NEAR EAST UNIVERSITY

INSTITUTE OF GRADUATE STUDIES

ENVIRONMENTAL EDUCATION AND MANAGEMENT DEPARTMENT

EXAMINATION OF KNOWLEDGE ON HEALTH EFFECTS OF AIR POLLUTION AND ENVIRONMENTAL SENSITIVITIES ON HIGH SCHOOL STUDENTS IN MONROVIA

M.Sc. THESIS

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Approval

We certify that we have read the thesis submitted by Nyonbada Deborah Strother titled **"Examination of Knowledge On Health Effects of Air Pollution and Environmental Sensitivities On High School Students in Monrovia"** and that in our combined opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Educational Sciences.

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Declaration

I hereby declare that all information, documents, analysis and results in this thesis have been collected and presented according to the academic rules and ethical guidelines of Institute of Graduate Studies, Near East University. I also declare that as required by these rules and conduct, I have fully cited and referenced information and data that are not original to this study.

Nyonbada Deborah Strother

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Abstract

Examination of Knowledge On Health Effects of Air Pollution and Environmental Sensitivities On High School Students in Monrovia

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The aim of this study was to assess high school students' knowledge of the health impacts of air pollution and environmental sensitivity in Monrovia, Liberia. A quantitative method was used, involving interviews with 389 students across five schools in the city. The findings of the study revealed that there is a limited knowledge of students on the health effects of air pollution (HEAP) and environmental sensitivity. The air quality in and around the schools was found to be poor, leading to serious health issues for students. The study highlights the need for education and awareness-raising efforts on the HEAP, as well as interventions to improve air quality in and around schools in Monrovia. The study provides important insights into the state of air pollution and its effects on the health of students in Monrovia, which can be used to inform the development of policies and interventions aimed at addressing this pressing public health concern. Succinctly, the study recommends the following: 1. Implement policies to reduce emissions from vehicles and industries in the vicinity of schools. 2. Encourage community involvement and participation in efforts to improve air quality in and around schools.

Key Words: air quality, air pollution, emissions, health effect, sensitivity

Table of Contents

CHAPTER I

CHAPTER II

CHAPTER III

CHAPTER IV

CHAPTER V

CHAPTER VI

List of Abbreviations

AP	:	Air Pollution
EAP	:	Environmental Air Pollution
GHG	:	Green House Gas Emission
HEAP	:	Health Effects on Air Pollution
NO_2	:	Nitrogen dioxide
SES	:	Social Economic Status
SO_2	:	Sulfur dioxide
SPSS	:	Statistical Package for Social Sciences

CHAPTER I
Introduction

Background

The Upper Guinean Forest is one of the two most significant forest blocks in Africa. More than half of West Africa's surviving tropical forests in Upper Guinea are found in Liberia. The country was designated a "central hotspot" in December 1999 for conservation efforts. It is a region that needs emergency security precautions. More than half of the Upper Guinean tropical forests in West Africa are found in Liberia. A total of 9.59 million hectares of land make up Liberia, of which 4.39 million hectares or 45% are covered by forests. Acres are categorized as degraded forests used for agriculture. Both the people of Liberia and the rest of the world gain a lot from the country's forests. In addition to supporting ecosystem services (including oxygen generation and soil stability) and providing habitat for a variety of local populations, forests can serve as a vital source of income. It makes it possible to extract non-timber forest products, which greatly benefits the government.

Due to investment, adaptation is essential in terms of population. Because attempts to generate jobs will be dependent on the future environment and that the young population will face the price of failure over the course of their lifetimes, investments aimed at the young population must consider climate change. Consequently, the creation and use of climate adaptation might be improved (Beccio, 2021). The future lifestyle of the young will differ from that of the elderly, who are more physically disadvantaged and susceptible to intense heat, which can worsen heat rises; thus, population aging may stress mortality caused by climate change. Additionally, warmer weather worsens outdoor air pollution like ozone, which disproportionately affects older individuals (PRB, 2001).

LISGIS acknowledges that there are 3.5 million people in Liberia. However, more recent estimates suggest that there may be between 4.2 million and 4.6 million people there (LISGIS, 2017a, and WHO, 2016), with around 48.9% men and 51.1% women. In the male-to-female ratio, the life expectancy at birth is 62/64 years (WHO, 2016). The demographic pyramid for Liberia demonizes the country's youthful majority.

For a number of reasons, the population pyramid's structure is crucial. The National Adaptation Plan process is first required since Liberia has a sizable youth population. Second, the nation will place a high premium on investments that generate new jobs. As was said in the vulnerability section, some of these jobs will be in the primary sector. Therefore, the sector's strategy and investments must guarantee that the technology and its development are environmentally friendly and climate change-resistant.

In addition, a youthful population will ultimately want to settle down and have kids, so they will need locations to grow that will protect them from the strains and shocks of climate change. In contrast to nations where the population is not rising, Liberia will eventually confront problems with spatial planning. As a result, the EPA considers climate change when planning for local and regional areas. The majority of Liberian roads are unpaved, making them inaccessible during the rainy season and polluting the air throughout the dry season. Flooding and the related health problems are brought on by the blockage of surface water channels with garbage. The ecology is impacted by how ships are disposed of after their useful lives. Ships may include substances that are hazardous to both human and environmental health, such as asbestos, oils, heavy metals, and polychlorinated biphenyls (PCBs).

One of the populations most susceptible to the negative effects of AP are young children (Fang et al., 2004). Air contaminants frequently target the respiratory system, which can have both short-term and long-term impacts. The range of respiratory side effects includes slight, asymptomatic alterations, minor symptoms, and even illnesses that can be fatal. However, AP is a changeable risk factor that may be subject to mitigating measures. Simple behavioural adjustments, structural modifications, and switching from unclean cooking fuels to clean cooking fuels are all examples of potential treatments. This study will continue the investigation of air pollution and its effects on school-age children in Monrovia, Liberia, in light of this reality Canha et al. (2015)

Statement of the Problem

Poor waste management and sanitation are some of Liberia's largest post-conflict issues. Poor waste management is a factor in the development of environmental conditions that might be hazardous to human health and welfare.

Other contributing issues included the decline and inefficiency of the pertinent metropolitan agencies. In certain localities, garbage collection and disposal systems were formerly in place, but they are no longer operational. Inadequate laws, lax enforcement, a lack of significant financial and human resources, a lack of the right technology, and an inefficient system to coordinate stakeholders are just a few of the issues.

Civil strife that has lasted more than ten years has caused infrastructure to be destroyed and fundamental services like waste management and environmental sanitation to be disrupted. Because of the war's increase in urban population, crowded conditions are now a serious issue, severely limiting access to essential services. For example, Monrovia's population density is expected to increase by 45% in 2000 (EIU 2003). Although Liberia lacks comprehensive information on trash creation and disposal, the Monrovia region is thought to produce about 145 000 t per year (UNICEF, 2004). This comprises garbage generated by cities, hospitals, businesses, and construction sites. The war and the on-going post-conflict economic crisis have rendered several municipal districts, including Monrovia, Buchanan, Gbarnga, Greenville, Harper, Kakata, and Robert sport, without garbage collection and disposal infrastructure.

Solid garbage is currently disposed of because suitable trash collection and disposal procedures do not exist. disposed of in porous soil in ecologically delicate areas like river channels, marshes, or abandoned quarries. Waste is frequently accumulated and burned outside. These dumping techniques, which are mostly used in vacant lots and streets, put the environment and public health at risk through air pollution, the possible contamination of surfaces and groundwater, exposure to pathogens, and harmful compounds.

