OPEN ACCESS
Global Journal of Research in Medical Sciences
ISSN: 2583-3960 (Online)
Volume 05 | Issue 03 | May-June | 2025
Journal homepage: https://gjrpublication.com/gjrms/
Original Research Article

Occupation distribution of Niger Delta residents with black soot-induced eye diseases, in some selected eye clinics in the Niger Delta, between 2017 and 2021

*Ihekaire, Desmond Eberechukwu.[1], S. J. Ozims [2] and P. O. Adogu [3]

[1,2,3] Department of Public Health, Faculty of Health Sciences, Imo State University, Owerri.

DOI: 10.5281/zenodo.15324366 **Submission Date: 27 March 2025| Published Date: 02 May 2025**

Corresponding author:** ***Ihekaire, Desmond Eberechukwu.
Department of Public Health, Faculty of Health Sciences, Imo State University, Owerri.

Abstract

This retrospective study compared the relationship between black soot and the prevalence of oculo-visual diseases among the residents of the Niger Delta Region, Nigeria, between 2017 and 2021. The study involved 4500 subjects (residents), 100 from each of the nine states of the Niger Delta, spanning the five year (2017 – 2021) period under study. The study population comprised males and females, between the ages of 11 and 60. The research design was anchored on document analysis, which was based on the clinical records of residents (patients) who visited the selected eye clinics in the capital cities of the Nine States of the Niger Delta region, with little or no history of such diseases prior to the period under study. The study identified some soot-induced eye diseases, like allergic conjunctivitis, corneal foreign body, dry eye/irritation, cataract, Pterygium and glaucoma, and determined their prevalence across the Nine States of the Niger Delta Region. It also determined the influence of age, gender and occupation on the oculo-visual impact of black soot on the Niger Delta residents. Occupation was categorized into indoor and outdoor workers for better organization and presentation. The data for this study were based on the clinical records of the residents (patients) who visited the selected eye clinics during the period under study. Percentages, arithmetic mean and standard deviation were used to determine the levels of the black soot-induced eye diseases. The sample t-test and analysis of variance (ANOVA) were used to determine the significance of average incidence of black soot-induced oculo-visual diseases, while the Fisher's least significant difference (LSD) method was used to determine the most prevalent black soot-induced eye disease(s) and the age group that was most affected. The findings showed a significant prevalence of black soot-induced eye diseases for all age groups, gender and occupation ($p \leq 0.05$). In all, Allergic Conjunctivitis (44.39%) has the highest prevalence of all black soot-induced eye diseases. Age group 21 – 30 was the highest affected by black soot-induced eye diseases with a percentage of 25.02, followed by age groups 11 – 20 (23.84%) and 31 – 40 (21.21%), respectively. Males were the highest affected by black soot-induced eye diseases with a percentage of 52.97. On the contrary, there is no significant difference in the effect of black soot induced eye diseases between male and female, across the Niger Delta States ($p = 0.104 < 0.05$). Outdoor workers were the highest affected by black soot-induced eye diseases, with a percentage of 68.12. Residents with black soot induced eye problems were more, with a percentage of 85.41 than residents without black soot-induced eye problems (14.59%). Generally, the findings show that there is no significant difference in the incidence of black soot induced eye diseases across the nine Niger Delta. In other words, the incidence of black soot-induced eye diseases across the nine Niger Delta states is virtually the same for all independent variables. Government failure to meet public demand for petroleum product, poverty and unemployment facilitate youth involvement in artisanal refinery activities, which caused the black soot pollution. It is important that government takes decisive actions to stop illegal oil business to prevent further pollution of Niger Delta environment, besides encouraging citizens to embrace healthy habits of personal hygiene and consumption of antioxidant rich fruits to neutralize the harmful effects of the soot, among other recommendations.

