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“Temporal not Permanent:” The impact of Covid-19 cities lockdown on improving Air Quality – a critical review of Africa

Emmanuel Mensah Aboagye

School of Law, Zhongnan University of Economics and Law, Wuhan-China, jaymens001@gmail.com

Felix Mensah

Department of Data Science and Economic Policy, University of Cape Coast, Ghana, emaboagye001@gmail.com

Kwaku Obeng Effah

Department of Political Science, University of Ghana, Accra-Legon, Ghana, effahkobeng@outlook.com

Sandylove Afrane

School of Environmental Science and Engineering, Tianjin University, Tianjin-China, sandilafrane@gmail.com

Jeffrey Dankwa Ampah

School of Environmental Science and Engineering, Tianjin University, Tianjin-China, emmens001@gmail.com

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Authors

Emmanuel Mensah Aboagye, Felix Mensah, Kwaku Obeng Effah, Sandylove Afrane, Jeffrey Dankwa Ampah, and Selina Annah Brenyah



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Emmanuel Aboagye

Zhongnan University of Economics and Law
jaymens001@gmail.com

Selina Brenyah

University of Energy and Natural Resources
mensmanuel001@gmail.com

Kwaku Effah

University of Ghana
effahkobeng@outlook.com

Sandylove Afrane

Tianjin University
sandilafrane@gmail.com

Jeffrey Ampah

Tianjin University
emmens001@gmail.com

Felix Mensah

University of Cape Coast
emaboagye001@gmail.com

ABSTRACT: The WHO declared the novel Covid-19 virus a global pandemic shortly after it broke out. The deadly virus spread has affected human health and seriously halted many economic and industrial activities globally. However, there has been a blight as there has generally been an improvement in air quality since the deadly Covid-19 pandemic caused various governments to lockdown their cities to regulate the spread of the virus. Since the widespread of Covid-19, there have been several researches to measure the extent of impact Covid-19 city lockdown has had global air quality, but no critical review has been done in Africa as a continent to assess the impact of Covid-19 on the impact of lockdowns on air quality. This study is geared towards a critical review of the impact of lockdowns on air quality in Africa. A total of 117 studies were found after a thorough review, and 87 studies met the screening criteria for the review. The literature was examined from Scopus, Google Scholar, PubMed and Web of Science. The study unraveled that in Africa, most of the studies were carried out on West Africa (45.6%), followed by North Africa (26.6%), East Africa (12.6%), South Africa (10.6%), and Central Africa (4.6%). Most of the studies have assessed the air pollutants like PM2.5, NO₂, SO₂ and CO. The study shows a significant improvement in air quality in Africa during the Covid-19 city lockdown. The research concludes that economic and industrial activities have resumed as various governments resort to partial city lockdowns. The improved air quality has just become an almost lost battle. Various governments in Africa should look for other effective means to help continue the fight against air pollution in Africa since Covid-19 lockdowns seem to be short-lived. This varied study on the impact of Covid-19 city lockdowns on air quality will certainly aid policymakers in Africa in finding any gaps, as it defines the perceptions of the existing systematic research.

KEYWORDS: *Covid-19 pandemic, urban city lockdown, air pollution, air quality, Africa*

I. INTRODUCTION

In December 2019, the world came to a standstill as it suffered from a novel coronavirus (Covid-19) [1,2]. The impact of the novel coronavirus was severe and fast-spreading such that the World Health Organization (WHO) in March 2020 declared it a “global pandemic” [3]. Various governments resorted to urban cities lockdown to control the wild spread of the deadly Covid-19 pandemic. Thus, there was temporal restriction and ban on industrial, economic, and major transportation activities [2]. To a more considerable extent, these restrictions served a lot of good by improving the general human health and environment since the fast spread of the Covid-19 was controlled. As the spread of the deadly Covid-19 increases, much research [4-7] unraveled that there has been some substantial improvement in air quality across the globe because of the controlled discharges from human, transportation and industrial activities during lockdowns. However, these improvements in air quality are considered temporal and not permanent since life is gradually reverting to its normal state.

