Impact of Industrial Pollutants on the Well-being of Residents in Obajana Cement Factory Area, Kogi State, Nigeria

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Abstract

Background: While industrial construction supports societal growth, the Obajana cement factory in Ajaokuta, Kogi State, Nigeria, has caused significant environmental issues due to toxin release. This study assessed the impact of industrial pollution on the physical and mental well-being of people living near the Obajana cement industry.

Methods: This study used a descriptive survey. The target population consisted of 5,085 locals living near the Obajana Cement Factory in Kogi State, Nigeria. Four hundred and twenty (420) heads of household were chosen using a multi-stage sample approach.

Results: The findings revealed that pollutants from cement mills severely harm the community's health.

Conclusion: This study highlights the importance of government action in enforcing environmental laws. Health agencies in Kogi State should launch awareness campaigns on the importance of regular medical checkups to reduce health risks. Meanwhile, relevant agencies must ensure factory compliance, and residents and workers must use personal protective equipment.

Keywords: Health, implication, pollutants, well-being, factory environment

Introduction

Industrial pollution can lead to respiratory infections, reduced lung function, and asthma exacerbation in local residents. Chronic obstructive lung disease, heart disease, and stroke are likely to be caused by prolonged exposure. Long-term exposure to nitrogen oxides and particulate matter can increase the risk of heart failure, and chronic exposure to air pollution has been linked to lung cancer. Industrial growth has benefited host nations, local communities, and global society despite the detrimental effects of industrial pollutants.

Prior research has shown that industrial growth is critical for creating the diverse economy that is required to attain

sustainable development (Perkins, 2022; Schroeder et al., 2019). The decrease in agricultural output, which is the main economic activity in sub-Saharan African nations, has contributed to this drive for industrialization. As a result, the region's expanding population has suffered in terms of both employment and income. According to the Joint WHO/Convention Task Force on the Health Aspects of Air Pollution (2007), health concerns associated with air pollution are a special issue associated with industrial growth.

The manufacturing and industrial sectors, which are the backbone of a country's economy, are mostly responsible for the tenfold increase in environmental pollution resulting from rapid economic expansion (Shah et al., 2021). Based on statistical data, the authors asserted that manufacturing facilities and industries account for almost half of pollution. Pollution is the primary source of many other interrelated societal problems and seriously threatens people's safety and financial security.

According to Shetty et al. (2023), numerous chemicals in environmental pollution may cause various human illnesses, climate change, and crises in public and private health. These contaminants may be linked to increased morbidity and mortality. Gull et al. (2013) noted that industrial pollution is caused by particles, specifically waste gases such as carbon monoxide, sulfur oxides, and nitrogen oxides, which are byproducts of businesses that ultimately enter the atmosphere.

Similarly, pollution occurs when any material or energy is discharged into the environment in quantities greater than what can be safely recycled or dispersed (Mabahwi et al., 2014). Pollution can be defined as the introduction of pollutants into the natural environment, which may result in undesirable changes. Siddiqua et al. (2022) define pollution as releasing hazardous substances into the air, water, or land.

Industrial pollution is one of the main causes of death globally compared to other pollution sources. Industrial pollution seriously affects fast-industrializing nations such as South Africa, Nigeria, and China (Shetty et al., 2023). Cement manufacturing commonly contains heavy metals such as cadmium, lead, and mercury, which can harm human health, particularly in children. For instance, the manufacture of cement is one of the many human activities that release cadmium into the atmosphere (RoyChowdhury et al., 2018; Hayat et al., 2019).

Humans frequently inhale most airborne contaminants through their respiratory systems. According to Brooks et al. (2023), air pollution caused by industrial pollutants is one of the primary causes of respiratory diseases such as asthma and lung cancer. Because pollutants are released into the atmosphere more quickly than the ecosystem can absorb and distribute, industries create a hazardous environment by releasing large amounts of smoke and other trash (Mabahwi et al., 2014).

The health of people is significantly affected by environmental contamination.

More than seven million people die each year as a result of fine particulate matter (PM), one of the most harmful pollutants (American Lung Association (ALA), 2020). According to ALA (2013), ozone and PM are two of the most dangerous air pollutants. Particulate matter (PM), a mixture of liquid and microscopic solid particles in the air, can lead to shorter lives. Shetty et al. (2023) highlighted the detrimental effects of environmental pollution and its links to respiratory conditions, infant mortality, and other health problems.