It is necessary to enhance the institutional and administrative framework for waste management. There has never been a thorough waste management strategy in Liberia. Neither a disposal system nor a recycling program exists (UN/World Bank 2003). The institutions participating in the sector's institutions have ambiguous duties and responsibilities. The health consequences of air pollution and environmental sensitivity on Monrovia's high school students have long gone unnoticed by school administrators. In Monrovia, Liberia, inadequate ventilation and air pollution have been associated with chronic diseases, diminished cognitive function, fatigue, and increased absenteeism among school-age children. Secondary schools are therefore

not an exception, particularly D. Tweh High School, Monrovia College, Haywood Mission Institute, William Booth, etc.

These issues at these schools are mostly related to an abundance of floor dust particles and a significant dumpsite deposit in the surrounding area. A bad learning environment will result if nothing is done to remedy the extremely poor indoor air quality at these institutions. Dust, bacteria, and other microbes in the air, mildew, paint, and fresh drywall producing volatile organic compounds are just a few factors that work in concert to contribute to air pollution (VOCs). The health impacts of exposure levels and the lack of information regarding the number of pupils exposed in Liberia have made it difficult to determine in classrooms (Peng et al., 2017).

Purpose of the Study

The purpose of this study acknowledges high school students' knowledge of the health impacts of air pollution and environmental sensitivity, as well as data on the prevalence of these various air pollutants, which include dust, germs, and microbes in the air. In order to provide a healthy environment for students in Monrovia, certain conditions must be met. These conditions include limiting the amount of gas allowed during the construction or remodelling of a school building; preventing mildew, paint, sewer, and public septic tank leaks in school environments; and installing new drywall. Give students access to a calming interior environment and a path to better policy judgments. To provide students access to mechanical and structural systems in the classroom, combine them with design spaces. Implement the necessary scientific technology so that Monrovia's schools may be periodically examined for student health concerns. The study's main objective is to provide new avenues for investigation in the future.

Research Questions

The research questions indicate that the following questions are what this study is trying to answer:

- How is the health effect of air pollution knowledge level of the high school students in Monrovia?

- How is the environmental sensitivity level of the high school students in Monrovia?

Significance of the Study

The significance of this study acknowledges the environmental sensitivities and the health impacts of air pollution at the five-targeted schools. Additionally, it offers a solution-focused suggestion for reducing air pollution in the study locations. By this study, the effort will provide the scholar with new information. Besides, this study will increase school officials' understanding of air contaminants and their detrimental impacts on students. This is the first study to examine the effects of air pollution on human health and the environment in Liberia. Data from the World Bank, the Organization for Economic Co-operation and Development (OECD) and the United Nations Development Program (UNDP) were used.

Definition of Terms

- Air pollution is any chemical, physical, or biological agent that changes the way the atmosphere normally works and pollutes either the indoor or outdoor air.

- A chemical molecule called carbon dioxide, which has a density around 53% greater than that of dry air, is made up of a carbon atom covalently double-bonded to two oxygen atoms (National Institute for Occupational Safety and Health, NIOSH).

- When chemicals called contaminants are put into the air, they hurt people or other living things (Merriam-Webster.com Dictionary).

- In both plants and animals, the respiratory system is a biological system with particular organs and structures employed for gas exchange (Merriam-Webster's Online Dictionary).

- Ventilation is the introduction of outside air into a room that is primarily used to reduce and remove indoor contaminants from the air. In order to improve thermal comfort, it may also be used to regulate interior humidity, air motion, and temperature. Satisfaction with additional features of the interior environment or other goals (Merriam-Webster.com Dictionary).

CHAPTER II
Literature Review

This chapter examines the studies of various scientists in the field of science as they relate to air pollution and its effects on human health and the environment. The other connected research demonstrates the mitigation techniques for resolving the air pollution issue they encountered, ensuring a more sustainable way of life.

Theoretical Framework

Ambient air pollution has been linked to a variety of negative health effects, including lung cancer and impaired lung function. SEP is a significant health indicator since it affects how much air pollution a person is exposed. SEP has been discovered in epidemiological studies as a potential confounder (Bobak and Leon 1999; Dockery et al. 1993) and an impact modifier (Gouveia and Fletcher 2000; Gwynn and Thurston 2001; Zanobetti and Schwartz 2000). In this article, we review the most recent data, theories, hypotheses, and approaches related to the effects of socioeconomic conditions and air pollution on human health and wellbeing.

Those with a lower SEP may be more susceptible to the negative effects of air pollution since they already have poor health because of financial struggle and psychological stress. International organizations have identified both poverty and poor air quality as priority areas for public health solutions. Coexistence of these serious problems requires intentional attention from academics and politicians (Ezzati et al. 2002). World Bank (2002) acknowledge WHO estimates that by 2025, 65% of the world's people will live in cities. About 1.5 billion people already live in polluted urban areas. Poor air quality has been linked to poorer physical and behavioral health, as well as higher rates of death and hospitalization (Brunekreef and Holgate 2002, Clancy et al. 2002, Ritz et al., 2002; Ritz 2002).

Numerous factors can cause air pollution. The burning of fossil fuels is the primary source. Direct emissions of primary pollutants into the atmosphere because of chemical interactions between primary pollutants and atmospheric gases, secondary pollutants are created in the air. Understanding primary and secondary pollutants is crucial for developing pollution control measures and understanding air pollution (Holman, 2000). Emissions from power plants and automobiles are the

primary contributors to air pollution. These have dominated how air pollution is sourced.

The primary causes of air pollution are energy generation and consumption. It has accrued benefits for the well-being of people, ecological services, plant life, economic growth, and issues unique to certain regions. Most emissions of GHG and haze/smog are brought on by human activities. Every year, 7 million people die from air pollution. One-third of deaths from heart disease, lung cancer, stroke, and HIV/AIDS are attributable to it. According to Xue-Chao Wanga and Ji Jaromir Kleme (2019), poor air quality raises medical expenditures, has detrimental economic repercussions, decreases worker productivity, and harms soil, crops, forests, lakes, and rivers. Air quality management must be used (Elsom 1992). Changes in industries and their management, as well as a more contemporary fleet of vehicles, can be blamed (Brimblecombe, 2005).

Power plants and vehicle transportation are the primary producers of traditional air pollutants. In 1994, 61% of all SO_2 emissions and 19% of all NO_2 emissions in the EU were attributed to combustion in the energy and transformation industries. In the UK, road travel was responsible for 49% of NO and 4% of SO_2. Only 10–20% of the total NO and NO_x emissions in several Eastern European nations come from road transportation. Road traffic contributes more in urban areas (Holman, 2000). Specifically, in power plants that burn coal and heavy fuel oil, sulfur-containing fossil fuels create the majority of the sulfur dioxide that is released into the atmosphere. Road traffic can have a considerable influence in specific metropolitan areas while being a relatively minor emitter of SO_2 on a national basis. Due to limitations on the allowed sulfur content of motor fuels that were implemented in both the EU and the USA in the mid-1990s, it is expected that the high concentrations along the roadside will diminish (Möller, Schuetzle, Autrup, 1994).

However, other classification approaches have been put forth. The recipient of the pollutants serves as the basis for still another classification, as seen below. The presence of toxins in the air over lengthy periods is referred to as "air pollution." Without respect to smog, air pollutants include scattered particles, hydrocarbons, CO, CO_2, NO, NO_2, and ozone. Environmental noise must be regarded as a different public health threat (Stansfield SA, 2015).

Environmental pollution is caused by the introduction of dangerous poisonous compounds or by the raising of levels of pollutants that harm our ecosystem. As was already noted, pollutants may be fabricated and natural, as well as biodegradable or not. Furthermore, they could have a single source (a point source) or a number of dispersed sources. Pollutants can have different effects on the environment.

