

Choking Futures: How Air Pollution Robs the Breath of Our Youngest

A Qualitative Study Assessing the Impact of Air Pollution
Within the First 1000 Days of Children's Birth in Delhi

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Executive Summary

Children are the future's vital human resources, and the importance of nurturing them for a thriving humanity is paramount. The environment where a child is born and raised significantly influences their overall health. Exposure to air pollution can severely affect a child's mental and physical development. This research study explores the severe repercussions of air pollution in Delhi on the health and well-being of young children, with a specific focus on their critical first 1000 days—a period marked by rapid developmental milestones. It examines the remedial actions undertaken by families, caregivers, and healthcare professionals to mitigate the harmful effects of air pollution on this vulnerable demographic.

The study targets poor and marginalized communities in Delhi's urban slums, resettlement areas, and regions near landfills and construction sites, which are acutely susceptible to the adverse effects of air pollution. Delhi was chosen as the focus area due to the spike in air pollution from November to February, though it persists throughout the year.

Qualitative research methods were employed for this study. Data collection was conducted through focused group discussions (FGDs) with mothers of children under 1000 days old in six socio-economically disadvantaged areas of Delhi, along with care workers, and in-depth interviews with medical experts across various healthcare settings, including public hospitals, neighborhood clinics, and private practices. A case study involving a mother of a four-month-old baby who suffered severe pneumonia in her first month was also conducted. These methods enabled an in-depth understanding of both mothers' and healthcare professionals' perceptions of

the impact of air pollution on young children. The recall method was utilized for data gathering.

The research delves into the multifaceted impact of air pollution on children's health, emphasizing its profound consequences on cognitive and physical development. It critically assesses the vulnerability of economically disadvantaged groups to air pollution's adverse effects. Compelling evidence suggests that a family's socio-economic status significantly influences the level of exposure to air pollution, the impact on the child, and the family's ability to address both the direct and indirect effects of air pollution.

Findings indicate that children from impoverished backgrounds are more susceptible to air pollution due to compromised immunity, inadequate access to clean environments and basic infrastructure, and poor nutrition. The research also highlights that prolonged and frequent episodes of ill health during the winter months further impair a child's growth and development by causing delays in vaccination and disrupting sleep and feeding patterns. Nasal blockages and congestion can prevent young infants from breastfeeding properly. Furthermore, it was observed that parental strategies to manage extended periods of illness often lead to the overuse of antibiotics and steroids in very young children, severely impacting their immunity and leading to long-term health consequences.

The study underscores that addressing the multifaceted impacts of air pollution requires a comprehensive approach that integrates environmental, healthcare, and policy interventions.



Key Recommendations

Mitigation of the impacts of air pollution on young children require the following measures:

- **Research and evidence**

Conduct more research studies to better understand the complex interactions between air pollution and infant health, as well as reproductive health outcomes in young women. Foster collaboration among researchers, healthcare professionals, and policymakers to advance knowledge and address gaps in understanding.

- **Public awareness**

Educate caregivers, parents, and communities about the detrimental effects of air pollution on infant health and on the ways to tackle it and protect them. Build awareness campaigns on the importance of taking nutritional food, keeping the surroundings clean, on waste/garbage disposal mechanisms, and on seeking professional medical care when the child is sick. Spreading awareness on the harmful effects of over usage of antibiotics and steroids is important as it has long term implications on children's health.

- **Improving public infrastructure**

Invest adequately in improving healthcare infrastructure, medical facilities, equipment, and trained personnel in heavily affected areas to address pollution-related health issues in infants. Ensure accessible and affordable healthcare services for timely diagnosis and treatment. Improving the public infrastructure in densely populated low-income areas like providing public parks, waste disposal systems and sanitation facilities. Take necessary action regarding disposal of industrial waste and management of landfills.

