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INFLUENCE OF AIR POLLUTANTS ON OCULAR HEALTH AMONG ROAD TRANSPORT WORKERS IN IMO STATE, NIGERIA

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ABSTRACT: *Air pollution is a major public health concern linked to various diseases, including ocular health problems. In Nigeria, road transport workers, particularly drivers, are highly exposed to pollutants due to occupational hazards. Limited research exists on the ocular impacts of air pollution in this population. This study aimed to determine the influence of air pollutants on ocular health among road transport workers in Imo State, Nigeria, and assess awareness and preventive measures related to air pollution and ocular health. A crosssectional descriptive study was conducted in motor parks across three senatorial zones of Imo State. A total of 552 road transport workers, including drivers, conductors, and traders, were surveyed using structured questionnaires and clinical eye examinations. Data were analyzed for socio-demographics, presence of ocular problems, awareness, and use of preventive measures. The study revealed that 81.2% of the examined eyes had ocular issues. Pterygium (35.8%) and dry eye syndrome (22.2%) were the most common conditions. Awareness of air pollution's impact on ocular health was high (84.1%), but only 31% of participants used preventive measures. Those who applied preventive measures had significantly lower rates of ocular problems (51.5%) compared to those who did not (94.5%). Protective practices like wearing glasses and avoiding smoke areas were associated with reduced ocular issues. Thus, air pollution significantly affects the ocular health of road transport workers in Imo State. Increasing awareness and promoting the use of preventive measures are essential to mitigating these health impacts.*

KEYWORDS: Air pollution, Ocular health, Road transport workers, Preventive measures, Nigeria.

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INTRODUCTION

All life on Earth depends on air for survival, and its quality directly affects human health. Air pollution remains a significant contributor to global disease burden, despite stricter air quality regulations (Cohen et al., 2017). Natural sources like wildfires and volcanoes contribute to pollution, but human activities, particularly industrialization and motorized transport, have significantly worsened air quality since the Industrial Revolution. For example, Taiwan's Central Weather Bureau reported an air quality index (AQI) of 130-160 in January 2021, indicating unhealthy conditions due to industrial emissions.

Exposure to air pollutants, particularly from fuel combustion, has been linked to severe health conditions, including lung cancer, respiratory infections, stroke, and cardiovascular diseases. Recent studies have also identified ocular diseases as an emerging concern. Indoor and outdoor air pollution continues to be a global challenge, affecting both high-income and low-income nations differently (Shima, 2017). Research has shown strong links between air pollution and cardiopulmonary diseases (Brook et al., 2004; Pope et al., 2004), as well as reproductive, neurological, and ocular health issues. Neurodegeneration caused by pollution can contribute to age-related macular degeneration (Calderon-Garciduenas et al., 2016), while psychological stress (Sass et al., 2016) and infertility (Jurewicz et al., 2018; Conforti et al., 2018) have also been documented.

Air pollution consists of hazardous particles and gases such as sulfur dioxide (SO2), nitrogen dioxide (NO2), carbon dioxide (CO2), carbon monoxide (CO), nitrogen oxides (NOx), and particulate matter (PM2.5 and PM10) (Kemp et al., 2011). These pollutants primarily originate from fuel combustion and industrial activities. Everyday activities like cooking and driving also release volatile organic compounds (VOCs), exacerbating air quality deterioration.

According to the U.S. Environmental Protection Agency (EPA), the six major air pollutants with severe health effects include ground-level ozone, nitrogen dioxide, sulfur dioxide, carbon monoxide, lead, and particulate matter. Studies indicate that prolonged exposure to these pollutants can significantly impact ocular health, potentially leading to blindness. However, limited research has been conducted on this issue in Nigeria.

The high level of ignorance among motorists regarding air pollution's impact on ocular health is concerning, particularly among commercial drivers and road transport workers who face prolonged exposure. Poor road infrastructure and inadequate vehicle maintenance contribute to excessive emissions, worsening pollution in transport hubs. The poor air quality in motor parks further exacerbates health risks for workers. The primary objective of this study is to assess the influence of air pollutants on ocular health among road transport workers in Imo State, Nigeria.

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METHODS

Study Design

This cross-sectional descriptive and observational study was conducted in both rural and urban areas of Imo State. The study assessed the influence of air pollutants on ocular health among commercial drivers and road transport workers using a structured questionnaire and clinical examination instruments.

Area of Study

The study took place in designated motor parks across the three senatorial zones of Imo State—Owerri, Orlu, and Okigwe. Imo State, located in southeastern Nigeria, has a population of approximately 4.928 million (2017) and consists of 27 local government areas.

Figure 1.0: showing map of Imo state with the 27 LGAs

Study Population

The study focused on commercial drivers and road transport workers in Imo State, which has an estimated 4,000 registered transport workers. Selected motor parks in the three senatorial zones were included in the study.

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Inclusion Criteria • Drivers, road transport workers, and traders/business people operating within the designated motor parks.

- Participants not using topical eye medications at the time of the study.

