BIBLIOGRAPHIC ANALYSIS OF AIR QUALITY AND EXPOSURE OF VARIOUS POLLUTANTS, CONDITIONS, AND BETTER ROUTING APPROACHES

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***Abstract*—Air quality is the biggest problem not at any one place but most of the world popular cities, various exotic destinations now suffering from air pollution, there are various conditions that are considered save but are not, as there are different pollutants or particles that harm human health. By considering those conditions and exposures to different particles, pollutants from various living conditions indoor and outdoor, traveling by Car, bus, cycle, or any other medium all are considered in this analysis. The cities, travel mode, various pollutants are considered to examine many studies and their major advantages and limitations. In this bibliographic analysis we analyse 566 documents/research articles, reviews for final analysis. We use various filters to give the data a pattern and easily understandable. The studies give us the outcome which are categorized in health outcome, exposure form different particle as well as pollutants, indoor/outdoor (in public transport, home, metro subway, room etc), mortality, better routing for least exposure to environmental pollutants and other particles they were most common one. Maximum information were showed in UK, USA, Europe and Asia, the total time span of the bibliography is from 1992 to the 2024. There are 220 resources for the analysis of the topic. From the reference perspective there are more than that of 27000. In summary the bibliographic study supplies research and evidence from multiple sources to show increase in air pollutants and particles and by exposing them what are the health outcomes.**

***Keywords*—Air Quality Index(AQI), Urban Pollution, Pollution Expose, Emission Control, Traffic-Related Pollution.**

I. INTRODUCTION

Air pollution has become a significant community health concern worldwide, particularly in urban areas. Exposing to air impurities can leads to a range of health issues, from respiratory diseases to cancer.[1] The air quality index (AQI) is the tool used for measuring the level of air pollution in each area, and it is calculated based on the concentrations of various pollutants, like particulate matter (PM), ozone (O_3), nitrogen dioxide (NO_2), and carbon monoxide (CO).[2] The objective of this paper is to conduct a critical evaluation of existing work on AQI exposure of different particle and pollutants in order to explore advanced routing techniques for lowering exposure to air pollutants. This paper basically examines various research's that highlight the negative health impacts of air pollution, pinpoint its origins and varieties, and investigate ways to lower exposure. Poor air quality can have major harmful effects on human health, according to some researches. Numerous health related issues are mainly associated with the primary pollutants that are assessed by the AQI, with CO, NO2, O3, and particle matter (PM).Respiratory disorders like chronic obstructive pulmonary disease (COPD) and asthma, cardiovascular illnesses, and lung cancer are deeply associated with the long term exposure toward the Particulate matter.

The Centers for Disease Control and Prevention (CDC) found that exposure to NO_2 increases the risk of respiratory issues in children (Centers for Disease Control and Prevention, 2019).Carbon monoxide (CO), another byproduct of fossil fuel combustion, can cause symptoms such as headaches, dizziness, and nausea. High levels of CO exposure can result in unconsciousness and even death. Research by the National Institute for Occupational Safety and Health (NIOSH) showed that CO exposure significantly increases the risk of various diseases. There is progress in recent years regarding prevention and control of air pollution; however, outdoors, it lasts to be a serious threat to humans. Some developing countries surpass the maximum allowed limit set by the World Health Organization. [12] Reducing exposure to air pollution, using respiratory protective equipment, monitoring air quality, developing an asthma action plan, educating patients and healthcare providers, encouraging policy changes, increasing access to clean energy, promoting sustainable transportation, creating green spaces, and supporting research can leads us to help and decrease the impact of air pollution on asthma patients.[13]

II. MATERIAL AND METHODS

First thing first: This was explored through broad questions, incorporating various concepts, target audiences, and the

benefits of good research strategies. Thus, "PCC" (Players, Concepts, Elements) was adopted to guide the development of research queries and inclusion criteria, while the SPICE concept was applied to conduct research on different materials, pollutants, and better technologies to reduce the impact of pollution.

Here is an example: SPICE Component Description Setting City areas with extreme levels of air pollution population people living in urban areas with high levels of air pollution Intervention Routing techniques for minimal exposure to air pollutants Comparison Traditional routing techniques Evaluation Exposure to air pollutants, as measured by air quality index.[4]

- Setting: The setting is urban areas with elevated levels of air pollution.
- Population: The population is individuals living in these areas.
- Intervention: The intervention is routing techniques for minimal exposure to air pollutants.
- Comparison: The comparison is traditional routing techniques.
- Evaluation: The evaluation is exposure to air pollutants, as measured by the air quality index. By using this table, you can ensure that each component of your SPICE strategy is clear, focused, and relevant to your research aims. It can also help you ensure that your research is relevant to stakeholders, such as policymakers, urban planners, and persons active in areas with high levels of air pollution.