According to the US Environmental Protection Agency [EPA] (2009), one of the primary health risks associated with fine particle pollution is cardiovascular damage, including heart attack, stroke, heart disease, and congestive heart failure. Moreover, early mortality may result from both brief and prolonged exposure. Particulate pollution may worsen respiratory conditions including inflammation and asthma. This harmful air pollution can affect human development and reproduction in addition to causing cancer. Oxidative stress, which upsets the cellular equilibrium and is associated with several health issues, is another effect of pollution. Furthermore, cardiovascular diseases and mental health conditions including anxiety and depression have been linked to pollution exposure (Ukaogo et al., 2020).

Pollutants released into the atmosphere generally negatively impact the physical health and well-being of Chinese inhabitants (Zhang et al., 2022). According to Wang and Tang (2023), a higher standard of living is likely to result from an improved environmental quality. Physical and mental issues, including decreased well-being, have been linked to environmental contamination. The release of industrial pollutants significantly affects the health of individuals. Heat exhaustion, fatigue, and bone atrophy are the physical health problems associated with chemical exposure from cement manufacturing. Factory emissions can result in vertigo, general weakness, and in extreme situations, coma, or even death (Fernández-Navarro et al., 2017). Lead poisoning in children can result from lead emissions from cement kilns, incinerators, and crematoria (Hon et al., 2017). Waste is commonly used for heating and cooking purposes.

Respiratory disorders, particularly influenza, pneumonia, asthma, and lung disease, are important ailments linked to pollution, and are responsible for 249,211 fatalities in Nigeria (World Health Organization [WHO], 2010). It has been demonstrated that cement dust alters the architecture of internal organs such as the heart and liver. Air, water, and even tainted food can carry pollutants that are released into the atmosphere (Mallongi et al., 2023). Respiratory disorders such as cancer and chronic obstructive pulmonary disease have been linked to cement dust (Rachiotis et al., 2018).

Research has shown a connection between the location of cement production and various conditions including cancer and cardiac issues (Donato et al., 2016). In Lokoja, Kogi State, the Obajana

Cement Factory is most likely not an outlier. Consequently, this study aimed to ascertain whether the hazardous chemical by-products emitted during cement production present a health concern to locals living close to the Obajana Cement Industry.

Statement of the Problem

Various factors, including well-being, influence individuals' general health and wellness. These include physical ailments, environmental factors, dietary intake, and illness patterns. Establishing industrial facilities benefits the local population in many ways, including increased employment opportunities, better healthcare, better living conditions, and enhanced communal welfare. However, the researchers discovered that these changes also entail health risks even though urbanization and business establishments significantly benefit some places.

Purpose of the Study

This research investigated the health risks associated with the release of industrial pollutants from the Obajana cement industry. This investigation aimed to address the following questions: (1) Will the cement factory's discharge of industrial pollutants improve the physical well-being of people living in the Obajana neighborhood of Kogi State, Nigeria? (2) Will the residents of the Obajana neighborhood in Kogi State, Nigeria, be affected psychologically by industrial pollutants released by the cement factory? (3) Will the cement factory's release of industrial pollutants cause physiological issues that impair the general health of people living in the Obajana neighborhood in Kogi State, Nigeria?

Null Hypotheses

1. Emissions of industrial pollutants from the cement factory will not significantly affect the physical well-being of residents in the Obajana area, Kogi State.
2. Emissions of industrial pollutants from the cement factory will not significantly affect the psychological well-being of residents in the Obajana area, Kogi State.
3. Emissions of industrial pollutants from the cement factory do not significantly affect the physiological well-being of residents in the Obajana area, Kogi State.

Methodology

This study used a descriptive survey design. The target population consisted of 5,085 locals living near the Obajana Cement Factory in Kogi State, Nigeria. A multiphase sampling technique was used in this study. Obajana Town was divided into 12 zones, each consisting of two zones: Oyo/Iwaa, Obajana, Apata, Iwaa, Oshokoshoko, and Obajana/Apata, using a stratified random selection technique. A cluster sampling technique was then used to select 420 households from the 12 zones. Finally, 420 heads of household were chosen for the study using a purposive sampling technique.

