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

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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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 ecosystem. 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%). However, 73.3% of the respondents have lived in Port Harcourt more than 11 years. This 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. Fifty percent of respondents identified two Climate seasons: raining and dry and (51.2%) observe the impact of air pollution to be more prominent during the dry season. Majority perceived that the associated health risk is very high (56.5%) and attributed health related issues such as difficulty in breathing, asthma,

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eye problem, heart problem, increase in cancer and headache to poor air quality in the city. It was also noted that the incidence of sooth affected their properties. Hence, there is an urgent need for government at all levels to put in place adequate enforcement institution that will work with community leaders (youth, women and other), health officials and academic researchers to implement the environmental policies and sanction offenders for the overall benefit of the wellbeing of the inhabitant towards achieving a sustainable environment in the state.

Keywords: Air pollution; seasons; health; properties; Port Harcourt.

1. 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) reported that air pollution is a major environmental risk as about 3 million annual deaths are linked to 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), air pollution causes almost seven million deaths per year around the world, [2] and reports says that air pollution is now the world's fourth-leading cause of premature death. In some sections of Rivers state, the rise of particle (soot) pollution, which is considered an environmental health threat, has prompted multiple rallies by environmental experts and locals against government inactivity [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. 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 [1]. 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 and plants 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 most significant outdoor pollution sources include power generation, vehicles, agriculture/waste incineration, industry and building heating systems, illegal refining sites etc. Smoke, generated by many forms of combustion such as biomass, industries, automobiles, furnaces, and other sources, contributes considerably to the increase in air pollution, particularly in urban areas such as Port Harcourt. Certain gases and chemicals react to produce hazardous fumes that can endanger the health of living creatures. Human activities such as burning dung, coal, or wood in inefficient stoves, or burning kerosene in simple wick lamps emit a number of health-damaging pollutants such as carbon monoxide, methane, particulate matter (PM), polyaromatic hydrocarbons (PAH), and volatile organic compounds (VOCs).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]. A study carried out in Port Harcourt 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.

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 and 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 [5]. 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 ozone (ground level) by 2030. [6].

The poor air quality in Port Harcourt has drawn a lot of concern as a result of the presence of soot seen in its environment [7]. The increase in soot has resulted in several complaints from residents and environmental experts about the effect it is having on health as well as domestic properties (Fig. 1 - Plate A- Chairs, Plate B -Table, Plate C – Car, Plate D – Curtains, Plate D- Lights, Plate F- Dirty water from cleaned surfaces of household items, Plate G- Shoes) shows some of the household items affected by sooth. 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.

In recent years, several studies have been conducted in various parts of the world, including Port Harcourt, to examine the levels of air pollutants, people's knowledge, viable solutions, and impact on human health and the environment. The majority of these studies have indicated a possible link with air borne diseases [5–9], and some studies have shown that Port Harcourt has exceeded the World Health Organization recommended limit of 10 g/m3, thereby worsening Respiratory Tract Infections (RTIs). The epidemiology of the RTIs showed that asthma, tuberculosis, pneumonia, and chronic obstructive pulmonary disease (COPD) are identified as the four (4) most common RTI diseases [9]. Residents of Rumuolumeni in Port Harcourt, Nigeria's Rivers State, have been suffering from the detrimental environmental effects of particle (soot) pollution for several years, prompting widespread outrage from environmental experts, the media, and the general public, this study revealed how black soot is affecting the people, leading to an increase in public health problems among the residents [10]. A similar study on the people's perception of soot in Port Harcourt was conducted, with results indicating that the majority of respondents (81.5%) were aware of soot pollution and (87.8%) perceived that the main causes of soot were from artisanal crude oil refining, while (76.5%) consented to burning of 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 [8].