Here is a sample search strategy using Scopus:
("air quality index" OR "air pollution" OR "exposure" OR "multirouting") AND ("health impacts" OR "human health" OR "environmental health").
Limit to:
Publication date: 1992- present
Language: English
Article type: peer-reviewed articles, editorials, and review articles, bibliographic paper.
Process of Research analogies:

A. Document Selection Criteria:
Our research questions were framed to encompass various concepts, target audiences, and outcomes relevant to the study of air quality index exposure to different particles, pollutants, and routing techniques for minimal exposure to air pollutants. We recognized specific criteria for inclusion based on these frameworks to ensure the relevance and completeness of our document selection.

B. Search Strategy:
We also apply Filters to refine the search results, focusing on articles, review articles, and bibliographic papers. This comprehensive approach aimed to capture a wide range of studies addressing the research questions and objectives of our analysis. Some of the recent search trends are shown in Table 1

C. Data Extraction Process:
Once relevant area were represented , proceeded with the data removal process. Idea extended from this selected articles comprised details such as information about author , publication year, journal name, and DOI. This systematic removal ensured that applicable for information from each way was captured and synthesized for further scrutiny.

D. Analysis Methods:
The critical evaluation and the evidence synthesis of some selected documents are the analysis techniques that are used in this particular study. We mostly evaluated each of the article's quality and reliability using well-known instruments like Newcastle-Ottawa Scale and the Cochrane Risk of Bias Tool.

Table 1: Trends in Air Pollution Research Topics

Item	Frequency	Year Q1	Year Median	Year Q3
Quality of Life	5	2000	2002	2016
Carbon Monoxide	7	2007	2007	2012
Commuter Exposure	5	2003	2007	2015
Nitrogen Oxides	5	2004	2007	2014
Benzene	7	2004	2008	2010
VOC	5	2007	2008	2009
Particles	8	2003	2009	2014
Traffic	18	2008	2011	2014
Asthma	28	2005	2012	2016
Epidemiology	16	2006	2012	2014