Exclusion Criteria

- Individuals who do not work daily at the selected motor parks.
- Participants who had applied eye drops within two weeks before the study.

Sample Size Determination

The sample size was determined using the formula:

$n = Z^2Pq/d^2$, where:

- n = minimum sample size
- P = proportion of the population required for the study
- q = 1 - P
- Z = 1.96
- d = sampling error

Random selection of parks was done using a lottery system based on data obtained from the Imo State Ministry of Transport.

Sampling Technique

A combination of stratified, purposive, and simple random sampling techniques was employed. Imo State was divided into three senatorial zones, from which motor parks were randomly selected. One park was selected in Orlu and Okigwe zones, while three parks were chosen in Owerri, covering routes to all three zones.

Instruments for Data Collection Data collection involved:

- Structured questionnaires focusing on demographics, occupational history, medical history, and ocular symptoms.
- Environmental monitoring instruments, including gas meters to measure air pollutants (CO_2, NO_2, SO_2, and particulate matter).
- Visual assessment tools such as the Snellen Chart, pen torch, ophthalmoscope, Schirmer test strips, fluorescein strips, and Schiotz tonometer.
- General health assessment instruments like a sphygmomanometer and thermometer.
- Geographic positioning system (GPS) for location tracking.

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Validity of Instruments

The questionnaire was reviewed and approved by the researcher's supervisor. Clinical instruments, such as the Snellen Chart, ophthalmoscope, and Schirmer test, were validated by the Optometrists and Dispensing Opticians Registration Board of Nigeria (ODORBN) and the World Council of Optometry (WCO).

Reliability of Instruments

Spearman's correlation coefficient was applied for test-retest reliability. The questionnaire and clinical tests were also approved by the Department of Public Health and the School of Health Technology.

Method of Data Collection Data collection involved:

- Administering questionnaires, with guidance provided to non-literate respondents.
- Clinical examinations conducted by a medical team, including a general practitioner and a nurse, who assessed vital signs (blood pressure, pulse rate, and blood sugar levels) before visual tests.
- Ocular tests such as visual acuity, Schirmer's test for tear production, fluorescein strip application for corneal integrity, pen torch assessment, ophthalmoscopic examination, and tonometry for intraocular pressure.
- Environmental air quality monitoring using gas meters and exhaust emission analyzers.

Method of Data Analysis

Data were analyzed using IBM SPSS software. Descriptive and inferential statistics, including chi-square tests, frequency tables, histograms, and pie charts, were used to interpret results and identify patterns and relationships.

Informed Consent

Verbal informed consent was obtained from all participants, ensuring confidentiality. Written consent was also secured from the Imo State Ministry of Transport and the Nigerian Union of Road Transport Workers (NURTW).

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RESULTS

Socio-Demographic Distribution of the Study Participants

Table 3.1 shows the demographics of the participants that were included in this study

Table 3.1 Socio-Demographic Distribution of the Study Participants

Socio-Demographic	Drivers & Conductors		RTWS		Traders / Business		OVERALL	
	Number	%	Number	%	Number	%	Number	%
21 – 30	9	2.4	8	12.9	14	12.1	31	5.6
31- 40	77	20.6	15	24.2	27	23.3	119	21.6
41- 50	118	31.6	15	24.2	39	33.6	172	31.2
51 – 60	118	31.6	15	24.2	18	15.5	151	27.4
>60	52	13.9	9	14.5	18	15.5	79	14.3
Total	374	100.0	62	100.0	116	100.0	552	100.0
Sex								
Male	374	100.0	48	77.4	64	55.2	486	88.0
Female	0	0.0	14	22.6	52	44.8	66	12.0
Total	374	100.0	62	100.0	116	100.0	552	100.0
Marital Status								
Married	299	79.9	48	77.4	91	78.4	438	79.3
Single	62	16.6	12	19.4	16	13.8	90	16.3
Separated/Divorced	13	3.5	3	4.8	9	7.8	25	4.5
Total	374	100.0	62	100.0	116	100.0	552	100.0
Religion								
Christianity	371	99.2	59	95.2	108	93.1	538	97.5
Moslem	1	0.3	0	0.0	2	1.7	3	0.5
Other	2	0.5	3	4.8	6	5.2	11	2.0
Total	374	100.0	62	100.0	116	100.0	552	100.0
Daily Income								
< 2000	15	4.0	0	0.0	12	10.3	27	4.9
2000- 3999	148	39.6	6	9.7	21	18.1	175	31.7
4000- 5999	121	32.4	42	67.7	54	46.6	217	39.3
6000+	105	28.1	14	22.6	23	19.8	142	25.7
Total	374	100.0	62	100.0	116	100.0	552	100.0

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Zone								
Owerri	179	47.9	27	43.5	49	42.2	255	46.2
Orlu	106	28.3	18	29.0	39	33.6	163	29.5
Okigwe	89	23.8	17	27.4	28	24.1	134	24.3
Total	374	100.0	62	100.0	116	100.0	552	100.0

Zonal Distribution for the Imo State Transport Workers Studied

Contained in table 3.1b is the zonal distributional classifications for the designation of the study group. The table shows that a total of 255 (46.2%) were from Owerri zone, 163 (29.5%) were from Orlu zone and 134 (24.3%) were obtained from Okigwe zone. The drivers make up the largest proportion of the sample (262: 47.5%), followed by the conductors (112: 20.3%). Those engaged in trading or business were also high (108: 19.6%). Within the zones, the drivers were 118 (46.3%) among the Owerri zone group, 79 (48.5%) among the Orlu zone group and 65 (48.5%) among the Okigwe zone group.

