Indoor and outdoor air pollutants as emerging public health threat in Latin America and the Caribbean: a systematic review

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Abstract

Purpose – This systematic review examined the emerging threat of indoor and outdoor pollutants to public health in Latin America and the Caribbean (LAC).

Design/methodology/approach – Pollutants and pollution levels are becoming an increasing cause for concern within the LAC region, primarily because of the rapid increase in urbanization and the use of fossil fuels. The rise in indoor and outdoor air pollutants impacts public health, and there are limited regional studies on the impact of these pollutants and how they affect public health. A comprehensive literature search was conducted using Google Scholar, PubMed, Scopus, EBSCOhost, Web of Science and ScienceDirect databases. Significant search terms included "indoor air pollution," "outdoor air pollution," "pollution," "Latin America," "Central America," "South America" and "Caribbean was used." The systematic review utilized the Rayyan systematic software for uploading and sorting study references.

Findings – Database searches produced 1,674 results, of which, after using the inclusion–exclusion criteria and assessing for bias, 16 studies were included and used for the systematic review. These studies covered both indoor and outdoor pollution. Various indoor and outdoor air pollutants linked to low birth weight, asthma, cancer and DNA impairment were reported in this review. Even though only some intervention programs are available within the region to mitigate the harmful effects of pollution, these programs need to be robust and appropriately implemented, causing possible threats to public health. Significant gaps in the research were identified, especially in the Caribbean.

Research limitations/implications – Limitations of the study include limited available research done within LAC, with most of the research quantifying pollutants rather than addressing their impacts. Additionally, most studies focus on air pollution but neglect water and land pollution's effects on public health. For this reason, the 16 studies included limited robustness of the review.

Originality/value – Although available studies quantifying pollution threats in LAC were identified in this review, research on the adverse impacts of pollution, especially concerning public health, is limited. LAC countries should explore making cities more energy-efficient, compact and green while improving the

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transportation sector by utilizing clean power generation. In order to properly lessen the effects of pollution on public health, more research needs to be done and implemented programs that are working need to be strengthened and expanded.

Keywords Indoor air pollution, Outdoor air pollution, Public health, Latin America, Caribbean

Paper type Literature review

1. Introduction

Pollution is an ever-growing global concern with long-lasting and multidimensional consequences. Introducing harmful substances into the environment, which negatively affects humans and other living organisms, is called pollution (Manisalidis, Stavropoulou, Stavropoulos, & Bezirtzoglou, 2020). Harmful substances, termed pollutants, can be in the form of solids, liquids and gases. Human activities, such as urbanization, industrialization and agriculture are the primary source of pollution that potentially impact public health (Wang, 2018). These human activities can increase pollution and environmental degradation, especially in developing countries (Dash, Behera, Rao, Sethi, & Loganathan, 2020). Currently, many developing countries within Latin America and the Caribbean (LAC) are experiencing rapid growth and urbanization rates of about 80%, comparable to that of more developed, high-income countries (Jaitman, 2015). The rapid growth and urbanization rate lead to an increase in pollution levels with an attendant adverse impact on public health (Husaini, Reneau, & Balam, 2022).

Pollution can broadly be divided into indoor and outdoor pollution, with the terms slightly overlapping. Indoor air pollution is pollution inside buildings such as homes, workplaces and schools, primarily caused by mold, dust, dirt or gases. In 2012 alone, environmental pollution was attributed to the deaths of about 7 million people, mainly due to diseases such as heart and respiratory diseases, lung cancers, stroke and other noncommunicable diseases (Azam & Khan, 2016). Furthermore, human deaths, loss of biodiversity, infrastructural damage, reduction in cultivation areas and depletion of natural resources have been attributed to environmental emissions (Usman, Balsalobre-Lorente, Jahanger, & Ahmad, 2023).