Experts from the Department of Health Promotion and Environmental Health Education at the University of Ilorin, Nigeria, validated the questionnaire for data collection. A pilot test was conducted using the test-retest method. Applying the Pearson product-moment correlation coefficient (PPMCC) to the collected data yielded a reliability coefficient of 0.83. The chi-square ($\chi 2$) test was used to evaluate the hypotheses at an alpha level of 0.05.

Results

Hypothesis One: Emissions of industrial pollutants from the cement factory will not significantly affect the physical well-being of residents in the Obajana area, Kogi State.

The findings of this study on the influence of industrial pollution emissions from the Obajana Cement Factory on physical health are shown in Table 1. The analysis revealed a significant Chi-square (χ^2) value of 61.49 at the 0.05 alpha level, with a critical value of 12.59 at 6 degrees of freedom. We rejected the null hypothesis because the calculated chi-square value exceeded the critical value. This indicates that the physical health of individuals residing in the Obajana region of Kogi State is significantly affected by emissions from the Obajana Cement facility.

Table 1

Chi-square (x^2) Analysis on Emissions of Industrial Pollutants and Physical Well-being

S/N	Item	SA	A	D	SD	Row Total	Cal. X^2 Value	df	Crit. X^2 Value	Dec.
1.	Inhalation of airborne dust containing mercury, commonly dispersed into the air, is known to induce physical debilitation.	24 (27)	301 (310.33)	75 (54.33)	20 (28.33)	420	61.49	6	12.59	Hypothesis Rejected
2.	Prolonged exposure to the substances present in cement can result in the loss of sensation in the hands and feet.	41 (27)	340 (310.33)	24 (54.33)	15 (28.33)	420				
3.	Skin exposure to elements such as lead, mercury, and cadmium present in cement has been associated with adverse effects such as skin cancer, muscle atrophy, and the contraction or shrinking of the skin, among other potential consequences	16 (27)	290 (310.33)	64 (54.33)	50 (28.33)	420				
	Column Total	**81**	**931**	**163**	**85**	**1260**				

P<0.05

Hypothesis Two: Emissions of industrial pollutants from the cement factory will not significantly affect the psychological well-being of residents in the Obajana area, Kogi State.

As shown in Table 2, the impact of industrial pollutants generated by the Obajana Cement Industry on the frequency of psychological problems affecting the well-being of locals was examined using the chi-square statistic. The calculated Chi-square (χ^2) value at the 0.05 alpha level was 66.35, with a critical value of 12.59 at 6 degrees of freedom. Because the calculated chi-square value is higher than the critical value, the null hypothesis is rejected. This suggests that the industrial pollutants released by the Obajana Cement Industry have a significant influence on the psychological health of residents of Kogi State's Obajana area.

Table 2

Chi-square (x^2) Analysis on Emissions of Industrial Pollutants and Psychological Well-being

Item	SA	A	D	SD	Row Total	Cal. X^2 Value	df	Crit. X^2 Value	Dec.
1. Prolonged exposure to mercury and lead present in cement poses a significant risk of inducing adverse neurological effects	40 (38.33)	330 (328.33)	28 (29.33)	22 (24)	420	66.35	6	12.59	Hypothesis Rejected
2. Inhaling or coming into excessive contact with mercury and cadmium in cement dust may result in speech impairment, loss of consciousness, and an inability to maintain balance, among other symptoms.	60 (38.33)	5 (328.33)	40 (29.33)	40 (24)	420				
3. Heightened exposure to lead in cement can lead to a loss of sensation and a diminished sense of judgment.	15 (38.33)	17 (328.33)	20 (29.33)	10 (24)	420				
Column Total	**115**	**985**	**88**	**72**	**1260**				

P<0.05

Hypothesis Three: Emissions of industrial pollutants from the cement factory do not significantly affect the physiological well-being of residents in the Obajana area, Kogi State.

Table 3 presents the results of the chi-squared analysis examining how industrial pollutants from the cement industry affect the health of residents in the Obajana area. At the 0.05 alpha level, the chi-square ($\chi 2$) value was 81.64, while the critical value at 6 degrees of freedom was 12.59. The calculated chi-square value exceeded the critical value, leading to the rejection of the null hypothesis. This indicates that emissions from the cement factory have a significant adverse effect on the physiological well-being of the Obajana community.

