

Perceived Seasonal Impact of Air Pollution on Health and Properties in Port Harcourt

Comment [HUR1]: Perception of the seasonal impact of air pollution on health and property in Port Harcourt

Abstract

Air pollution is an environmental menace that has attracted a lot of concern both locally and globally. The Environment is very important to sustainability of life and air pollution has become of great concern to many countries across the world especially its impact on human health and the environment. This study thus, assessed perceived seasonal impact of air pollution on health and property of the inhabitants of Port Harcourt. Primary data in form of questionnaire was used to solicit information from the inhabitants of the study area. A cross-sectional research design was adopted using an online survey and a 24-question survey was designed on goggle documents website (doc.goggle.com). The link was active for three months and was strictly monitored, the link was disabled after receiving 400 responses. Data for the study were analyzed using cross-tabulation and bivariate percentage analysis. Results revealed that majority of the respondents were females (53.2%) and (45.8%) were men. However, 73.3% of the respondents have lived in Port Harcourt for between 11-20 years and above 20 years which is an indication that they have high knowledge of the environment. Majority of the respondents 79.4% have observed a change in air quality which was rated low and (80.1%) have attributed the source of the air pollution to illegal refining of crude oil within the city. 50% of respondents identified two seasons which are raining season and dry season and they observe the impact of air pollution to be more prominent during the dry season (51.2%). Majority perceived that the associated health risk is very high (56.5%) and attributed health related issues such as difficulty in breathing, asthma, eye problem, heart problem, increase in cancer and head ache to poor air quality in the city. Hence, there is an urgent need for government at all levels to put in place adequate enforcement institution that will work with youth leaders, women leaders, health officials, academic researchers and relevant bodies to implement the environmental policies and sanction offenders for the overall benefit of the wellbeing of the inhabitant and properties towards achieving a sustainable state.

Comment [HUR2]: Fifty percent

Comment [HUR3]: The results presented here are very poor, it would be necessary to include more information from the applied surveys.

Keywords: Air pollution, Seasons, Health, Properties, Port Harcourt

Introduction

The Environment is very important to sustainability of life and air pollution has become of great concern to many countries across the world due to its detrimental impact on human health. The effect of air pollution on the environment and human health has attracted a lot of interest from government, researchers, media, and individuals. The World Health organization (WHO) has reported that air pollution constitutes a major environmental risk as about 3 million annual deaths are associated with outdoor air pollution exposure [1] and this calls for a serious concern, as the earth is the habitation of man. According to the World Health Organization (WHO), each year air pollution is responsible for nearly seven million deaths around the globe and [2] reports that air pollution is now the world's fourth-largest risk factor for early death. The emergence of particle (soot) pollution considered to be an

environmental health threat, has led to several protests from environmental expert and residents against government inaction in some parts of Rivers state [3]. This environmental menace has caused a lot of fear as the inhabitants are handicapped without the necessary instrument from government to combat it hence, so many have resulted to relocating to other states with less pollution challenges. Air quality is of great concern to many as non-compliance to the accepted rate can affect human health.

Air pollution refers to the release of pollutants into the air known as pollutants which are detrimental to human health and the planet as a whole [1]. It simply means that the environment is termed to be polluted when dust particles, fumes (or smoke) and hazardous gases are introduced into the atmosphere and exceeds the acceptable limit and becomes a threat to human life. There are two sources of air pollution, natural sources and man-made sources. Natural sources of air pollution include dust carried by the wind from locations with very little or no green cover, gases released from the body processes of living beings (Carbon dioxide from humans during respiration, Methane from cattle during digestion, oxygen from plants during photosynthesis) and volcanic eruptions etc. Man-made sources of air pollution on the other hand, can be further divided into outdoor pollution and indoor pollution. The major outdoor pollution sources include power generation, vehicles, agriculture/waste incineration, industry and building heating systems, illegal refining sites etc. Smoke features as a prominent component of air pollution emitted from various forms of combustion like in biomass, factories, vehicles, furnaces, etc contribute significantly to the increase in air pollution, especially in urban area like Port Harcourt. The reactions of certain gases and chemicals also form harmful fumes that can be dangerous to the well-being of living creatures. Indoor air pollution arises from human activities that include burning fuels such as dung, coal, wood in inefficient stoves, burning kerosene in simple wick lamps, all of these produces a variety of health-damaging pollutants such as carbon monoxide, methane, particulate matter (PM), polyaromatic hydrocarbons (PAH) and volatile organic compounds (VOC). There are various causes of air pollution, which include burning of fossil fuels, agricultural activities, waste in landfills, exhaust from factories and industries, mining operations. The major source of air pollution is from the use of energy and in the process of production [2]. However, the major cause of air pollution since the industrial revolution has been attributed to man. [4] carried out a study in Port Harcourt which revealed that Man-made activities resulting from human quest to generate returns for survival have increased the rate of pollutants emissions within the earth's atmosphere.