- **Policy interventions**

Enact comprehensive policies ensuring access to clean water, nutritious food, and adequate healthcare services for pregnant women and infants. Promote breastfeeding and maternal well-being to enhance the infant's resilience against pollution-related health hazards. Ensure that the guidelines regarding the use of antibiotics and steroids are strictly implemented, as the over usage of these drugs is widely prevalent.

- **Investment in care infrastructure**

Provide adequate investments for establishing more care institutions and care centers for young children not only to support parents in their childcare duties but also to boost early childhood growth and development of our young ones.

1. Introduction

Every child has the fundamental right to grow up in a safe, clean, and healthy environment. The pervasive presence of air pollution poses a significant threat to this right. The environment in which one is born and lives contributes significantly to their well-being and is a well-established social determinant of health. Exposure to air pollution can have profound and lasting effects on children's cognitive and physical development which jeopardize their health and well-being. Therefore, there is an urgent need to comprehensively address the issue of air pollution.

The first 1000 days of a child's life are globally acknowledged to be the most critical as the pace of development during these days is extremely rapid. Recent research (Balietti et al, 2022) in the field of neuroscience, particularly on the brain, has provided strong evidence of the 'critical periods' located within these early days for the formation of synaptic connections in the brain and for the full development of the brain's potential. It is marked by significant physical growth and motor development. Infants typically double their birth weight by six months and triple it by one year, reflecting the rapid pace of growth. Motor milestones include lifting the head, rolling over, sitting, crawling, and eventually walking, and they demonstrate the progressive maturation of the nervous system and musculoskeletal system (World Health Organization, 2017). In addition, cognitive development during the first 1000 days lays the groundwork for future intellectual abilities and academic achievement. Infants exhibit early cognitive abilities such as attention, memory, and sensory perception, which form the basis for more complex cognitive processes later in life (Center on the Developing Child, 2010). Language development also progresses rapidly, with infants transitioning from cooing and babbling to

producing their first words and eventually forming simple sentences (Fenson et al., 2007).

It is, however, also indicated by research (Singh et al, 2019) that if these early days are not supported by or embedded in a stimulating and enriching physical and psychosocial environment, the chances of the child's brain developing to its full potential are considerably, and often irreversibly, reduced.

The prenatal environment, including exposure to toxins, can impact fetal development and contribute to long-term health outcomes (Barker, 1998). Mounting evidence (Jayachandran, 2009; Chen et al., 2013; Arceo et al., 2016; Deschenes et al., 2020) suggests that exposure to air pollution, both during pregnancy and childhood, is associated with childhood developmental outcomes ranging from changes in brain structures to subclinical deficits in developmental test scores, and, ultimately, developmental disorders such as attention-deficit/hyperactivity disorders or autism spectrum disorders. Although the biological mechanisms of effects remain to be elucidated, multiple pathways are probably involved and include oxidative stress, inflammation, and/or endocrine disruption. These pathways foreground the complex interconnections between air pollution and a young child's health.

1.1 What is air pollution?

The term "pollution" refers to the contamination of the earth's environment with materials that interfere with human health, quality of life, or the natural functioning of ecosystems. The major forms of pollution include water pollution, air pollution, noise pollution, and soil

contamination. Other less-recognized forms include thermal pollution and radioactive hazards (Rizwan et al., 2013).

Air pollution contributes substantially to premature mortality and disease burden globally, with a greater impact in low-income and middle-income countries than in high-income countries (Cohen et al., 2017). India has one of the highest exposure levels to air pollution globally. The major components of air pollution are ambient particulate matter pollution, household air pollution, and, to a smaller extent, ozone in the troposphere, the lowest layer of the atmosphere. In India, the major sources of ambient particulate matter pollution are coal burning for thermal power production, industry emissions, construction activity and brick kilns, transport vehicles, road dust, residential and commercial biomass burning, waste burning, agricultural stubble burning, and diesel generators. Indoor or household air pollution is caused mainly by the residential burning of solid fuels for cooking and, to some extent, heating, with major types being wood, dung, agricultural residues, coal, and charcoal. Cramped living spaces with negligible ventilation, a common situation for many low-income households, aggravate the problem of air pollution as the pollutants get trapped within the confines of the home, prolonging their presence. For children under 1,000 days old who usually stay indoors most of the time, indoor air pollution is a major factor affecting their health. Rapidly developing countries such as India face the dual challenge of exposure to both ambient and household air pollution (Balakrishnan et al., 2014).

