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Air Pollution Management and Policy in Sub-Saharan Africa: A Systematic Review

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Abstract

Air pollution is a global concern which has adverse effects on human health. In sub-Saharan Africa(SSA), several sources of emission, such as industrial processes and combustion engines, contribute significantly to air pollution due to the region's reliance on conventional energy sources. However, there is little knowledge regarding policies and management frameworks in place in sub-Saharan Africa to address the issue of air pollution. As a result, a better understanding of the policy and management landscape is crucial for guiding interventions and providing information for decision-making to decrease the health risks related to air pollution in SSA.

Method

Systematic searching of published research were obtained from PubMed, Embase, Web of Science, Scopus, Google Scholar, and grey literature between 2005 and February 2023. 1,843 studies were found in the primary search. After removing duplicates, 1,236 studies were assessed for eligibility using only the titles and abstracts. After screening for appropriateness, 50 studies were chosen for full-text review, and 20 were ultimately included in the systematic review.

Results

There has been a Policy on Air Pollution in Sub-Saharan Africa, but the enforcement and/or management is very poor. There is a critical need for improved air pollution policies and management frameworks in sub-Saharan Africa (SSA).

Conclusion

Governments and non-governmental organisations involved in decision making in SSA should emphasis the creation and execution of policies based on empirical evidence that considers the specific circumstances faced by individual nations and regions. To chart progress and identify problem areas, establishing good monitoring and assessment mechanisms is essential.

Keywords: Air Pollution, Sub-Saharan Africa, Management, Policy, and Interventions

Introduction

Air pollution is one of the most significant threats to public health around the globe, and sub-Saharan Africa (SSA) is not an exception (WHO, 2024) [27]. Due to the rapid urbanization, industrialization, and over reliance on conventional energy sources, air pollution has been a major issue confronting SSA. Consequently, researchers call for policies, legislation, and actions aimed at minimizing air pollution and achieving a net zero in the region (Amegah, & Agyei-Mensah, 2017; Sicard *et al*., 2023) [1, 22].

The approaches taken by policymakers in response to these difficulties can affect the health of millions of people throughout the region (Mesagan, 2022; Sicard *et al*., 2023) [13, 22]. There needs to be more knowledge regarding the policies and management frameworks in place in SSA to address the issue of air pollution (Amegah, & Agyei-Mensah, 2017; Mesagan, 2022) [1, 13]. As a result, a better understanding of the policy and management landscape is crucial for guiding interventions and providing information for decision-making to decrease the health risks related to air pollution.

This systematic review evaluation aims to provide insight into how SSA nations manage and set policies to fight air pollution. The review will draw together evidence of air pollution policies and management techniques which are being used in the area, as well as how effective and harmful they are.

The review will help understand how air pollution is managed and what policies are in place in SSA. Also, the results will help develop and implement effective ways to reduce the harmful effects of air pollution on people and the planet.

Health Impacts of Air Pollution

Air pollution has been causing a wide range of health issues (and in some cases death) in SSA. The most common of these include respiratory symptoms (such as sneezing and coughing), bacterial, and viral infections such as pneumonia (Fisher *et al*., 2021) [8]. Others include cardiovascular diseases, mortality, and poor birth weights. High exposure to delicate particulate matter was linked to an elevated risk of hypertension in a study conducted in Uganda (Chasant, 2019) [3]. Another Ghanaian study discovered an increased risk of cardiovascular illness among people living close to a gold mine.

Several studies found that places with a lot of air pollution had more people with respiratory illnesses and symptoms. For example, a study done in Ghana found that children who lived in areas with high levels of particulate matter were much more likely to get severe respiratory infections (Mud, 2021) [14]. A similar finding was made in Nigeria, where it was shown that inhabitants living closer to a cement industry had a higher incidence of respiratory complaints compared to those who lived further away (Etim *et al*., 2021) [7].

Method

Search Strategy and Selection Criteria

To find research that can help SSA's (although SSA is a geographical entity, it's composed of many nations, each of which will have a different approach to air pollution) management and policy on air pollution, a thorough search method will be put in place. Electronic databases such as PubMed, Embase, Web of Science, Scopus, and Google Scholar will be used to find English-language studies published between 2005 and February 2023. By referencing grey literature searches, we found further studies. Combinations of keywords like "air pollution," "sub-Saharan Africa," "management," "policy," and "interventions" was used in the searches. Only research conducted in countries sub-Sahara Africa was considered.

Inclusion/Exclusion Criteria

This review explored studies that investigated the effectiveness, implementation, and effects of policies and programs meant to clean up the air in SSA. Publications from January 2005 through February 2023, written and published in English and carried out in SSA, were considered. Research that does not fit the parameters of the inquiry, does not address the topic of air pollution management and policy, is of low quality, was published in a language other than English, or is unavailable in the full text will be disregarded.