Report from WHO shows that pollution may lead to non-communicable diseases, such as cardiovascular diseases (CVDs), chronic obstructive pulmonary disease (COPD), and lung cancer, or loss of life and property. In a report by WHO using air quality model, it was confirmed that 92% of the world's population lives in places where air quality levels exceed "WHO's Ambient Air quality guidelines" for annual mean of particulate matter with a diameter of less than 2.5 micrometres (PM2.5) WHO guideline limits for annual mean of PM2.5 are 10 µg/m³ annual mean [5]. PM2.5 includes pollutants such as sulfate, nitrates and black carbon, which penetrate deep into the lungs and in the cardiovascular system, posing the greatest risks to human health. Various policies have been put in place to help reduce air pollution both locally and internationally. Recently, United Nations Environment Programme (UNEP) convened Climate and Clean Air Coalition (CCAC) approved the Coalition's 2030 strategy, which will see scaled-up efforts to significantly reduce short-lived climate pollutants (SLCPs) such as methane, hydrofluorocarbon (HFCs), black carbon, and tropospheric (ground level) ozone—by 2030. [6].

Concerned over poor air quality in River state and port Harcourt in particular has deepened as a result of the presence of soot seen everywhere within port Harcourt and its environment [7] the increase in soot has resulted to several complain from residents and environmental

Comment [HUR4]: it would be necessary to put a table with the permissible limits of gases in the atmosphere. International and national legislation if it exists.

Comment [HUR5]: It is the only data of permissible values that is presented. Are only PM2.5 important? What about the other atmospheric pollutants?

expert on the resultant effect it is having on health as well as household properties (plate A – H). The black soot was observed in Port Harcourt and its environs in the last quarter of 2016 [8] and has become an environmental issue for residents of the city, state and country. The increased presence of soot in the environment resulting to air pollution is suspected to come from illegal refining activities around Port Harcourt City.

Plate (A-H):



Comment [HUR6]: The sheet should be identified as a figure. And it should have a caption.

In recent years, several studies have been carried out to assess the levels of air pollutants, people's awareness, possible solutions and impact on human health and the environment in different part of the world including Port Harcourt. Majority of these studies have found a possible association with air borne diseases, provide evidence on poor air quality which has exceeded the above national and international regulatory-recommended levels of ambient air pollutants [5–9]. Studies have also been carried out in the Niger delta to determine the relationship between Particulate Matter (PM2.5) concentration and the incident of Respiratory Tract Infections (RTIs). Findings reveal that for Port-Harcourt, there were significant variation in the occurrence of PM2.5 and the mean monthly variation (2016-2019) showed that Port Harcourt had 47.27 $\mu\text{g}/\text{m}^3$ for January, which is far above the World health organization approved limit of 10 $\mu\text{g}/\text{m}^3$ thereby aggravating Respiratory Tract Infections (RTIs). The epidemiology of the RTIs showed four (4) prominent RTI diseases namely Asthma, Tuberculosis, Pneumonia and Chronic Obstructive Pulmonary Disease (COPD) [9]. Residents of Port Harcourt in Rivers State, Nigeria has been experiencing negative environmental impacts of particle (soot) pollution for some years now and there has been a lot of outcry from environmental expert, media and the general public. [10] in his studies revealed how black soot is affecting the people of Rumuolumeni in Rivers State and has led to an increase in public health problems among the residents also a similar study on the people's perception of soot in Port Harcourt was assessed and results indicate that most respondents (81.5%) were aware of the soot pollution and (87.8%) perceived that the main causes of soot were from artisanal refining of crude oil while (76.5%) consented to burning of