The World Health Organization (WHO) reported that the most significant environmental risk to health is air pollution, with 99% of the world population in 2019 living in areas where the WHO guidelines on air quality levels were not met (WHO, 2021). The report further indicated that globally in 2016, approximately 4.2 million premature deaths were recorded in rural and urban areas due to outdoor air pollution, with approximately 91% of those deaths occurring in low- and middle-income countries. The mortality attributed to cardiovascular and respiratory diseases and cancer that was mainly due to exposure to fine particulate matter (PM) of 2.5 (2.5 microns or less in diameter). Reduction of the burden of disease from respiratory disease (including asthma), lung cancer, heart diseases and stroke can be achieved by reducing air pollution levels (WHO, 2021; Husaini *et al.*, 2022).

Within the LAC region, the primary source of indoor air pollution, especially in rural areas, is the burning of solid fuels. Recently, WHO identified and reported severe air pollution health risks in approximately 2.4 billion people utilizing coal and biomass to heat their homes or cook, causing indoor smoke pollution in households (WHO, 2021). In 2016, approximately 3.2 million deaths were attributed to household pollution, mostly in low-middle-income countries. Most countries in LAC are listed as low-middle-income countries, making them vulnerable to the threat of air pollution. The formation of acid rains and smog from the release of nitrogen oxides in the atmosphere has been reported when fossil fuels are used (Perera, 2017). Furthermore, indoor pollution has been reported to cause respiratory illnesses and premature deaths (Schilmann *et al.*, 2021). On the other hand, outdoor pollution has a broader subset of categories, including air, water and land pollution, causing adverse impacts on public health, from respiratory diseases to dysentery and cancers (Sweileh *et al.*, 2018; Sun & Zhu, 2019).

Research on the effect of the various pollutants on public health is very limited in LAC compared to the more developed and high-income countries, primarily due to a lack of resources. The limited research on pollution in LAC is a source of concern to the region already grappling with other major communicable and noncommunicable diseases. In order to put the right policies, infrastructure and regulations in place, appropriate and necessary research must be done. This article systematically reviewed the studies conducted on indoor and outdoor pollution to provide the LAC region's impacts on public health. The purpose of this study is to identify gaps and provide the basis for further research or implementation of agreed policies on indoor and outdoor pollution within the region. This review examined indoor and outdoor pollution as emerging threats to public health in LAC.

2. Methodology

Databases such as Google Scholar, PubMed, Scopus, EBSCOhost, Web of Science and ScienceDirect were comprehensively searched for relevant literature on indoor and outdoor pollution in LAC. Significant search terms included "indoor pollution," "outdoor pollution," "pollution," "Latin America," "Central America," "South America" and "Caribbean." Rayyan systematic review software was used for uploading and sorting study references. The relevant studies were identified using inclusion/exclusion criteria (Table 1). The potential risk of bias was identified and evaluated for each included study and appropriate subset of studies. The studies were rated based on the quality and strength of the evidence across all diseases caused by indoor and outdoor pollutants. Studies were only included if the report contained original data from human studies correlated with specific pollutants.

2.1 Risk of bias in individual studies

Two independent reviewers conducted a qualitative assessment on which studies to include and exclude and classified the studies as low or high risk of bias to reduce bias. Additionally, publication bias for included studies was assessed using a funnel plot.

3. Results

Database searches produced 1,674 results, of which, after using the inclusion–exclusion criteria and assessing for bias, 16 studies were included and used for the systematic review (Figure 1). These studies covered both indoor and outdoor pollution (Table 2). The study characteristics based on indoor pollutants threat to public health included exposure to coal and biomass smoke leading to potential chronic obstructive pulmonary disease (COPD) (Menezes *et al.*, 2008), acute lower respiratory tract infections (Smith, 2000), low birth weight (Bruce, Perez-Padilla, & Albalak, 2000) and coughing, wheezing and asthma incidents (Forno *et al.*, 2015).