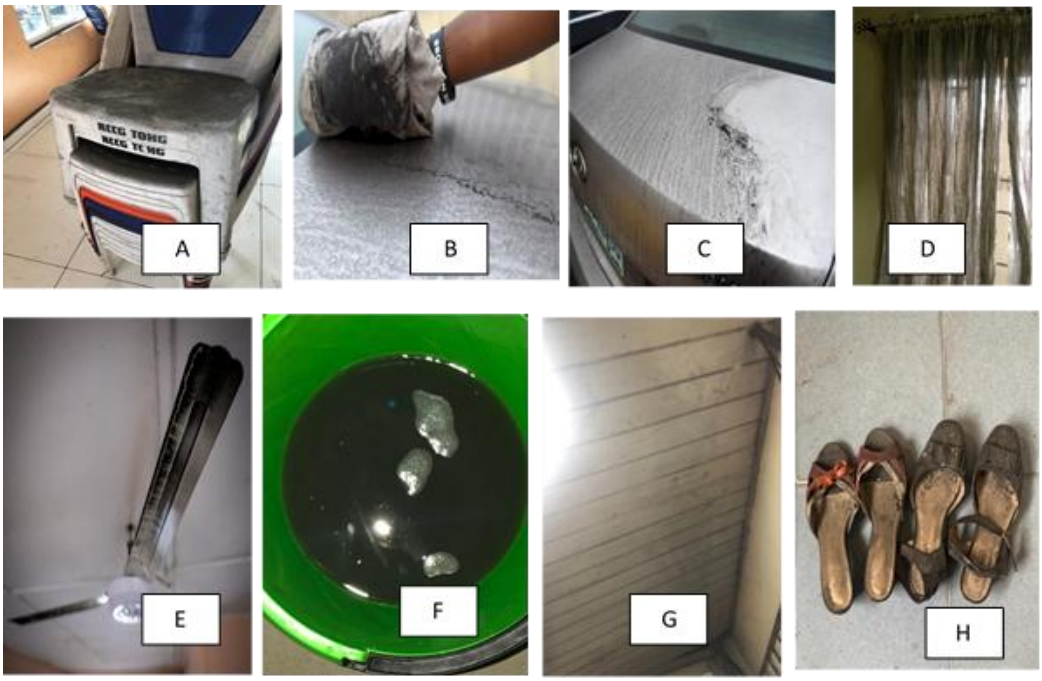

Fig. 1. Household properties affected by sooth

A five-year (2003-2007) survey of epidemiological data by Nigeria Upstream Petroleum Regulatory Commission (formally known as Department of Petroleum Resources DPR) showed that the levels of all criteria for air pollutants in Rivers State were 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) [11,12]. 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.

1.1 Study Area

Port Harcourt metropolis is the capital of Rivers State (Fig. 2). It is the centre of oil and gas in Niger delta region of Nigeria. It occupies approximately 1811.6 km^2 area [13,14], with a population of about 1.5 million [15,16]. This metropolis 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. 2). 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

Fig. 2. Rivers State showing Port Harcourt Metropolis
Source: Department of Geography, UNIPORT

that the city experiences two distinct seasons, wet and dry. 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].

2. 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 (0.05)

N = Population Size of Port Harcourt (1.5 million)
n= Sample size

This formula is reliable at 95% and less than 5% variation factor [19,20].

2.1 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 more than 11 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.

3.2 Perceived Knowledge of Seasons in Port Harcourt

Two seasons were largely acknowledged by the inhabitants of Port Harcourt, namely wet and dry season. Above 200 people identified dry season periods to be January, February and December (Fig. 3) and identified wet season to be from April – October (Fig. 4) 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].

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
Widow/Widower	9	2.2	3
Educational qualification(X^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(X^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