Air pollution has caused many serious health problems like respiratory infections, stroke, Chronic Obstructive Pulmonary Disease (COPD), and lung cancers [8,9]. About 60% of the global urban population has been severely exposed to air pollution [10]. By far, air pollution poses one major health risk that eventually leads to the death of infected persons [11]. Following the reports of WHO, about 7 million persons have lost their lives due to air pollution and its attending health risks [10]. Further research reports unraveled that about 1 million premature deaths were reported in 2016, largely because of outdoor Particulate Matter ($PM_{2.5}$) pollution [12]. Based on the WHO statistics [10] on Global Ambient Air Quality of $PM_{2.5}$ of about a hundred

(100) countries, it was unraveled that the concentration of $PM_{2.5}$ was comparatively higher across the cities of developing countries, such as India, Bangladesh, Pakistan and Mongolia. More so, developing cities like Delhi (India), Dhaka (Bangladesh), Kabul (Afghanistan), Manama (Bahrain), and Beijing (China) are susceptible to dangerous air pollution. Globally, the current occurrence of the deadly Covid-19 pandemic has significantly impacted air pollution and air quality [1,2]. Since the outbreak of the Covid-19 pandemic, several researches have been conducted to ascertain the nexus between urban city lockdowns and air quality [13-16]. Most research conducted unraveled that the concentration level in $PM_{2.5}$, SO_2 , CO , and NO_2 , were reduced to an appreciable level due to the restrictions of human and industrial activities. To a larger extent, these studies have given the opportunity to identify, point out and understand the effects of human-caused emissions on the troposphere at all longitudinal scales, from provincial to worldwide. The research conducted demonstrated that there had been an appreciable improvement in air quality because of the lockdown. Still, researchers anticipate that the situation will be reverted when the lockdown restrictions are lifted [2, 5]. Some researchers [17, 18] have associated the rapid decrease in the concentration of air pollutants with the substantial decrease in fuel demand due to the lockdown restrictions.

Although numerous researches [19,20] have sought to unravel the relationship between air quality and the Covid-19 pandemic, the issues have not been fully explored. To the best of the authors’ knowledge, there has not been an assessment of the impact of the Covid-19 pandemic on air quality from the African perspective. The African continent has, over the years, suffered from air pollution control [21], and the government has found it challenging to curb the menace. Since the Covid-19 pandemic, the African continent has had its fair share of the spread of the deadly virus. Some researchers [22,23] also tout

that there has been a significant impact on air quality on the African continent due to the Covid-19 cities lockdown. With this research gap in the authors' mind, this paper sought to summarize the existing literature from April 2020 to April 2021, consisting of a hundred and seventeen (117) publications adopted to quantify changes in atmospheric pollutant levels. Thus, the researchers stipulate a point of view on the means and evaluations needed to develop from specific case research to a continental context of readily analogous outcomes. With the Covid-19 pandemic and its attending urban city lockdowns unending as of this study, this critical review aims to aid as a landmark in finding and measuring the general impacts of emission reductions to air quality on the African continent. This paper adds to the literature by exploring the premise that urban city lockdowns have significantly impacted air quality through a critical review approach. Also, the author's are of a strong opinion that, this paper is the first attempt at a critical review on the impact of Covid-19 urban city lockdowns on air quality in Africa. This research will help stakeholders and policymakers understand and implement plans to reduce air pollution concentrations at the city, regional, and country bases.