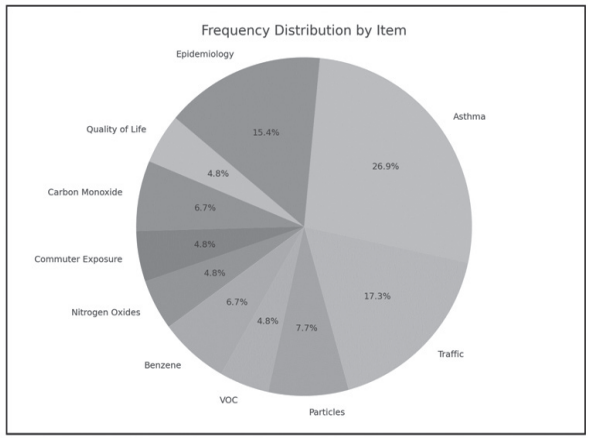

Fig.1 :Pie Graph Research representation for Trends in Air Pollution

III. HEALTH EFFECTS OF AIR POLUTION

A. Pictorial representation of Particulate Matter (PM)

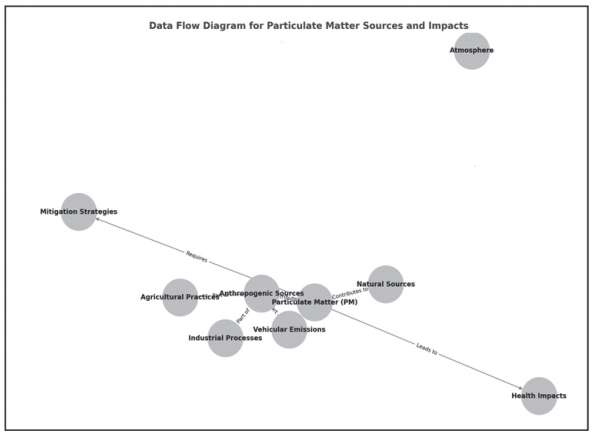

Fig.2 :Data flow diagram for Particulate matter(PM) and Impact

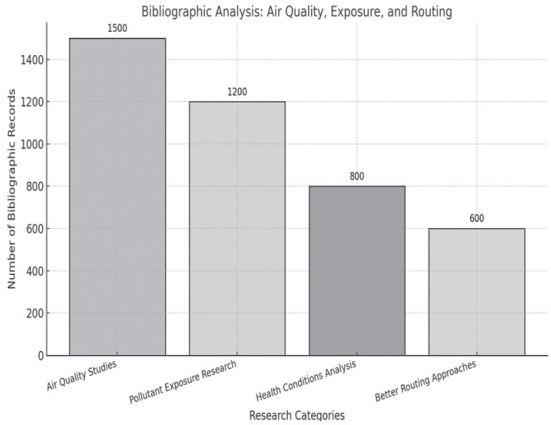

Fig.3 : Bibliographic Analysis: Air Quality , Exposure and Routing

B. Ozone(O3)

Ozone (O3) stands as a secondary air pollutant engendered through intricate photochemical reactions including precursor pollutants such as nitrogen oxides (NOx) and volatile organic compounds (VOCs) in conjunction with solar irradiation. NOx and VOCs are released from a variety of pollutants, such as waste from industries, automobile exhaust, and solvents made of chemicals. They participate in ambient interactions that result in the creation of ozone.

This phenomenon predominantly manifests in urban locales characterized by elevated NOx and VOC emissions, particularly amid periods of heightened solar exposure and stagnant atmospheric conditions. The intricacies of ozone genesis are further modulated by meteorological variable quantity such as temperature, humidity, and wind dynamics, which exert influence over ozone concentrations and dispersion patterns in the atmosphere. Exposure to escalated ozone levels (O3) has been incontrovertibly associated with an array of adverse health manifestations, predominantly affecting respiratory functions. Ozone, characterized by its robust oxidizing properties, poses a pronounced irritant to the respiratory mucous, precipitating symptoms encompassing coughing, wheezing, chest constriction, and dyspepsia. Prolonged or intense ozone exposure exacerbates extant respiratory morbidity such as asthma, chronic obstructive pulmonary disease (COPD), and bronchitis, as the resultant inflammatory cascades impede pulmonary function and amplify airway inflammation.[11] Moreover, ozone exposure elicits cardiovascular ramifications, including augmented heart rate, blood pressure, and susceptibility to myocardial in fractions and cerebrovascular accidents.

C. Nitrogen Dioxide (NO2)

Nitrogen Dioxide (NO2) represents a smoky air pollutant primarily originating from combustion processes, notably those entailing the utilization of fossil fuels such as coal, oil, and natural gas. Prominent sources of NO2 emissions encompass vehicular exhaust, industrial discharges, power generation facilities, and residential heating systems.[2] Within urban environs, traffic-related activities emerge as the principal contributors to NO2 concentrations, as vehicles discharge NOx compounds during combustion. Concurrently, industrial pursuits encompassing manufacturing, power generation, and construction operations further contribute to NO2 emissions through combustion processes and industrial procedures [13]

Prolonged exposure to NO2 manifests in the onset and aggravation of respiratory sicknesses including asthma, bronchitis, and chronic obstructive pulmonary disease (COPD).[10] Furthermore, NO2 exposure bears correlation with cardiovascular sequelae such as escalated blood pressure, variations in heart rate, and augmented risks of cardiovascular incidents like myocardial infarctions and cerebrovascular accidents. Particularly susceptible populations including children, the elderly, and individuals afflicted with pre-existing respiratory or cardiovascular conditions confront escalated risks of enduring adverse health outcomes consequent to NO2 exposure.[4], [11]

D. Carbon Monoxide (CO)

Carbon Monoxide (CO) represents a colourless, odourless, and hazardous gas generated through the incomplete burning of carbonaceous fuels, encompassing gas, diesel, natural gas, and wood. Prominent sources of CO emissions encompass vehicular exhaust, industrial processes, residential heating systems, and natural phenomena like wildfires.[13] Particularly in urban settings, motor vehicles emerge as the principal contributors to CO emissions, given that internal combustion engines produce CO as a byproduct of incomplete fuel combustion. Carbon monoxide (CO) emissions are a

result of industrial activities such as mining, manufacturing, and power production, mostly through combustion processes and other industrial operations. Additionally, gas stoves, heating appliances, and tobacco smoke are also became the causes of CO pollution that can occur indoors and can also contribute to poor indoor air quality. [10] The Thematic Analysis of the Pollutant as shown in Table 2

IV. SOURCES AND CHARACTERISTICS OF AIR POLLUTANTS

A. Individual Measures

a) Respiratory Protective Equipment: One individual measure for reducing exposure to air pollution involves the use of respiratory protective equipment such as masks and respirators. These devices act as physical barriers, filtering out harmful airborne pollutants and particles before they can be inhaled into the respiratory system.[5] Masks and respirators are particularly beneficial for individuals who are exposed to high levels of air pollution in occupational settings, such as construction workers, industrial workers, and healthcare professionals. N95 respirators are very successful for preventing respiratory disease because they are made to filter out approximately 95% of airborne particles, including fine particulate matter. A perfect fit is very much essential for reducing exposure to hazardous pollutants therefore it's been very crucial to select the appropriate respirator type and make sure it fits perfectly to guarantee the best protection.