Keywords: *air pollution; black soot; cataract; eye diseases; allergic conjunctivitis; Pterygium; cornea foreign body; glaucoma; ocular surface diseases; retinal ischemia; myopia; age-related macular degeneration; Niger Delta.*

Introduction

All life on Earth depends on air for its survival and growth. Human health is directly impacted by its quality, which is highly influenced by civilizational level. A significant contributor to the worldwide burden of disease is air pollution. Although air quality standards were more stringent in developed nations like the United States, air pollution-related mortality was higher in both developing and developed nations [1]. Since the Industrial Revolution, human technology has been responsible for most significant air pollution, despite the fact that there are several natural sources, such as volcanoes and wildfires. Industrialization and international transportation have evolved with human civilization. High levels of air pollution and poor air quality are the result of growing numbers of factories and motorized vehicles that burn fuel as a result of industrialization. For instance, the Central Weather Bureau of Taiwan reports that in January 2021, the air quality index (AQI) in South Taiwan, the location of the island's major power plants, was between 130 and 160. This is deemed hazardous to the average person and calls for a restriction on outdoor activities.

In several areas of the Niger Delta region, there was a growing uproar and genuine alarm over the growing amount of black soot, which led to poor air quality. This bug was originally observed in November 2016. The incomplete burning of fossil fuels produces black soot, a black particulate substance composed of carbon. Black soot is thought to be caused by illicit crude oil operations and the destruction of products from illegal oil refineries, according to specialists throughout Nigeria and residents of the Niger Delta, particularly in Rivers and Bayelsa States. The destruction of products obtained from illicit crude refineries is one of the causes of black soot; when these products are burned, the smoke enters the atmosphere and both indoor and outdoor spaces, causing and/or exacerbating respiratory, cardiovascular, skin, and eye conditions, as well as the resulting irritation and discomfort [2].

The government of Rivers State expressed worry about the black soot problem and connected illegal oil refineries, bunkers, and tire burning to the soot pollution. This persistent issue, which has grown to be a significant public health concern, also worries important stakeholders. An increase in the number of patients experiencing respiratory difficulties has already been documented by Port Harcourt hospitals and health centers [3]. The most vital organ for human endeavor is the eye. The degree of its functionality dictates the pace and scope of human growth and progress, and consequently, the pace and scope of a country's human capital development. Any incapacitating oculo-visual health deficit will always have a detrimental effect on the sufferers' lives and means of subsistence from birth through childhood, adolescence through adulthood. The policies and programs of the world's best economies are driven by visually healthy citizens. Not only do visually impaired people lack a significant capacity for productivity, but they also typically represent a social and economic burden to their surroundings. Just as our personal goals are primarily based on our ability to read, write, understand, see, appreciate, and act, so too is a nation's human capital development projected on the oculo-visual capabilities of its workforce; therefore, optimal oculo-visual health is a sine qua non to human and national development. Based on this premise, the oculo-visual health of Niger Delta residents is now a concern, with regard to the black soot pollution in the region [5]. Good health plays a central role in nations economic development, and it is also a fundamental human right. For health to achieve this in any economy, the environment must play a significant role as the relationship between both cannot be denied. Analysis of Rivers State hospitals from 2014-2018 showed that in over 20,000 people who received care for soot-related conditions, black soot had caused adverse respiratory, skin and reproductive disorders [6]

This black soot event has also polluted water, soil, contaminated plants, aquatic life and animals with associated health consequences after consumption. Outdoor air pollution is a major environmental health problem that affects everyone, in low-, middle-, and high-income nations across the world. In the same way, black soot has become a major environmental health problem in the Niger Delta region of Nigeria. Ambient (outdoor) air pollution in cities and rural areas was estimated to cause 4.2 million premature deaths worldwide per year in 2016 [7]

People living in low- and middle-income countries unduly experience the problem of outdoor air pollution with 91% (of the 4.2 million premature deaths) occurring in low- and middle-income countries, with the greatest burden in the WHO South-East Asia and Western Pacific regions. The latest burden estimates reflect the very significant role air pollution plays in cardiovascular illness and death. More and more indicators of a link between ambient air pollution and cardiovascular disease risk are becoming available, including studies from highly polluted areas [8].