II. LITERATURE REVIEW

Covid-19 has not only wreaked havoc on the global economy but has also disrupted transportation and almost all other forms of mobility around the planet. These variants have considerably impacted the natural quality [2-4]. Covid-19 has a severe impact on human health and the global economy; nevertheless, limited social and economic activities also reduce contamination [24]. During the urban cities' lockdown, there were significant reductions in SO_2 , $\text{PM}_{2.5}$, CO , and NO_2 , and air quality. Most countries have declared a state of emergency to lessen the effects of Covid-19 and stop the spread of the novel coronavirus [25]. Polluted air contains harmful clusters of particles and gases such as black

carbon (soot), smoke, mold, pollen, methane (CH_4), and carbon dioxide (CO_2). Particulate matter (PM), black carbon, ground-level ozone (O_3), nitrogen dioxide (NO_2), nitrous oxide (N_2O), sulfur dioxide (SO_2), and carbon monoxide (CO) are only a few of the major sources of air pollution [26, 27].

From March to May 2020, researchers looked at the impact of Covid-19 on air quality in the US, Italy, and France [28-30]. The most significant cause of climate change is pollution in the air. The importance of air quality and its connection to the propagation of Covid-19 is revealed in this study. Covid-19 interventions resulted in considerable reductions in PM_{10} , $\text{PM}_{2.5}$, CO , and nitrous oxide emissions. Other researchers' point of view demonstrates the dramatic changes in the new coronavirus may have been significantly reduced due to the massive reduction in aerosol concentration during isolation [31]. Huang and Brown investigate the topographical differences in air contamination to analyze the impact of air pollution on Covid-19 disease in Germany. The findings reveal that prolonged exposure to NO_2 is entirely linked to the Covid-19 frequency rate in Germany [32].

The collection includes NO , NO_2 and PM_{10} concentrations, vehicle counts, and weather data obtained during the COVID-19 lockdown in Italy [33]. Coker also, in a study, investigated the ecological relationship between long-distance convergences of the region-level fine particulate issue ($\text{PM}_{2.5}$) and excess deaths in Northern Italy in the first quarter of 2020. Other studies also employed over 10,000 air quality stations spread across 34 countries to collect lockdown-related abnormalities for nitrogen dioxide, Ozone, and particulate matter smaller than 2.5 m in measurement during lockdown dates until May 15, 2020. ($\text{PM}_{2.5}$) [35]. More so, there has been a positive effect of the coronavirus outbreak and its city lockdown and public scenes on air pollution levels in East Asia investigated using satellite remote sensing [2]. Researchers find that the massive growth of the Ozone in East China is due to massive drops in

NO₂ convergences during lockdown conditions. The impact of Covid-19 relief gauges on air pollution concentration levels and the associated decreases in eternality for urban regions in ten US states and the District of Columbia have been investigated Berman et. al. The researchers discovered that PM_{2.5} concentrations in most states and the capital decreased throughout the relief period [19].

2.1 Covid-19 and Air Quality in Africa

Air quality around the continent has improved due to lower pollution discharges, with NO₂ down 45.5 percent, CO down 46.23 percent, Ozone down 61.1 percent, and AOD down 68.5 percent compared to the previous two years. Because of the lockdown and contrast with earlier extended stretches of 2018

and 2019, this investigation used a dual-information sensor from astronomical space to predict the progressions of air quality over Egypt in the first half-year from January to June 2020 [36]. In Morocco, the National Weather Service provided data on air quality (daily concentrations of NO₂, PM₁₀, and CO) collected in air quality stations. Covid-19 lockdown measures also resulted in a decrease in the concentration levels of traffic-related pollutants (NO₂, PM_{2.5}, and CO) and an increase in the country's air quality. In addition, it has been demonstrated in numerous studies that some pollutants, such as Ozone (O₃), have grown [37].