Table 3.1b: Distribution by zone for the designation of the study Participants.

Designation at Park	**OWERRI ZONE**		**ORLU ZONE**		**OKIGWE ZONE**		**OVERALL**	
	Freq	**%**	**Freq**	**%**	**Freq**	**%**	**Freq**	**%**
Drivers	118	46.3	79	48.5	65	48.5	262	47.5
Conductors	61	23.9	27	16.6	24	17.9	112	20.3
Ticket/Toll givers	8	3.1	3	1.8	3	2.2	14	2.5
Loaders	13	5.1	12	7.4	11	8.2	36	6.5
Security	6	2.4	3	1.8	3	2.2	12	2.2
Traders/Business	46	18.0	36	22.1	26	19.4	108	19.6
Other businesses	3	1.2	3	1.8	2	1.5	8	1.4
Total	255	100.0	163	100.0	134	100.0	552	100.0

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Ocular Problems Associated with Road Transport Workers in Imo State Nigeria

Presence of Ocular Problems among Road Transport Workers in Imo State Nigeria

Figure 3.1is a pie chart showing the distribution for ocular problems among the road transport workers studied. It shows that majority of the group have ocular problems. For a total of 1104 eyes examined (i.e.

552 persons) ocular issues were found to be present in 896 (81.2%) of the eyes while the remaining 208 (18.8%) were not found with ocular problems. It therefore implies that the rate of occurrence for ocular problems among the studied group was found to be 18.8% in this study.

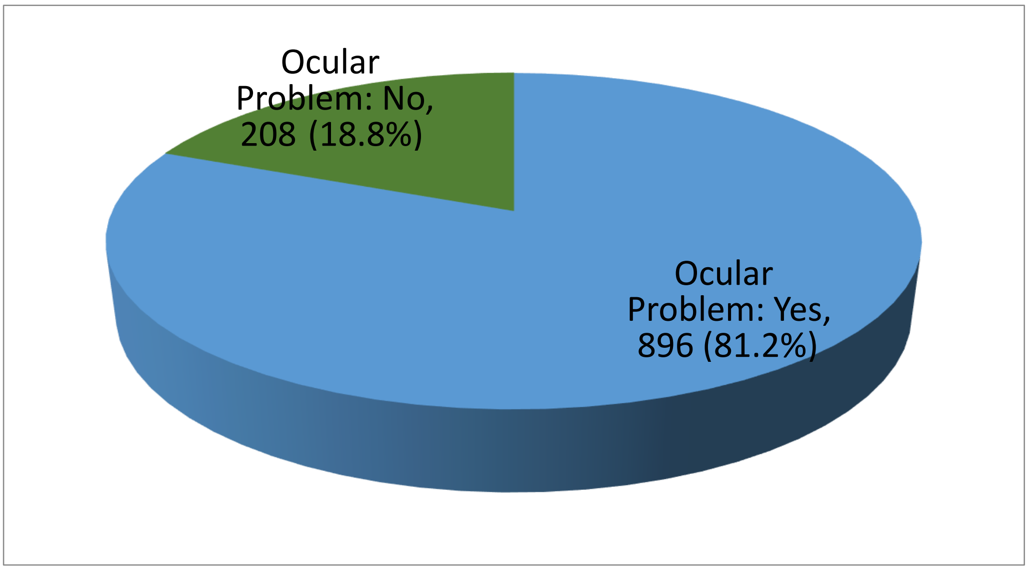

Figure 3.1 Presence of Ocular Problems among Road Transport Workers in Imo State Nigeria

(Both eyes were examined in each participant)

Figure 3.2 represents the distribution of the study group showing the proportion that did not record any ocular problem along with the rate of occurrence of each type of ocular problem found from the eyes of the participants.

The figure indicates that while in all 57% showed good vision, 57.9% of the eyes shows pterygium, 35.9% showed dry eye vision while 31% showed moderate vision. Glaucoma was found on 2.4% of the eyes while

1.7% of the eyes showed macular degeneration.

