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Prevalence of Cement Dust Exposure Related Illnesses among Residents of A Mining Community in North West Nigeria

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Abstract
Background: *Air pollution is a significant factor in morbidity and mortality within industrial societies. Hazardous substances are distributed widely due to diverse human activities such as energy usage, agriculture and industrial production enterprises such as cement manufacturing factories. In most industrial areas of the world pollutants such as ozone, sulphur oxides, nitrous oxides cause acid rains as a result of acidic dust in the pollution complex, some industrial regions however are confronted with problems of alkalization due to high content of various industrial alkaline dusts like cement dust and ash. Toxic effects of air borne alkaline pollutants like cement dust on humans include damage to eyes, respiratory and nervous systems and a number of teratogenic, carcinogenic and mutogenic effects. Dust and fumes produced in cement factories make the respiratory tract an easy point of contact and entrance into the body by cement dust.*
In a community in which such an industrial activity has been carried out on a large scale, since 1967, (its impact on the health of residents especially on long term basis warrants attention and needs to be investigated.
Objective: *This study investigated the prevalence of cement dust exposure related illnesses among residents of Kalambaina, the host community of a cement factory and compared it with that in Gidan Madi a similar community but without a cement factory. Both communities are situated in Sokoto State, Nigeria.*
Methodology: *A total of 514 respondents participated in the study; 244 residents of Kalambaina, the exposed community and 270 in the non exposed community (Gidan Madi,) a The study employed a comparative cross-sectional analytical design. An interviewer - administered semi-structured questionnaire was used to collect information on socio-demographic parameters, exposure to cement dust, respiratory signs and symptoms, and symptoms of other cement exposure related illnesses. It also enquired about habits like cigarette smoking. The information on occupation elicited those in dusty trades. The concentration of respirable dust was measured using the universal sample pump. The results were presented as mean ± standard deviation (SD),with statistical significance set at $p < 0.05$.*
Results: *The prevalence of cement exposure related illnesses: cough, phlegm, wheeze, shortness of breath with wheeze, chest pain, chest tightness, skin lesions and conjunctivitis were significantly higher in the exposed community $P<0.0001$ for all except breathlessness $P=0.005$. The concentration of respirable dust in the exposed community ($0.614 mg/m^3 \pm 0.02 mg/m^3$) was also significantly higher than in the non exposed community*

($0.06 mg/m^3 \pm 0.001 mg/m^3$) ($P<0.01$).

Conclusion: *These results suggest that the health of residents of the host community of the cement factory was adversely affected as evidenced by the higher prevalence of cement dust exposure related illnesses and this may be due to the higher level of cement dust they were exposed to.*

Keywords: *Silica, Cement dust, cement dust related illnesses, air pollution, Kalambaina. Nigeria.*

INTRODUCTION

In contrast to the world's experience of pollutants such as ozone, nitrous oxides sulphur oxides, and acid rains, a lot of industrial areas are confronted with problems of alkalization due to high content of various industrial alkaline dusts like cement dust and ash in the pollution complex.[1] Toxic effects of airborne pollutants such as cement dust on humans include damage to eyes, respiratory and nervous systems and a number of teratogenic, carcinogenic and mutagenic effects[2]. Cement making is inevitably a dusty operation as it is much concerned with hot dry powders. Various operations where stone or raw material is crushed in the cement factory produce fugitive dust emissions. Exposure to Portland cement dust has long been associated with the prevalence of respiratory symptoms and varying degrees of airway obstruction in man[1]. The symptoms include cough, phlegm, breathlessness, wheeze, shortness of breath with wheeze, chest pain, chest tightness, skin lesions and conjunctivitis which together may be referred to as cement dust exposure related illnesses. Apart from respiratory diseases; cement has also been found to be the cause of lung and laryngeal cancer, gastrointestinal tumours and also dermatitis.[3]

Deficiencies in monitoring of environmental performance and the compliance of many industries have been exploited by some factories in Nigeria. Consequently, several host communities and their environments are at risk from the negative health effects of such factory activities.[4-6] Cement manufacture causes enviro-nmental impacts at all stages of its production. These include emissions of airborne pollutants in the form of dust, gases, noise and vibration when operating machinery and during blasting in quarries.[7] Many of these air pollutants have been associated with increased respiratory morbidity and mortality across all age groups.[8-10] Children have been identified as a particularly high risk and vulnerable group.[10] In a community in which such an industrial activity has been carried out on for 44years, its impact on the health of residents warrants attention and needs to be investigated.