Study Region	Pollutants	Major Remarks	References
West Africa	PM _{2.5} NO ₂ SO ₂	It is seen that the new sorts of vehicles produced have to settle for what is the most convenient option, making them produce and emanate a greater amount of these into the air.	[43, 44]
North Africa	PM _{2.5} PM ₁₀ NO ₂ SO ₂ CO	Because of the fast development and expanded interest in transportation, food and other buyer products, there are weighty enterprises set up to satisfy these needs, and as such, a greater amount of these pollutants are delivered day by day.	[45, 46]
East Africa	PM _{2.5} NO ₂ SO ₂	There has been an expanded interest in modern heavy machines. These modern heavy machines are known to contribute vigorously to air pollutant discharge.	[47]
South Africa	PM _{2.5} PM ₁₀ NO ₂ SO ₂ CO	Exposure to these pollutants is higher in urban areas than in the countryside. This is because, in the urban areas, the issues of the traffic are high, the usage of power generators and domestic warming systems is too much.	[48, 49]
Central Africa	PM _{2.5} NO ₂ SO ₂	These air contaminants are abundantly found in regions that are close to urban communities than in distant regions.	[50, 52, 53]

Table 1: Presents various air pollutants and their observations in the study areas

Source: Authors Own Construct, 2022

Other researchers attempted to assess variations in the concentration levels of several air pollutants (mostly PM_{10} , NO_2 , and SO_2) in Salé city (North-Western Morocco) throughout the lockdown assess in this study. Before and during the Covid-19 lockdown period, constant measurements of PM_{10} , SO_2 , and NO_2 were taken. The discharges from vehicle exhaust and industrial output were meaningfully decreased due to the security measures and control activities implemented, contributing to the decreased concentrations of the analyzed pollutants [38]. In Ghana, for instance, during the coronavirus lockdown period in Ghana, West Africa, pollution levels in a traffic hotspot in the capital Accra decreased to historic levels. There is a current research sandpit that uses real-time, low-cost air-monitoring sensors. However, once the lockdown limitations were relaxed, pollution levels rose to pre-pandemic levels [39].

NO_2 emissions grew by 1.16 percent in Dar es Salaam during the same period, while the AAI stayed nearly steady [40]. The favorable impacts of the temporary Covid-19 lockdown on the air quality of Port Harcourt, Nigeria, were investigated. Before, during, and after the Covid-19 pandemic lockdown, air quality measurements aimed at determining the AQI of Port Harcourt Metropolis were monitored and compared [41]. After the lockdown, however, there was a regular increase of 100.7 points, ensuing highly poor air quality for people [42].

III. METHODS

In 2020, scientists concentrated much of their efforts on analyzing pollution readings from the ground and space, relying on the available satellites. More than two hundred (200) research publications were accepted for publication in peer-reviewed journals in the seven (7) months following the pandemic's start (March–September 2020).. To thoroughly assess the extent of this material, additional reviews will be required. This research aims to give an early amalgamation of this fast-emerging literature and a

critical valuation of the status of the first literature that authors of subsequent articles could find instructive.

The researchers using keywords, searched a total of one hundred and seventeen (117) research studies to begin the study. From the 117 research documents, eighty-seven (87) research papers were finally selected on two bases. In the preliminary stages, through screening, the researchers sorted the paper using the abstracts and titles of the papers. At the second stage, the researchers did further screening using the literature of the papers. The papers were selected based on the research scales, including the city, region, and country. Hence the selection of the eighty-seven (87) papers was finally included in this literature screening. The researchers set a premise before the final selection of the review assessment. In this review process, the researchers first counted the impact of lockdowns on the air quality at the city, regional, and country scales. Secondly, the researchers did the literature screening from April 2020 to April 2021. The specifics of the literature screening procedures are shown in Figure 1. The researchers further considered previous literature based on the objectives of the study (*see* Tables 1 and 2), for instance, studies performed on the impact of lockdowns on the air quality at the city, regional and country scales, respectively. The researchers have presented the literature screening using the PRISMA flow chart [51] (Figure 1).

2.1 Keywords for Search of Academic Databases

The researchers searched the following keywords “air pollution,” “air quality,” “urban city lockdown,” “Covid-19 pandemic,” and “Africa”. Scopus, Google Scholar, PubMed, and Web of Science were the main databases searched. Most of the articles were searched from Google Scholar, followed by Scopus and Web of Science (Figure 1).