Climate and Air Pollution

The other side of the same coin is climate change, which degrades the condition of our planet (D'Amato, Pawankar, Vitale, Maurizia, 2016). Aerosols, methane, tropospheric ozone, and black carbon are some of the pollutants that block sunlight from reaching the atmosphere. As a result, the Earth's temperature is increasing, which leads to the melting of glaciers, ice, and icebergs.

The incidence and prevalence of both endemic and imported diseases in Europe will shift because of climate change. The length, timing, and intensity of outbreaks are significantly influenced by climate and weather, which alters the distribution of infectious diseases globally (Bezirtzoglou, Dekas, Charvalos, 2011). Mosquito-borne parasitic or viral illnesses are extremely vulnerable to climate change because heat both reduces the virus's incubation period and changes its geographic spread (Kjellstrom, Lodh, McMichael, 2017; Menne, Murray, Floods, 2013). Aerosol compounds, although quite tiny, have a big effect on the climate, as was previously stated. They have decreased global temperatures over the past 30 years and may spread sunlight (the albedo effect) by reflecting a quarter of the sun's rays back into space (Schneider SH).

Air Pollutant

Groundwater, soil, and the air are just a few of the environmental elements that air pollution has the power to destroy. Additionally, it poses a serious threat to all living things. In this respect, these pollutants are of particular importance to us since they are associated with more significant and pervasive issues with human health and environmental harm. Environmental factors such as climate change, acid rain, global warming, and the greenhouse effect all significantly affect air pollution (Wilson and Suh, 1997).

Pollutants come in two varieties: primary and secondary. Compounds emitted directly from a process, such as sulphur dioxide from industries, are examples of primary pollutants. Secondary pollutants arise from interactions of the main contaminants in the air. Ground-level ozone is one of the many secondary pollutants that contribute to photochemical smog (Puja Mondal, 2011). Almazán et al (2019) noted that air pollution has its side effect.

Air pollution is a major problem coming mostly from cars, buses trucks, industries, etc. It has been reported that living in some developing countries like Mexico and China is equivalent to smoking 40 sticks of cigarettes a day. Urbanisation and Unemployment one of the main costs of the quick procedure of urbanisation have been the growth provided by job searchers in together the new (formal) and customary (informal) areas of the economy of urban. Migration of Rural-urban has an important effect on joblessness stages of the destination towns. The urban' unemployment between 1998 and 1999, rose from 5.5 perecent to 6.5 percent, a rate more advanced than the state unemployment which boomed from 3.9 percent to 4.7 percent through the same time. Almazán et al (2019) noted that air pollution has its side effect.

Particulate Matter and Health

Wilson and Suh (1997) acknowledges the United States Environmental Protection Agency more commonly refers to the term "particles" as "particulate matter". Extremely small particles, often 2.5 micrometers in diameter or less, and PM10 particles, which have a diameter of 10 micrometers or less, make up particulate matter (PM) pollution (Cheung, Daher, Kam, Shafer, Ning, Schauer, et al., 2011; Cheung, Daher, Kam, Shafer, Ning, Schauer, et al., 2011; Daher, Kam, Shafer, Ning, Schauer, et al., 2011).

PM 2.5 monitors are limited in terms of the study region or city area and, as a result, are not representative of the entire population. An exposure error (Berkson error) appears to form, although the relative magnitudes of the short- and long-term effects are still not fully understood (Kloog I, Ridgway B, Koutrakis P, Coull BA, 2013). People who are exposed to high levels of air pollution experience a variety of illness symptoms and states. The relative magnitudes of the short- and long-term impacts have not been fully defined. Older people, children, diabetics and those with a history of heart disease or lung illness are among the most vulnerable groups.

There is a clear connection between respiratory ailments and breathing in air pollutants. These toxins will enter the body through the airways and congregate in the cells. The toxicity of numerous air pollutants can cause a variety of cancers to grow over time (Nakano, Otsuki, 2013). Benzene, dust, particulate matter, and long-term ozone depletion are all harmful to the environment. Birth weight, mother's smoking, genetic make-up, socioeconomic situation, and level of schooling are a few examples of these. However, diet starting with breastfeeding is still a significant factor. Most antioxidants that are essential to human defines against air pollution come from food (Kelly, 2004). Antioxidants work as free radical scavengers and stop free radicals in the brain from interacting with one another. Similar to this, a person's genetic makeup may have a varied impact on how vulnerable they are to the oxidative stress pathway (Boschi, 2012). Children exposed to lead exposure are hyperactive, violent and delinquent, and have lower IQs and may struggle in school (Bellinger, 2008). Increased levels of C_3 and immunoglobulin (IgA and IgM) serum levels are seen.

The Impact of Air Pollution on Children's Health

There is mounting proof that air pollution is bad for kids. Particulate air pollution has been linked to acute bronchitis in children. Even while it has long been believed that air pollution might make mild acute diseases worse, infant mortality, asthma, and atopy have all been related to it (Schwartz, 2004). Human health is negatively impacted by air pollution. It has been established that prolonged exposure to particulate matter (PM) has detrimental consequences for health. The presence of polycyclic aromatic hydrocarbons (PAHs), indicators of oxidative stress and chromosomal abnormalities are associated with high levels of biomarkers, such as PAH-DNA adducts. Pollution may have a negative influence on children's health from an early age (Srama, Blanka, et al., 2012).

Children suffer from the emissions caused by the use of fossil fuels. CO_2 is a major contributor to CO_2 emissions. The impoverished are the most vulnerable group. The consequences of air pollution and climate change brought on by the burning of fossil fuels on children's health and the economy are well proven in scientific and economic studies, according to all available literature. Pope Francis underlined the moral importance of protecting children and the less fortunate from the hazardous pollution brought on by fossil fuels in his most recent encyclical,

"Laudato" (Perera, 2012). There is no question that early exposure to air pollution causes a decline in lung capacity. In contrast to those who had migrated, children who had moved to new, less polluted neighbourhoods had higher lung matter levels.

The rise in the concentration of some harmful air pollutants is a result of climate change. Climate change causes emissions from burning fossil fuels, greater temperatures, and a unique interplay between harmful air molecules. The creation of O_3 from its predecessors has been accelerated by climate change. For instance, O_3 levels considerably increased during the summer of 2003 (Schär et al., 2003) during the European heat wave. In a substantial percentage of both Europe and the United States, especially during the summer, the climatic O_3 levels will rise as a result of the shift (Watts et al. 2015). States with an estimated median increase in O_3 fatalities throughout the summer in 2050 of 40.5 present compared to values from that decade (Knowlton et al., 2004).

Due to the many millions of children and adults who are made public, this purportedly tiny relative risk becomes a huge attributable risk. During the summer of 2013, there were median increases in emergency department visits of 7.3%. In the New York City metropolitan region, visits for asthma in children aged 0 to 17 are predicted to peak in the 2020s (Sheffield et al. 2011). Additionally, as previously indicated, asthma attacks and a rise in mortality due to O_3 have been related to delayed lung growth, lung health, as well as other problems with children's respiratory systems. In metropolitan areas all over the world, air pollution is one of the key factors contributing to poor respiratory health outcomes. Due to their undeveloped immunological and metabolic systems, fast lung development, abnormal breathing patterns, and high levels of outdoor activity, children. The Children's Health Study (CHS) is an ongoing series of longitudinal studies with the objective of demonstrating the long-term impact of respiratory infections in children. It was originally established in 1993 (Chen, Salam, Eckel, Breton, and Gilliland, 2015).