Comment [HUR7]: As soon as they exceed national and international regulations

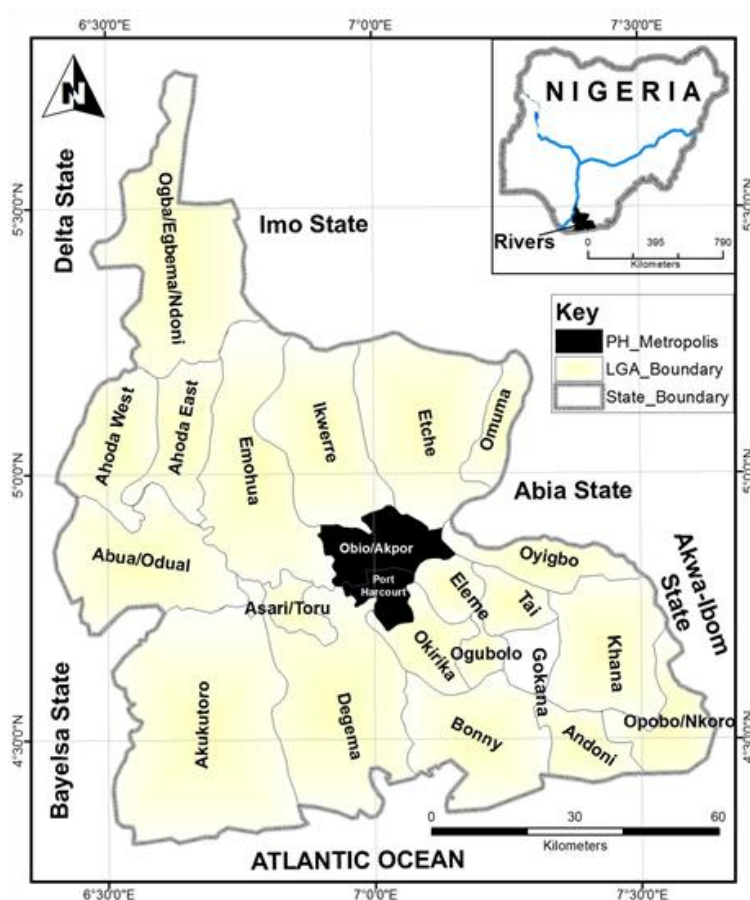
Comment [HUR8]: Homogenize "Port Harcourt" or "Port-Harcourt"

confiscated crude oil and its products, about 69.9% perceived that the soot had caused them chronic cough and irritation to eyes, nose and throat (64.2%)[8].

Further studies carried out on air quality in four locations in Rivers State with varying distance of (60, 100, and 500 m) from emission source, findings show that almost all the samples complied with (Department of Petroleum Resources (DPR) guidelines for annual average. With the exception of SO_x and NO_x whose annual means exceeded specification at only one location and fails to conform to the policies of the regulatory bodies [11] and [12] carried out a five years survey (2003–2007) using epidemiological data, the study showed that the levels of all the criteria air pollutants in Rivers State was significantly higher than the WHO specification. The study revealed that air pollution was associated with air related morbidities and mortalities in the State. Amongst the air-related morbidity assessed, including cerebrospinal meningitis (CSM), chronic bronchitis, measles, pertussis, pulmonary tuberculosis, pneumonia, and upper respiratory tract infection (URTI), pneumonia was the most prevalent for all of the years that were studied, and was responsible for the highest number of deaths in 2005. The environmental assessment reports on air pollution calls for immediate action to be taken by the government and regulatory body responsible for environmental issues. The environment is very important to man and studies have shown that pollution is affecting people's health especially soot, coming from illegal refining activities going on in the State. This work therefore, examined people's knowledge of the seasons and their perception on the current air pollution situation in Port Harcourt.