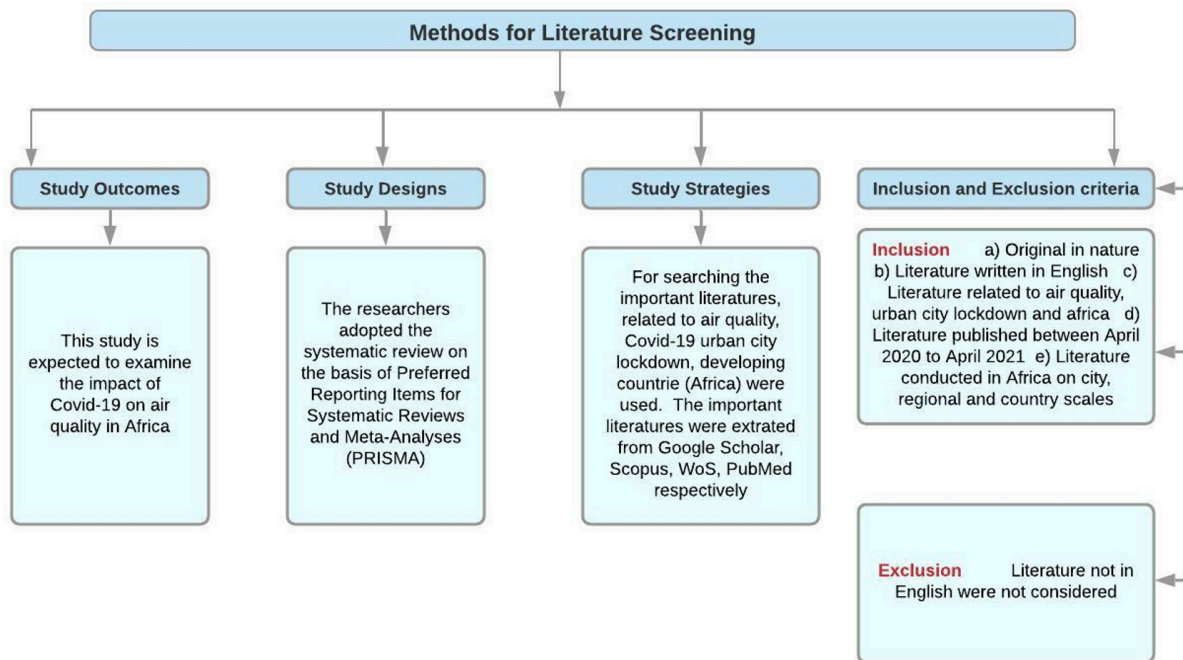


Figure 1: PRISMA flow diagram showing procedure used for literature screening.

Region	Country	Number of Studies	Percentage (%)
North Africa	Algeria (6), Egypt (9), Morocco (5), Tunisia (4)	24	26.6
East Africa	Ethiopia (3), Kenya (2), Madagascar (1), Uganda (3), Zambia (2)	11	12.6
West Africa	Burkina Faso (4), Cameroon (3), Gambia (1), Ghana (7), Niger (5), Nigeria (10), Senegal (3), Mali (6)	39	45.6
South Africa	Botswana (3), Namibia (1), South Africa (5)	9	10.6
Central Africa	Angola (2), Central African Republic (2)	4	4.6
Total		87	100

Table 2: Distribution of literature across African continents.

IV. RESULTS

4.1 Geographical Distribution and Covid-19 Studies in Africa

In Africa, the population continues to increase. Some researchers have made projections about the exponential growth across the continent by 2050 [54]. Researchers [55] have indicated considerable inequality in population distribution among African countries. There is a representation of the continent's high populace supply, including Nigeria, obviously the most populated close to the middle and our adjusted at the borders - Egypt, Algeria and Sudan toward the north, Ethiopia, Kenya, Tanzania and Uganda to the east and South Africa toward the south.