Air pollution is a significant global public health concern, according to the Global Air Pollution Assessment 2016. Exposure to air pollution puts people of all ages at risk for health problems. Children are more vulnerable than adults are to the many harmful health impacts of air pollution due to a combination of behavioural, environmental, and physiological variables. They could spend a lot of time playing outside and engaging in activities that could contaminate new-borns. New-borns and

young children spend the majority of their time indoors with their parents; this proximity to their moms when they cook polluting foods makes them more susceptible to home air pollution. Equipment and fuels Due to their shorter life expectancies than adults, children's health is more vulnerable to the manifestation of latent disease processes. They are more vulnerable because of their quick physical growth, especially where the lungs are concerned. Inflammation brought on by pollution and other damage.

While still within their mother, they are exposed to her environment. The embryo may be potentially exposed to latent dangers from pollution exposure before conception. They frequently carry on after delivery. The extremely young cannot just stand up and walk out of a room full of smoke. Their exposure can cause illness and other health issues by ingestion, inhalation, or exposure in utero. Lifetime commitments aside, it is solely our job as adults to protect children from the perils of dangerous air.

Liberia Air Pollution Status

In Liberia, air pollution is a serious problem for the next generation and is affecting all aspects of society. The energy needed by many businesses to run on a daily basis is produced by burning fossil fuels, and many Liberians use a lot of coal and oil in their homes. The Environmental Protection Agency of Liberia has only made small regulatory and interventionary efforts to address the problem (US Embassy Report 2015). One of the biggest environmental health hazards is air pollution, which is also the world's leading contributor to airborne illnesses and fatalities. Liberia's air is rated as being only somewhat safe. The estimated 1.5 million people of Monrovia and Paynesville cities' health and wellbeing are gravely in danger due to the area's deteriorating air pollution (Sheriff, 2020).

These disposal methods put the environment and public health in peril by polluting the air, perhaps contaminating surface and groundwater, and exposing people directly to pathogens and toxic substances. Prior to the conflict, the Monrovia City Corporation worked with a private company named Betty Garbage System to collect and transport residential and commercial solid waste in central Monrovia for disposal. According to sources, municipal solid waste was collected from 85% of the city prior to 1990.

A limited trash management system has started to operate in Monrovia. Monrovia City Corporation (MCC) has started to distribute garbage containers, collect rubbish, and dispose of it at a landfill with help from the World Bank. Approximately 4 km from the city centre, in the residential district of Fiamah, the legally authorized garbage disposal sits on the edge of a swamp. It is not the best location because it is a wetland's edge and an open dump, not an engineered landfill (although drainage structures have been built to direct off-site runoff around the dump site).

The MCC started using a landfill as the dumping location in Weintown, a rural region several kilometers outside of urban Monrovia, in June 2008, after the Fiamah dump was shut down. This is Liberia's first landfill to be built. Although it is a step in the right direction, it is still only a temporary solution because it is not a properly constructed landfill (it lacks a leachate collecting and treatment system). It is suggested that a properly designed landfill be built during the course of the following two to three years.

The MCC is running the system using both its own hardware and a subcontract with two outside contractors. MCC is making efforts to collect all of the trash produced in Monrovia, which is estimated to be 221,000 kilos per day, but it is currently unable to do so. The MCC has also made a determined effort to clear the city of rubbish accumulations with financial support from the World Bank. Hospital waste disposal poses a concern for human health as well as another possible cause of environmental deterioration. There is no list of medical institutions and how they dispose of their trash. It is known that several institutions in Monrovia are trying to handle and get rid of hospital waste in an efficient manner. However, the John F. Kennedy Hospital's medical waste incinerator has been out of commission for a while, so household and medical trash are disposed of in the courtyard and occasionally burned outside.

Given the low level of activity in these industries, potential hazards from construction and demolition, hazardous materials, and industrial solid wastes are assumed to be minor. Monrovia had 350 businesses operating there in 1990, down from 850 in the middle of the 1980s. Unknown numbers currently exist. Facilities are generally found in and around Monrovia and are mostly limited to producing non-metallic mineral goods, furniture, textiles and clothes, and brewing. However, it is possible that hazardous wastes will be generated in workshops and garages and

disposed of alongside household garbage. Although the extent of this degradation is unknown, pollution from industry, urbanization, automobile expansion, and burning (clearing for agriculture, bushfires, and wood fuel) has undoubtedly worsened Liberia's air quality.

Economic activity is the first step in the process of air pollution, when emissions from the sources are disseminated by the wind and other meteorological factors. In order to incorporate air pollution mitigation measures at the sources as well as the receiving ends, responses are needed in the form of technical intervention, economic incentives, laws and regulations, or monitoring procedures.

Related Research

Pertinent publications using Science Direct, Wiley Online Library, Springer Link, and Web of Science were ckecked. Regarding language or the year of publication, there were no limitations. The following search terms were entered:

(1) "Traffic-related pollution around the school";

(2) "Traffic-related pollution" and "children/students' health";

(3) "Transportation" and "student health";

(4) "Traffic environment exposure";

(5) "Student commuting style";

(6) "Influencing factors of traffic-related pollution";

(7) "Mitigation measures of traffic-related pollution";

(8) "Urban air pollution dilution";

(9) "Urban greening" and "traffic pollution"; and

(10) "Traffic emission reduction policy".

The following criteria were used to determine if a paper would be included in this study: (1) Papers were epidemiological or observational studies, including case-control, cohort, and cross-sectional studies, examining student health issues related to traffic-related pollution; (2) "traffic-related pollution" was added as a result of the study; (3) studies looked at the impact of traffic conditions on environmental pollutants during the school period, such as particulate matter, carbon monoxide (CO), elemental carbon (EC), nitrogen oxide (NOx), and sulfur dioxide (SO_2). Data were taken from significant publications and incorporated in this analysis after being manually taken from all articles and studies that could be connected. In all, 127

articles fulfilled the aforementioned requirements. 8.7% of the publications were reviews, while 91.3% were research articles.

CHAPTER III

Methodology

Research Design

The major goal of this study is to ascertain high school students' understanding of the health impacts of air pollution and environmental sensitivity in Monrovia and identify remedies to those issues. The negative impacts of air pollution that harm or damage human health and the environment are causing a lot of Liberians to suffer. In order to conduct a quantitative study, a structured survey was distributed to respondents through a Google Form. The answers were then put into the SPSS software so that a detailed analysis and evaluation could be done. Since people who responded to the surveys are from Monrovia, Liberia, and experience the direct and indirect health consequences of air pollution and environmental sensitivity among students, surveys are a useful tool for gathering data. The advantage of using a planned survey in the research's conception is that it is the least expensive way to carry out the study and obtain the data on schedule.

With the use of an interview-based questionnaire or survey research design, the quantitative research approach was employed to finish the quantitative interview data gathering procedure for this study. The technique of naturalistic inquiry known as "research design" tries to comprehend the intricate details of social phenomena in the environments in which they naturally occur. It also aids in concentrating on the who, what, when, and where of social phenomena. It also depends on the direct human experiences that act as the generators of meaning in their daily lives. Particularly primary data collection is encouraged by quantitative research. These are examples of primary data. Primary data may be acquired more rapidly and is simple and inexpensive to gather. This type of data collection is also known as desk-based research. However, for this study, data will also be gathered by "survey" (Long-Sutehall, Sque, and Addington-Hall, 2010).

Population and Sample

The term sample size is widely used in the statistical research. It has to deal with how research on a sizable population is carried out. The sample of this study is the high school students in Monrovia City. The population of the five schools in Monrovia from which the data were gathered is 9000 students according the data

collected from the principal head of those schools. The sample size for this research is 389. In order to calculate and determine the sample size, this formula was used with 90% confidence level 1.645, 5% standard deviation, and a margin of error (confidence interval) of +/-5%.