Ground-level ambient ozone is produced when nitrogen oxides and volatile organic compounds emitted from transport vehicles, power plants, factories, and other sources react in the presence of sunlight.

In a study published in *The Lancet* (Cohen et al., 2017), India contributed 50 percent to global estimates of mortality and disability-

adjusted life-years attributable to ambient particulate matter pollution for the year 2015. One in eight deaths in India is attributable to air pollution. A study by researchers at the Energy Policy Institute at the University of Chicago (EPIC) concluded that people in India would live 4.3 years longer if the country met WHO guidelines (EPIC, 2018). Air pollution in the capital city of Delhi (or the National Capital Territory of Delhi) is severe during winters. Strong links have long been established between exposure to air pollution and cardiovascular diseases, such as strokes and heart disease, cancers, chronic obstructive pulmonary diseases; respiratory diseases, including acute respiratory infections (especially in vulnerable groups like children and the elderly); poor birth outcomes, etc. These entail adverse health, economic, and developmental consequences (WHO, 2018).

1.2 Effects of Air Pollution

Children below 1,000 days of age are particularly vulnerable to air pollution because of their underdeveloped natural defense mechanisms (e.g., blood-brain barrier, immune system), higher ratio of breathing rate to body size, and less awareness of the conditions of their surrounding environment (Salvi, 2007). Typical brain development is a complex process that involves controlled cell proliferation, neuronal migration, myelination, and the establishment of specific neuronal connections (Jiang & Jeannette, 2015). These complicated and tightly regulated events are sensitive to environmental conditions, especially during periods of rapid brain growth and high neuroplasticity, such as pregnancy and early childhood.

Pollutants, especially fine and ultrafine particles, can invade a pregnant female's respiratory barrier, pass into the maternal bloodstream, and cross the placental barrier by direct transport (Ministry of Health &

Family Welfare, GoI, 2015). A recent landmark study found the presence of black carbon particles on both the fetal and maternal sides of human placentae, and the amount of black carbon was positively correlated with the mother's residential exposures (Ministry of Environment, GoI, 2015). These findings suggest that pollutants inhaled by pregnant females can directly reach the placenta and developing fetus. Once in the placenta, pollutants can trigger multiple omics-scale changes (i.e., genomics, epigenetics, transcriptomics, metabolomics, and proteomics), many of which are capable of altering transplacental oxygenation and nutrient transport, or trigger other mechanisms (e.g., preterm birth, restricted growth) that can adversely affect the developing fetal brain. Once in the brain, pollutants can induce neurological impairments that are known to be major contributors to common developmental disorders. Studies have also highlighted that exposure to air pollution during the first trimester increases the probability of stunting, wasting, and underweight issues in the newborn child (Ji & Johnson et al., 2023).

In terms of the health and development of young children who are about 1,000 days old, experts (Gough, 2019) have underscored three primary reasons why they are more vulnerable compared to other age groups. Firstly, as mentioned earlier, children have a significantly faster respiratory rate than adults. While a typical adult breathes between 12 and 18 times per minute, a 3-year-old child breathes in the range of 20 to 30 times per minute, and a newborn takes even more breaths, ranging from 30 to 40 per minute. Consequently, young children are inhaling polluted air at a rate 2-3 times higher than that of adults. This heightened exposure increases their susceptibility to the adverse effects of air pollution.