Inclusion criteria	Exclusion criteria
Published in 2000 or after	Published before 2000
Countries in Latin America and the Caribbean	Countries outside Latin America and the Caribbean
Correlation research	Causal research
Field research, observational research	Laboratory experiments
Published in English	Published in a language other than English
Quantitative research	Qualitative research

Note(s): Studies were only included if the report contained original data from human studies correlated with specific pollutants

Table 1.
Criteria for inclusion and exclusion

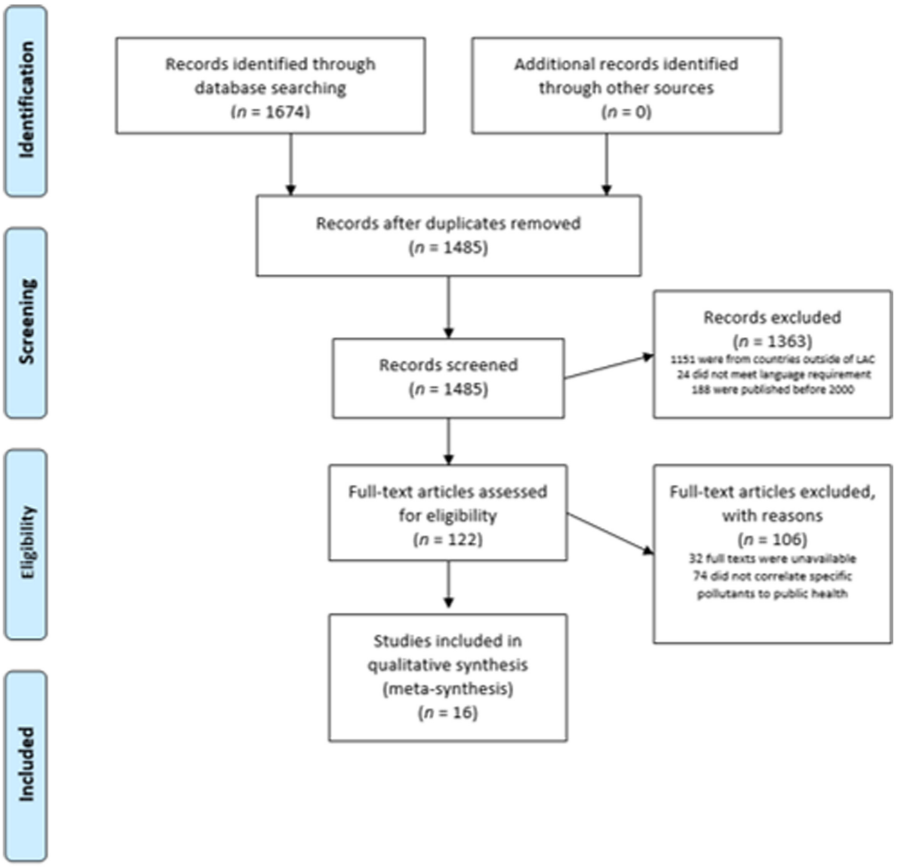

Figure 1.
Flow chart of identification and selection process

In this review, four studies reported the public health impact of coal and biomass smoke. Reported exposure to coal biomass smoke has the potential for COPD (Menezes *et al.*, 2008), acute lower respiratory tract infections (Smith, 2000), low birth weight (Bruce *et al.*, 2000), coughing, wheezing and asthma incidents (Forno *et al.*, 2015). Several pollutants exist in biomass fuel and are known to contain substances such as acrolein, formaldehyde, nitrogen oxides, sulphur and carbon monoxide (Sigsgaard *et al.*, 2015). The impact of exposure to biomass fuel and health has been reported to include cancers, cardiovascular, respiratory, metabolic, neurocognitive and reproductive diseases (Awopeju, 2020). Biomass pollutants can independently or synergistically work together to cause oxidative stress, a proposed mechanism commonly cited to cause diseases (Laumbach & Kipen, 2012).

Furthermore, one study indicated that lead is linked to neurological impairment, reduced cardiovascular function, immune system alterations and errors in the DNA copying process (Olivero-Verbel, Alvarez-Ortega, Alcala-Orozco, & Caballero-Gallardo, 2021). Inhalation and ingestion are the primary exposure routes for lead. Exposure to high levels of lead has been reported to brain and kidney damage, hypertension, weakness, anemia and behavioral problems. After crossing the placental barrier, lead may cause injury to the nervous system of a developing baby (WHO, 2022; Yu *et al.*, 2023).

