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Research Article

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ABSTRACT:

Over the past two decades there has been increasing interest in studies of air pollution and its effects on human. The purpose of this study is to assess the prevalence of respiratory symptoms and to relate these measures to the degree of air pollution in an urban area (Sapele) and to establish a relationship between peak flow rate and the anthropometric measurements among the respondents in an urban area.

Four hundred respondents were administered on the frequency and duration of cough, production of phlegm (viscid mucous secreted in abnormal quantities in respiratory passages and sputum) (saliva discharge from respiratory passages), shortness of breath and occurrence of chest illness. The expiratory flow rate was recorded in a standing position using a mini-Wright peak flow meter (Clements Clarke-London UK). Anthropometric measurements; weight and height were also done.

Keywords: Air Pollution, Respiratory Symptom, Urban Area, Peak Flow Rate Meter, High Volume Gravimetric Sampler.

1. INTRODUCTION

The ubiquity of respiratory morbidity such as bronchial asthma, emphysema, lung cancer and chronic bronchitis appear to have heightened in recent years. A change in the genetic predisposition can snowball into allergic symptoms. Consequently this change in gene can be influenced by change in the environmental components.

The average adult may require about 14 Kilograms of air each day compared with less than 1.4 Kilogram of food and about 2 Kilograms of water. Compared with the other necessities of life, obligatory continuous consumption is a unique property of air. The insensible intimate inter-penetration of air which of course flows in and out from the lungs gives to all pollution its essential importance.

One of the major components of particulate matter which is the crystalline Silica has also been classified as a known human carcinogen and is associated with systemic autoimmune disease [1]. The relationship between Silica and pneumoconiosis has been reported in the Azandarian Area [2]. The occurrence of a pneumothorax was associated with complaints of pleuretic chest pain, resting dyspnea, respiratory distress, paroxysmal nocturnal dyspriea, orthopnea crackle. [3]

Exposure to pollutants can cause adverse health effects. They are also linked to higher mortality rate, heart disease and respiratory illness. [4-5]

Patients with pre-existing respiratory or cardiac illness appear to be at particular risk of the most severe adverse health effects caused by exposure to Inhalable particles. [6,7]

It has been suggested that plethora of ultra fine particles (particles smaller than 0.1µm) in urban air may be the explanation for the observed health effects of PM [8,9]. The adverse effects of ultra fine particles on respiratory symptoms, lung function and daily cardiopulmonary mortality have been discussed in several studies. [10-13]

The peak expiratory from rate (PEFR) has been shown to be very significant in the routine monitoring of healthy and asthmatic children. [14.15]

The burgeoning levels of particulate matter pollution can be deadly to humans during serious episodes by aggravating existing health problems through inflammation of respiratory tissues [16]. A serious air pollution episode in London in 1953 resulted in the deaths of 4,000 to 12,000 people [17]. Particulate matter can also damage the lung capacity of individuals who are exposed during childhood and adolescence, significantly decreasing their lung capacity through long term exposure [18].

2.0 MATERIALS AND METHODS

2.1 Background of the Study Area

The town Sapele is situated in the south-south geopolitical region of Nigeria with a population of about 135,800 (NPC 2005/2006). It was once an integral part of the old western region of Nigeria. It is presently a part of Delta State of Nigeria created in August 27, 1991, after having been part of the defunct Mid Western State (1963-1976) and the defunct Bendel State (1976-1991)

This study area is located within the co-ordinates of latitude 005^0 50$'$ 0$''$-005^{0}560$''$N and longitude 005^{0}37$'$0$''$ – 005^{0}45$'$0^{0}E. The study area has a total aerial extent of 165.25 square kilometers.

Sapele is located near the junction of Jamieson and Ethiope rivers and about 80 miles (144 kilometers) from the sea, well close into the timber yielding forest of the interior. Sapele is one of the first-rate wood industries in this region.

However, it is a commercial city with four petroleum and allied industries. The climate is tropical with two distinct seasons, wet and dry.