Other researchers have predicted that Asia, the populated continent, is expected to drop in population by about 4% by 2050 and a possible drop of about 43% in 2100 [56,57]. It is expected that the world's population growth will be concentrated on the African continent due to increased fertility. Although many developed economies have suffered more severe consequences than underdeveloped economies, the world has been worried about the African continent, especially considering the capacity to manage the Covid-19 novel virus, which was declared a global pandemic [58].

Africa recorded its first Covid-19 case in the Northern part of the continent, specifically Egypt, on 14th February 2020. The Covid-19 virus quickly spread to West Africa, specifically Nigeria, in February 2020. The virus spread so fast throughout the African continent. At the end of May, almost every country in Africa had recorded at least a Covid-19 case. It's realized that many studies have been conducted to measure and ascertain the impact of the Covid-19 pandemic on air pollution and air quality (87) (see table 2). Considering the available literature on Air Quality (AQ) and Covid-19 in Africa, it was realized that researchers had examined issues in these areas from West Africa (45.6%), followed by

North Africa (26.6%), East Africa (12.6%), South Africa (10.6%), and Central Africa (4.6%). In all these studies, most of the research was conducted in urban cities, which are mostly considered highly polluted areas, especially in capital cities and heavy industrial areas. More so, most of the studies focused on the concentration of $PM_{2.5}$, PM_{10} , NO_2 , SO_2 , CO (see table 1).

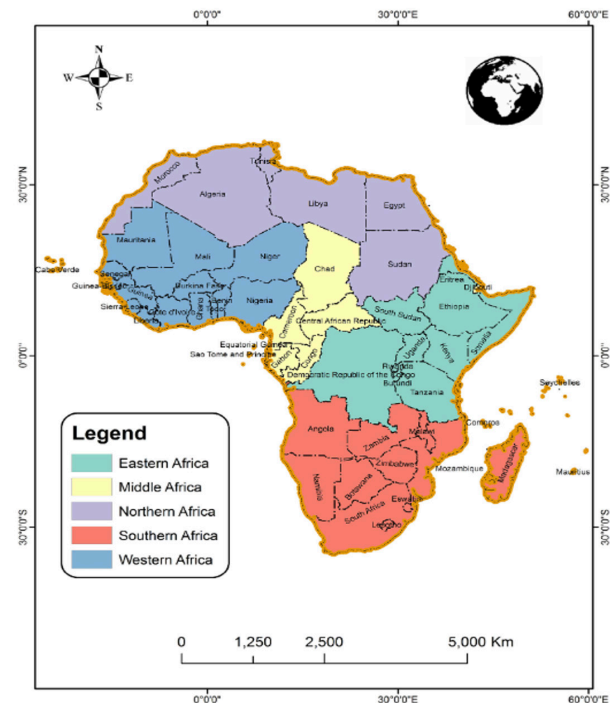


Figure 2: map showing study area on regional division

4.2 Impact of Covid-19 on Air Quality in Africa

In a quick countermeasure to the spread of Covid-19, most governments in Africa put in place some shut down measures of economic and industrial activities. Several researchers suggest that air pollution, AQ and Covid-19 are linked such that there is a massive improvement in AQ from a global point of view [2-5]. The literature further shows that Covid-19 spread is higher in polluted regions where