In Rumuolumeni, Port Harcourt in the Niger Delta, environmental degradation is evident as the city and the region host all the oil activities, which, often times, degrade the environment. Such degradation takes place in form of oil spill and gas flaring. Over the years, a new dimension to this emerged due to air pollution, which is a product of rising cases of artisanal refineries, which, over time, produced black soot. The operators of these artisanal refineries rely on oil theft [9]. To curb this, the government set up Joint Military Taskforce (JTF) to monitor the activities of these operators. As it stands, illegal refineries are virtually in all coastal communities of the Niger Delta. The taskforce operation technique is to set these refineries on fire. Because the business is scattered everywhere, everyday artisanal refineries are set on fire,

there is emission of an uncontrolled and uncontrollable thick black smoke (soot) pervading the sky, and clouding the cities [10].

Over the years, soot has been classified as a threat to public health. Public health, generally, is concerned with promoting and protecting the health of people and the community where they live, learn, work and play. By this, an incidence that is capable of affecting negatively the safety and well-being or improvement in the health of the people is considered a public health problem. This theory specifically claims that man and nature are in an interdependent relationship. This sentiment of the close affinity between nature and man is further emphasized by Rift theory which sees the relationship as dynamic, and that the dynamics are between humans and non-humans in the natural world, which for them are distinct entities, but are united within one metabolic system [11].

Theoretically, several theories exist in this regard. Gibson's ecological psychology theory, a derivation of general ecological theory views organism and environment as inseparable pair. The critical feature of Gibson's conception of the pair between organism and environment is that the environment and the individual interact, and influence each other [12]. That is, the action of an individual influences the environment, and is influenced in return by the other. So, both are in an inseparable relationship, and a part of a greater whole. Arising from this, an applied ecological theory strengthened the affinity between organisms and the environment further. Among its core assumptions is that human beings like other organisms are parts of the web of life which induce both interrelated and interdependent contacts. Human being depends on the environment and its resources. That is, both enjoy mutual influences [13]. The striking thing in this ecological theory is that one thing (whether negative or positive), which occurs in this mutual influence between organism and the environment, produces an equivalent event on the other. When the individual in the environment, for example, abuses the environment when he exploits the resources endowed in the environment, such abuse produces negative consequences on man [14].

Unfortunately, there is no appreciable effort at examining the relationship between black soot and oculo-visual health of the residents of the region. In recent times, black soot pollution has become a factor in the increased cases of eye diseases and deterioration of existing eye defects as responses to changes in the environment occasioned by black soot pollution [15]. Surprisingly, there is no report of scientific investigation into the nature and degree of adverse effects of black soot pollution on oculo-visual health of the residents of the Niger Delta region. Furthermore, it is also important to understand the levels of this relationship in each of the nine states of the Niger Delta, with main focus on their capital cities [16]. In other words, this work is the first large-scale study on the impact of black soot on the oculo-visual health of the Niger Delta residents. Hence, the need to compare the relationship between black soot and the prevalence of oculo-visual diseases among the residents of the Niger delta Region of Nigeria.

Materials and Methods

Study Design

The study was a retrospective survey study to compare the relationship between black soot and the prevalence of oculo-visual problems among the residents of the Niger Delta Region of Nigeria, between 2017 and 2021, relying on the clinical (medical) records of the patients who visited selected eye clinics in a period of five years of the black soot incident, between 2017 and 2021. The research design of this study was anchored on document analysis, which was based on the clinical records of patients (residents) who visited the selected eye clinics in the capital cities of the nine states of the Niger Delta region of Nigeria during the period under study, with little or no history of such diseases prior to the period under study.

Area of the Study

This study was carried out across the capital cities of the Niger Delta region in Nigeria, involving some selected private and public facilities (eye clinics).

Study Population

The population for this study comprised a total of 4500 male and female outpatients, 100 from each of the capital cities of the 9 states that make up the Niger Delta region, between the ages of 11 and 60 (organized into 5 age groups), covering the study period of five years (2017 – 2021). The age groups are: A (11 – 20 years), B (21 – 30 years), C (31 – 40 years), group D (41 – 50 years) and group E (51 – 60 years), as presented on the data (table 4.1). The study population included, only individuals, who visited the selected private and public health facilities (eye clinics) in the capital cities of the nine states of the Niger Delta region, Nigeria during the period (2017 – 2021) under study, and by their clinical records, had little or no history of such diseases prior to the period under study. The choice of the use of the selected eye clinics was informed by the ease of accessing patients' records, with little or no administrative bottlenecks.