Data Extraction

A data extraction template was used to gather information from the studies. This included information about the study's setup, participants, treatments, outcomes, and findings. The review also includes details about the study's reliability and any possible biases. Descriptive statistics like frequencies, means, and percentages were used to summarize the data that have been extracted. Patterns will be identified thematically.

Data Definition

The recommendations for acceptable air quality standards for key pollutants set by the World Health Organization (WHO) will be used to define air pollution. According to WHO (2021) [25], air pollution is one of the biggest environmental threats to human health, alongside climate change. Therefore, air pollution is when there are enough pollutants in the air to harm people or the environment (WHO, 2023) [26]. These substances include particulate matter, Sulphur dioxide, ozone, nitrogen dioxide, and carbon monoxide.

Quality and Bias Assessment

Cochrane's Risk of Bias technique for randomized controlled trials and the Risk of Bias (Higgins, *et al*., 2011) [9] in Non-randomized Research of Interventions tool will be used to evaluate the studies' quality. Study design, data collection, analysis, and presentation of results will all be evaluated for potential bias. Selective reporting and publication bias will also be evaluated as potential sources of bias. A funnel plot will be used to evaluate the possibility of publication bias. Comparing the study protocol and the published journal articles were used to determine the possibility of selective reporting bias.

Results

Search Results and Study Characteristics

One thousand eight hundred and forty-three studies were found in the primary search. After removing duplicates, 1,236 studies were assessed for eligibility using only the titles and abstracts. After screening for appropriateness, 50 studies were chosen for full-text review according to the Cochrane Library's recommended principles (Cochrane, 2007), and 20 were ultimately included in the systematic review based on the Cochrane Library's recommended principles, the studies were examined for reliability and validity, and the areas of appraisal. Figure 1 shows the PRISMA flowchart, describing how researchers choose which studies to include.

Fig 1: Flow chat of Systematic review

This research, published between 2005 and 2023, spanned 22 nations in sub-Saharan Africa. Over 60% of the research was cross-sectional, with qualitative studies at 22% and quantitative studies at 19%. Study participants ranged from 10 to 5,000. Overall, 56% of the research focused on outdoor air pollution, with 19% on indoor air pollution and 15% on ambient air pollution also receiving attention.

Management and Policy Frameworks

The included research found that SSA already has a wide range of policies and management frameworks in place to fight air pollution. Policies and laws at the national level included rules about emissions, standards for fuel quality, and ways to keep an eye on air quality (Coker & Kizito, 2018) [5]. For example, in 2010, the National Archives and Records Administration investigated a study on how well the National Emission Standards for Hazardous Air Pollutants in Nigeria were working. These standards set limits on how much pollution different industries, like cement plants, refineries, and power plants, could put into the air. Similarly, Dagestani *et al*. (2022) [6] reported on the enactment of the National Environmental Conservation: Air Quality Act in Sub-African. This act established the management of air quality zones and mandated that industries comply with emission limits for SSA.

Community-based initiatives have included programs to encourage the use of clean stoves and alternative energy sources. For instance, Ng'wandu *et al*. (2009) [17] observed a community-based action that took place in Tanzania. This intervention encouraged the use of biofuels for cooking and heating, which resulted in a decrease in the amount of indoor air pollution and an improvement in respiratory health. Similarly, Roche and Blanchard's (2018) [20] research noted community-based involvement in Kenya. This intervention encouraged the use of solar lamps as a clean source of illumination, which in turn decreased the amount of air pollution in households and improved the health of both mothers and children.

Public awareness initiatives included educational programs, advocacy activities, and media campaigns to increase knowledge of the health concerns linked with pollution and encourage behavior change. For instance, the research by Mujuru *et al*. (2012) [15] described a public education initiative in Zimbabwe. This campaign utilized digital platforms and community interaction to increase knowledge of air pollution and encourage behavior change. Also, Mudu (2021) [14] examined advocacy efforts in Ghana to encourage the adoption of renewable energy supplies and decrease air pollution caused by the traditional burning of biomass.

Impact of Interventions

There has been relatively little systematic analysis of the effectiveness of programs to mitigate air pollution in sub-Saharan Africa. However, there were promising results in a few research projects. Women and children in Kenya experienced fewer respiratory symptoms, and indoor air pollution was significantly reduced after a community-led hygienic cookstove intervention (Chasant, 2020) [4].

Barriers to Effective Management and Policy

Several things make it challenging to manage and enforce policies to reduce air pollution in sub-Saharan Africa. Many countries in sub-Saharan Africa do not seem to have enough resources to invest in air pollution management and policy implementation that works well (Amegah & Agyei-Mensah, 2017) [1]. Many nations in Africa's Sahel region (ecoclimatic and biogeographic realm of transition between the Sahara to the north and the Sudanian savanna to the south), need to gain the know-how to control and regulate their air pollution properly (Okello *et al*., 2022) [18]. Most of the Sahel nations have limited appropriate technology to track and stop the spread of harmful gases, which is making this air pollution crisis worse in Sahel nations.

