 (54.3%) for between 10 and 20 years, whereas 50 (43.1%) had been employed for over 20 years.

The distribution of patients according to departments/subsidiaries is shown in Table 1. The various departments include Directorate of Petroleum Resources, Warri Refinery and Petrochemical Company, Petroleum Product and Marketing Company, Nigerian Gas Company, Nigerian Petroleum Development Company, National Petroleum Investment Management Services, Zonal Office, Medical, and Fire Safety and Environmental Protection Department (FSEPD). The various occupations of the technical workers are shown

Table 1 Departmental distribution of petroleum workers

Department	Technical workers	Non-technical workers	Total (%)
DPR	18	6	24 (8.9)
WRPC	102	44	146 (54.1)
PPMC	18	10	28 (10.4)
NGC	6	14	20 (7.4)
NPDC	2	2	4 (1.5)
PIMS	0	2	2 (0.7)
Z/O	8	12	20 (7.4)
FSEPD	0	4	4 (1.5)
Medical	0	22	22 (8.1)
Total	154	116	270 (100)

in Table 2. Among non-technical workers, four patients (3.4%) were management staff, 31 (26.7%) were senior administrative staff, 42 (36.2%) were junior administrative staff, six (5.2%) were nurses, eight (6.9%) were teachers, 14 (12.1%) were drivers, and 11 (9.5%) were security guards.

There was no reported case of ocular trauma. The visual acuity in the better eye of the petroleum workers is shown in Table 3. There was a significant difference in visual acuities ($P < 0.05$). The technical workers had relative better visual acuities. Furthermore, three patients among the technical workers had monocular blindness. The duration of symptoms varied from a few hours to 10 years before presentation. The symptoms suggestive

of ocular irritation are shown in Table 4 whereas other presenting symptoms are shown in Table 5. Symptoms suggestive of ocular irritation were much more common in technical workers but the difference was not statistically significant ($\chi^2 = 13.904$, $P = 0.0529$). There was also a significant difference in other ocular symptoms ($\chi^2 = 14.384$, $P = 0.0256$). Relatively more non-technical workers complained of poor vision. The ocular disorders are shown in Table 6. There was also a significant difference between ocular disorders in technical and non-technical workers ($\chi^2 = 47.748$, $P = < 0.0001$). Allergic conjunctivitis, pterygium, corneal abrasion, and foreign body on the cornea were significantly more common in the technical workers.

Table 2 Occupation of technical workers

Occupation	No.	%
Engineers	21	13.6
Technicians	71	46.1
Plant operators	39	25.3
Inspectors	11	7.2
Welders	4	2.6
Quality controllers	2	1.3
Carpenters	2	1.3
Crane operators	2	1.3
Shipping assistants	2	1.3
Total	154	100

Table 3 Visual acuities in the better eye of petroleum workers

Visual acuity	Technical workers (%)	Non-technical (%)
6/6 or better	82 (53.2)	58 (50)
6/9–6/12	64 (41.6)	40 (34.5)
6/18–6/24	8 (5.2)	16 (13.8)
6/36–6/60	0 (0)	2 (1.7)
Total	154 (100)	116 (100)

Table 4 Symptoms suggestive of ocular irritation in petroleum workers at presentation

Symptom	Technical workers (%)	Non-technical workers (%)
Tearing	18 (11.7)	4 (3.4)
Redness	18 (11.7)	6 (5.2)
Grittiness	17 (11)	2 (1.7)
Itching	30 (19.5)	16 (13.8)
Pains	28 (18.2)	14 (12.1)
Foreign body sensation	12 (7.8)	0 (0)
Burning sensation	5 (3.2)	0 (0)
Photophobia	14 (9.1)	2 (1.7)

Discussion

Few similar studies in industrial technical workers have been carried out in Urban centres in Nigeria.^{16–20} None has been carried out in the petroleum industry. The technical workers in petroleum industry are exposed to various chemical irritants used in the refining of petroleum products. These include gaseous and particulate matter such as hydrogen sulphide and other

Table 5 Other symptoms in petroleum workers at presentation

Symptoms	Technical workers (%)	Non-technical workers (%)
Difficulty reading	48 (31.2)	40 (34.5)
Poor distant vision	48 (31.2)	45 (38.8)
Haloes	5 (3.2)	3 (2.6)
Headache	14 (9.1)	4 (3.4)
Lid swelling	5 (3.2)	0 (0)
Eye swelling	19 (12.3)	5 (4.3)
Drooping lids	0 (0)	1 (0.9)