Sample and Sampling Technique

In this respect, the study population was first sampled according to the symptoms and nature of eye conditions observed in the capital cities of the Niger Delta region of Nigeria. It was further classified into five age groups, and by gender (male and female). The occupations of the population were also categorized into indoor and outdoor workers. Generally, and specifically, the data were arranged in line with what obtained in the nine states (represented in the capital cities) of the Niger Delta, within the period(s) under study. The data collected were presented, using frequency tables.

Instruments for Data Collection

Majorly, the data for this study were based on the clinical records of the regular patients who visited the selected eye clinics during the period under study. However, the following instruments were used for clinical examinations and diagnoses of the patients (subjects):

1. Snellen's visual acuity charts for far and near visual acuity measurements.
2. Pen torch for external eye examination
3. Ophthalmoscope for internal (fundal) eye examination.
4. Retinoscopy for objective evaluation of the subjects' refractive errors
5. Slit lamp biomicroscope for comprehensive examination of the external and internal structures of the eyes of the subjects (patients).
6. Perkins tonometer for standard measurement of the intraocular pressure of the subjects.

Method of Data Analysis

Percentages, arithmetic mean and standard deviation were used as methods to describe the level of black soot-induced oculo-visual diseases in the Niger Delta region (2017 – 2021). The sample *t*-test and analysis of variance (ANOVA) were used to determine whether the average incidence of black soot induced oculo-visual diseases is significant in the Niger Delta States between 2017 and 2021, while the Fisher's least significant difference (LSD) method was used to determine the most prevalent black soot-induced oculo-visual disease(s) in the Niger Delta region between 2017 and 2021, and the age group that is most highly affected.

Results

Table 1: Occupation distribution of Niger Delta residents who visited selected eye clinics in the Niger Delta, between 2017 and 2021.

S/N	Niger Delta States	Indoor Figure	%	Outdoor Figure	%	Total Figure	%
1	**Abia**	218	4.84	282	6.27	500	11.11
2	**Akwa Ibom**	202	4.49	298	6.62	500	11.11
3	**Bayelsa**	142	3.16	358	7.93	500	11.11
4	**Cross River**	161	3.58	339	7.93	500	11.11
5	**Delta**	199	4.42	301	6.42	500	11.11
6	**Edo**	251	5.58	249	4.76	500	11.11
7	**Imo**	178	3.96	322	6.87	500	11.11
8	**Ondo**	216	4.8	284	5.13	500	11.11
9	**Rivers**	161	3.58	339	7.53	500	11.11
	Total	1728	38.4	2772	61.6	4500	100

Table 1 is Occupation distribution of Niger Delta residents who visited selected eye clinics in the Niger Delta, between 2017 and 2021. It shows that out of the 4500 residents, 1728 (38.4%) residents were indoor workers and 2772 (61.6%) residents were outdoor workers.

Table 2: Occupation distribution of Niger Delta residents who presented with black soot-induced eye diseases, across the Nine states of the Niger Delta, to selected eye clinics in the Niger Delta, between 2017 and 2021.

		Indoor		Outdoor		Total	
S/N	Niger Delta States	Freq.	%	Freq.	%	Freq.	%
1	Abia	155	4.03	262	6.82	417	10.85
2	Akwa Ibom	169	4.4	288	7.49	457	11.89
3	Bayelsa	131	3.41	357	9.29	488	12.7
4	Cross River	112	2.91	329	8.56	441	11.48
5	Delta	120	3.12	289	7.52	409	10.64
6	Edo	129	3.36	214	5.57	343	8.93
7	Imo	157	4.09	309	8.04	466	12.12
8	Ondo	94	2.45	231	6.01	325	8.46
9	Rivers	158	4.11	339	8.82	497	12.93
	Total	1225	31.88	2618	68.12	3843	100

Table 2 is occupation distribution of Niger Delta residents who presented with black soot-induced eye diseases, across the Nine states of the Niger Delta, to selected eye clinics in the Niger Delta, between 2017 and 2021. It shows that out of the 3843 residents of the Niger Delta, who presented with black soot-induced eye diseases, there were 1225 (31.88%) indoor workers and 2618 (68.12 %) outdoor workers.