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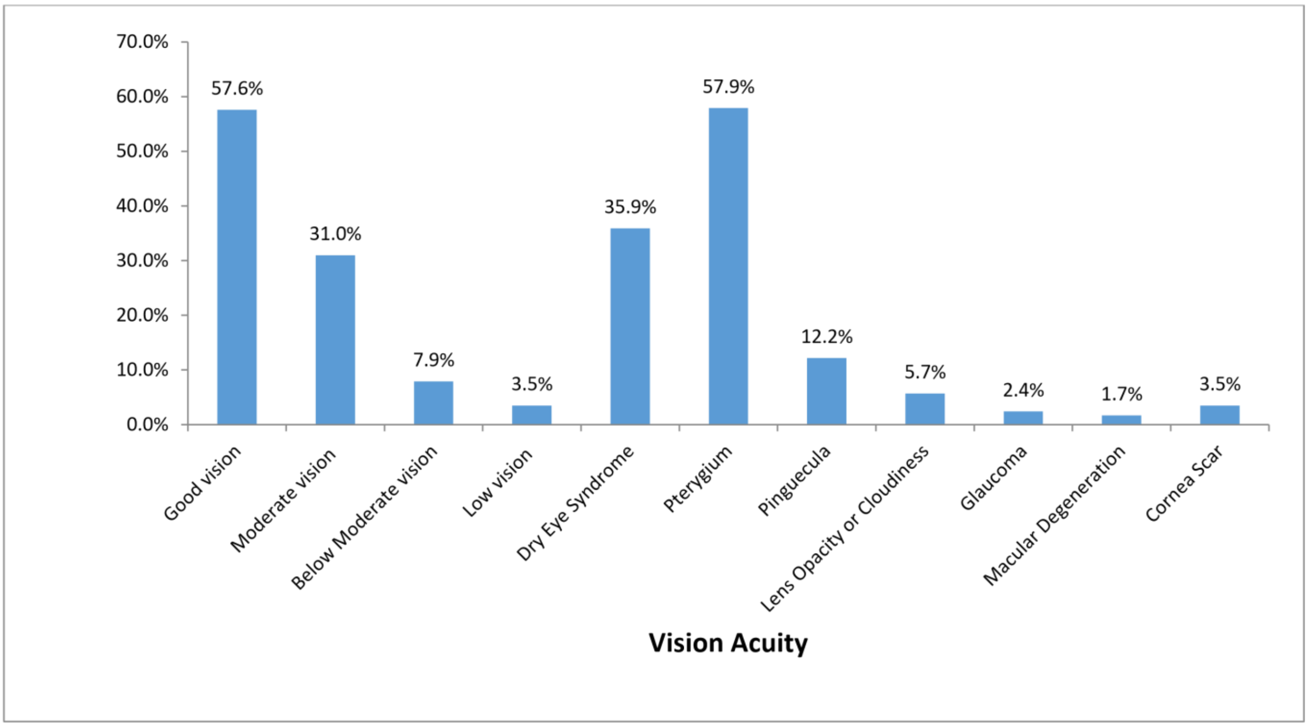

Figure 3.2: Distribution for Ocular Defects among Road Transport Workers with Ocular Issues in Imo State

(Note that more than one ocular issue was detected in some eyes).

3.2 Distribution of Types and number of ocular problems among the eyes that showed ocular Issues

Table 3.2 represents that distribution for different types of ocular problems and the number of ocular issues found from the eyes of the road transport workers in Imo State Nigeria. The table showed that a total of 1786 ocular problems were detected from 888 eyes that showed ocular problems. Among the ocular problems, eyes of the subjects that showed ocular problem, Pterygium was found to be present in 639 (35.8%) eyes and dry eye syndrome was also found present in 386 (22.2%) eyes. The lowest three of the ocular issues found were macular degeneration (19: 1.1%), and glaucoma (ocular hypertension) (27: 1.5%). A total of 342 (19.1%) of the issues were of moderate vision, while 135 (7.6%) were pinguecula.

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Table 3.2: Distribution of Types and number of ocular problems among the eyes that showed ocular Issues

Ocular Problem Type	Number of ocular problems	Percent
Moderate vision (6/9 – 6/18)	342	19.1
Below Moderate vision (6/24 – 6/60)	87	4.9
Low vision (HM –NLP)	39	2.2
Dry Eye Syndrome	396	22.2
Pterygium	639	35.8
Pinguecula	135	7.6
Lens Opacity or Cloudiness	63	3.5
Glaucoma (Ocular Hypertension)	27	1.5
Macular Degeneration	19	1.1
Cornea Scar	39	2.2
Total	1786	100

Note: Both eyes were examined in each participant and some of the eyes showed more than one ocular issue

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Use of Preventive Measures against Air Pollution in Ocular Health

The extent of the use of preventive measures against air pollution in ocular health among the studied group is contained in table 3.3. It can be observed from the table that the use of preventive measures is quite poor among the study group with 171 (31%) using protective measures against

381 (69%) that do not use it. Poor application of the preventive measures is most pronounced among the traders and business dealers with just 23 (21.3%) using it, the usage was also quite poor among the security (25%), and the drivers (32.1%).