A few studies in Nigeria[11-16] have examined the effect of chronic exposure to cement dust on the health of cement factory workers. A study carried out on the workers of this cement factory found that the vital capacity and forced expiratory volume for one second percent were significantly lower in cement factory workers than in control subjects,($P<0.001$ and $P<0.005$) respectively. The haemoglobin concentration and packed cell volume were significantly lower than those of the control group ($P<0.0005$ and $P<0.02$) respectively). The white cell count and platelets count were significantly higher in the cement factory workers than in the control group ($P<0.05$ and $P<0.001$ respectively. For liver enzymes, alkaline phosphatase was significantly lower in the cement factory workers than in the control subjects $P<0.01$.[11,12] Thus cement dust was detrimental to health of the workers. It was found to be harmful to the lungs[11] and the heamopoetic system. [12] If these effects were reported in cement factory workers who are aware of the health risks of cement dust and claim to use protective devices, the fate of residents in the host communities, who are unaware of the health risks and use no protective devices should be of great concern.

Few researchers have measured the level of respirable cement dust in their study environment. Oguntoke *et al*[17] in their study on both work and host community environments of a cement factory in South West Nigeria, found mean concentrations of particulate matter of 10 µ (74–338 µg/m3) and 2.5 µ (28–116 µg/m^3) were significantly higher than permissible limits (50 µg/m^3 and 10 µg/m^3). Yang[18] in a study in a cement factory in Taiwan reported a mean dust concentration level of 3.58mg/m^3. This was much lower than 30.81mg/m^3 level reported by Oleru[19] a researcher working on cement factory workers in a cement factory in Nigeria. The National Institute for Occupational Safety and Health (NIOSH) [19] recommends that the exposure level of respirable dust must not exceed 0.05mg/m^3. There is therefore a need to measure dust levels when reporting health effects of cement dust exposure. This study investigated the prevalence of cement dust exposure related illnesses among residents of Kalambaina community in Sokoto State, Nigeria. It also measured the concentration of cement dust in the environment in Kalambaina community.

MATERIALS AND METHODS

This study was embarked upon following ethical approval obtained from the Usmanu Danfodiyo University Teaching Hospital Research Ethics Committee. A total of 514 respondents participated in the study: 244 residents of Kalambaina, the host community of the cement factory and 270 in the control group, residents of Gidan Madi, a community that has neither cement nor any dust generating factory. Gidan Madi is 70km away from Kalambaina. Both communities are rural, culturally and socio-economically similar. Kalambaina the host community of the cement factory is one of the 10 political wards in Wamakko Local Government Area (LGA) of Sokoto State. Kalambaina is divided into 22 settlement areas. The non exposed community, Gidan Madi is a political ward of Tangaza Local Government Area (LGA) of Sokoto State with 10 political wards.

Inclusion criteria were that the respondents must have resided in the study area for at least 5 years, must be 18 to 80 years old, must not have a respiratory infection(s), smoke or work in a dusty trade.

An interviewer administered semi-structured questionnaire elicited information on socio-economic and demographic parameters, exposure to cement dust, respiratory symptoms and other cement dust exposure related signs and symptoms.

Environmental Dust Measurements

Dust sampling

Samples of inhalable dust were collected from the three selected settlements in each of the two communities, 2 dust samples per settlement, that is, 6 samples per community, using the universal sample pump (SKCInc., 863 Valley View Road, Eighty Four PA15330 USA.). The pumps had been previously calibrated using the bubble meter calibration method that involved sucking a soap bubble through a 1 Litre burrette to estimate air flow.[20] This sampling equipment consists of a gas pump that sucks in air thereby causing respirable dust in the air to be captured. Its cassette consists of a fibre filter which was weighed before use. The sampling periods ranged from 8 to 10 hours at a rate of 2 litters/min. The samplers were mounted at an approximately head height of at least 160cm.[20] away from obstructions, fresh air inlets or strong winds. Thereafter the filter paper containing the dust was removed from the filter holder and weighed. The weight of the dust so obtained was expressed in milligrams per cubic meter of air (mg/m^3).[20] The volume of air passing through the sampler is calculated by multiplying the mean volumetric flow rate in cubic meters per minute by the sampling time in minutes. (Flow rate in litre/min = 1000 × flow rate in m^3 /min). The net weight gain (mg) of the sample substrate was divided by the volume of air sampled (m^3) to give the average dust concentration in milligrams per cubic meter of air (mg/m^3)[20]

Data management and analysis

Completeness of the questionnaire was checked while in the field. Data were entered in a computer using SPSS 15.0. Chi-square test was used for test association of two categorical variables, and for parametric data, the students't-test for two independent samples was conducted in SPSS 15.0 for windows (Inc., Chicago, USA, 2001). The results were expressed in mean ± standard deviation and statistical significance was set at P< 0.05.