Table 3: Descriptive Statistics of Black Soot induced Eye Diseases across Niger Delta States between 2017 and 2021

Variable (Eye diseases)	N	Percent	Mean	StDev	Sum
Allergic Conjun.	9	44.39	189.6	36.9	1706.0
Cataract	9	0.23	1.000	1.658	9.000
Corneal FB	9	16.29	69.56	18.93	626.00
Dry Eye/Irrita	9	21.96	93.78	6.10	844.00
Glaucoma	9	0.03	0.111	0.333	1.000
Pterygium	9	17.10	73.00	29.24	657.00

Table 3 is the descriptive statistics of black soot induced eye diseases across Niger Delta States between 2017 and 2021. The result shows that Allergic Conjunctivitis (44.39%) is the highest black soot-induced eye disease, followed by dry eye/ irritation (21.96%) and Pterygium (17.10%), respectively across the nine Niger Delta States.

Table 4: Descriptive Statistics of Black Soot induced Eye Diseases across Niger Delta States between 2017 and 2021, with respect to Occupation.

Occupation	N	Percent	Mean	StDev	Sum
Indoor	9	31.88	136.11	25.11	1225.00
Outdoor	9	68.12	290.9	48.5	2618.0

Table 4. is the descriptive statistics of black soot-induced eye diseases across Niger Delta States between 2017 and 2021, according to occupation. The result shows that the outdoor workers were the highest affected by black soot-induced eye diseases, with a percentage of 68.12

Table 5: Descriptive Statistics of Residents with black soot-induced eye problems and Residents without black soot-induced eye problems

Sample	N	Mean	StDev	SE Mean	Percent
W. Black Soot	9	427.0	60.3	20.1	85.41
Wo. Black soot	9	73.0	60.3	20.1	14.59

Table **5** is the descriptive statistics of residents with black soot induced eye problems and residents without black soot induced eye problems across Niger Delta States between 2017 and 2021. The result shows that residents with black soot induced eye problems were more, with a percentage of 85.41than residents without black soot-induced eye problems (14.59%).

Table 6: Analysis of Variance of Black Soot induced Eye Diseases across Niger Delta States between 2017 and 2021

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Factor	5	220549	44109.7	101.24	0.000
Error	48	20913	435.7		
Total	53	241461			

Table **6** is the Analysis of Variance of Black Soot induced eye diseases across Niger Delta States between 2017 and 2021 to determine whether the incidence of black soot induced eye diseases is significant across the Niger Delta States between 2017 and 2021. The table shows that black soot-induced eye diseases is significant. This is because p-value is less than alpha level. ($0.000 \leq 0.05$)

Table 7: Grouping Information Using the Fisher LSD Method of Black Soot-induced Eye Diseases across Niger Delta States between 2017 and 2021

Eye diseases	N	Mean	Grouping
Allergic Conjun	9	189.6	A
Dry Eye/Irritation	9	93.78	B
Pterygium	9	73.00	C
Cornea Foreign Body	9	69.56	C
Cataract	9	1.000	D
Glaucoma	9	0.111	D

**Means that do not share a letter are significantly different.*

Table **7** is the grouping information using the Fisher LSD Method of Black Soot induced Eye Diseases across Niger Delta States between 2017 and 2021 to determine among the black soot induced eye diseases, the one that has more significant effect on the Niger Delta States between 2017 and 2021. The table shows that Allergic Conjunctivitis is the most significant black soot-induced eye disease, followed by dry eye/irritation. Pterygium and Cornea Foreign Body have the same effect on Niger Delta States while Cataract and Glaucoma also have the same effect across the nine Niger Delta States.