The major activities among the people of Sapele that generate particulate pollution are usually bush burning as pre planting preparation, combustion of solid waste as a means of waste disposal, gas flaring, re-suspension of dust from unpaved road, and the production of charcoal which involves the burning of wood in an open space from dawn till dust in four different locations in the city. These charcoal are usually exported to other countries and sometime nearby cities.

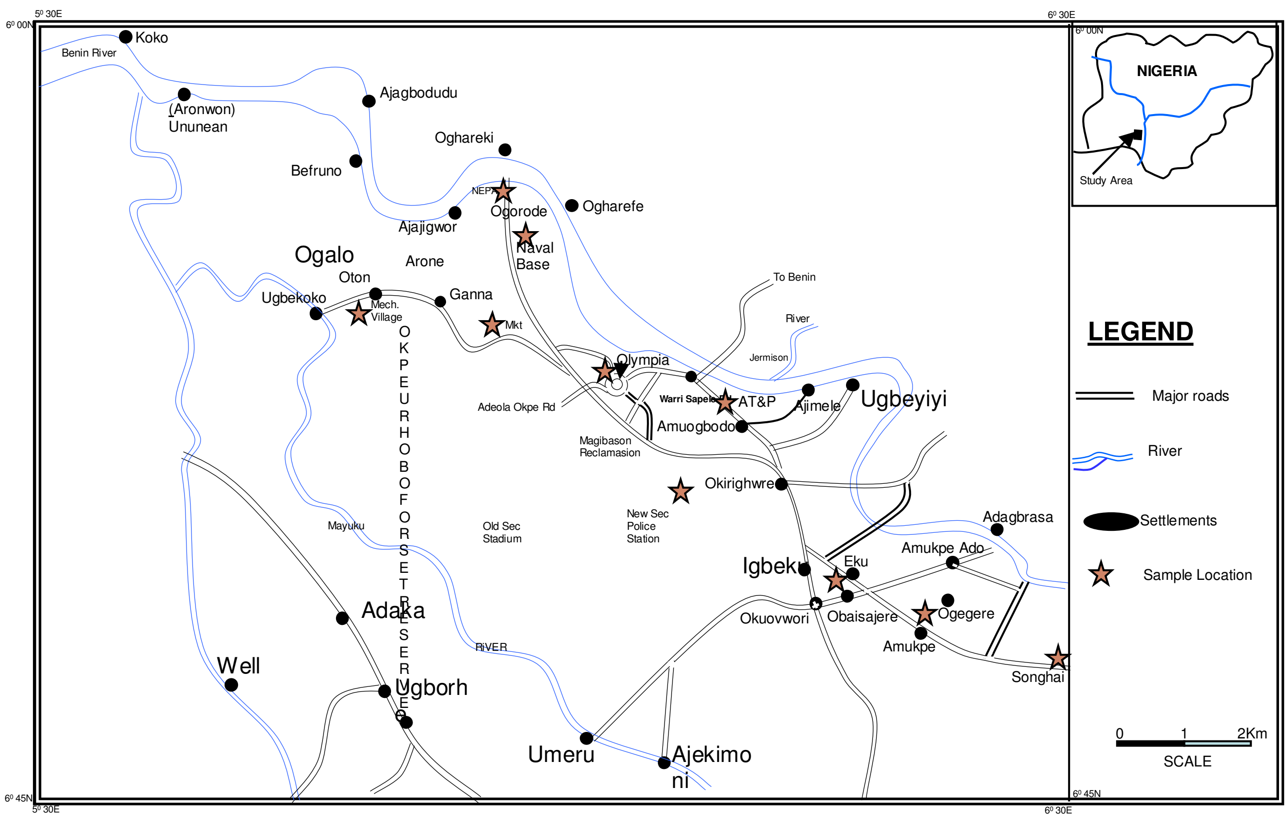

Fig.1 Map of Sapele Reflecting the various Sampling locations.

2.2 The SKC Air check XR5000 High Volume Gravimetric Sampler and I.O.M multi fraction dust sampler (institute of occupational medicine).