Study Area

Port Harcourt metropolis is the capital of Rivers State, it is the hub of oil and gas in Niger delta region of Nigeria. It occupies approximately 1811.6 km² area [13,14], with a population of about 1.5 million [15,16]. It is located between Latitude 4°45'N and Latitude 4°55'N, and Longitude 6°55'E and Longitude 7°05'E in Rivers State. The city is bounded in the north by Abia and Imo states; east by Akwa-Ibom state; west by Bayelsa state; and, south by the Atlantic Ocean Fig. 1. Its estimated mean altitude is 12 km above average sea level, lying between the Dockyard creek/Bonny River and the Amadi creek [13]. Port Harcourt metropolis spans over two local government areas (LGAs) viz Port Harcourt and Obio/Akpor. The climate of Port-Harcourt shows that the city experiences two distinct seasons, wet season and dry season. The months with the highest monthly rainfall are July and September with monthly mean of 348.92 mm and 364.68 mm respectively. The lowest rainfall is recorded in the month of December with 26.40 mm. Temperature over Port Harcourt metropolis is high with a mean maximum of about 34°C in March and a mean minimum of about 21°C in January. The harmattan period which is climatically experienced by many cities in West Africa, is less pronounced in Port Harcourt [17, 18].



Source: Department of Geography, UNIPORT

Figure 1. Rivers state showing Port Harcourt Metropolis.

Methods of Data Collection

The study used primary data collected from residents living in Port Harcourt who had access to internet enabled devices, like smartphone, laptop etc. A brief message was attached to the link to the survey and posted selectively on different groups pages where you find inhabitants of Port Harcourt, individual WhatsApp, emails and other social media vices. The link was active for four months and was strictly monitored, immediately the respondent reached 400, the link was closed. A 24-question survey was designed on goggle documents website (doc.goggle.com) and divided into four parts: Socio economic characteristics of respondent, perceived knowledge of seasons in Port Harcourt, composite indices of perceived level of air pollution and perceived related risk on health and property. The questions ranged from single to multiple choice and some open-ended questions. The study was conducted from November 2021 to February 2022. The data was analysed using cross-tabulation and bivariate percentage analysis. The study used the simplified formula for sampling provided by Yamane in 1967 [19,20] to identify the appropriate total respondents. This resulted to using 400 copies of structured questionnaire. The formula is presented as

$$n = \frac{N}{1+N} (e)^2$$

Where,

e = Deviation of sampling

N = Population size and

n= Sample size

This formula is reliable at 95% and less than 5% variation factor [19.20].

Method of Data Analysis

Descriptive statistics was applied in summarizing the socio- economic characteristic and Information obtained from the administered questionnaire using tables, charts, frequency and percentage.

3. Results and Discussion

3.1 Socio-economic characteristics of respondents

In the sampled population shown in Table 1, majority of the respondents were females (53.2%) and men (45.8%), this shows that women show more interest in issues relating to human care as they are mostly in charge of caring for the family and taking care of the home. A higher percentage of respondents were between 40-49 years (31.8%), 30-40 years (26.5%), 20-29 years (22%) and above 50 years (19.7%). The study revealed that a greater percentage of respondents (73.3%) have lived in Port Harcourt for between 11-20 years and above 20 years. This implies that the respondents have adequate knowledge of Port Harcourt air pollution status, health challenges, and changes that has occurred in the environment. Table 1, also revealed that more than half of the respondents are married (64.3%) and possibly would have a home and children under their care, this is an indication that they are aware of the poor quality of air in their homes and environment and how it is affecting their properties. In addition, majority of the population are well educated as (46%) have completed postgraduate level of education, 38% has attained tertiary education. Lastly, 29.5% of respondent are business owner/self-employed and 23% works with the public or private sector within the study area.

Table 1. Socio-economic characteristics of respondents (n=400)

Age(years)($X^2=7.815$; p-value 0.00367)	Frequency	Percentage %	Rank
20-29	88	22	3
30-39	106	26.5	2
40-49	127	31.8	1
>50	79	19.7	4
Duration of stay in Port Harcourt ($X^2=7.8155$; p-value 0.00367)			
1-5	40	10	4
6-10	67	16.7	3
11-20	110	27.5	2
>20	183	45.8	1
Marital Status ($X^2=7.8155$; p-value 0.00367)			
Single	129	32.3	2
Married	257	64.3	1
Divorced	5	1.2	4

Comment [HUR9]: What are the values that were substituted in the formula to obtain the 400 respondents?