Discussion

A study conducted in Taiwan found that visiting an outpatient eye clinic was linked to an increased risk of visiting an eye clinic for nonspecific conjunctivitis due to increased exposure to PM10 and PM2.5, NO2, SO2, and O3 [19]. NO and NO2, the main byproducts of diesel oil consumption by trucks and large vehicles, can travel long distances [18], and workers who commuted daily to their workplace in open vehicles (e.g., scooters, motorcycles, or bicycles) for more than 10 years experienced more ocular surface symptoms, including redness, irritation, lacrimation, burning, and dryness, compared to those who lived close to their workplace in the vicinity [17].

Between 2017 and 2021, there was a significant difference ($p < 0.05$) in the prevalence of black soot-induced eye diseases between indoor and outdoor workers in the Niger Delta States. Among the study population, outdoor workers were more likely than indoor workers to suffer from eye diseases brought on by black soot. This may be because most outdoor workers were more exposed to the contaminants, with little or no protection, than those working inside covered dwellings, such workplaces, schools, hospitals, churches, etc. Moreover, this finding is in consonance with a previous study by [20] in New Delhi, which showed that people who commuted daily to the workplace using open vehicles (e.g., scooters, motorcycles, or bicycles) for more than 10 years had more ocular surface symptoms, such as redness, irritation, lacrimation, burning, and dryness, than people living near their workplace[21].

Air pollution jeopardizes the survival of humans, and also impacts everyday living in societies. It is a common knowledge that outdoor air pollution influences health. Air pollution causes many health problems and diseases, such as cardiovascular disorders, respiratory tract problems, ocular disease, neurologic disease, cancer, and death [22]. In this study, we observed a significant difference between residents with black soot induced eye diseases and residents without black soot induced eye diseases across Niger Delta States between 2017 and 2021 ($p < 0.05$). It showed that the number of residents with black soot-induced eye diseases (and their effects) and the number of residents without black soot-induced eye diseases across Niger Delta States are not the same, considering the population under study. One study, in line with our findings, showed that, among persons who travelled regularly through high-polluted areas, a considerable portion suffered from subclinical ocular surface changes [23]

Outdoor air pollution is a major environmental health problem that affects everyone, in low-, middle-, and high-income nations across the world. In the same way, black soot has become a major environmental health problem in the Niger Delta region of Nigeria. Ambient (outdoor) air pollution in cities and rural areas was estimated to cause 4.2 million premature deaths worldwide per year in 2016. This mortality is due to exposure to fine particulate matter of 2.5 microns or less in diameter (PM2.5), which cause cardiovascular and respiratory disease, and cancers [24]. People living in low- and middle-income countries unduly experience the problem of outdoor air pollution with 91% (of the 4.2 million premature deaths) occurring in low- and middle-income countries, with the greatest burden in the WHO South-East Asia and Western Pacific regions. The latest burden estimates reflect the very significant role air pollution plays in cardiovascular illness and death [25]

Furthermore, 99 per cent of the global population is exposed to a high level of air pollution, which puts them at risk for heart disease, stroke, cancer, eye diseases, and other life-threatening medical conditions [26]

This study showed that there was no significant difference in the incidence of black soot-induced eye diseases across the nine states of the Niger Delta ($p > 0.05$). In other words, there was a universal spread of eye diseases occasioned by black soot pollution in each of the Nine states of the Niger Delta, between 2017 and 2021.

The alarming and comparatively intolerable levels of poverty and unemployment in Nigeria, and the Niger Delta in particular, have inevitably pushed the populace into criminal activity and social vices. As a result, the illegal oil trade and the establishment of artisanal refineries (kpo fire) gained popularity over the riskier areas of crime, such as abduction and armed robbery [27]. Government failure to supply the ever expanding public demand for petroleum products is a significant element in the spread of artisanal refineries, a crude way of oil refining. The government task force on illegal oil business's frequent and prolonged burning down of artisanal refineries contributed to the spread of black soot and the resulting incidence of eye diseases throughout the Niger Delta.