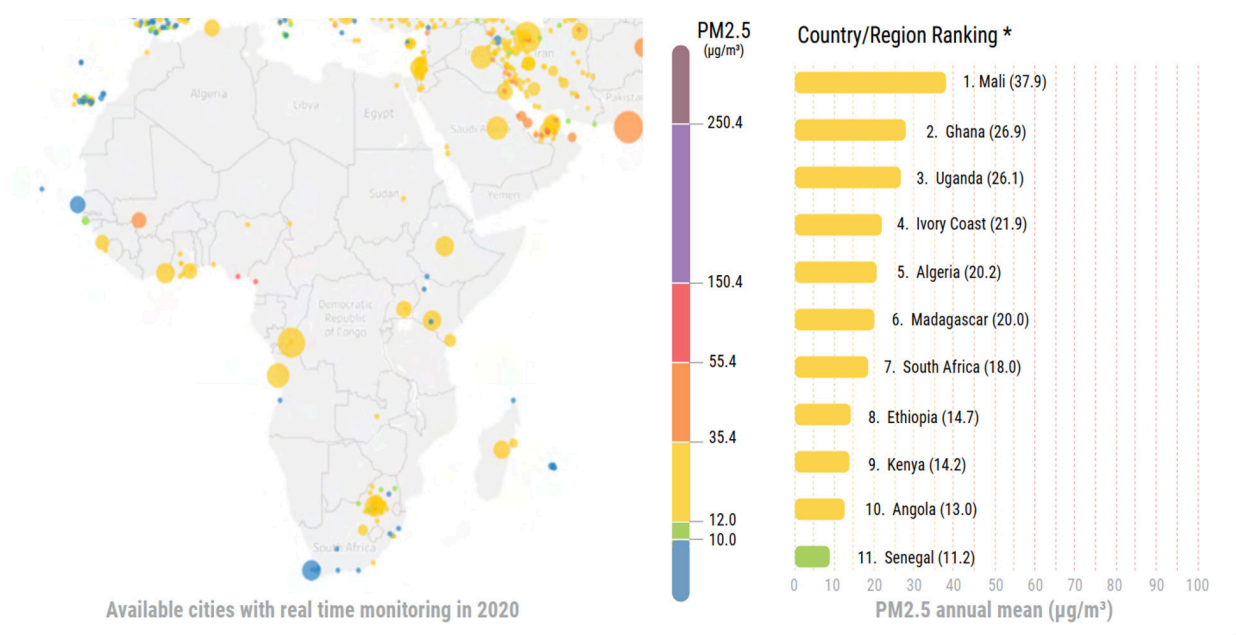


Figure 3: map showing $PM_{2.5}$ on African ranking.

high long-haul exposure to $PM_{2.5}$ concentrations goes beyond healthy standards (see figure 3). Other literature shows that in West Africa, poor air quality is predominant at the household level resulting from indoor cooking and warming. Researchers [59] show that the concentration of NO_2 was reduced by 92%, 42%, and 38% in South Africa, Central Africa and East Africa. Similarly, in West Africa and North Africa, $PM_{2.5}$ dropped significantly by 3% and %, respectively, during the urban city lockdown, which halted economic and industrial activities.

V. DISCUSSION AND IMPLICATIONS

The current study centers around a critical review of the impact of the deadly Covid-19 urban cities lockdowns on air quality in Africa. From the results, most of the study on the impact of Covid-19 on air quality in Africa was conducted in Nigeria, West Africa. Based on literature screening done by the researchers, it was accounted that several researches on the effect of Covid-19 cities lockdown on air

quality were from West Africa (45.6%), North Africa (26.6%), followed East Africa (12.6%), South Africa (10.6%), and Central Africa (4.6%). From the past researches, it was perceived that there was a strong relationship between air pollution and respiratory diseases in Africa [12,15]. By implications, the current research outlines that are pollutants like NO_2 , SO_2 , $PM_{2.5}$ are major risk causes of Covid-19 deaths [12]. Hence, regions with extreme exposure to air pollution are susceptible to death due to respirational infections.