Indoor/ outdoor	Pollutant	Effect on public health
Indoor	Coal/biomass smoke	Exposure to coal and biomass smoke can potentially lead to COPD (Menezes *et al.*, 2008), acute lower respiratory tract infections (Smith, 2000), low birth weight (Bruce *et al.*, 2000), and affect coughing, wheezing and asthma (Forno *et al.*, 2015)
	Lead	Lead is linked to neurological impairment, reduced cardiovascular function, immune system alterations and errors in the DNA copying process (Olivero-Verbel *et al.*, 2021)
	Nitrogen dioxide	Nitrogen oxide leads to higher rates of asthma and atopy (Robinson *et al.*, 2011)
	Mold	Prenatal mold exposure impairs children's cognitive development (Gonzalez-Casanova *et al.*, 2018)
	Tobacco smoke	Tobacco smoke exacerbates preexisting respiratory illnesses (Forno *et al.*, 2015) and affects cognitive development (Gonzalez-Casanova *et al.*, 2018)
	Asbestos	Asbestos causes lung cancer/mesothelioma (Algranti *et al.*, 2019)
	Dust	Dust negatively affects and may lead to COPD (Menezes *et al.*, 2008)
	Dust mites	Dust mites exacerbate preexisting respiratory illnesses (Forno *et al.*, 2015)
Outdoor	Pesticides	Prenatal exposure to pesticides can lead to impairment of cognitive development (Gonzalez-Casanova *et al.*, 2018)
	Tobacco smoke	Impairment of cognitive development due to exposure to tobacco during the prenatal period (Gonzalez-Casanova *et al.*, 2018)
	Arsenic	Arsenic leads to cancer, adverse reproductive outcomes and impaired childhood cognitive function (McClintock *et al.*, 2012)
	Airborne microplastics	Airborne microplastics facilitate the spread of COVID-19 (Amato-Lourenço *et al.*, 2022)
	Aeroallergens	Aeroallergens cause inflammation and allergic reactions and affect preexisting respiratory illnesses (Cepeda, 2011)
	Ozone	Ozone decreases lung function (Amadeo *et al.*, 2015)
	Particulate matter	Particulate matter is linked to a higher risk of lung cancer (Turner *et al.*, 2020) and exacerbates asthma symptoms in children (Cadelis *et al.*, 2014)
	Volatile organic compounds	Volatile organic compounds affect asthma and cause damage to DNA (Montero-Montoya *et al.*, 2018)
	Mercury	Mercury increases oxidative stress (Olivero-Verbel *et al.*, 2021)

Table 2. Characteristics of the included studies

In addition, one study reported that exposure to nitrogen oxide leads to higher rates of asthma and atopy (Robinson *et al.*, 2011). In a recent review, Ritz, Hoffmann, and Peters (2019) summarized the health impacts of nitrogen oxide exposure to cause increased mortality from diabetes and cardiovascular diseases. Furthermore, nitrogen oxide can aggravate asthma, lower lung defenses against bacteria and increase mortality and respiratory disease admissions. Exposure to higher levels of indoor nitrogen oxide in children has been reported to increase the frequency of asthma attacks and worsen asthma and asthma symptoms (Paulin *et al.*, 2017).

Also, one study reported impairment of children's cognitive development due to prenatal mold exposure (Gonzalez-Casanova *et al.*, 2018). Mold exposure has been reported to cause difficulty breathing, wheezing, coughing, sneezing, runny nose, fatigue and headache (Weinhold, 2007). Serious adverse effects from long-term exposure to mycotoxins have been reported to cause cancers and immune deficiencies (WHO, 2018).

Two studies from the review reported that tobacco smoke exacerbates preexisting respiratory illnesses (Forno *et al.*, 2015) and affects cognitive development (Gonzalez-Casanova

et al., 2018). The most common risk factor for COPD is tobacco smoke and smokers have been reported to have a heightened prevalence of respiratory diseases and abnormalities of the lungs (Zha *et al.*, 2019). Conversely, the United States Environmental Agency (USEPA) reported that nonsmokers have an increased risk of developing heart diseases by up to 30% when exposed to secondhand smoke at work or in the home environment (USEPA, 2022). Environmental tobacco smoke is a significant indoor and outdoor pollutant with multiple hazardous PM.