Conclusion

Black soot exists and it has become a complex environmental problem. The prime source is the artisanal refineries (Kpo Fire) scattered all over the Niger Delta Region. The study showed that there was a significant effect of back soot pollution on the visual health of the residents of the Nigerian Niger Delta during the peak period (2017 to 2021) of black soot incidence. This era of black soot pollution impacted negatively on the oculo-visual health of the residents of the Niger Delta Region, causing eye discomfort, including irritation, foreign body sensation, etc. the effect of these eye cuts across occupation, with greater effect on outdoor workers.

References

1. Nwanaji-Enwerem, J, C., Wang, W. and Nwanaji-Enwerem, O. (2019). Association of long-term ambient black carbon exposure and oxidative stress allelic variants with intraocular pressure in older men. Journal of American Medical Association Ophthalmology. 137:129–137.
2. Richardson, R. B., Ainsbury, E. A., Prescott, C. R. and Lovicu, F. J. (2020). Etiology of posterior subcapsular cataracts based on a review of risk factors including aging, diabetes, and ionizing radiation. International Journal of Radiation Biology. 96(11):1339-1361.
3. Aidenloo, N. S., Motarjemizadeh, Q. and Heidarpanah, M. (2018). Risk factors for pterygium recurrence after limbal-conjunctival autografting: A retrospective, single-centre investigation. Japanese Journal of Ophthalmology. 62:349–56.
4. Chang, C. J., Yang, H. H., Chang, C. A., and Tsai, H. Y. (2012). Relationship between Air Pollution and Outpatient Visits for Nonspecific Conjunctivitis. Investigative Ophthalmology & Visual Science. 53:429–433.
5. Gulani, A. C. and Gulani, A. A. (2020). Cosmetic Pterygium Surgery: Techniques and Long-Term Outcomes. Clinical Ophthalmology. 14: 1681–1687.
6. Huff, R. D., Carlsten, C. and Hirota, J. A. (2019). An update on immunologic mechanisms in the respiratory mucosa in response to air pollutants. Journal of Allergy and Clinical Immunology: 143:1989–2001.