b) Monitoring Air Quality: One realistic strategy to minimize the exposure to air pollution is to check the air quality levels and also take appropriate action according to the given information. The current air quality monitoring systems can give real time data on the amount of concentrated pollutant such as Ozone, Nitrogen dioxide, Particle matter and carbon monoxide. This assists people by controlling their exposure to harmful contaminates and also making well-informed decisions regarding outdoor activities. Now a days its very easy to keep informed about the air quality just because of mobile apps and internet resources. People may also take proactive measures to protect themselves by using these various technologies, which can offer real-time warnings and advisories during time of low air quality. By this communities may utilize this knowledge to make it safer and cleaner interior environments by using technologies like air purifiers, by staying at home with windows closed to keep pollutants out, and also limiting outside activities when pollution levels are high. [12]

c) Developing Asthma Action Plans: By developing individualized asthma action plans with healthcare professionals, the people suffering from asthma can better protect themselves form air pollution. All these programs use some specialized techniques to limit exposure to triggers, like air pollution, and also help to control asthma symptoms. [12] Asthma action plans are usually contains instructions for keeping an eye on symptoms, which can utilize for rescue

Table 2: Thematic Analysis for the research topics.

From	To	Words	Weighted Inclusion Index	Inclusion Index	Occurrences	Stability Index
air pollu-tion--1992-2005	air pollution--2006- 2010	air pollution	0.71	0.33	12	0.08
asthma--1992-2005	air pollution--2006- 2010	asthma; epidemiology	0.33	0.17	8	0.07
asthma--1992-2005	particles--2006- 2010	particles	1.00	1.00	3	0.17
children--1992-2005	air pollution--2006- 2010	children	0.40	0.50	3	0.09
exposure-- 1992-2005	benzene--2006-2010	benzene	0.50	1.00	2	0.33
air pollution--2006-2010	air pollution--2011- 2015	air pollution;traffic;asth ma;epidemiology;chi ld ren	0.76	0.10	15	0.03
Carbon momoox-ide 2006- 2010	air pollution--2011- 2015	carbon monoxide	0.22	0.33	3	0.03
Carbon monooxide 2006 - 2010	in-vehicle exposure--2011-2015	in-vehicle exposure	1.00	1.00	3	0.33
global positioning system--2006-2010	air pollution--2011- 2015	global positioning system	1.00	1.00	2	0.03

drugs like inhalers and limiting exposure to pollutants. It can also explain when to get medical hep or how to modify medication dosages during asthma emergencies or flare-ups. Peoples with asthma can effectively manage their disease and lower the negative effect of air pollution on their respiratory health by following to these measures.in order to empower all individuals with asthma is to take care of their health and enhance their well being, education and awareness campaigns all these are very essential in promotion of asthma action plans.[10]

B. Community Measures

a) Policy Changes: To address the source of pollution and improved air quality, community initiatives towards lessen exposure to air pollution normally centre on local, regional, and federal policy reforms.[11] All those incentives and subsidies are used to promote the use of cleaner technology and renewable energy, these policies will also may include rules and standards for emission from automobiles, industry, and other sources. Stricter car emission, for example, might be implemented, and mandating cleaner fules and cutting edge technology like particle filters and catalytic converters which are used to reduce pollutants like particulate matter (PM), nitrogen oxides (NOx), and volatile organic compounds (VOCs).[12] Furthermore, by increasing the eco-friendly modes of mobility which include walking, bicycling, and public transportation can also lessen reliance on cars that will run on fossil fuels and minimize pollution from traffic. Communities may also greatly reduce air pollutant emissions, for improving public health and air quality, by implementing evidence-based policies and regulations.[13]

b) Increasing Access to Clean Energy: In addition towards community-level tactic for lowering air pollution is have an access to sustainable energy source like hydroelectric, wind and solar electricity. Carbon dioxide (CO2), sulphur dioxide (SO2), and nitrogen oxides (NOx) all these emissions can also be significantly reduced by switching from fossil fuels to renewable energy. This switch towards renewable energy sources benefits the environment and health of public since these pollutant are not only determine the air quality but also contribute to climate change.[11] Community initiatives and programs can promote the adoption of clean energy technologies and incentive investments in renewable energy infrastructure, such as solar panels, wind turbines, and energy-efficient appliances. By increasing access to clean energy, communities can reduce dependence on fossil fuels and improve air quality, leading to better public health outcomes and environmental sustainability.[5]