Table 3

Chi-square (x^2) Analysis on Emissions of Industrial Pollutants and Physiological Well-being

S/N	Item	SA	A	D	SD	Row Total	Cal. X2 Value		Crit. X2 Value	Dec.
1.	Prolonged inhalation of cement dust has been identified as a potential catalyst for the development of chronic lung diseases.	25 (44.33)	305 (286.67)	60 (49.67)	30 (39.33)	420	81.64	6	12.59	Hypothesis Rejected
2.	Extended exposure of crucial internal organs, including the lungs, heart, liver, and spleen, to cement dust has been associated with a range of physiological issues, such as pneumonia, lung cancer, asthma, and arterial stiffness.	40 (44.33)	265 (286.67)	40 (49.67)	75 (39.33)	420				
3.	The dispersion of particles inhaled from cement dust within the body can manifest in various symptoms, including severe chest pains, headaches, and respiratory difficulties.	68 (44.33)	290 (286.67)	49 (49.67)	13 (39.33)	420				
	Column Total	**133**	**860**	**149**	**118**	**1260**				

P<0.05

Discussion

Physical issues are often caused by exposure to dust, which pollutes the air with harmful components such as lead, cadmium, and mercury. These pollutants are linked to health problems including skin tightening, muscle degeneration, and skin cancer. This aligns with WHO (2010) findings that lead and mercury exposure may cause lung problems, airway inflammation, and other physical restrictions. These findings also corroborate a 2001 study by the Portland Cement Association that demonstrated the harmful health effects of cement dust inhalation, such as skin cancer and respiratory diseases, through skin, eye, and inhalation contact.

Psychological effects, primarily caused by neurological poisoning from lead and mercury, significantly influence brain function. Inhaling dust containing mercury and cadmium can lead to cognitive impairment, numbness, difficulty speaking, and fainting. The study results are consistent with a United Nations Environmental Protection Agency report from 2002 that highlighted the harmful effects of mercury on brain development in both adults and children. In addition, symptoms of Minamata disease, such as nerve damage, difficulty in speaking, balance issues, sensory abnormalities, and movement problems, can result from exposure to lead and mercury (WHO, 2010).

Diseases affecting the heart, liver, spleen, lungs, and other organs can result from long-term exposure to cement dust. Cancer and other illnesses including asthma have been linked to this exposure. Symptoms include headaches, chest pain, breathing issues, and general discomfort. The findings support studies by Rachiotis et al. (2018) that examined the connection between cement dust and chronic lung diseases, as well as studies by Anthony et al. (2016) and Reuter (2013) that discovered chemicals from cement production can cause lung cancer, breathing problems, and even death.

According to the study, exposure to chemical emissions from the cement mill has a significant negative physiological, psychological, and physical impact on the Obajana people. This is consistent with previous research by the Portland Cement Association (2001), Shanshal and Al-Qazaz (2014), Moghadam et al. (2017), and Rahman et al. (2018), who demonstrated that emissions from cement factories are connected to a variety of health issues, including lung disorders, cancer, respiratory allergies, stomach and colon ulcers, and skin diseases. This study offers several recommendations.

Recommendations

1. The government must enforce compliance with the laws and rules for factory operations and environmental protection. This is essential for halting the continuous discharge of industrial pollutants into the ecosystem.
2. Regarding preventive measures, it is imperative to encourage and mandate the use of protective gear such as face masks, safety glasses, helmets, nose masks,

overall coats, and sanitizers by both residents and industrial personnel, whether operating within the plant or its premises. These safeguards are necessary to prevent people from breathing and absorbing toxins produced by cement manufacturers.

3. Health professionals, particularly health workers and related professionals, should raise health awareness and sensitization programs. Informing the local population of the need to closely follow preventive and control measures against the risks of living close to the Obajana cement mill in Kogi State, Nigeria, should be the primary objective of these programs.

4. Healthcare providers in Kogi State should educate residents about the importance of routine checkups. In addition to supporting overall health, this preventative approach addresses any potential degenerative disorder that can arise from exposure to environmental dangers.

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Conflicts of interest: None

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