7. Miyazaki, D., Fukagawa, K., Fukushima, A., Fujishima, H., Uchio, E., Ebihara, N., Jun Shoji, J., Takamura, E., Namba, K., Ohashi, Y., Okamoto, S., Satake, Y., Ohtsu, H., Shimizu, Y. and Inoue, Y. (2019). Air pollution significantly associated with severe ocular allergic inflammatory diseases. Scientific Reports. 3:9: 18205.
8. Jung, Se. Ji., Mehta, J. S. and Tong, L. (2018). Effects of environment pollution on the ocular surface.
9. Kalagbor, I. A., Orji, D., Amala, N. and Ekpete, O. A., (2019). Exposure to heavy metals in soot samples and cancer assessment in Port Harcourt, Nigeria. Journal of health pollution 9(24).
10. Lin, C-C, Chiu, C-C., Lee, P-Y. Chen, K-J., He, C-X., Hsu, S-K. and Cheng, K-C. (2022). The Adverse Effects of Air Pollution on the Eye: A Review: International Journal of Environmental Research and Public Health. 19(3): 1186.
11. Gawande, S., Tiwari, R. R., Narayanan, P. and Bhadri, A. (2020) Indoor Air Quality and Sick Building Syndrome: Are Green Buildings Better than Conventional Buildings? Indian Journal of Occupational and Environmental Medicine. 24:30–32.
12. Macias, A. A. and Goldfarb, J. (2024). Preoperative Evaluation of Patients Undergoing Eye Surgery. Anesthesiology Clinics. 42(1):159-168.
13. Kappos, A. D., Bruckmann, P., Eikmann, T., Englert, N., Heinrich, U., Höppe, P., Koch, E., Krause, G.H., Kreyling, W.G. and Rauchfuss, K. (2004). Health effects of particles in ambient air. International Journal of Hygiene and Environmental Health. 207:399–407.
14. Chua, S. Y. L., Khawaja, A. P., Dick, A. D., Morgan, J., Dhillon, B., Lotery, A.J., Strouthidis, N. G., Reisman, C., Peto, T., and Khaw, P. T. (2020). Ambient Air Pollution Associations with Retinal Morphology in the UK Biobank. Investigative Ophthalmology and Vision Science. 61:32. doi: 10.1167/iovs.61.5.32.
15. Cohen, A. J., Brauer, M., Burnett, R., Anderson, H. R., Frostad, J., Estep, K., Balakrishnan, K., Brunekreef, B., Dandona, L., and Dandona, R. (2017). Estimates and 25-year trends of the global burden of disease attributable to ambient air pollution: An analysis of data from the Global Burden of Diseases Study 2015. Lancet. 2017;389:1907–1918.
16. Kiziltoprak, H., Tekin, K., Inanc, M. and Goker, Y. S. (2019). Cataract in diabetes mellitus. World Journal of Diabetes. 10(3):140-153
17. Guan, J. Y., Ma, Y. C., Zhu, Y. T., Xie, L. L., Aizezi, M., Zhuo, Y. H. and Wumaier, A. (2022). Lens nucleus dislocation in hypermature cataract: Case report and literature review. Medicine (Baltimore). 101(35):e30428.
18. Moshirfar, M., Webster, C. R., Seitz, T. S., Ronquillo, Y. C., and Hoopes, P. C. (2022). Ocular Features and Clinical Approach to Cataract and Corneal Refractive Surgery in Patients with Myotonic Dystrophy. Clinical Ophthalmology. 16:2837-2842.
19. Neuhann, I., Neuhann and L. Neuhann, T. (2022). Age-related Cataract. Klinische Monatsblatter Fur Augenheilkunde. 239 (4):615=633.
20. Weli, V. E. and Adekunle, O. (2014). Air quality in the vicinity of a landfill site in Rumuolumeni, Port Harcourt, Nigeria. Journal of environment and earth science 14(10).
21. Yakubu, O. H., (2017). Particulate (soot) pollution in Port Harcourt, Rivers State, Nigeria- double air pollution burden? Understanding and tackling potential environmental public health impact. Environment 5(2).7
22. Nüssle, S., Reinhard, T. and Lübke, J. (2021). Acute Closed-Angle Glaucoma-an Ophthalmological Emergency. Deutsches Ärzteblatt International. 118(Forthcoming):771-80.
23. Seo, J. W., Youn, J. S., Park, S., and Joo, C. K. (2018). Development of a Conjunctivitis Outpatient Rate Prediction Model Incorporating Ambient Ozone and Meteorological Factors in South Korea. Frontiers in Pharmacology. 9 doi: 10.3389/fphar.2018.01135.
24. Elem, M. (2021). Review paper: Black soot and public health of Rumuolumeni residents in Port Harcourt, Nigeria. Direct Research Journal of Social Science and Educational Studies. 8: 9-13.
25. Fu, Q., Mo, Z., Lyu, D., Zhang, L., Qin, Z., Tang, Q., Yin, H., Xu, P., Wu, L., and Lou, X. (2017). Air pollution and outpatient visits for conjunctivitis: A case-crossover study in Hangzhou, China. Environmental Pollution. 231:1344–1350.
26. Kim, G. Y., Song, K. S. and Hyun, J. W. (2020). Diesel particulate matter2.5 promotes epithelial-mesenchymal transition of human retinal pigment epithelial cells via generation of reactive oxygen species. Environmental. Pollution: 114301.
27. Shu, L., Qi, S., Qingwei, G., Wei, W., Xiaodong, Q., Xinran, Y. (2024). Hypothyroidism is a causal determination of age-related cataract risk in European population: A Mendelian randomization study. Frontiers Endocrinology. Vol. 15 – 2024.

CITATION

Ihekaire, D. E., S. J. Ozims, & P. O. Adogu. (2025). Occupation distribution of Niger Delta residents with black soot-induced eye diseases, in some selected eye clinics in the Niger Delta, between 2017 and 2021. In Global Journal of Research in Medical Sciences (Vol. 5, Number 3, pp. 1–8). https://doi.org/10.5281/zenodo.15324366