RESULTS

Questionnaire response rate

Of the 540 respondents projected for enrolment into the study, 514 participated in the study; 244 from the exposed community (Kalambaina, the host community of the cement factory) and 270 from the non exposed community (Gidan Madi) giving an overall response rate of 95.2%.

Tables 1: Shows the socio-demographic parameters of the Exposed and Non- Exposed communities.

There were no statistically significant difference in the age, distribution of the two communities (P>0.05). Of the 244 respondents in Kalambaina, 14, (5.7%) were females. Out of the 270 respondents in the control community, 12 (4.4%) were females. The ratio of females to males for the two communities was 1:18 for Kalambaina 1:17 . Gidan Madi 1:22. Of the total respondents 4.5% had uncompleted primary or no education whatsoever. However, majority of the respondents, 70.0% had only quranic education. 1.6% however had tertiary education. The majority of the educated, 11.3% had completed primary education or uncompleted secondary education whilst 10.3% had uncompleted tertiary and complete secondary school education. There was statistical significant difference between the two communities in educational attainment. The non exposed community had higher educational attainment than the study community (P=0.04). Farming was the major occupation of the two communities as 48% of them were farmers. 32.5% were traders and very few 4.3%, were artisans. Civil servants made up 6.6%. There were significantly more farmers, artisans and civil servants in the non-exposed community than in the exposed community (p<0.003). The dominant ethnic group in the two communities was Hausa; accounting for 94.3% of the exposed subjects and 96.7% of the non exposed community. Majority, 95.5% of the total respondents were Hausas. Fulanis were 4.1% of all the respondents. Other tribes made up 0.4% of total respondents. The two communities had similar ethnic group distribution. The exposed subjects were 100% Muslims while 98.9% of the non exposed were Muslims with 1.1% Christians. The religious inclination of the two communities was similar (p< 0.2839).

Table1: Socio – demographic parameters of Respondents (Exposed and Non- Exposed communities)

AGE in years	Exposed n=244 Frequency (%)	Non-Exposed n=270 frequency(%)	Total n=514 frequency (%)	Test statistics P value
18- 35	148 (60.6)	159 (58.9)	307 (59.7)	
36- 55	71 (29.1)	95 (35.2)	166 (32.3)	χ= 11.545
56 – 80	25 (10.3)	16 (5.9)	41 (8)	p= 0.0729
Total	244(100)	270 (100)	514 (100)	
Gender				
Males	230 (94.3)	258 (95.6)	488 (94.9)	χ^2= 0.2177
Females	14 (5.7)	12 (4.4)	26 (5.1)	p= 0.6408
Total	244 (100)	270 (100)	514 (100)	
Educational Attainment				
None/ Primary uncompleted	14 (5.7)	9 (3.3)	23 (4.5)	
Primar completed/Secondary uncompleted	18 (7.4)	40 (14.8)	58 (11.3)	χ^2= 22.070
Secondar completed/ Tertiary uncompleted	18 (7.4)	35 (13)	53 (10.3)	p=0.04
Tertiary completed	2 (0.8)	6 (2.2)	8 (1.6)	
Vocational school	2 (0.8)	10 (3.7)	12 (2.3)	
Quranic education only	190 (77.9)	170 (63.0)	360 (70.0)	
Total	244 (100)	270 (100)	514 (100)	
Occupation				