Secondly, children's organs, including their lungs, are still in the developmental stage. This renders them particularly vulnerable to

damage from air pollutants (Salvi, 2007). Such vulnerability can manifest in both immediate and long-term effects. For instance, exposure to air pollution can trigger conditions like asthma in the short term, while in the long term, it may lead to a reduction in lung volume, which could persist throughout their lives (Anderson et al., 2012). Therefore, the ongoing development of children's organs makes them more susceptible to the harmful effects of pollutants, with potential implications for their respiratory health in the short and long term.

Thirdly, the youngest children face additional risks due to the incomplete formation of the blood-brain barrier (Brockmeyer & Angiulli, 2016). This barrier serves to protect the brain by regulating the passage of substances from the bloodstream into the brain tissue. In young children, this barrier is not yet fully developed, allowing air pollutants to pass from the lungs into the bloodstream and subsequently reach the brain. Once in the brain, these pollutants can cause inflammation and damage to brain cells, potentially impairing cognitive and intellectual development (UNICEF, 2017). This underscores the critical importance of protecting young children from exposure to air pollution, as it can have significant and lasting effects on their neurological development and overall well-being.

Thus, the combination of faster respiratory rates, ongoing organ development, and the incomplete blood-brain barrier makes young children particularly vulnerable to the adverse effects of air pollution. Understanding these vulnerabilities is crucial for developing effective strategies to mitigate the impacts of pollution on children's health and development.

Further, it is also important to note that while air pollution affects everyone, socio-economic factors play a significant role in exacerbating vulnerability to air pollution.



The susceptibility of young children from poor and marginalized communities to the impact of air pollution is multifaceted and complex (UNICEF, 2016). Addressing these disparities requires a comprehensive approach that addresses underlying socio-economic inequalities, improves access to healthcare and basic amenities, and implements policies to reduce pollution levels. It requires comprehensive policy measures and interventions at both the

national and local levels. There is an urgent need to enforce stricter emissions standards for industries and vehicles, invest in cleaner energy alternatives, and promote sustainable urban planning to reduce pollution levels. Additionally, public awareness campaigns and community-based initiatives are crucial for educating individuals to adopt cleaner practices and advocate for environmental protection.

2. Scope of the Study

In the context of the above literature, this research project investigates the impact of severe air pollution in Delhi on the health and well-being of young children, particularly focusing on the critical first 1,000 days of their lives. The project explores the adaptation strategies employed by families and care providers, including doctors, creche workers, ASHA, and Anganwadi workers, to mitigate or manage the adverse effects of air pollution on young children. It specifically targets poor and marginalized communities residing in urban slums, resettlement areas, ghettos, and work sites in Delhi, due to their increased vulnerability to air pollution.

Delhi has been specifically chosen because, while air pollution is a consistent problem throughout the year, its intensity becomes severe during the months of November to February. Multiple reasons have been factored in for this phenomenon, including vehicular emissions, dust, agricultural stubble burning in neighboring states, the frequency of festivals and weddings during this period which involve bursting of crackers, and the cold, foggy weather itself, which keeps dust particles and other pollutants close to the earth's surface. The most concerning aspect of this is the high proportion of fine and ultrafine particulate matter, PM10 and PM2.5, in the air. While PM10 particles, whose size is less than or equal to 10 microns, stay in the lungs, PM2.5 particles, which are thinner than human hair, can travel with the bloodstream to reach other parts of the body and organs (Banerjee, 2023). According to the Fifth Round of the National Family Health Survey (NFHS-5) conducted by the Government of India, the prevalence of children suffering from Acute Respiratory Infection (ARI) is highest in Delhi. While the national average is 2.8 percent, in Delhi, the percentage of children aged less than five years who suffer from ARI is 5.8 percent (NFHS-5). The

prevalence of ARI is higher in the winter months (Varghese & Muhammad, 2023). As a result, residents of Delhi across class segments suffer from numerous health issues that can be directly linked to the toxic air they are breathing in daily. However, young children and the elderly, specifically from the poor and marginalized communities living in slums, resettlement areas, and roadsides, are more vulnerable and susceptible to this toxicity due to limitations in being able to protect themselves from overexposure to air pollutants along with having compromised immunity (Banerji, 2023). This is even more so as Delhi is surrounded by four landfills, which emanate toxic gases and where people from low socio-economic backgrounds reside: the Ghazipur landfill in the east, the Okhla landfill in the south, the Bhalswa landfill in the north, and Narela-Bawana also in the north.