Widow/Widower	9	2.2	3
Educational qualification ($\chi^2=388.36$;p-value 4.6837)			
Non – formal	11	2.7	4
Primary	5	1.3	3
Secondary	41	10.3	2
Tertiary	184	46	1
Post graduate	152	38	
Other	7	1.7	
Current occupation ($\chi^2=117.82$;p-value 4.17)			
Student	54	13.5	4
Unemployed	45	11.2	5
Business Owner/Self Employed	118	29.5	1
Civil Servant	33	8.3	6
Public Servant	92	23	2
Other	58	14.5	3

Source: Fieldwork, 2022

Perceived knowledge of seasons in Port Harcourt

Comment [HUR10]: 3.2?

Two seasons were largely acknowledged by the inhabitants of Port Harcourt, namely wet and dry season, above 200 of the population identified dry season periods to be January, February and December (Figure 2) and identified wet season to be from April – October (Figure 3) but studies have shown Port Harcourt experiences dry season from the months of December to February and wet season from March to November [17, 18]. The study also showed that 51.9% of respondent perceived air pollution to be more severe in the dry season as compared to wet season (Table 2). This could be attributed to the effect of raining season washing away the impurity in the atmosphere. This is also in conformity with other studies carried out in River state and other African countries [21, 22, 23].

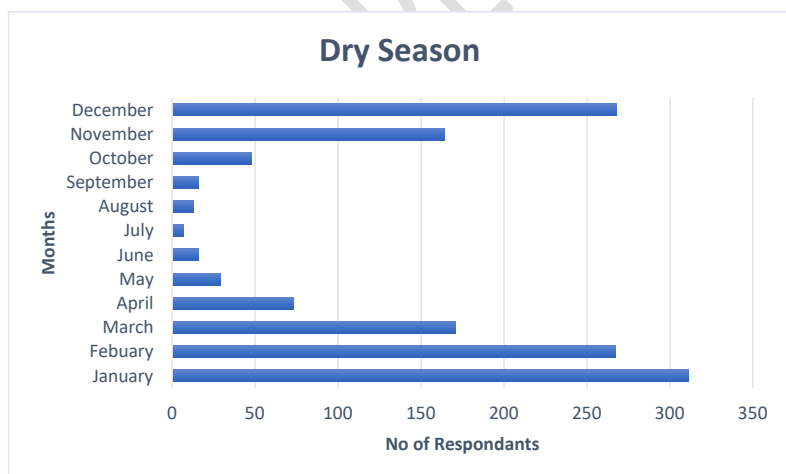


Figure 2: Observed period of Dry season

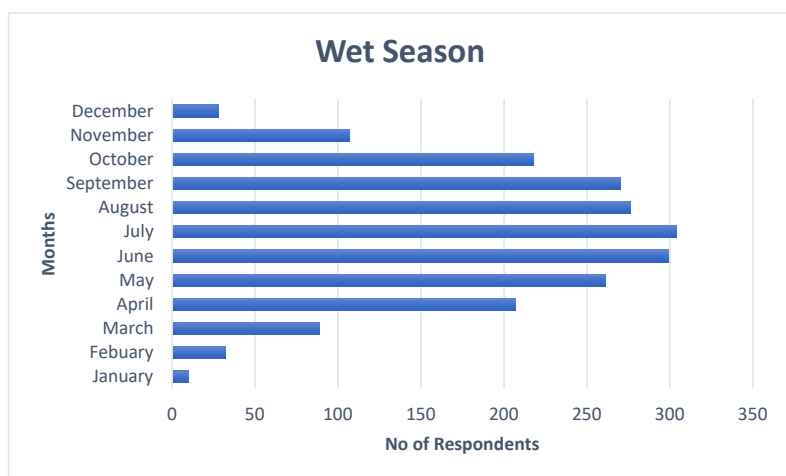


Figure 3: Observed period of Wet season

Table 2: observed seasonal highest impact of air pollution

Responses	Frequency	Percentage %	Rank
Dry Season	209	51.9	1
Wet Season	23	5.8	2
Both Dry and wet Season	169	42.3	3
Total	400	100	

Composite indices of perceived level of air pollution and perceived related health risk

Comment [HUR11]: 3.3?