In many studies conducted in Africa, it is evident that air pollution is firmly connected with Covid-19 cases and its associated death. Almost all countries in Africa affected by the deadly Covid-19 have been forced to impose countermeasures like restricting economic and industrial activities to decrease the spread of the virus. These restrictions were placed on public gatherings, public transportations and factories that operate heavy machinery, reducing emissions. Researchers have suggested that countries with heavy

economic activities contribute heavily to air pollution, concluding that many such activities release air pollutants like SO_2 , NO_2 , $\text{PM}_{2.5}$ into the atmosphere [60]. There is a higher concentration of air pollutants like NO_2 , SO_2 , $\text{PM}_{2.5}$ in urban areas. It was observed that there was a decline in the concentration of $\text{PM}_{2.5}$ during the Covid-19 cities lockdown across the African continent. This is because of the limited discharge of these air pollutants into the atmosphere. It can be observed that there is a considerable enhancement in air quality in most cities in Africa. In Western Africa, mentions can be made of Accra, Ghana, and Lagos in Nigeria. In the East of Africa, mentions can be made of Addis Ababa, Ethiopia and Nairobi, Kenya. In Central Africa, mentions can also be made of Luanda, Angola and Bangui, Central Republic of Africa. In the Northern part of Africa, mention can be made of Cairo, Egypt and Algiers, Algeria. In Southern Africa, mentions can be made of Johannesburg, South Africa and Gaborone, Botswana. In this way, Covid-19 city lockdowns have positively affected air quality across the African continent.

City lockdown can somewhat be an effective measure to decrease air pollution levels in Africa. Governments in Africa have struggled to fight the battle against air pollution. Some African governments have been committed to winning the battle against air pollution. However, there have not been available funds to support this course. The deadly Covid-19 virus does not seem to be existing the African continent soon; even developed countries are still struggling to control the menace. Some governments have still resorted to partial city lockdowns. Due to the low economic backgrounds of many households in Africa, full lockdowns to control the Covid-19 virus become a considerable burden on the governments. Nonetheless, it is beyond control to halt economic and industrial activities since it is a major human means of sustenance. In this way, policymakers should execute and follow manageable plans to decrease air pollution concentration levels

across Africa. The city lockdowns during Covid-19 not just initiated the improvement of air quality, yet it has likewise had other beneficial outcomes on the overall climate of Africa.

This current research on Covid-19 and its impact on air quality has some ramifications on strategies in Africa. There is a government well-being assistance policy of Covid-19 city lockdown. It has been outlined that the Covid-19 city lockdown has significantly further developed air quality, which is indispensable for measuring the advantage of such city lockdowns. WHO has added that around 4.2 million deaths are connected to air pollution every year. Many studies on air pollution fundamentally influence individuals' well-being, like future and mortality. Accordingly, it is evident that air pollution has put a significant challenge, and the potential medical advantages from improved air quality after the Covid-19 pandemic could be considerable.

VI. CONCLUSION

The researchers endeavor to assess the impact of Covid-19 city lockdown and air quality in Africa. The research unraveled that there has been a significant improvement in air quality because of urban lockdowns across the African continent. Air quality in Africa improved by around 40% during months of lockdown. All the countries in Africa that adopted the city lockdown approach to fighting the Covid-19 spread have benefited from improved air quality. This allows us to understand the effect of the human-caused pressures on the environment, especially air pollution. There has been an improvement in air quality across Africa. However, since the various governments cannot continue to halt economic and industrial activities, they have resorted to partial lockdowns. Partial lockdowns across some African cities mean that economic and industrial activities have resumed. Since the resumption of these economic and industrial activities, the improved air quality seemed to be compromised, and it's going

back to the polluted state. The WHO believes that since the partial lockdowns in Africa became effective, the concentration of air pollutants seems to rise, making the Covid-19 city lockdown just a temporal means to improve air quality. The study results will help policymakers get that city lockdown might be an effective and resourceful measure to reestablish the environment. Based on the above discussions, the researchers recommend that various governments across the African continent should resort to partial lockdowns, especially in the transportation and industrial sector. Since various governments have invested huge amounts of money in fighting air pollution but no convincing evidence has been gained, this will help because the Covid-19 city lockdowns have proven so.

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