By centering the voices and experiences of women from marginalized backgrounds who are mostly engaged in informal and low-wage labor sectors (their work profiles are discussed briefly in the sections below), the study aims to uncover the nuanced ways in which air pollution impacts the lives of their babies. By focusing on this demographic and geographical context, the study aims to generate evidence that can inform policy interventions to address the intersection of air pollution and child health, particularly for those belonging to low-income households.

The main objectives and research questions of the study are stated below:

The **Main Objectives** of this research are:

- a. To highlight the impact of severe air pollution in Delhi on the health and well-being of young children specifically in the first 1000 days.
- b. To examine the adaptation strategies that families and care providers (doctors, creche workers, ASHA workers) are adopting to limit or manage this impact.

Research Questions include:

- a. What kind of impact severe air pollution in Delhi has on young children in their first 1000 days in terms of -Frequency of ill-health
 - Vaccination schedule
 - Sleep patterns
 - Breastfeeding/food intake
 - Activity/daily routine
- b. What impact severe air pollution has on pregnant women?
- c. Is there any visible difference in children's health, development, activity and daily routine between summer months and winter months (when the severity of pollution increases)?
- d. Is there a disease pattern that is common to most young children during the winter months when pollution is severe?
- e. What strategies are parents/doctors/care workers using to support the young child to cope with the impact of pollution?
- f. What support are parents/doctors/care workers receiving from the state/employer to manage and limit the impact of air pollution on young children and pregnant women?

2.1 Methodology and Sampling

The study uses a qualitative research methodology to understand the perceptions of mothers and health professionals regarding the impact of air pollution on young children and to highlight the mechanisms and strategies they adopt to deal with the issues. For data collection, focus group discussions (FGDs) were conducted with mothers who have children under 1,000 days old in six low socio-economic localities of Delhi (four localities within Delhi and two in neighboring regions—NCR). In-depth interviews were conducted with experts who are medical professionals and practicing doctors associated with public hospitals, mohalla clinics (neighborhood clinics), and some private practitioners. In total, we interviewed ten medical professionals and one ASHA worker. An FGD was also conducted with a group of ASHA workers and creche workers.

The number of participants in the FGDs ranged from 10 to 20 women on average, predominantly from marginalized socio-economic backgrounds. Primarily comprising domestic workers, construction workers, and a few waste segregators who work from home, this sample encompasses women engaged in labor-intensive and often informal employment sectors. Through open-ended questions and group interactions, FGDs with young mothers facilitated the exploration of complex issues such as health impacts, coping strategies, and barriers to accessing healthcare services, thereby generating valuable insights to inform research findings and policy recommendations.

In addition to FGDs, interviews with doctors and care workers provided a crucial perspective from the healthcare profession, offering insights into the clinical manifestations, diagnosis, and



Focus Group Discussion with Mothers in Process

management of air pollution-related health conditions in infants. We also spoke to the Director of the National Institute of Health and Family Welfare (NIHFW), an autonomous organization under the Ministry of Health and Family Welfare, which plays a crucial role within the larger policy paradigm concerning family health and welfare.

This research also included a case study with a mother, Farah, whose one-month-old child developed severe pneumonia and had to be hospitalized. The case study method was a valuable means of understanding the complex interplay between environmental exposures, health outcomes, and socio-economic factors through the lens of individual experiences. By closely examining Farah's experiences, including her socio-economic background, living environment, access to healthcare, and caregiving practices, the study gained insights into the specific pathways through which air pollution affects infant health.