Table 3, shows responses on the severity of air pollution in Port Harcourt and a greater number of respondents (79.4%) said yes, they observed a change in the air quality and (44.7%) rated the air quality in the place they live to be low (Table 4) while 57.8% (Table 5) responded that the air quality inside the house is equally very low. On the severity of air pollution in Port Harcourt, 51% respondents perceive that air pollution is very high and 37.2% says it high (Table 6). This is an indication of how badly they perceive air quality in the study area. Similarly, (Table 7) shows that 59% of respondents are not certain if air quality will improve ,22.5% respondents says no, there is no hope for air quality to improve while (18.5) % are of the view that air quality will improve. This shows uncertainty of the inhabitants in the study area to the improvement of air quality. This assertion could be due to how they perceive the commitment from concerned agency on putting an end to the perceived factor causing air pollution. The respondents perceived sources of outdoor or indoor air pollution within Port Harcourt is a multi-choice question and above half of the population believed it's from illegal refining activities(320 persons) and industrial emission (228 persons), while 150 persons believe it's from vehicular emission,138 person dust ,109 persons smelly sewage ,108 persons burning trash ,51 persons cigarette smoking ,50 persons cooking fuel ,23 persons said its from other sources (23) and 8 persons have no idea (Table 8).

Table 3: Responses on observed change of air quality in Port Harcourt

Responses	Frequency	Percentage %	Rank
Yes	318	79.4	1
No	41	10.3	2
Maybe	41	10.3	2
Total	400	100	

Table 4: Responses on the rate of air quality in the community where they live within Port Harcourt

Responses	Frequency	Percentage %	Rank
Very low	135	33.8	2
Low	179	44.7	1
High	57	14.2	3
Very high	29	7.3	4
Total	400	100	

Table 5: Responses on the rate of air quality indoors

Responses	Frequency	Percentage %	Rank
Very low	231	57.8	1
Low	82	20.5	2
High	75	18.7	3
Very high	12	3	4
Total	400	100	

Table 6: Severity of air pollution in Port Harcourt

Responses	Frequency	Percentage %	Rank
Low	14	3.5	3
Moderate	32	8	4
High	149	37.2	2
Very high	204	51	1
None	1	0.3	5
Total	400	100	

Table 7: Improvement of air quality in Port Harcourt

Responses	Frequency	Percentage %	Rank
Yes	74	18.5	3
No	90	22.5	2
Maybe	236	59	1
Total	400	100	

Table 8: Perceived sources of outdoor/ indoor pollution within Port Harcourt

Perceived sources of air pollution	No. of Respondents
Illegal refining activities	320
Industrial Emission	228
Vehicular Emission	151
Dust	138
Smelling Sewage	109
Burning Trash	108
Cooking fuels	50
Cigarette smoking	51
Other source	23
No idea	8

Associated health related risk to air pollution

Comment [HUR12]: 3.4?

In Table 9: the perception of the respondents to the rate of health risk associated with air pollution shows that 56.5% of the respondent believes that health associated risk is very high, 35.7% says it is moderately high. This could be as a result of increased health challenges experienced within the study period. in a multi choice question, the respondents selected the related health risk the inhabitants are liable to experience, Table 10 shows the number of respondents, Cough/cold 264, difficulty in breathing 306, eye problem 171, asthma 201, cancer 131, heart problem 151, headache 88 and some respondents selected other 13, which includes, destruction of sperms cell, results to skin diseases and reduce resistance to infection. This calls for further research by the health experts. The health risk associated with air pollution is of great concern in Nigeria and across the world, especially for a county that has a plan for the sustainability of its inhabitant.

Table 9: Associated health related risk to air pollution

	Frequency	Percentage %	Rank
None	5	1.3	4
Low	26	6.5	3
Very High	226	56.5	1
Moderate high	143	35.7	2
Total	400	100	

Table 10: Perceived related health risk

Perceived sources of air pollution	No. of respondents
Headache	88
Heart problem	151
Cancer	131
Asthma	201
Eye problem	171
Difficulty in breathing	306
Cough/cold	264
other	13

Protective measures adopted

Comment [HUR13]: 3.5?

Table 11. Shows the methods adopted by residents in protecting themselves and families from air pollution 60.5% use nose mask, 8.5% hand kerchief to cover their nostrils. 27% do nothing and 4% use other methods.

Table 11: Method of protection from the air pollution

Responses	Frequency	Percentage %	Rank
I wear face mask	242	60.5	1
Cover my nostrils with handkerchief	34	8.5	3
Do nothing	108	27	2
other	16	4	4
Total	400	100	

Perceived impact of air pollution on household items

Comment [HUR14]: 3.6?