Farming	139 (57.0)	108 (40)	247 (48)	
Trading	72 (29.5)	95 (35.2)	167 (32.5)	χ= 26.492
Artisan	2 (0.8)	20 (7.4)	22 (4.3)	p= 0.0031
Student	21 (8.6)	21 (7.8)	42 (8.2)	
Civil Servant	10 (4.1)	24 (8.9)	34 (6.6)	
Total	244(100)	270(100)	514(100)	
Ethnicity				
Hausa	230 (94.3)	261 (96.7)	491 (95.5)	χ^2= 4.988
Fulani	14 (5.7)	7 (2.6)	21 (4.1)	p= 0.0826
Others	0 (0)	2 (0.7)	2 (0.4)	
Total	244 (100)	270 (100)	514 (100)	
Religion				
Islam	244 (100)	267(98.9)	511 (99.4)	χ^2= 1.148
Christianity	0(0)	3(1.1)	3 (0.6)	p= 0.2839
Total	244 (100)	270 (100)	514 (100)	

Table 2: Anthropometric Parameters of Exposed and Non- Exposed Subjects

Variable	Exposed Subjects n=(244)	Non- Exposed n=(270)	Statistics t test	degrees of freedom	95% CI	p-value
Age range	18-80yrs.	18-75yrs.				
Mean Age yrs. ± sd	35.7±13.6	35.2 ±11.5	0.45	512	-2.68 to 1.68	0.65
Weight range(kg)	29-103	37-105				
Weight kg mean ± sd	61.3 ± 11.4	60.9 ± 9.6	0.43	512	-2.22 to 1.42	0.67
Height range	135-190cm	150-190cm				
Height cm. mean ± sd	172.1±5.9	173.8±5.9	0.134	512	-2.27 to 1.77	>0.1

The anthropometric paramaters of the exposed and non exposed subjects as presented on Table2. shows that in terms of anthropometry, the exposed and the non exposed subjects were marched for age, weight and height (P>0.05)

Table 3: Prevalence of Cement Exposure Related Illnesses

Symptoms	Exposed n=244(%)	Non-exposed n=270 (%)	Statistics χ^2	P value
Cough	98 (40.2)	10 (3.7)	15.54	<0.0001
Phlegm	102 (41.8)	9 (3.3)	13.01	<0.0001
Breathlessness	18 (7.4)	2 (0.7)	25.32	0.005
Wheeze	15 (6.1)	6 (2.2)	93.91	<0.0001
Shortness of breath with wheeze	30(12.3)	0(0.0)	22.02	<0.0001
Chest pain	15(6.14)	4(0.09)	60.75	<0.0001
Chest tightness	20(8.2)	0(0.0)	24.23	<0.0001
Skin lesions	18 (7.4)	3 (1.1)	37.30	<0.0001
Conjunctivitis	15 (6.1)	6 (2.2)	91.91	<0.0001

Table 3 shows that the prevalence of cement dust exposure related illnesses was significantly higher in the exposed than in the non-exposed community (P<0.01). In Kalambaina, the exposed community, a total of 200(81.96%) reported cough; out of these, 102 (41.8%) were productive of phlegm and 98 (40.2%) had dry cough. In the non-exposed community, 19 (7%) respondents reported cough and 9 (3.3%) of these produced phlegm. Haemoptysis was not recorded in any of the groups. Shortness of breath and chest tightness were not recorded in the non exposed group but were prevalent at 20(12.3%) and15(8.2%) respectively in the exposed community.

Skin lesions were reported in 18(7.4%) of the exposed respondents. These were dry itchy superficial lesions with lichenification on the exposed parts of the body i.e face, arms and legs. Most of the dermatitis from the non-exposed group were fungal lesions. Three respondents(1.1%) among the non-exposed group had skin lesions (tinea capitis, and tinea corporis). 15(6.1%) respondents in the exposed community had conjunctivitis while 6 (2.2%) in the non exposed community had conjunctivitis.

Association of cough with socio demographic variables (the exposed community)

Table 4 Analysis of cough in the various age categories, occupation and years of residence in Kalambaina

Characteristics	Cough	No cough	χ^2	Df	P value
Age					
18-45	64 (33.3%)	128(66.7%)	14.494	1	0.0001
46-65	30 (66.7%)	15 (33.3%)			
66-80	4 (57.1%)	3 (42.9%)			
Occupation					
Farmer	44(31.7%)	95(68.3%)	16.835	1	0.0001
Trader	30(41.7%)	42(58.3%)			
Others	24(72.7%)	9(27.3%)			
Years of residence					
Less than 10years	10(10.2%)	40(27.4%)	9.610	1	0.0019
More than 10 years	88(89.8%)	106(72,6%)			

Table 4 above shows the analysis of cough in the various age categories, occupation and years of residence in Kalambaina. The bivariate analysis showed that there was a statistically significant association between age of respondents and prevalence of cough (χ^2=14.494, df= 1, p= 0.0001).The age group 18-45years had more cough than those above 45years of age. Between the occupations, there is statistically significant association with cough (χ^2 16.835,df= 1,p= 0.0001) in the farmers. There is also statistically significant association with cough and years of residence (χ^2 9.610.df=1 p= 0.0019).