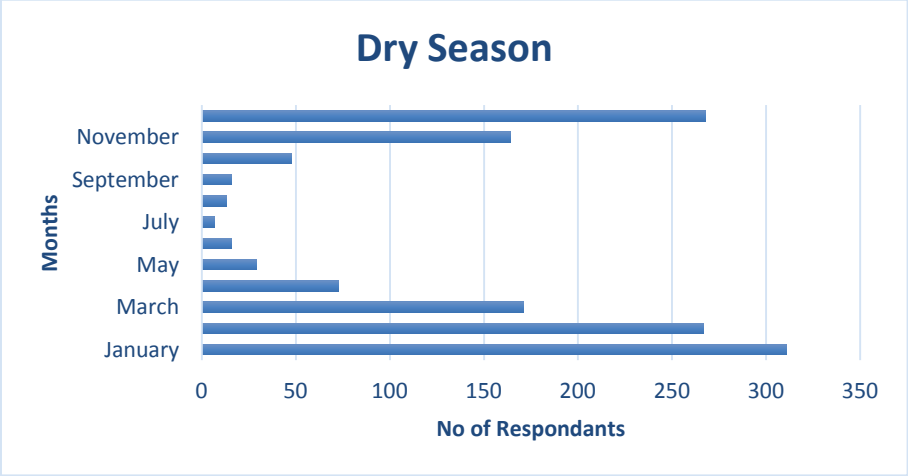

Fig. 3. Observed period of dry season

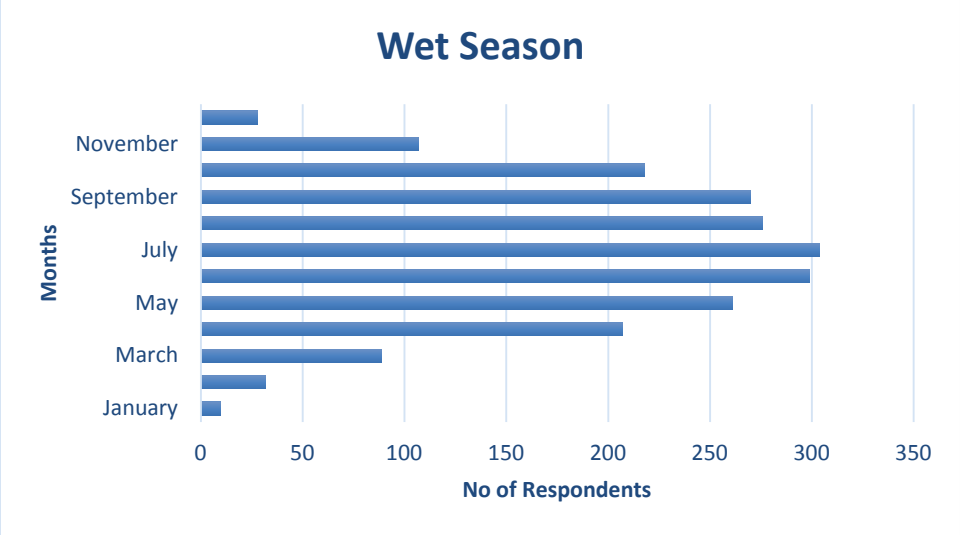

Fig. 4. Observed period of wet season

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	

3.3 Composite Indices of Perceived Level of air Pollution and Perceived Related Health Risk

Table 3 shows responses on the severity of air pollution in Port Harcourt and a greater number of respondents (79.4%) observed a change in the air quality. 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 is 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 unsure whether air quality will improve, 22.5% of respondents say there is no hope that air quality will improve, while 18.5% believe air quality will improve. This shows the uncertainty of the inhabitants of the study area for the improvement of air quality. This statement may be due to the way they perceive the country's environmental agency's commitment to ending the factor perceived as 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 high	29	7.3	4
High	57	14.2	3
Low	179	44.7	1
Very low	135	33.8	2
Total	400	100	

Table 5. Responses on the rate of air quality indoors

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

Table 6. Severity of air pollution in Port Harcourt

Responses	Frequency	Percentage %	Rank
Very high	204	51	1
High	149	37.2	2
Moderate	32	8	4
Low	14	3.5	3
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

3.4 Associated Health Related Risk to Air Pollution

In Table 9 is showed the perception of the respondents to the rate of health risk associated with air pollution 56.5% of the respondent believes that health associated risk is very high and 35.7% says it is moderately high. This could be as a result of increased health changes 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.

3.5 Protective Measures Adopted

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.

3.6 Perceived Impact of air Pollution on Household Items

In Table 12, majority of the respondents (63 %) have observed some changes to house hold 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, house hold items such as air conditioning, unit furniture and kitchen utensils, fridge, chairs, vehicle colour, water treatment plant and roofing sheets.

Table 9. Associated health related risk to air pollution

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

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	

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	

3.7 People Consciousness and Sensitization Approach

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 house hold 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 sockings, 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 includes; 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.

4. 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 *"kpofire"*) 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 posed a threat to the health and properties of people living in Port Harcourt. 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 ensue implementation of the policies

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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