Table 3.3: Use of Preventive Measures against Air Pollution in Ocular Health

Class Business		Drivers & Conductors Other			Road	Transport		Workers
Traders/								Other
		Drivers Total	Conductors	Loaders		Ticket Givers		Security
Business								business
Use of Preventive Measures	**Freq (%)**	**Freq (%)**	**Freq (%)**	**Freq (%)**	**Freq (%)**	**Freq (%)**	**Freq (%)**	**Freq (%)**
Yes	84 (32.1)	40 (35.1)	13 (36.1)	6 (42.9)	3 (25.0)	23 (21.3)	2 (25.0)	171 (31.0)
No	178 (67.9)	72 (64.9)	23 (63.9)	8 (57.1)	9 (75.0)	85 (78.7)	6 (75.0)	381 (69.0)
Total	262	112	36	14	12	108	8	552

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Applications of preventive strategies against Air Pollution in Ocular Health and ocular problem occurrence among the study group

On table 3.3b, ocular problems occurred in 51.5% of those who applied preventive strategies against air pollution compared to 94.5% against those that did not apply preventive techniques. Those that do not use preventive measures against air pollution are at greater disadvantage for ocular health problems. This is because, the e odds of having ocular problem was found to be 94% significantly lower among those that applied preventive measures compared to those that do not apply preventive measures (OR =0.06, P= 0.001, Chi sq= 142.89. df =1).

Table 3.3b: Applications of preventive strategies against Air Pollution in Ocular Health and ocular problem occurrence among the study group

Applied preventives		Ocular Issue: Yes		Ocular Issue: No		Chi-sq (df)	*P*	*Odds Ratio*
	Total	Number	%	number	%			
Yes	171	88	51.5	83	48.5			
No	381	360	94.5	21	5.5			
Total	552	448	81.2	104	18.8	142.89 (1)	0.0001	0.06

Strategies Used in Preventing Air Pollutants on Ocular Health

Among the group studied, 381 (69%) do not apply preventive measures against air pollutant on ocular health. The strategies applied to prevent air pollutant are contained on table 3.4. It can be observed from the table that those that wear sunshade as preventive measures against air pollutants were 40 (7.2%) while 38 (6.9%) of the study population wear glass as preventive measures. A total of 28 (5.1%) indicate that they close their eyes, 12 (2.2%) avoid areas of smoke and 11 (2.0%) wind up glasses. Only 10 (1.8%) of the study group do go for eye checkup as a preventive measure against air pollutants. Less than 1% of the drivers and the conductors go for eye checkup (drivers= 0.8%; conductors – 0.9%)

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Table 3.4: Strategies Used in Preventing Air Pollutants on Ocular Health

Use of Preventive Measures	Drivers & Conductors		RTWS		Traders / Business		TOTAL	
	Drivers & Conductors		Other Road Transport Workers			Business		
	Drivers	Conductors	Loaders	Ticket Givers	Security	Traders/ Business	Other business	Total
	Freq (%)	Freq (%)	Freq (%)	Freq (%)	Freq (%)	Freq (%)	Freq (%)	Freq (%)
Wear Glasses	25 (9.5)	7 (6.3)	0 (0.0)	2 (14.3)	0 (0.0)	4 (37.0)	0 (0.0)	38 (6.9)
wear Sunshade	21 (8.0)	7 (6.3)	1 (2.8)	1 (7.0)	1 (8.3)	8 (7.4)	1 (12.5)	40 (7.2)
Self-medication	10 (3.8)	7 (6.3)	4 (11.1)	0 (0.0)	1 (8.3)	5 (4.6)	1 (12.5)	28 (5.1)
Eye check-up	2 (0.8)	1 (0.9)	1 (2.8)	2 (14.3)	1 (8.3)	3 (2.7)	0 (0.0)	10 (1.8)
Close eyes	15 (5.7)	11 (9.8)	4 (11.1)	0 (0.0)	0 (0.0)	2 (1.9)	0 (0.0)	32 (5.8)
Avoid Area of Smoke	5 (1.9)	2 (1.8)	3 (8.3)	1 (7.0)	0 (0.0)	1 (0.9)	0 (0.0)	12 (2.2)
Wind-up glass	6 (2.3)	5 (4.5)	0 (0.0)	0 (0.0)	0. (0.0)	0 (0.0)	0 (0.0)	11 (2.0)
None	178 (67.9)	72 (64.3)	23 (63.9)	8 (57,1)	9 (75.0)	85 (78.7)	6 (75.0)	381 (69.0)
Total	262	112	36	14	12	108	8	552

Use of different preventives and the occurrence of ocular Issues among the subjects using preventive strategies

In table 3.5, preventive practices that showed significant against occurrence of ocular issues include wearing of eye glass (P=0.002, χ^2=13.73), having eye checkup (P=0.040, χ^2=4.21), and avoiding smoke areas (P=0.016, χ^2=5.82),

The ocular issues are reduced among those that wear eye glass (26.3%) compared to those that do not wear it (58.6%). For those that do not wear eye glass, the odds for ocular issues were found to be more than 4 times significantly higher compared to those that do wear it (OR =4.28, 95% CI = 1.81 -10.67).