Association of skin lesion and socio demographic variables in the various age categories, occupation and years of residence in Kalambaina. (the exposed community)

Table 5 Analysis of skin lesion in the various age categories, occupation and years of residence in Kalambaina

Characteristic	Skin lesions	No skin lesions	χ^2	Df	P value
Age					
18-45	9 (50%)	183(95.3%)	15.049	2	0.0005
46-65	6(33.3%)	39(86.7%)			
66-80	3(16.7%)	5(62.5%)			
Occupation					
Farmers	10(55.6%)	129 (86.3%)	0.1869	2	0.9108
Traders	6 (33.3%)	66(91.7%)			
Others	2 (11.1%)	31(93.9%)			
Years of residence					
Less than 10yrs	8 (44.4%)	100(44.2%)	0.0002614	1	0.9871,
More than 10 years	10 55.6%)	126(55.8%)			

The bivariate analysis (table 5) above showed that there was statistically significant association between age of respondents and prevalence of skin lesion (χ^2= 15.049, df= 21, p= 0.0005) age group 18 – 45years had more skin lesions than those older than 45years. prevalence of skin lesions was not significantly related with occupation of respondents ($p>0.05$) or duration of stay in the community ($p>0.05$)

There is also statistically no significant association with skin lesions and years of residence (χ^2 0.0002614 .df=1 p= 0.9871). Younger residents (aged 18-45yrs) were significantly more likely to have skin lesions compared with older ones.

Association of conjunctivitis with sociodemographic variables in the various age categories, occupation and years of residence in Kalambaina. (the exposed community)

Table 6 Analysis of conjunctivitis in the various age categories, occupation and years of residence in Kalambaina

Characteristic	Conjunctivitis	No conjunctivitis	χ^2	Df	P value
Age					
18-45	10(66.7%)	182(79.5%)	1.683	2	0.4310
46-65	4(26.7%)	41(17.9%)			
66-80	1(6.7%)	6(2.6%)			
Occupation					
Farmers	10(66.7%)	129(56.3%)	0.7540	2	0.6859
Traders	3(20%)	69(30.1%)			
Others	2(13.3%)	31(13.5%)			
Years of residence					
Less than 10yrs	5(33.3%)	109(47.6%)	0.6491	1	0.4204
More than 10 years	10(66.7%)	120(52.4%)			

The bivariate analysis (table 6) showed that there was no statistically significant association between age of respondents and prevalence of conjunctivitis (χ^2= 1.683, df= 2, p= 0.4310).

Similarly occupation of respondents and duration of stay in the community bore no significant relationship with prevalence of conjunctivitis ($p>0.05$).

Environmental Dust Measurements

Table 7 Dust Concentration in the Exposed and non exposed Communities

	Exposed	**Non exposed**	**statistics**			
Particulates (mg/m^3)			t-test	df	95% CI	(p value)
Mean ± SD (mg/m^3)	0.614 ±0.012	0.06 ±0.001	112.69	10	-0.57 to -0.54	0.0001
Range	0.602 – 0.614	0.058- 0.06				
No.of samples	6	6				

NIOSH recommended level ≤ 0.05 mg/m^3

Table 7 shows that the concentration of dust in the environment was significantly higher ($p<0.01$) in Kalambaina (the exposed community) than in the non-exposed community. (0.614± 0.012mg/m^3 for Kalambaina the exposed community and 0.06± 0.001mg/m^3 for Gidan Madi (the non-exposed) community.