Table 6 Ocular disorders in petroleum workers

Diagnosis	Technical workers (%)	Non-technical workers (%)
Allergic conjunctivitis	53 (34.4)	10 (8.6)
Refractive errors	55 (35.7)	74 (63.8)
Presbyopia	85(55.2)	56 (48.3)
Pterygium	20 (13)	8 (5.2)
Glaucoma	23 (14.9)	12 (7.8)
Macula disorder	9 (5.8)	5 (4.3)
Uveitis	7 (4.5)	14 (12.1)
Cataract	5 (3.2)	4 (3.2)
Corneal abrasion	4 (2.6)	0 (0)
Foreign body on cornea	2 (1.3)	0 (0)
Chalazion	2 (1.3)	0 (0)
Episcleritis	2 (1.3)	0 (0)
Spastic ptosis	0 (0)	2 (1.7)
Bil optic atrophy	2 (1.3)	0 (0)

hydrogen gases, catalyst dust, ammonium compounds, carbon black, fuel gases, and other hydrocarbons. They are also exposed to heat, steam, acids, caustic soda, asbestos, radioactive materials, and liquid lead compounds. These chemicals may affect the eyes if protective goggles are not worn. Furthermore, some of these workers are exposed to other injurious agents, which are not peculiar to the petroleum industry such as the welder's arc, physical trauma, and smoke among others. The Nigerian National Petroleum Company has a department dedicated to safety and ensuring that protective gadgets are provided and worn by the workers. This department is known as the FSEPD. However, it was observed that only those who work in furnaces or are exposed to the welder's arc were mandated to wear protective goggles, whereas most of the others were mandated only to wear facemasks to protect their airways from the toxic dust particles. This leaves their eyes exposed to various irritant chemicals and dust particles. Furthermore, many of the workers who were provided with goggles occasionally did not comply with their use because of ignorance of the possible toxic effects of these chemicals. This may lead to some possible adverse ocular effects in technical workers, which may become evident when compared with the non-technical workers.

More technical workers were seen than non-technical workers and majority of the workers were males especially among the technical workers. Majority of the workers were in their middle ages (between 40 and 60 years), and have been employed for over 10 years. Thus, most of the workers have had chronic exposure to the chemical and other injurious agents used in the petrochemical industry.

The pattern of ocular disorders seen in petroleum workers is different from what was reported in other industries in Nigeria, especially in the order of occurrence of these disorders. The most common disorders in this study were presbyopia, refractive errors, allergic conjunctivitis, glaucoma, pterygium, and uveitis. In contrast to this, a study in Kaduna (Northern Nigeria)¹⁶ showed that conjunctivitis, corneal opacity, pingueculum, and pterygium were the most common ocular disorder. In Enugu (Eastern Nigeria), presbyopia, refractive error, pterygium, and cataract were the most common. This may reflect the difference in the harmful agents emitted in the different industries studied.

There was no case of ocular trauma in both the technical and non-technical workers. This is in contrast to several similar studies in industries in Nigeria and in the diaspora.⁶⁻⁸ The absence of ocular trauma in these workers may be due to the high safety standards in the petroleum industry where a full department is dedicated toward ensuring safety and eliminating occupational

hazards. Apart from supervision to ensure compliance with the safety measures, regular lectures and workshops are carried out to ensure safety. Periodic medical examinations are carried out at least once a year to detect any occupational hazards. All these measures may have contributed to the absence of direct ocular trauma in the technical workers.

None of the workers, technical or non-technical, was blind using the World Health Organization definition of blindness using the visual acuity of inability to count fingers at 3m or less than 3/60. This may be due to the availability of excellent medical facilities for the staff of the company, regular periodic medical examinations to detect disease early and at a treatable stage, and the safety measures put in place. It is also possible that if such a worker existed, he would no longer be able to carry out his normal duties and would since have been retired.

Symptoms suggestive of ocular irritation were much more common among the technical workers but the difference was not statistically significant. The technical workers are exposed to various irritant chemicals used in the refining process and several workers did not wear protective eyewear. This may be responsible for these symptoms being more common in technical workers. There was however a significant difference in the occurrence of other symptoms. Symptoms suggestive of refractive errors and presbyopia were more common in the non-technical workers, whereas other symptoms such as haloes, headache, lid and eyeball swelling were more common in technical workers. This difference may be due to the greater need for reading by the non-technical workers who were mainly administrative staff.