Among those that had eye check, 20% had ocular issues against 53.4% found among those that never had eye check. The odds ratio indicates that the risk for having ocular problems was almost 5 times higher on those that do not go for eye check (OR =4.28, 95% CI = 0.87 - 45.28).

Avoiding areas of smoke is associated with less ocular issues in this study (16.7% against 54.1%). The odds ratio shows that non avoidance for areas of smoke is significantly accompanied with about 5.6 times more odds for ocular issues (OR = 5.58, 95% CI = 1.13 - 53.53).

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Also, ocular issues were recorded lower among those that wear sunshade (45%), compared to the rate among those that do not wear it (53.4%). It was much higher on the use of self-medication (60%). However, both the use of sunshade and self-medication were not found as significant factors for ocular issues in this study (p >5%). Similarly, closing of eyes and winding up of glasses were not found significant.

Table 3.5 Use of different preventives and the occurrence of ocular Issues among the subjects using preventive strategies

	Total	**Having Ocular Issues**				**P (χ^2)**	**OR (95% CI)**
Use of	**n=171**	**Yes**	**%**	**No**	**%**		
Preventives		**n=88**		**n=83**			
Wear Glasses Yes	38	10	26.3	28	73.7		
No	133	78	58.6	51	38.3	0.002 (13.73)	4.28 (1.81 - 10.67
wear Sunshade Yes	40	18	45.0	22	55.0		
No	131	70	53.4	61	46.6	0.320 (0.87)	1.40 (0.65 – 3.05)
Self medication Yes	28	17	60.7	11	39.3		
No	143	71	49.7	72	50.3	0.284 (1.15)	0.64 (0.25 – 1.57)
Eye check-up Yes	10	2	20.0	8	80.0		
No	161	86	53.4	75	46.6	0.040 (4.21)	4.59 (0.87 – 45.28)
Close eyes Yes	32	17	53.1	15	46.9		
No	139	71	51.1	68	48.9	0.835 (0.04)	0.92 (0.39 – 2.13)

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Avoid Area of Smoke Yes	12	2	16.7	10	83.3		
No	159	86	54.1	77	48.4	0.016 (5.82)	5.58 (1.13 – 53.53)
Wind-up glass Yes	11	4	36.4	7	63.6		
No	160	84	52.5	76	47.5	0.300 (1.07)	1.93 (0.47 – 9.34)

Assessment of Environmental Air Pollution

The assessment of environmental air pollution within the study arena is depicted on table 4.7. The table shows that some of the average scores for some of the parameters were not beyond the recommended standard permissible limit. However, in Orlu zone, Pm2.5 was above the permissible limit, but the difference not found to be statistically significant (p=0.556, t =0.660).

In Owerri zone, the temperature was below normal but it was not found statistically significant (P= 0.228, t=1.512) . However, the average O2 level in Okigwe zone was found to be above permissible limit. The difference was statistically significant which is likely to cause hazards (p=0.002, t =11.88).

Table 3.6: Assessment of Environmental Air pollution

S/N	Parameter	Limit	Values 1	Values 2	Values 3	Values 4	Mean	St. Dev	P	T
	ORLU ZONE									
1	GPS: N05 29.449, E007 10.903									
2	CO_2	5000ppm	1859	1218.25	1207.5	629.75	1228.63	502.19		
3	TEMP.	26.1˚C	28.975	17.3	22.7	18.35	21.83	5.31		
4	NO_2	1.0%	2.345	0.235	0.2775	0.3	0.79	1.04		
5	SO_2	5ppm	0.155	0.325	0.1625	0.25	0.22	0.08		
6	CO	5000ppm	358	147.5	415	352.5	317.25	117.8		
7	CH_4	1000ppm (0.1%)	576.75	576	771.5	724.75	662.25	100.98		

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8	O_2	19.5-23.5	7.275	11.175	7.25	12.325	9.51	2.63		
9	Pm 2.5 (annual)	15Mg/m^3	60.75	75.75	43.725	34.75	53.74	18.21	0.556	0.660
10	Pm 10 (annual)	40Mg/m^3	10.75	16.33333	13.6	9.15	12.46	3.17		
11	RAD (mR/hr)	*5-50 rem (0.05-0.5 Sv)*		0.03925	0.00825	0.005925	0.02	0.02		
12	H_2S	1000	28.975	7.5	175	392.25	150.93	177.26		

OWERRI ZONE

S/N	**Parameter**	**Limit**	**Values 1**	**Values 2**	**Values 3**	**Values 4**	**Mean**	**St. Dev**	**P**	**t**
OWERRI ZONE										
1	**GPS**	**N05 28.673, E007 03.011**								
2	**CO_2**	**5000ppm**	**1286.25**	**1328.75**	**443.5**	**1067.75**	**1031.56**	**408.38**		
3	**TEMP.**	**26.1˚C**	**30**	**20.9**	**14.8**	**28.775**	**23.62**	**7.13**	**0.228**	**1.512**
4	**NO_2**	**2.0%**	**2.3**	**1.33**	**1.4.04**	**2.0725**	**1.901**	**0.507**		
5	**SO_2**	**5ppm**	**0.9025**	**0.74**	**5.04**	**0.4625**	**1.79**	**2.18**		
6	**CO**	**50ppm**	**0.2525**	**7.5025**	**32.9805**	**0.2**	**10.23**	**15.55**		
7	**CH4**	**1000ppm (0.1%)**	**687.25**	**542.775**	**670.5**	**520**	**605.13**	**85.93**		
8	**O2**	**19.5-23.5**	**14.15**	**6.3**	**7.675**	**13.225**	**10.34**	**3.93**		
9	**Pm 2.5**	**15Mg/m3**	**26.25**	**54**	**84.75**	**101.25**	**66.56**	**33.25**		