One study from the review reported that asbestos causes lung cancer and mesothelioma (Algranti *et al.*, 2019). Exposure to asbestos in the home, community or workplace can lead to the accumulation and trapping of tiny asbestos fibers in the lungs. Over time, these fibers can cause inflammation and scarring of the lungs as they accumulate, leading to breathing problems and adverse health issues (ATSDR, 2016). Asbestos exposure to humans may also increase the risk of asbestosis, presenting symptoms such as cough, shortness of breath and permanent lung damage. Pleural disease and other nonmalignant lung disorders with increased risk for lung cancer have been reported due to asbestos exposure (O'Reilly, Mclaughlin, Beckett, & Sime, 2007).

Dust and dust mites were reported in two studies (Table 2). Dust negatively affects the respiratory tract and may lead to COPD (Menezes *et al.*, 2008), while dust mites exacerbate preexisting respiratory illnesses (Forno *et al.*, 2015). Dust and dust mites have been reported to cause mild allergic reactions such as sneezing, watery eyes and runny nose. In chronic cases, prolonged exposure to dust and dust mites can result in severe asthma, congestion, cough, persistent sneezing, eczema flare-up and facial pressure (Aggarwal & Senthilkumaran, 2022).

Outdoor air pollution is a significant contributor to the global burden of diseases (GBD, 2017 Risk Factor Collaborators, 2018). In this review, environmental outdoor air pollutants showed that threats to public health in LAC through prenatal pesticide exposure could impair cognitive development (Gonzalez-Casanova *et al.*, 2018). Impairment of cognitive development due to exposure to tobacco during the prenatal period (Gonzalez-Casanova *et al.*, 2018) was also identified. Arsenic is carcinogenic and causes cancer, adverse reproductive outcomes and impaired childhood cognitive function (McClintock *et al.*, 2012). Airborne microplastics were reported to enhance the spread of COVID-19 when microplastics become carriers for viruses (Amato-Lourenço *et al.*, 2022). On the other hand, aeroallergens cause inflammation and allergic reactions affecting preexisting respiratory illnesses. Additionally, ozone decreases lung function (Amadeo *et al.*, 2015), while the PM is linked to a higher risk of lung cancer (Turner *et al.*, 2020) and exacerbates asthma symptoms in children (Cadelis, Tourres, & Molinie, 2014). Ultimately, volatile organic compounds affect asthma and cause damage to DNA (Montero-Montoya, López-Vargas, & Arellano-Aguilar, 2018), while mercury increases oxidative stress (Olivero-Verbel *et al.*, 2021).

Substantial health effects of outdoor air pollution exposure have been reported to include aggravation of preexisting COPD, asthma, pulmonary diseases, cardiac failure, ischemia, increased vulnerability to infection, arrhythmias and sensitivity to allergens (Abelsohn & Stieb, 2011).

4. Discussion

The reviewers observed trends that indicated very little research on indoor and outdoor air pollution from LAC due to a lack of resources. Most studies were from the South American region, with a few in Central America and the Caribbean. The countries that have research output on indoor and outdoor pollutants have the potential to lead and influence the general research direction on indoor and outdoor pollutants. Ultimately, there is a need to establish collaborative and multidisciplinary research groups in the region that will adopt validated standard research protocols across the board to study indoor and outdoor pollution.

International cooperation and cooperation among LAC governments are significant for financing, regional monitoring and large-scale air pollution reduction campaigns that will help to close the gap between LAC countries and other developed countries. Elevated pollution levels in the Latin American and Caribbean regions place undue stress on public health, a struggling and underfunded region-wide system. Sixteen articles were included in this systematic review that showed that indoor and outdoor pollutants could severely impact health and the quality of life (Table 2). LAC faces a potential public health threat from indoor and outdoor pollutants.