GeoPoll

$$\text{Sample Size} = \frac{(\text{Z-score})^2 \times \text{StdDev} \times (1-\text{StdDev})}{(\text{confidence interval})^2}$$

(1.645)2 x .5(.5)/(.05)2

(3.29 x .25)/.0025

.8225/.0025

389

The population targeted in this study area is 389 a total of which all respond as the minimum sample size. After distributing the data collection form all the students responded which indicates accurate data collection. Hence, the 389 sample size comprised of 200 females, constituting 51.4%, while males were 189 representing 48.6%. Therefore, more girls were interviewed compared to boys during the collection.

Table 1.

Distribution of Sample

Gender					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	200	51.4	51.4	51.4
	Male	189	48.6	48.6	100.0
	Total	389	100.0	100.0	

Data Collection Tools

The data collection tool which is generally used in quantitative methods research methodology is known as *"survey"*. The data collection forms were sent to participant via google form a well-encrypted platform together their view on the

research. As far as the analysis of data is considered, the evaluation was comparatively presented for the data collected during interviews. In addition, the interview findings were also supported by the quantitative analysis.

In this study a question form which prepared by researcher was used. In the preparation of the measurement tool, first of all, the literature was scanned, and question pools were created for the health effects of air pollution knowledge form and the environmental sensitivity form from the related studies and related measurement tools. The question pools sent for expert opinions took their final form after the corrections. Thus, a data collection tool was created in which demographic information is included in the first part, "The Health Effects of Air Pollution Knowledge Form" is in the second part, and "The Environmental Sensitivity Form" is in the third part.

Data Collection Procedure

The survey was primarily graded and heavily researched. The survey, which is created with the literature review and expert opinions, is the most effective way to investigate the student's opinion on the subject of study. The survey examines respondents' perspectives and knowledge of the various health risks associated with air pollution.

It is said to be that data collection tool in which a set or formally chosen structured questions are written and gathered at one place. The participants or the population is then required to provide answers to these questions based on their experiences and knowledge. It is considered as a data collection process as per the standard research approach. It allows the research to gain access to the information from a group of participants during the whole research. There are different kinds of questions that the researcher can use in a survey. In this survey, the questions that are used mostly fall in the category of closed-ended questions.

Data Analysis Procedures

The researcher uses quantitative research techniques as a strategy to provide results from data that were collected, through the use of SPSS Software data analysis. The data for this research was collected through the usage of survey as a data collection tool. It was based on online platform because it is extremely tough to gather participants and collect in-depth data about the research topic. Therefore, the

software or the online platform which was used for data gathering process is known as google form. In the current era, it is considered as the most successful software for seamless collection of data and conduction of survey. It is extremely easy to upload data on this platform regarding the survey, a link will be generated which will then be provided to the participants. In this study, data were collected through two separate forms. Frequency and percentage calculations were used in the analysis of the data, and the findings were expressed in tables.

CHAPTER IV

Findings

Findings for Research Question I: The Health Effect of Air Pollution Knowledge Level of the Students

Table 2.

How each participant understood the definition of air pollution?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	a) Poor air quality that is harmful to human	74	19.0	19.0	19.0
	b) Good air quality	209	53.7	53.7	72.8
	c) Clean environment	55	14.1	14.1	86.9
	d) Don't know	51	13.1	13.1	100.0
	Total	389	100.0	100.0	

The statistics provided show that the majority of students (53.7%) have a misconception about air pollution, believing it to be "good air quality." This suggests that there is a lack of understanding among students about what constitutes air pollution and the negative effects it can have on human health. Additionally, 14.1% of students believe air pollution to be a "clean environment" which further emphasizes the lack of understanding about the topic. Only 19% of the students correctly identified air pollution as "poor air quality that is harmful to human." This lack of understanding about air pollution among students is concerning, as it highlights the need for education and awareness-raising efforts on the topic.

Table 3.

Statistics showing answerable survey questions on the causes of pollution.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	a) A filthy environment with harmful substances in the air	76	19.5	19.5	19.5
	b) Only smoke	54	13.9	13.9	33.4
	c) Only waste	214	55.0	55.0	88.4
	d) Don't know	45	11.6	11.6	100.0
	Total	389	100.0	100.0	

This statistic shows that a majority of students (55%) believe that only waste causes air pollution. This suggests that there is a lack of understanding among students about the various sources and causes of air pollution. While waste can be a contributing factor to air pollution, it is not the only cause. Only 19.5% of students correctly identified that a "filthy environment with harmful substances in the air" causes air pollution. This highlights the need for education and awareness-raising efforts on the topic, as students may not fully understand the sources and causes of air pollution and the negative effects it can have on human health. Additionally, 13.9% of students believe that only smoke causes air pollution, which further emphasizes the lack of understanding about the topic. The statistics also reveals that 11.6% of students don't know what causes air pollution. This highlights the need for further research in the area of air pollution and environmental sensitivity among students in Monrovia, Liberia to better.

Table 4.

Different actions taken by the students to address the issues of air pollution

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	a) To reduce the risk of illness among students	22	5.7	5.7	5.7
	b) To create an environmentally friendly learning environment	99	25.4	25.4	31.1
	c) To improve air quality	45	11.6	11.6	42.7
	d) To enhance enrolment statistics	223	57.3	57.3	100.0
	Total	389	100.0	100.0	

Table 5.

Different answers on the existence of air pollution

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	a) From garbage piles in the environment	25	6.4	6.4	6.4
	b) From Unclean drainage	246	63.2	63.2	69.7
	c) Leakage of Public latrines Sewage System	60	15.4	15.4	85.1
	d) Smoke from the burning of garbage	58	14.9	14.9	100.0
	Total	389	100.0	100.0	

This table shows that garbage piles represented 6.4 percent, unclean environment 69.7 percent, leakage 85.1 percent, emission from burning garbage 14.9 percent. With this representation, it shows that lots of students answered leakage from sewage system at 85.1 percent.

Table 6.

Different kinds of effect from the aftermath being exposed to toxic air

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	a) Leads to a poor health condition	82	21.1	21.1	21.1
	b) Leads to happiness	207	53.2	53.2	74.3
	c) Leads to the good life	55	14.1	14.1	88.4
	d) Malaria	45	11.6	11.6	100.0
	Total	389	100.0	100.0	

The effect on exposure to toxic air numeric representation shows that 21.1 percent shows poor health condition, lack of happiness is 74.3 percent, lack of good health is at 88.3 percent and having malaria is 11.6 percent.

Table 7.

The overall numerical data collected on the statistics of the yearly air quality results

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	a) Very good	15	3.9	3.9	3.9
	b) Good	66	17.0	17.0	20.8
	c) Fair	69	17.7	17.7	38.6
	d) Poor	239	61.4	61.4	100.0
	Total	389	100.0	100.0	

This table shows the the overall air quality data of which many students says very good at 3.9 percent, good at 20.8 percent, fair 38 percent and poor 61 percent.

Table 8.

Answers on the definition of clean environment from the participants' view

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	a) An environment void of air pollution	61	15.7	15.7	15.7
	b) Half pollution-free environment	85	21.9	21.9	37.5
	c) filthy environment	210	54.0	54.0	91.5
	d) Environment with more smoke	33	8.5	8.5	100.0
	Total	389	100.0	100.0	

This table explains the different perspectives on the definition of clean environment, 15.7 percent says environment void of pollution, 37.5 percent half pollution-free environment, 21.5 percent filthy environment and 8.5 environment with reduce smoke.

Table 9.

The results of ways to minimize exposure to toxicity

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	a) Use a nose mask	61	15.7	15.7	15.7
	b) Cover my nostril with a handkerchief	67	17.2	17.2	32.9
	c) Bear it	65	16.7	16.7	49.6
	d) Do nothing	196	50.4	50.4	100.0
	Total	389	100.0	100.0	

This table shows the valid percent and cumulative percent of which 15 percent says the use of nose mask, 32.9 percent says cover nostril with handkerchief, 49 percent talks about bear it and 50 percent says to do nothing.