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10	Pm 10	40Mg/ m3	7.266667	8	15.75	18.25	12.32	5.51		
11	RAD (mR/hr)	5-50 rem (0.05-0.5 Sv)	0.007025	0.0295	0.01525	0.017	0.02	0.01		

S/N	Parameter	Limit	Values 1	Values 2	Values 3	Values 4	Mean	St. Dev	P	t
	OKIGWE	ZONE								
1	GPS	N05 28.658, E007 03.012								
2	CO_2	5000ppm	555.5	467.25	1260.848	988.3725	817.99	372.86		
3	TEMP.	26.1˚C	27.6	18.175	28.025	36.15	27.49	7.35		
4	NO_2	2.0%	2.89	2.3525	0.34	1.5825	1.79	1.10		
5	SO_2	5ppm	0.355	0.2175	0.1625	0.085	0.21	0.11		
6	CO	5000ppm	245.595	202.5	48.325	301	199.36	1086.46		
7	CH_4	1000ppm (0.1%)	586.5	569.5	710.75	612	619.69	63.17		
8	O_2	19.5-23.5	13.325	13.7	11.35	10.2	12.14	1.66	0.001	11.88
90	Pm 2.5	15Mg/ m^3	85	86.25	80	64.75	79.00	9.88		
10	Pm 10	40Mg/ m^3	12.75	13.5	15.75	27.5	17.38	6.87		
11	RAD (mR/hr)	5-50 rem (0.05-0.5 Sv)	0.01325	0.03525	0.01225	0.01075	0.02	0.01		

DISCUSSION

The influence of air pollutants on ocular health is a significant public health concern, particularly for road transport workers who are constantly exposed to outdoor environmental

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hazards. In Imo State, where transport workers form a crucial sector of the workforce, understanding the impact of air pollution on ocular health is essential. This study highlights the specific risks faced by transport workers, the prevalence of ocular conditions, and the role of awareness and preventive measures in mitigating these effects. Analyzing these factors, we provide insights for targeted interventions to protect the vision and overall well-being of road transport workers. The study's demographic data show that most drivers fall within the 41-50 age range, aligning with findings in the transportation sector (Afolabi, Alli, & Falayi, 2021). This suggests that accumulated exposure over time may increase their risk of ocular health issues. The gender distribution reveals a significant imbalance, with most drivers being male, consistent with trends in transportation (Xlu, 2012). The majority (79.3%) were married, and Christianity was the predominant religion (97.5%). In terms of income, 28.1% of drivers earned 6,000 naira or more daily, while traders had the lowest proportion in this category (19.8%).

Health monitoring varied across regions, with Owerri showing the highest rate of health examinations (46.2%), suggesting a relatively proactive approach compared to Orlu (29.5%) and Okigwe (24.3%) (Paguntalan & Gregoski, 2016). This variation indicates the need for uniform health surveillance programs across transport hubs. The study found that 57.6% of participants had good visual acuity (6/4 - 6/6), but a significant portion (31.0%) exhibited moderate vision (6/9 - 6/18), indicating potential need for corrective measures (Garcia-Sanchez et al., 2019). Pterygium was highly prevalent (57.9%), significantly higher than rates reported in studies by Smith et al. (2018) and Chen et al. (2017). This may be attributed to prolonged exposure to UV radiation and airborne irritants (Coroneo, 2013). Dry eye syndrome affected 35.9% of participants, aligning with findings by Uchino et al. (2018) and Li et al. (2019), who reported high occupational prevalence. Other ocular issues such as glaucoma and lens opacity were also observed, consistent with prior epidemiological data (Flaxman et al., 2017; Tham et al., 2014).

Environmental assessments indicated elevated levels of CO_2 and NO_2, particularly in Owerri, suggesting poor air quality (Liu et al., 2020; Zhang et al., 2019). These findings highlight the need for air quality control measures in transport hubs. The study also established statistically significant correlations between exposure to air pollutants and ocular conditions, including visual acuity ($p = 0.0021$), dry eye syndrome ($p = 0.0071$), pterygium ($p = 0.0286$), and pinguecula ($p =$

0.0025), reinforcing prior studies on air pollution's impact on ocular health (Wu et al., 2019; Kim et al., 2018).