In Table 12, majority of the respondents have observed some changes (63 %,) to household items while (26%) have not experienced any changes in household items and 11% are uncertain. Some of the items identified by the respondents includes; window and blinds curtains, floor tiles and wall tiles, wall paint, clothing, household items such as air conditioning, unit Furniture and kitchen utensils, fridge, chairs, vehicle colour, Water treatment plant and roofing sheets.

Table 12: Observed damage to household items as a result of air pollution

Responses	Frequency	Percentage %	Rank
Yes	252	63	1
No	104	26	2
Maybe	44	11	3
Total	400	100	

People consciousness and sensitization approach

Comment [HUR15]: 3.7?

The impact of air pollution on health has become a great concern because majority of the respondents agree that it is affecting their health as well as causing damage to household properties and they look unto the government to stop the source of this air pollution because individuals alone cannot proffer solution to this menace. Also with the rate of inflation in Nigeria, things are so expensive and the little property acquired is being destroyed by the soot. Majority of respondent are very much aware of the danger posed by soot and as such has adopted several measures in safeguarding members of their family. Measures adopted by residents in protecting themselves and family members include; ensure the doors and windows are closed, regular clean up and mopping of the floor tiles and household items with disinfectant, kitchen utensils, windows and window blinds, ensure that every member of the family sleeps inside a mosquito net and regular medical check up. Other responses include, the use of air purifier, take drugs that strengthens the immune system such as vitamin C and antibiotics, regular bath, washing of hands, regular putting on of socks, eating of fruit and healthy vegetables, use of air conditioning, and curtains, regular

exercise, regular intake of warm water with lime, eat a well-balanced diet, restrict movement outside by staying indoors more often, regular intake of water and milk, regular washing of the hands, natural herbs, join the voices that are speaking against environmental pollution. Several properties affected by soot include; window and blinds curtains, floor tiles and wall tiles, wall paint, clothing, house hold items such as air conditioning, unit Furniture and kitchen utensils, fridge, chairs, vehicle colour, Water treatment plant and roofing sheets etc.

IMPLICATION OF THIS STUDY

This study can serve as a source of providing useful information to the government and environmental expert to develop health related assessment tool, create more awareness and to discourage perpetrator of this illegal refining of crude oil by bringing to light the danger their activities is posing to the health and properties of resident. In addition to the identified health risk by health literatures in Port Harcourt, this study identified some other health risk which include, destruction of sperms cell, results to skin diseases and reduce resistance to infection, this identified health risk from this survey is open for further research.

Conclusion

This study investigated the seasonal impact of air pollution on health and properties by Port Harcourt inhabitant. The Study shows that majority of the respondents attributed the cause of the air pollution to illegal refining sites (which the inhabitants nick named "*kporfire*") in Port Harcourt which result to increased soot in the environment. This has largely affected the life style of the inhabitants, as many people resort to spending more time indoors. This action has affected community interaction, communication amongst friends, business and life style. Several residents within the study area have relocated to other States and many other have plans to relocate as advised by their health provider. If this migration continues, it is likely going to result to an economic imbalance within the communities especially in human capital. The study therefore recommends, (1) the urgent need to reduce air pollution levels and increase public awareness of this threat. (2) Government should continue with the fight against illegal refining site to stop their operation so as to save lives and property. (3) Policies should be developed and the relevant authorities should ensure that it is implemented. (4) The government should create jobs for the youth to reduce the unemployment rate thereby creating an alternate livelihood structures for artisanal refiners in Port Harcourt. (5) Awareness and extensive campaign should be created by the Environmental and Medical specialist through the media on how the inhabitants can stay healthy in a polluted environment. (6) Special task force should be created to work with the regulatory bodies and members of the task force should include environmental scholars, youth representatives, women leaders, health practitioners, government official who will work together with the regulatory bodies to ensure implementation of the policies

Comment [HUR16]: Although it is true that the perception of the inhabitants is important in the elaboration of public policies, that is only an adjuvant. Public pollution policies should be based on measurements of atmospheric pollutants in the impacted area at different distances from the supposed point sources and from the entire study area and only be complemented with perceptions, but it is incorrect to make public policies exclusively with perception.

Comment [HUR17]: The conclusions should be limited to what is thrown by the surveys and not make other types of assumptions?

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