The filter and cassette rear was pre-weighed to determine the initial respirable dust, while the filter foam and whole cassette together was pre-weighed to determine the initial inhalable. After sampling, the filter foam, and the whole cassette together was re-weighed to determine the inhalable fraction. Then the whole cassette was split in order to weigh the cassette rear and filter only to determine the final weight of the respirable fraction. The particles were collected at a flow of 2L/min for eight hours and the sampler was placed between heights of 1.5m-2m of humans.

$$Conc.(\mu g/m^3)=\frac{\text{Final weight (mg)} - \text{Initial weight (mg)}}{\text{Flow rate}\left(\text{m}^3/\text{min}\right)\times \text{sampling period (min)}}\times 1000$$

2.3 Sampling Technique for Respiratory Symptoms

In each selected house, random sampling was used to select one respondent from among all eligible respondents. To be eligible, respondents must have lived in the location for not less than one year, and be above 18 years, not been diagnosed to have cardiac or respiratory disease. Four hundred questionnaires were administered. Data was collected using an interviewer administered English language Semi-structured questionnaire focusing on demographic characteristics, history of respiratory symptoms and perception of atmospheric air. Measurement of weight, height and Peak Expiratory Flow Rate (PEFR) were carried out for each study subject. Peak flow rate was assessed using the portable Wright's Peak Flow Meter (Clement Clarke International London UK). The technique involved a maximum inspiration followed by a forced expiration into the instrument with maximum effort without hesitation. A test was considered as technical satisfactory if it was without hesitation, laughing or coughing at expiration. Three readings were taken and the highest value recorded as the final reading. Values <300L/min] were taken as abnormal, while those ≥300L-/min were taken as normal. [19]

The administered questionnaires were collated and analyzed using SPSS version Software Package. Results were presented as statements, figures and tables with Chi-square test of association at statistical significance set as 0.05 calculated where appropriate. [19]

3. Results and Discussion

A total of 400 respondents participated in the study. The mean age for the study was 32.14±10.54. A greater proportion was between 20-29 age-group in the location. Also, a greater proportion of the respondents were single 206(51.5%)

The proportion of the respondents who lived in residential location was 188(47%) while a greater proportion of the respondents were in business premises 212(53%). Respondents with secondary level education were higher with 205(51.3%). The respondents who had resided for less than 4 years had the greatest proportion.

Table 3.1: Duration of stay of respondents

Duration of stay(years)	Urban Location
1 – 4	235(58.8)
5 – 9	104(26.0)
≥ 10	61(15.3)
Total	400

Table 3.2: shows prevalence of Respiratory symptoms by locations. In terms of self report of perceived air quality, 98(24.5%) of the respondents described the air they breath in as clean. From table 2 42(10.5%) experienced cough within the past 3 months, 43(21.3%) experienced phlegm while symptoms of difficulty in breathing chest pain and sore throat were low 59(14.8%), 55(13.8%) and 41(10.3%) respectively.

Table 3.2: Prevalence of Respiratory Symptoms in Sapele (Urban Area)

Symptom	Urban
Cough	42(10.5)
Phlegm	43(21.3)
Wheeze	53(13.5)
Difficulty in breathing	59(14.8)
Chest Pain	55(13.8)
Sore throat	41(10.3)

From table 3.3, the mean Peak Flow values in the Urban area (Sapele) were quite high (363.26±62.41) L/min, when compared to the normal value of peak flow rate which is $\geq$ 300

Table 3.3: Comparison of Peak Flow rate among respondents in Sapele (Urban Area)

	Smoker (n=136)	Non-Smoker (n=264)
PEFR (L/Min)	310.33±59.11	375.08±85.81

Tobacco smoke is a complex mixture of over 4,000 compounds, more than 40 of which are known to cause cancer in humans and animals and many of which are strong irritants. Exposure to tobacco smoke is responsible for approximately, 3,000 lung cancer death each year of non-smoking adult and impairs the respiratory health of hundreds of thousands of people.