Awareness of air pollution's impact on ocular health was high among drivers (90.9%) and other transport workers (83.9%), though slightly lower among traders (85.3%). These findings align with studies indicating high awareness among outdoor workers (Al-Shidi, Ambusaidi, & Sulaiman, 2021; Solaja, Omobowale, & Alliyu, 2015). However, awareness did not always translate into preventive actions. Various protective strategies were reported, including wearing glasses (9.4%), using sunshades (7.5%), undergoing eye check-ups (9.7%), and closing eyes to prevent exposure (9.7%). However, preventive practices were suboptimal, especially among traders, where only 21.6% took active measures. Drivers exhibited moderate engagement (33.2%), while other transport workers had the highest compliance (35.5%) (Rivera, 2021; Porter et al., 2015).

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Statistically, individuals who practiced preventive measures had significantly lower ocular health risks ($p < 0.05$). The study reveals the need for targeted health interventions. Policies promoting air quality regulation in motor parks, improved vehicle emission controls, and worker education on ocular health protection are essential. Given the high prevalence of pterygium and dry eye syndrome, workplace interventions such as routine eye examinations and subsidized protective eyewear should be encouraged. Further research on long-term ocular effects of air pollution in high-risk occupational groups is recommended to develop more effective public health strategies.

CONCLUSION

This study demonstrated the multifaceted relationship between air pollution exposure and ocular health among park workers in Imo State, Nigeria. The findings underscore the critical importance of understanding and addressing the potential hazards posed by environmental factors on visual well-being. The prevalence of various ocular conditions, including dry eye syndrome, pterygium, and pinguecula, among park workers highlights the need for targeted interventions and increased awareness regarding ocular health in this occupational group. Moreover, the observed variations in visual acuity levels and the presence of specific eye problems emphasize the dynamic nature of environmental influences on ocular health.

The environmental parameters measured at different parks reveal significant fluctuations in key metrics such as CO_2 and NO_2 levels. These variations suggest the presence of diverse air quality profiles across different locations and time periods, highlighting the need for tailored mitigation strategies based on specific environmental conditions. The association between exposure to air pollutants and specific ocular conditions further underscores the potential health implications of prolonged exposure to polluted environments.

Additionally, the study's identification of prevalent strategies employed by park workers to mitigate air pollution's impact on ocular health provides valuable insights into adaptive measures within this occupational setting.

Outdoor and indoor air pollution is derived from different sources and can cause different eye diseases. Ocular surface irrigation, conjunctivitis and dry eye disease are the most direct results of air pollution. However, chronic inflammation, oxidative stress, and toxicity resulting from air pollution can further cause cataracts, glaucoma, uveitis, retinal layer thinning, macular degeneration, and diabetic retinopathy. Further research on the effects of air pollution on retinal ganglion cells and the chorioretinal vasculature may help identify the underlying pathological mechanisms. In addition, further research on the association between air pollutants and ophthalmological disorders is needed to improve the understanding of exposure patterns and ocular effects. Such studies will help determine the long-term impacts of air pollutants on the eye, which are currently unknown.

Moreover, this study contributes significantly to the body of knowledge concerning the intricate interplay between environmental factors and ocular health. The implications extend beyond the specific cohort of park workers, serving as a broader call to action for enhanced occupational health initiatives and public policies aimed at safeguarding visual well-being in the face of evolving environmental challenges. It is imperative that future research continues

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to explore and address the nuanced relationships between environmental parameters, occupational settings, and ocular health to promote a healthier and more sustainable work environment for all individuals.

Air quality significantly affects ocular health, with implications for both short-term discomfort and longterm vision preservation.

As air pollution continues to be a global concern, eye doctors should remain informed about its effects and provide appropriate guidance to patients.

RECOMMENDATIONS

Based on the findings of this study, further studies are highly recommended to address areas which this study failed to address adequately. Apart from the recommendation of further studies which is highly recommended, several other recommendations emerged to promote the ocular health and overall well-being of park workers in Imo State, Nigeria:

First, enhanced Occupational Health Education: Implement targeted educational programs to raise awareness among park workers about the potential ocular health risks associated with air pollution. Provide training on preventive measures and strategies to mitigate these risks, including the use of protective eyewear and regular eye check-ups.

Regular Eye Check-ups: Encourage Park workers, especially Drivers and Road Transport Workers (RTWs), to undergo regular eye examinations to detect and address ocular conditions at an early stage. Provide access to affordable and accessible eye care services within close proximity to their workplaces.

Air Quality Monitoring and Regulation: Advocate for the establishment of comprehensive air quality monitoring systems in and around parks. Work with relevant authorities to enforce regulations aimed at reducing air pollution levels, particularly in areas with high vehicular traffic and industrial activity. Personal Protective Equipment (PPE): Provide park workers with appropriate PPE, such as high-quality sunglasses, safety glasses, and sunshades, to mitigate the adverse effects of air pollution on their ocular health time. This will provide valuable insights into the effectiveness of implemented interventions and help refine strategies for long-term ocular health preservation.

Conflict of Interest

The Authors have declared no conflict of interest

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