4.1 Indoor pollutants

This systematic review revealed indoor pollutants, such as lead, nitrogen dioxide, coal/biomass fuel smoke, dust, mold, tobacco smoke, asbestos and dust mites as threats to LAC. The most significant on the list is coal/biomass fuel smoke, which carries a wide range of harmful substances constituting pollutants. These pollutants include PM, Nitrogen Dioxide (NO_2), Carbon Monoxide (CO), Sulphur Oxide, polycyclic organic matter and formaldehyde (Saini, Dutta, & Marques, 2020). Although, as a region, coal/biomass fuel consumption is only 16%, many countries and rural areas still rely heavily on biomass fuel (Rehfuess, Mehta, & Prüss-Üstün, 2006). In Guatemala, over 90% of rural households and about half of urban homes continue to rely on biomass for cooking and stoves, adding to the burden of indoor pollutants (Pachauri, Rao, & Cameron, 2018). Based on the articles reviewed, biomass fuel exposure can potentially lead to COPD (Menezes *et al.*, 2008), acute lower respiratory tract infections (Smith, 2000), low birth weight (Bruce *et al.*, 2000), and simulate coughing, wheezing and asthma (Forno *et al.*, 2015). People residing in rural areas are more likely to use biomass fuel and, thus more, likely to suffer from its adverse health effects than households in urban areas. Rural areas are already under-served within the region due to a lack of access and a fragmented healthcare system (Villar Uribe, Escobar, Ruano, & Iunes, 2021), so those within rural communities, although more readily exposed, are less likely to seek or receive treatment for the adverse health effects caused by biomass fuel pollutants.

Also of great concern is that asbestos is still prevalent in Latin America and the Caribbean. Mesothelioma and other cancers have been linked to asbestos since 1924 when the hazards of using asbestos were first published in the *British Medical Journal* (Bartrip, 2004). It has been almost 100 years, yet Latin American asbestos consumption alone accounts for 10% of the global total (Algranti *et al.*, 2019). In Brazil and Argentina, utilization of asbestos is expected to raise within the next few years, mainly due to a lack of clear evidence of its harmful effects, the invisibility of asbestos-related diseases in the region, and the increased difficulty of those exposed in accessing health services (Algranti *et al.*, 2019). Prolonged asbestos exposure has been linked to oropharyngeal, colorectal, stomach, esophagus, laryngeal, ovarian, kidney and lung cancers (Frank, 2020). The increase in the utilization of asbestos emphasizes a need for more effective regulations combined with targeted educational campaigns.

4.2 Outdoor pollutants

This review revealed pesticides, tobacco smoke, arsenic, airborne microplastics, aeroallergens, ozone, mercury, PM and volatile organic compounds as outdoor air pollutants with significant health threats. A significant difference between indoor and outdoor air pollutants is that outdoor pollutants are more likely to be found in urban areas than their rural counterparts. It has been considered that because the size of pollution particles is more prominent in urban air, they tend to be more polluted than rural air. However, recently, Wang *et al.* (2022) reported that the oxidative potential of particles in rural areas could be twice as toxic in urban areas even though smaller. Furthermore, agricultural emissions and the sequestration of greenhouse gases

contribute to the burden of rural air quality (Aneja, Schlesinger, & Erisman, 2009; Majra, 2011). This difference suggests that, unlike indoor air pollutants, exposure to outdoor air pollutants is harder to control as they are outside and depend on variables outside a single person's control. Outdoor air pollutants are primarily a result of agriculture, motor vehicles, bushfires, power plants, improper waste management and disposal, construction, waste burning and nature itself such as pollen and dander. In addition, outdoor pollutants are linked to respiratory diseases, cancer and impaired cognitive development (Sweileh *et al.*, 2018). The critical and primary concern for outdoor pollutants in LAC is microplastics which have been reported to facilitate the spread of disease within the region, as found by (Amato-Lourenço *et al.*, 2022). In the LAC region, approximately 17,000 tons of plastic wastes are disposed of in open dumpsites daily (Orona-Návar *et al.*, 2022). These plastics eventually degrade to microplastics and infiltrate waterways, livestock, produce, and air. The WHO considered droplets or aerosols as significant routes for COVID-19 transmission (WHO, 2020). Recently, Amato-Lourenço *et al.* (2022) reported that SARS-CoV-2 aerosols may bind to total suspended particles, such as microplastics, and facilitate virus entry into the human body. These microplastic-aided carriers potentially allowed the coronavirus to spread more quickly. Earlier studies have shown that viral particles can travel longer distances floating in the for much longer than respiratory droplets (Zuo, Uspal, & Wei, 2020). The implications of this systematic review for public health within LAC are broad and far-reaching as it raises the question of what other diseases can be more readily transmitted via microplastics in addition to the earlier listed health impact of outdoor pollutants.