DISCUSSION AND CONCLUSIONS

The major findings of this study is that the health of the residents of Kalambaina, the host community of the cement factory was adversely affected and that this may be due to the high respirable dust concentration they were exposed to. Oguntoke *et al*[17] in their study on Impact of cement factory operations on air quality and human health in Ewekoro Local Government Area, South-Western Nigeria, found that the health profile of the factory workers and some residents of neighbouring communities showed high levels of respiratory and skin infections. Earlier studies[11,13,15,18] focused on cement factory workers or measured respirable dust concentration to which the workers were exposed to within the factory[13]. The present study showed that illnesses such as cough, phlegm, breathlessness, wheeze, shortness of breath with wheeze, chest pain, skin lesions and conjunctivitis were significantly more prevalent in the host community of the cement factory than in Gidan Madi, the non-exposed community. The respirable dust concentration in Kalambaina was also significantly higher than in the non-exposed community. Since the two communities were matched and therefore similar, the significantly increased respirable dust concentration in the cement factory host community must have been due to cement dust from the factory. Putting these together, it may be inferred that the higher prevalence of these illnesses in the host community may be due to the higher level of respirable dust, chiefly cement dust, to which they were exposed. It is also noteworthy that the respirable dust concentration obtained in the exposed community was more than ten times higher than the NIOSH recommended level of respirable environmental dust of ≤ 0.05 mg/m^3 while the dust concentration of the non-exposed community was only slightly higher. This may be because the non-exposed community (as well as the exposed) is located in the northern fringes of the Nigeria close to the Sahara desert. Earlier studies have shown that cement dust exposure in the factory[11,17] or in the community[17] led to higher prevalence of illnesses such as cough, phlegm, breathlessness, wheeze, shortness of breath with wheeze, chest pain, skin lesions and conjunctivitis.

This high prevalence of illnesses as a result of chronic cement dust exposure could be as a result of the nature of cement which is highly alkaline; (P^H12-13)[7] its setting process is exothermic. As a result, wet cement is strongly caustic and can easily cause severe skin burns if not promptly washed off with water. Similarly, dry cement powder in contact with mucous membranes can cause severe eye or respiratory irritation.[7]

Very few studies have been carried out to measure cement dust levels and to investigate the prevalence of chronic cement dust exposure on the health of residents or hosts of a cement factory. Oguntoke *et al*[17] in their study on Impact of cement factory operations on air quality and human health in Ewekoro Local Government Area, South-Western Nigeria found mean concentrations of particulate matter significantly higher than permissible limits within and around the production plant. They also found that the health profile of the factory workers and some residents of neighbouring communities showed high levels of respiratory and skin infections. In Tanzania Yhdego,[21] in his study found that diseases such as chest pain, cough, and eye problems in the villages affected by cement dust were likely to be due to cement dust. Adak et al[22] in their study on Ambient air quality and health hazards near mini cement plants, found that people of cement dust zone were badly affected by respiratory problems, and gastrointestinal diseases, Mehra et al in India,[23] in their study on health risks for population living in the neighborhood of a cement factory also had similar findings as this study. They found that cement dust is not only the major cause of environmental pollution in the study area but also a threat to health of local residents.

Based on the findings of this study, we recommend that To safeguard the health of cement dust exposed communities, regulatory agencies must ensure compliance by all dust producing industries and factories. Cement factories must acquire more effective dust emission control equipment to curb the level of cement dust emission into the environment. Periodic monitoring of dust level in the host communities and fines to be paid by offending industries will go a long way to improve air quality in the environment and compel cement factories to operate within acceptable levels. The health department of the local government of this host community should ensure the reduction to acceptable level, the emissions produced by this factory to reduce the occurrence of health hazards among the residents. The residents need to be educated on preventive and health promotion measures (improved personal hygiene) to protect themselves from the hazards of cement dust such as covering their noses and mouths with cloth to decrease inhalation of cement dust, and bathing at least once a day to reduce skin lesions caused by prolonged contact with cement dust. The residential houses and schools located in proximity to cement plants should be designed with the aim to achieve zero in-house dust exposure. As children studying in the schools situated in proximity to factories are particularly prone to cement dust exposure, the school buildings and rooms are required to be equipped with efficient and perpetually functioning dust capture devices like air conditioners where possible. The isolation of residential houses and schools near factory premises from the industrial production plants with robust green-belts, plantation strips and shelterbelts has also been suggested.[24-25] The species with high pollution tolerance index can be planted in several rows.[24-25]

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Competing Interests

The authors declare that they had no competing interests.

Author's Contributions

Merenu IA and Mojiminiyi FBO designed the study. Omokhodion F, Mojiminiyi FBO and Ibrahim MTO supervised the project. Merenu IA wrote the manuscript and all the authors read and approved the final version of the manuscript.