Table 10.

Answers on the best way to prevent air pollution

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	a) Keep the environment clean and safe	78	20.1	20.1	20.1
	b) Keep more garbage around us	55	14.1	14.1	34.2
	c) Burn dirt	202	51.9	51.9	86.1
	d) Release more C02 in the air	54	13.9	13.9	100.0
	Total	389	100.0	100.0	

The best ways to prevent air pollution question shows that 20 percent talks about having a clean environment, 34.5 percent have to keep more garbage around us, 86.1 percent burn dirt ad lastly 13.9 percent.

Table 11.

Air pollution health effects

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	a) Strongly	60	15.4	15.4	15.4
	b) Moderately	61	15.7	15.7	31.1
	c) Slightly	90	23.1	23.1	54.2
	d) Not at All	178	45.8	45.8	100.0
	Total	389	100.0	100.0	

This data shows that 15 percent answered strongly, 31 percent says moderate, 23 percent answered slightly and lastly 45 percent had no knowledge on the question.

Findings for Research Question II: The Environmental Sensitivity Level of the Students

Table 12.

Rating of the air quality in schools

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	a) Better	36	9.3	9.3	9.3
	b) Much better	77	19.8	19.8	29.0
	c) Worse	74	19.0	19.0	48.1
	d) Much worse	202	51.9	51.9	100.0
	Total	389	100.0	100.0	

This data shows the rating of air quality in schools of which 9 percent says better, 29 percent much better, 19 percent says worse and lastly 51 percent says much worse.

Table 13.

Severity of air pollution in schools

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	a) Moderate	32	8.2	8.2	8.2
	b) Low	86	22.1	22.1	30.3
	c) High	69	17.7	17.7	48.1
	d) Don't know	202	51.9	51.9	100.0
	Total	389	100.0	100.0	

This data shows the numerical representation on the air pollution within the environment of which 8 percent is moderate, 30 percent low, 48 percent high and 51 percent do not have an idea.

Table 14.

Students' view on improving their school environment

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	a) Strongly agree	67	17.2	17.2	17.2
	b) Agree	53	13.6	13.6	30.8
	c) Disagree	104	26.7	26.7	57.6
	d) Strongly disagree	165	42.4	42.4	100.0
	Total	389	100.0	100.0	

Do you agree that improving the environment in your school is the responsibility of everyone including students is the question for this data of which 17 percent strongly agree, 30 percent disagree, 57 percent strongly agree on the ratings.

Table 14.

How long it will take to improve air quality in schools?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	a) In the short term	63	16.2	16.2	16.2
	b) Within 3–5 years	57	14.7	14.7	30.8
	c) At least 10 years	174	44.7	44.7	75.6
	d) Long time	95	24.4	24.4	100.0
	Total	389	100.0	100.0	

"How long do you think it will take for air quality to improve in the school environment?", this question shows the numerical representation that answered in short term 16 percent, within hours 30 percent, at least 10 yrs 44 percent and longtime 24 percent

Table 15.

Scaling answers about environmental health problems

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	a) Not a problem	149	38.3	38.3	38.3
	b) Medium problem	136	35.0	35.0	73.3
	c) Problem	75	19.3	19.3	92.5
	d) Serious problem	29	7.5	7.5	100.0
	Total	389	100.0	100.0	

This data shows that 38 percent not a problem, medium problem 73 percent, 92 percent more problem and the last rating as 7.5 percent.

Table 16.

Raking of school administration priority on addressing air pollution

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	a) Low priority	67	17.2	17.2	17.2
	b) Medium priority	75	19.3	19.3	36.5
	c) High Priority	59	15.2	15.2	51.7
	d) Don't know	188	48.3	48.3	100.0
	Total	389	100.0	100.0	

The answers about "How would you rank the level of school administration priority in addressing environmental issues leading to air pollution?" show that low priority at 17 percent, medium priority 19 percent, high priority 15 percent and 48 percent do not know.

Table 17.

Different responses on the largest amount of gaseous air pollution

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	a. Industrial processes	170	43.7	43.7	43.7
	b. Fuel burning for space heating and electricity	72	18.5	18.5	62.2
	c. Transportation	62	15.9	15.9	78.1
	d. Solid waste disposal	85	21.9	21.9	100.0
	Total	389	100.0	100.0	

This data shows that 43 percent says industrial process, 18 percent fuel burning, transportation 15 percent, and solid waste disposal 21 percent.

Table 18.

Different kinds of harmful air pollutants

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	b) Carbon monoxide	96	24.7	24.7	24.7
	c) Hydrogen	65	16.7	16.7	41.4
	d) Nitrogen	182	46.8	46.8	88.2
	Oa) Carbon dioxide	46	11.8	11.8	100.0
	Total	389	100.0	100.0	

This table shows that 24 percent suffer carbon monoxide, 16 percent suffers hydrogen, 46 percent nitrogen and lastly 11 percent carbon dioxide.

Table 19.

The various types of diseases that arises from exposure to toxic air

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	a) Respiratory diseases	34	8.7	8.7	8.7
	b) Skin diseases	195	50.1	50.1	58.9
	c) Other diseases	90	23.1	23.1	82.0
	d) Don't know	70	18.0	18.0	100.0
	Total	389	100.0	100.0	

This data says that 8 percent suffer respiratory problems, 50 percent skin disease, 23 percent other diseases and 18 percent do not know anything.

Table 20.

Different answered survey questions relating to air pollution

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	a) Agree	44	11.3	11.3	11.3
	b) Strongly agree	68	17.5	17.5	28.8
	c) Disagree	70	18.0	18.0	46.8
	d) Don't know	207	53.2	53.2	100.0
	Total	389	100.0	100.0	

This table shows different results of the participants as it relates to air pollution 11 percent agreed, 17 percent strongly agree, 18 percent disagree and 53 percent did not know anything.

Table 21.

Survey rating of air quality in schools

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	a) Better	36	9.3	9.3	9.3
	b) Much better	77	19.8	19.8	29.0
	c) Worse	74	19.0	19.0	48.1
	d) Much worse	202	51.9	51.9	100.0
	Total	389	100.0	100.0	

"How do you rate the air quality in your school?" is a question that students answered 9 percent better, 19 percent much better, 19 percent worse, 51 percent worse 51 percent much worse.

CHAPTER V
Discussion

This chapter presents discussion of the findings, conclusion and recommendation of research with respect to the study questions:

- How is the health effect of air pollution knowledge level of the high school students in Monrovia?

- How is the environmental sensitivity level of the high school students in Monrovia?

The main aim of the study is to examine knowledge on the health effects of air pollution and environmental sensitivities on high school students in Monrovia, as well as statistics on the prevalence of these numerous air pollutants, which include dust, germs, and microorganisms in the air. A qualitative method was used in the methodology to analyse the findings and conclusion was made.

The survey forms were done by interviews in various high schools of which they answered based on their experiences. The data shows that air pollution toxicity is at its highest peak and it is very devastating and dangerous to human health and the environment. 389 people were interviewed about air pollution and the hazards that are associated with it. There were different questions being posed to individual students on air pollution hazards of which some includes, health impacts, direct diseases etc.

There are numerous Liberians being affected by the toxicity from air pollution, which causes many effects to human's health and the environment. For qualitative methodology an organized interview survey questions were posed to students and the responses were analyse into the SPSS software for exact examination of aftermath of the reviews. A survey is an advantageous method for leading this exploration because the examples of individuals who answer the inquiries are situated in Monrovia, Liberia. Another data approach that helped the researcher to understand the health impacts is the increase in different types of diseases arising from air pollution effects.

How is the health effect of air pollution knowledge level of the high school students in Monrovia?