There was a significant difference in ocular disorder between the technical and the non-technical workers. Allergic conjunctivitis, pterygium, corneal abrasion, and foreign body on the cornea were significantly more common in the technical workers. These disorders are related to acute and chronic ocular irritation, which may result from exposure to toxic refinery chemicals and particles.

Refractive errors and presbyopia were the most common conditions encountered in both groups of workers and are related to the common occurrence of these conditions in the general population and not necessarily occupational.²¹

In conclusion, exposure to the gaseous, liquid, and particulate byproducts of the refining process in petrochemical companies may cause acute and chronic ocular irritation and make the workers more prone to allergic conjunctivitis, pterygium, corneal abrasion, and foreign body on the cornea. It is recommended that all technical workers exposed to these chemicals should wear protective goggles in addition to the facemasks.

References

- 1 Fong L P, Taouk Y. The role of eye protector in work related injuries. *Aust-N-Z-J- Ophthalmol* 1995; **23**(5): 10–11.
- 2 Montague H. Eye hazards for outside workers. *Occup Health* 1992; **44**(7): 198–201.
- 3 Abiose A, Otache MA. Ophthalmic needs of Nigerian factory workers. *J Trop Med Hyg* 1981; **84**: 161–163.
- 4 Ensor GF. Eye protection. *Ann Occup Hyg* 1987; **37**: 67–70.
- 5 The laws of the Federation of Nigeria (factories Act) 1990; **25**: 5463–5493.
- 6 Lambah P. Adult injuries at Wolver-Hampton. *Trans Ophthalmol Soc UK* 1968; **88**: 661–673.
- 7 Garrow A. A statistical enquiry into one thousand cases of eye injuries. *Br J Ophthalmol* 1923; **7**: 65–80.
- 8 Canavan YM, O'Flaherty J, Archer DB, Elwood J. A ten-year survey of eye injuries in Northern Ireland. *Br J Ophthalmol* 1980; **64**: 618–625.
- 9 Millodot M, Earlam RA. Sensitivity of cornea after exposure to ultraviolet light. *Ophthalmic Res* 1984; **16**(6): 325–328.
- 10 Cullen AP, Chou BR, Hall MG, Jang SE. Ultraviolet B damages corneal endothelium. *Am J Optom Physiol Optics* 1984; **1**: 473–478.
- 11 Klinwork GK. Chronic actinic keratopathy—a condition associated with conjunctivital elatosis (pinguecula) and typified with characteristic extracellular concretions. *Am J Pathol* 1972; **67**: 327–334.
- 12 Karai I, Horigushi S. Pterygium in welders. *Br J Ophthalmol* 1984; **168**: 347–349.
- 13 Anderson J, Fuglsang H. Droplet degeneration of the cornea in the North Cameroon (prevalence and clinical appearances). *Br J Ophthalmol* 1976; **60**: 256–262.
- 14 Goldman H. The genesis of the cataract of the glassblower. *Am J Ophthalmol* 1935; **18**: 590.
- 15 Langley RK, Mortimer CB, McCullough C. The experimental production of cataracts by exposures to heat and light. *Arch Ophthalmol* 1960; **63**: 473.
- 16 Abiose A, Otache MA. Ocular health status of Nigerian industrial workers. *J Trop Med Hyg* 1980; **83**(3): 105–108.
- 17 Abiose A, Otache MA. Ophthalmic needs of Nigerian workers. *J Trop Med Hyg* 1981; **84**: 161–163.
- 18 Okoye OI. Ocular health status of industrial workers in Enugu area in Nigeria. Fellowship Dissertation. National Postgraduate Medical College of Nigeria. May 1998..
- 19 Alakija W. Eye problems among cement factory workers in Bendel State, Nigeria. *Public Health* 1988; **102**: 69–72.
- 20 Alakija W. Eye morbidity among welders in Benin-City Nigeria. *Public Health* 1988; **102**: 381–384.
- 21 Akinsola FB, Majekodunmi AA, Obowu CB, Ekanem EE. Pattern of eye diseases in adult 16 years and above in Ikeja and Alimosho local government areas of Lagos State. *Nig Post Grad Med J* 1995; **2**: 56–61.