The results show that laws and rules about air pollution are usually limited and where they do exist are not implemented well. Air quality suffers as a result, as does population health. Air pollution control and policy can only be a top priority for political leaders because of competing interests, such as promoting economic development (Larcom & Richards, 2022) [12]. As a result, it can be challenging to generate public support for successful policy implementation in sub-Saharan Africa, where many people still need to be made aware of the health implications of air pollution (Schwela, 2012) [21].

In sub-Saharan Africa, controlling air pollution and putting policies into action should be a top priority. Adequate resources should be set aside, and practical policy frameworks should be made to deal with these problems (Cai *et al*., 2021) [2]. People also need to be made aware of how dangerous air pollution is for their health and how important good leadership and rules are.

Limitation of Laws and Rule about Air pollution in Sub-Saharan Africa.

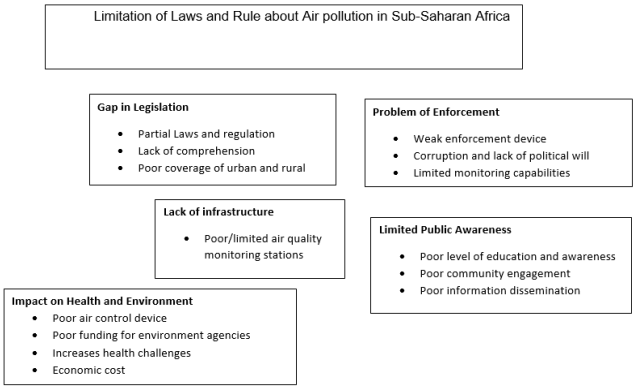

Fig 2: Main study outcome

Discussion

In sub-Saharan Africa, controlling air pollution and putting policies into action should be a top priority. Adequate resources should be set aside, and practical policy frameworks should be made to deal with these problems (Cai *et al*., 2021) [2]. People also need to be made aware of how dangerous air pollution is for their health and how important good leadership and rules are.

Sub-Saharan Africa (SSA) as stated in the introduction faces specific issues with air pollution due to its fast urbanization, industrialization, and reliance on conventional energy sources. This systematic review aimed to assess studies on air pollution control and policy in SSA. In order to find relevant research published in English between 2005 and February 2023, the Cochrane principle was used in this review conducted extensive searches of electronic databases, grey literature, and published journal articles. Twenty studies were considered in the study from a total of 1,236 screenings; these studies represented 22 different countries

in SSA.

Most of the studies were cross-sectional, and the focus was on outdoor air pollution, followed by indoor and ambient air pollution (Kouao *et al*., 2019) [11]. The sample sizes varied from 10 to 5,000 people, and qualitative approaches predominated. Both the Risk of Bias in Non-randomized Research of Interventions tool and the Cochrane Risk of Bias tool were used to evaluate the quality of the studies as highlighted earlier in the method.

The results of the review show that policies for managing and regulating air pollution in SSA need to be stronger, more consistent, and enforced better. Even though many countries have made national plans and strategies to fight air pollution, these plans are rarely put into action, and different sectors rarely work together on them. Air pollution is a big public health problem, with limited knowledge about its effects to come up with and implement good solutions (Sicard *et al*., 2023) [22].

Despite these obstacles, several attempts have been made in SSA to combat air pollution. Several nations have instituted programs to encourage the use of renewable energy sources, while others have enacted rules and limits for emissions from automobiles and industry (UN Environment Programme, 2021) [23]. Unfortunately, due to insufficient monitoring and assessment, the effect of these actions on the health of humans and the air we breathe is largely uncertain (Karanasiou *et al*., 2011).

This analysis stresses the critical need for improved air pollution policies and management frameworks in SSA. Governments and other Nsss in SSA should emphasize the creation and execution of policies and plans based on empirical evidence (WHO, 2016) that considers the specific difficulties and circumstances faced by individual nations and regions.

To keep checks on development and spot problem spots, it is also essential to improve monitoring and assessment mechanisms.

Conclusion

In conclusion, this systematic review examined the policies and management systems in place in SSA to reduce air pollution. A new approach in implementation and enforcement is to be improved in order for policies and management techniques to reduce air pollution to work well. Policies must be redirected to address air pollution in all its forms, not just that which is visible from the outside. In the future, more attention should be paid to assessing the effects of initiatives and policies on public health outcomes and air pollution in SSA. This study may increase knowledge about air pollution interventions strategies and management. We provided a complete set study that implemented policies and strategies by governments to reduce air pollution or improve air quality in various fields to be used by planners and decision makers in this area.

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