The study conducted to assess the knowledge of 389 students on the health effects of air pollution in 5 schools in Monrovia, Liberia, found that there is a limited knowledge of students on the subject and its effects. This lack of knowledge is a cause

for concern, as air pollution has been linked to various health issues such as respiratory and cardiovascular diseases, cancer, and stroke. This is consistent with previous studies on air pollution and health knowledge in developing countries, highlighting the need for increased education and awareness-raising efforts on the topic.

Correlatively, a study by the World Health Organization (WHO) in 2016 found that in low- and middle-income countries, including Liberia, there is a lack of knowledge and awareness of the health risks associated with exposure to outdoor and indoor air pollution. This lack of knowledge can lead to a lack of motivation to advocate for policies and programs that address the issue, as well as a lack of individual actions to reduce exposure.

Another study by the United Nations Development Programme (UNDP) in 2017 found that in Liberia, as well as other sub-Saharan African countries, there is a significant gap in knowledge and awareness of the link between air pollution and health. This lack of knowledge can inhibit the ability of individuals and communities to make informed decisions and take actions to protect their health.

The results of the current study support the thesis that there is a need for increased education and awareness-raising efforts on the health effects of air pollution in Liberia. This could include incorporating information on air pollution and health into school curricula, providing training for teachers on the subject, and implementing community-based education and awareness-raising programs.

Lastly, the limited knowledge of students on the health effects of air pollution in Liberia, as revealed in this study, is consistent with previous studies on the subject in developing countries. It highlights the urgent need for increased education and awareness-raising efforts to address the issue in order to ensure the health and well-being of the population.

How is the environmental sensitivity level of the high school students in Monrovia?

The study, "Examination of Knowledge on Health Effects of Air Pollution and Environmental Sensitivities on High School Students in Monrovia," conducted an assessment of environmental sensitivity and knowledge of the health effects of air pollution (HEAP) in 5 schools in Monrovia, Liberia. The findings indicate that the air quality in the vicinity of all five schools is poor, which is causing serious health issues

for students. This is supported by previous studies on air pollution and health in developing countries, including Liberia.

A study by the World Health Organization (WHO) in 2016 found that in low- and middle-income countries, including Liberia, there is a high burden of disease from exposure to outdoor and indoor air pollution. The study found that air pollution is responsible for an estimated 7 million deaths per year globally, with the majority of deaths occurring in low- and middle-income countries.

Another study by the United Nations Development Programme (UNDP) in 2017 found that in Liberia, as well as other sub-Saharan African countries, air pollution is a significant public health concern. The study found that the majority of air pollution in these countries is caused by the burning of biomass for cooking and heating, as well as by vehicle emissions and industrial activities.

The results of the current study support the thesis that poor air quality in the vicinity of schools in Monrovia, Liberia, is causing serious health issues for students. This highlights the urgent need for actions to be taken to improve the air quality in and around schools, such as implementing policies to reduce emissions from vehicles and industries, promoting clean energy sources, and providing education and awareness-raising efforts on the health effects of air pollution.

Finally, the findings of this study indicate that the air quality in the vicinity of schools in Monrovia, Liberia, is poor and causing serious health issues for students. This is consistent with previous studies on air pollution and health in developing countries. It highlights the urgent need for actions to be taken to improve the air quality in and around schools in order to ensure the health and well-being of students.

CHAPTER VI
Conclusion and Recommendations

This thesis has emphasized the poor air quality in and around schools in Monrovia, Liberia, and its detrimental effects on the health of students. The studies conducted as part of this thesis have shown that there is a limited knowledge of students on the health effects of air pollution (HEAP) and environmental sensitivity. This suggests that there is a need for education and awareness-raising efforts on the topic.

Based on the findings of this thesis, the following recommendations are proposed to improve the air quality in and around schools in Monrovia and ensure the health and well-being of students:

1. Implement policies to reduce emissions from vehicles and industries in the vicinity of schools.

2. Promote the use of clean energy sources in and around schools to reduce air pollution.

3. Provide education and awareness-raising efforts on the health effects of air pollution for students, teachers, and school staff.

4. Tailor interventions according to the examination of students' environmental sensitivity and knowledge of HEAP, to address potential gaps.

5. Increase monitoring and surveillance of air quality in and around schools to track progress and assess the effectiveness of interventions.

6. Encourage community involvement and participation in efforts to improve air quality in and around schools.

It is important to note that addressing air pollution and improving air quality in and around schools in Monrovia will require a multi-faceted approach involving collaboration between government, schools, communities, and other stakeholders. It is also important to consider the socio-economic and cultural context in Liberia when implementing interventions.

Inclusive, the findings of this thesis suggest that poor air quality in and around schools in Monrovia, Liberia, is a significant public health concern that requires immediate attention. The recommendations provided can help to address the issue and improve the health and well-being of students. The thesis has successfully demonstrated that with proper knowledge, understanding and implementation of

appropriate measures, air pollution can be effectively addressed in the Monrovia schools and surroundings.

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Appendices

Appendix A
Ethical Approval

NAER EAST UNIVERSITY

SCIENTIFIC RESEARCH ETHICS COMMITTEE

04.11.2022

Dear Nyonbada Deborah Strother

Your application titled **"Examination of Knowledge on health effects of air pollution and environmental sensitivities on high school students in Monrovia"** with the application number NEU/ES/2022/900 has been evaluated by the Scientific Research Ethics Committee and granted approval. You can start your research on the condition that you will abide by the information provided in your application form.

Prof. Dr. Aşkın KİRAZ

The Coordinator of the Scientific Research Ethics Committee

Appendix B

Consent Form

Dear Participants,

I am writing my thesis that seeks to survey your opinion on how to support, promote and find mitigation measures to the impacts of air pollution in Liberia to close the gap of almost 60-70% of Liberians that are highly affected by the impacts of air pollution in order to have an environmentally friendly atmosphere.

By agreeing to participate, an interview session will take place through phone calls or direct face of which all information will be kept confidential. The data collected and information provided, will be stored for 2 years with security access lock so that others cannot get the information after which it will be deleted from the database. All interviews will be transcribed by anonymize any identifying information.

Please note that your participation in the study is voluntary and the data collected during the course of this study will be used for the academic research purposes only of which your identity will not be revealed in any case to third parties and pseudonyms will be used in all observational and interview data.

You may quit participating at any time by contacting us. If you opt out the study, your data will be deleted from our database and will not be included in any part of the study.

In case you have concerns and questions, please contact us using the information below.

Signature:

NYONBADA DEBORAH STROTHER

Environmental Education Department

Appendix C

Question Forms (Samples)

Section I. Demographic Information
Father's level of education
Mother's level of education
Gender
In which age group do you fall?
What class do you belong to?