C. Urban Development and Environmental Measures

a) Creating Green Spaces: To enhance the quality of life and lower the air pollution exposer in urban planning we need to develop environmentally conscious. In addition to this improving the air quality, integrating the green areas like parks, gardens and urban forests are required in city design which makes cities more sustainable and habitable. To make the urban cities healthier place, we need to make green areas who absorb pollutants, filter out particulate matter (PM), and cool off urban heat islands. For improving the air quality the

b) Supportive Research and Development: To improve the air pollution and air quality the investment in Research and development(R&D) is very essential for noticing the innovative ways to combat. However these projects drive the creation of cleaner technologies, emission-reduction methods, and tools for one-to-one care and forecasting pollution. To address these issue the cooperation between Scientists, governmental organizations, business administrator, and community organization is very essential for delivering the exchange of information and also using the multidisciplinary approaches.*

Table 3 : Particulate Matter (PM)

Factors	Interactions
Genetic Factors	- Heritable predilection to respiratory diseases
	- the unpredictability in exposure to PM-related effects
Environmental	- Closeness to the industrial facilities
	- Exposure to vehicular emissions
	- Indoor air quality
Socioeconomic	- Access to the health care and socioeconomic standings as well.
	- Housing conditions
	- Occupational exposures

Table 4: Ozone(O3)

Factors	Interactions
Genetic Factors	- genetic vulnerability to the oxidative pressure
	- Variation in inheritable factor associated to lung function
Environmental	- Temperature and sunlight levels
	- Closeness to circulation and industrial productions
	- impact of topographical factor on air stagnation.
Socio-economic	- Availability to healthcare and medical resources.
	- Socioeconomic disparities in exposure to O3
	- Housing conditions and indoor air quality

Table 5: Nitrogen Dioxide (NO_2)	
Factors	Interactions
Genetic Factors	- Polymorphisms in genes related to respiratory health
	- Genetic predisposition to asthma and COPD
Environmental	- Traffic density and proximity to roadways
	- Industrial emissions and combustion processes
	- Building ventilation and indoor air quality
Socioeconomic	- Socioeconomic status and access to healthcare
	- Residential segregation and exposure disparities
	- Occupational exposures and workplace regulations

Table 6: Carbon Monoxide	
Factors	Interactions
Genetic Factors	- Genetic factors affecting CO metabolism
	- Polymorphisms in genes related to hemoglobin levels
Environmental	- Indoor air quality and ventilation
	- Combustion processes and fuel types
	- Traffic congestion and vehicle emissions
Socioeconomic	- Socioeconomic disparities in exposure to CO
	- Housing conditions and indoor pollution
	- Occupational exposures and workplace safety

These Table 3, Table 4, Table 5 and Table 6 provide an indication of the various factors that influence the interactions between air pollutants (PM, O3, NO2, CO) and genetic, environmental, and socioeconomic factors, highlighting the complexity of air pollution exposure and its impact on public health.

CONCLUSION

A. Summary of Findings:

This bibliographic paper provides an all-inclusive literature analysis that has indicated the immense influence of air pollution on public health, especially in town settings. The results highlight that contact to air pollutants associated with assorted adverse health conclusions, including respiratory and cardiovascular diseases and increased mortality. Several trainings have confirmed that poor air quality is associated with increased sickness and mortality. This suggests the need for strategies to minimize exposure to air pollutants in order to safeguard public health. In addition, the analysis underscores the multifaceted nature of the response to air pollution, incorporating individual behaviors, community-level initiatives, and broader environmental interventions, all of which must be targeted at this complex problem to foster good respiratory health.

B. Implications for Public Health:

The aggregation of this listing paper have important connote for public health policy and practice. The evidence presented highlights the necessity for proactive measures to mitigate the impact of air pollution on respiratory health and reduce the burden of respiratory diseases such as asthma and chronic obstructive pulmonary disease (COPD). Implementing emission controls will encourage the environmentally friendly mode of transportation, expanding the access to clean energy source, and backing urban planning projects that place a very high value on green spaces and pedestrian-friendly environments are some ways to improve air quality and lower exposure to air pollutants. Public health involvements aimed at raising alertness about the health risks of air pollution, educating individuals and communities about protective measures, and advocating for evidence-based policies are essential for addressing the root causes of air pollution and promoting respiratory health equity.

C. Recommendations for Future Research:

By fixing the focus on air quality and respiratory health, we can provide valuable insights for policy formulation, develop targeted interventions, and create healthier, more sustainable communities for the present and future.

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