4.3 Future outlook

Although gradual progress is being made to curb indoor and outdoor pollution in LAC, more needs to be done to curb the rise of these pollutants and minimize public health threats. Presently a few very successful programs are in place to mitigate the escalation of indoor and outdoor pollution and its possible impact on public health. Many countries in LAC, such as El Salvador, Guatemala, Belize and Bolivia, are implementing strategies and programs to reduce biomass fuel consumption. These strategies include educational programs, outreach and the utilization of liquefied petroleum gas (LPG) fuel subsidies. These subsidies have worked so well in Bolivia that they have reached 98% urban clean fuel for cooking (Troncoso, 2021).

A daily and over time relationship exists between increased mortality or morbidity and exposure to high concentrations of PM10 and PM2.5. Related mortality or morbidity rates decrease with a decrease in small and fine particulates presuming other factors remain the same (WHO, 2021). Therefore, LAC countries should explore strategic local, national and regional policies to effectively reduce and control air pollution's health and environmental effects. Successful strategies include improved agricultural and urban waste management, reduction of smokestacks emissions using clean technologies and biogas production using anaerobic waste digestion methods. Furthermore, strategies for recycling, reuse, waste processing, waste separation and waste reduction management, such as open incineration of solid waste or using combustion technologies with strict emission controls, should be explored (WHO, 2021). Additionally, providing affordable, safe and clean household energy for lighting, heating and cooking reduces the health risks of indoor pollutants and the burden of disease. Finally, LAC countries should explore making cities more energy-efficient, compact and green while improving the transportation sector by utilizing clean power generation (Usman & Balsalobre-Lorente, 2022).

Presently, nongovernmental organizations are lobbying for more research and funding to provide data and develop policies. In Brazil, nongovernmental organizations were pivotal in counterbalancing misinformation and inequities, ending recently in a Supreme Court decision that led to an asbestos ban (Algranti *et al.*, 2019). Despite the positive strides, continuous

efforts should be made to stimulate the growth of competent and ethical research that conveys adequate information to the scientific community and the general public that can affect the change necessary to reduce the health burden of indoor and outdoor pollutants on public health in LAC.

4.4 Limitations

Limitations of the study include limited available research done within LAC, with most of the research quantifying pollutants rather than addressing their impacts. Additionally, most studies focus on air pollution but neglect water and land pollution's effects on public health. For this reason, the 16 studies included limited robustness of the review.

5. Conclusion

Various indoor and outdoor pollutants negatively impact public health in LAC. Notable indoor air pollutants include coal/biomass fuel smoke and asbestos, linked to COPD, acute lower respiratory tract infections, low birth weight, coughing, wheezing, asthma and cancer. The most notable outdoor pollutant identified in this review was microplastics. Microplastics infiltrate waterways, livestock, produce and air. They can also facilitate the spread of diseases as carriers. The majority of the research available in the region focuses on quantifying pollutants. Though programs exist to attempt to reduce the levels of pollutant exposure, more needs to be done. To address the emerging threats from indoor and outdoor air pollution in LAC, governments must demonstrate political willpower to make appropriate policies and investments. Supporting industry and better municipal waste management, power general, energy-efficient homes and cleaner transportation systems, thereby reducing significant sources of air pollution at the local, national and regional levels, should be explored. Reducing air pollution will significantly improve health and reduce disease burdens such as acute and chronic respiratory and heart diseases, stroke and lung cancer. In order to properly lessen the impact of indoor and outdoor pollution in LAC, more research needs to be done, policies and appropriate laws need to be developed and adhered to and implemented programs that are working need to be strengthened and expanded.

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