Section II. Knowledge of HEAP
1. What is air pollution?
a) Poor air quality that is harmful to human
b) Good air quality
c) Clean environment
d) Don't know
2. What causes air pollution?
   a) A filthy environment with harmful substances in the air
   b) Only smoke
   c) Only waste
   d) Don't know
3. Where does air pollution come from?
   a) From garbage piles in the environment
   b) From Unclean drainages
   c) Leakage of Public Latrines Sewage System
   d) Smoke from the burning of garbage

Section III. Environmental Sensitivities
1. How do you rate the air quality in your school?
   a) Better
   b) Much better
   c) Worse
   d) Much worse
2. How severe would you say is the air pollution in your school environment?
   a) Moderate
   b) Low
   c) High
   d) Don't know
3. Do you agree that improving the environment in your school is the responsibility of everyone including students?
   a) Strongly agree
   b) Agree
   c) Disagree
   d) Strongly disagree

Appendix D

Turnitin Similarity Report
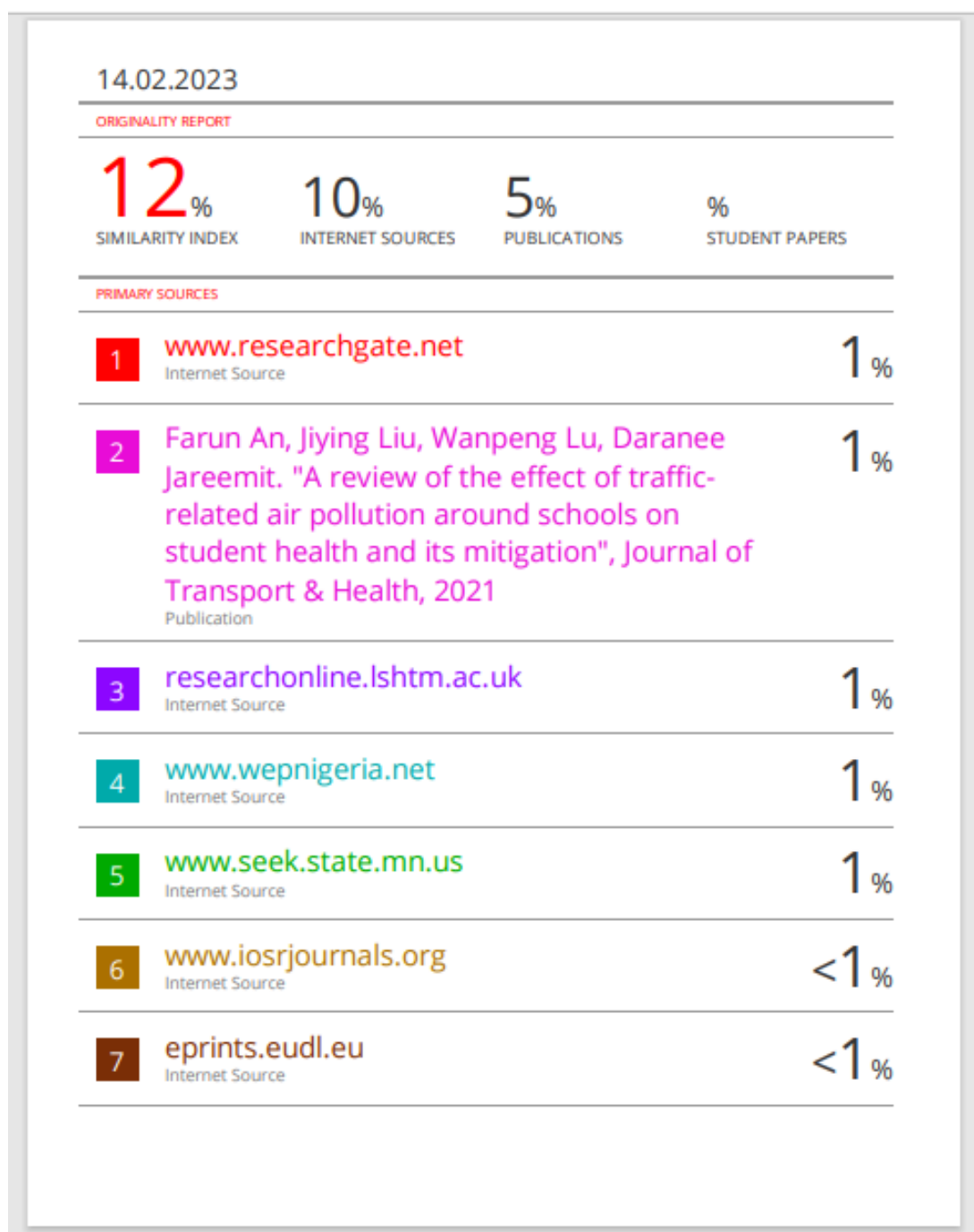
Curriculum Vitae

Nyonbada Deborah Strother

nyonbada@gmail.com

PROFESSIONAL BACKGROUND

Innovative teachers are skilled in integrating the 21st century into secondary education. They are adept at using modern instructional technologies (such as tablets, computers, smartboards, digital cameras, and the Adobe Creative Suite) both within and outside of the classroom. 9+ years of experience as a professor, mentor, and coordinator in charge of creating fresh programs and projects.

EMPLOYMENT HISTORY

Jul. 2018 - Present Montserado, Liberia

Coordinator STEM, National Science Teacher Association of Liberia

• Hold meetings with other staff members to organize and arrange classes that foster learning while adhering to the authorized curriculum.

• Consult with other specialists to discuss the requirements and development of specific pupils.

• Maintain accurate and thorough student records in accordance with legal requirements, school district rules, and administrative guidelines.

• Modify teaching strategies and course materials to accommodate students' various learning styles and interests.

• To prevent injuries and property damage, instruct and supervise students while they use the tools and supplies.

• Participate in staff meetings and committee work as needed.

• Work together with other educators and administrators to design, assess, and improve secondary school curricula.

Mar. 2015 - Present Monrovia, Liberia

Biology Teacher, Monrovia Consolidated School System

• Create course materials, including handouts, worksheets, and syllabuses.

• Make and use activities for a well-balanced schedule of teaching, demonstration, and work time that gives students the chance to watch, ask questions, and do

research.

• Serve as advisors to collegiate associations.

• Pick, order, and distribute textbooks, supplies, and other items for projects or courses.

• Use computers, TV, audiovisual aids, or other tools, resources, or technology to give content in an interactive or audiovisual format.

Jul. 2018 - Mar. 2021

Monrovia, Liberia

Coordinator/ Lab Tec, I-HELP LIBERIA

• Manage the stockpiling or distribution of supplies, resources, or other items used in the classroom.

• Create learning objectives and plans for courses of study in accordance with state and institutional curriculum standards.

• Set up classrooms with a range of resources or objects that kids may investigate, play with, or utilize for learning activities.

• Arrange and oversee class assignments, field trips, guest speaker appearances, or other hands-on activities, and assist students in deriving learning from them.

• Maintain precise and comprehensive student records in accordance with applicable laws, district policies, and administrative rules.

Jun. 2019 - Jun. 2020

Monrovia, Liberia

Community Service, June Care Foundation

• Control the professional, technical, and volunteer staff members' actions.

• Do research to find out what members or the community need to set the program's direction and goals.

• Execute and assess community, volunteer, or employee training initiatives.

null

• Speak on behalf of groups when interacting with governmental and media agencies.

Jul. 2018 - Oct. 2019

Monrovia, Liberia

Brain-science, Carter Center

• Instruct students in socially acceptable conduct using strategies like behavior modification or positive reinforcement.

• Use nonverbal communication to calm, inspire, or reinforce good behavior in youngsters.

• Make and follow rules for how students should act and how to keep order in the classroom.

• Develop or implement plans to meet the needs of students with various disabilities.

• Create assignments for volunteers or teacher helpers.

• Use specialized teaching methods or strategies to help students learn language, thinking, memory, and sensory-perceptual-motor skills.

EDUCATION

Nov. 2021

GED: Emerging Leaders Programs

• Young African Leadership Initiative, Accra, Ghana

Jul. 2018

GED: Economic Empower of Women

• Young African Women Congress, Accra, Ghana

Jul. 2018

GED: Brain Science

• The Ministry of Education and the Carter Center, Monrovia, Liberia

Jan. 2018

GED: Science Teacher Training Workshop

• I-HELP LIBERIA and MINISTRY OF EDUCATION, Monrovia, Liberia

Dec. 2013

Bachelor of Science: Biology

• T.R. Faulkner College of Science and Technology, Monrovia, Liberia

Sep. 2008

High School Diploma: High School

• Haywood Mission Institute, Monrovia, Liberia

SKILLS

Classroom Management Good communication Media Support

Experienced Skillful Beginner