Infants and young people whose parents smoke in their presence are at increased risk of lower respiratory tract infections (pneumonia and bronchitis) and are more likely to have symptoms of respiratory irritation like cough, excess phlegm and wheeze. [20]

Table 3.4: Abnormality of Peak Flow Rate and Smoking Status

Location	Smoking Status					
	Smokers			*Non-smokers*		
Urban	**Abnormal**	**Normal**	**Total**	**Abnormal**	**Normal**	**Total**
	20(14.7)	116(85.3)	136	34(12.9)	230(87.1)	264

Table 3.5: Spatial Variation of Measured Inhalable Fractions (µg/M^3) in Sapele from December 2008 – October 2009

S/N	Sampling Site	Site Code	Max	Min	Mean	Standard Deviation
1.	Mechanical Village	SP/MV	520.83	104.17	255.68	149.97
2.	Songhai	SP/SG	520.83	208.33	321.97	127.19
3.	New Ogorode Road	SP/NOR	625.00	104.17	321.97	183.13
4.	Residential House	SP/RH	312.50	104.17	132.58	67.36
5.	Olympium Junction	SP/OJ	416.67	104.17	227.27	78.20
6.	Sapele Market	SP/SM	625.00	104.17	303.03	164.40
7.	Industrial Area	SP/IA	1250.00	208.33	549.24	319.67
8.	New Eku Road	SP/NER	1041.67	312.50	568.18	330.26
9	Warri Sapele	SP/WSR	416.67	104.17	284.09	114.97
10.	Okinghwre	SP/OK	416.67	104.17	189.40	112.37

Table 3.6: Spatial Variation of Measured Respirable Fractions in Sapele (µg/M^3) from December 2008 – October 2009.

S/N	Sampling Site	Site Code	Max	Min	Mean	Standard Deviation
1.	Mechanical Village	SP/MV	208.33	104.17	132.57	48.65
2.	Songhai	SP/SG	312.50	104.17	170.45	70.23
3.	New Ogorode Road	SP/NOR	208.33	104.17	151.51	54.40
4.	Residential House	SP/RH	104.17	104.17	104.17	149
5.	Olympium Junction	SP/OJ	208.33	104.17	142.05	52.55
6.	Sapele Market	SP/SM	208.33	104.17	132.58	48.65
7.	Industrial Area	SP/IA	625.00	104.17	284.09	132.51
8.	New Eku Road	SP/NER	625.00	208.33	331.44	130.26
9	Warri Sapele	SP/WSR	208.33	104.17	123.11	42.13
10.	Okinghwre	SP/OK	312.50	104.17	170.45	70.23

Tables 3.6 and 3.7 show the concentration of inhalable and respirable fractions captured using SKC gravimetric sampler. From the data gotten, the permissible limits were exceeded in both respirable and inhalable (except site 4) - Respirable 65µg/m^3, Inhalable 150µg/m^3 (NAAQS)

Table 3.7: Pearson Correlation coefficient of anthropometric measurements on the Peak Respiratory Flow Rate

	PEFR
AGE	-0.34**
WEIGHT	0.07
HEIGHT	0.178**

**. Correlation is significant at the 0.01 level (2-tailed).

Age has a significant ($P<0.01$) weak inverse linear relationships ($r=-0.34$) with PEFR, weight has no relationship with PEFR while Height has a weak positive linear relationship ($r=0.178$) with PEFR. See table 7.

CONCLUSION

Numerous studies on respiratory mortality found no evidence for a threshold of PM effects which does not imply that no threshold exist (WHO, 2000). The inhalable and respirable components of the suspended particulate matter generated in Sapele (urban area) in Nigeria clearly exceeded the regulatory limit set by NAAQS. 14.7% of 136 smokers had abnormality with the peak flow rate, while 12.9% of 256 of non-smokers had abnormality with the peak flow rate. The highest respiratory symptom was shown in difficulty in breathing (14.8%)

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