Interview with Private Doctor

The breakup of methodology and sampling is given below in Table 1.

Methodology	Target Group	Sample Size	Specifics
Key Informant Interviews	Health Professionals	2	1 Senior Paediatrician and Director, National Institute of Health & Family Welfare 1 Senior Community Paediatrician and Community Health Professional
In-depth Interviews	Doctors	8	1 Neonatologist, associated with Public Hospital. 3 General Physicians associated with Primary Health Centres 1 doctor associated with Mohalla Clinic 3 local health practitioners practising as private doctors in the targeted localities but do not have medical degree
In-depth interviews	Care workers	1	1 ASHA (Accredited Social Health Activists) worker
FGD	Care workers	1	Group of 7-8 ASHA workers
FGDs	Women (Young mothers)	1	Each group has 10-20 women. 4 FGDs within Delhi (Dakshinpuri, Seemapuri, Bhalswa, Shabad Dairy) and 2 in NCR area (Barola and a construction site in Gurgaon)
Case Study	Family	1	Family residing in Bhalswa landfill area

The research tools and the questionnaire deployed by the study are given separately in **Annexure**.

2.2 The Geographical Context

The geographical context of this study is crucial for understanding the environmental conditions and potential sources of air pollution that young children and other residents are exposed to in these low-income areas. By conducting focus group discussions in specific locations such as Dakshinpuri, Barola in Noida, Signature

income area characterized by rapid urbanization and industrialization. The region is known for its high population density, informal settlements, and inadequate urban planning, leading to environmental degradation and pollution hotspots. Signature 81 in Gurgaon is a construction site that has seen the impact of developmental activities on air quality. Construction sites are significant sources of particulate matter and other pollutants due

Table 2: Geographical Locations and profile of respondents

Geographical Area	Sampling	Method
Dakshinpuri	Domestic workers	Focused group discussion
Barola	Domestic workers	Focused group discussion
Signature 81	Construction workers	Focused group discussion
Seemapuri	Private sector employees and domestic workers	Focused group discussion
Bhalswa Dairy	Domestic workers, waste segregators, and housewives	Focused group discussion
Shabad Dairy	Domestic workers	Focused group discussion

81 in Gurgaon (a construction site), Seemapuri (a resettlement colony), Bhalswa Dairy (near a landfill), and Shabad Dairy, the research was able to gather valuable insights into the impact of air pollution within diverse urban settings.

Table 2 below outlines the geographical areas selected for the study, the sampling criteria, and the method of data collection employed for each area.

Dakshinpuri, located in South Delhi, is a densely populated area. It is surrounded by industrial zones and traffic-congested roads, contributing to high levels of air pollution. Barola, situated in the National Capital Region (NCR), is another low-



Bhalswa Landfill

to activities such as excavation, demolition, and heavy machinery operation. Infants residing in close proximity to such sites are particularly vulnerable to air pollution exposure.

Bhalswa Dairy is near a landfill, where the disposal of solid waste generates various pollutants, including methane, volatile organic compounds, and particulate matter. These pollutants can affect air quality not only in the immediate vicinity but also in surrounding areas, posing health risks to residents, including infants. Seemapuri, located in the northeastern part of Delhi, is a densely populated urban locality and a resettlement colony. It has

several small-scale industries and commercial establishments. Shabad Dairy, located in a low-income area, faces challenges related to waste management and environmental pollution. Overall, the geographical locations chosen for the study represent diverse urban contexts characterized by different sources of air pollution, including industrial activities, construction sites, landfills, and urban settlements.

3. Key findings of the study

3.1 Is air pollution considered a problem?

As we initiated the data collection for the study, conducting focus group discussions with mothers of young children in various locations, two aspects immediately stood out. First, we found the mothers to be quite aware of the levels of pollution in the city and its known impacts. Second, despite being aware of the effects of pollution, none of them seemed to connect the increased air pollution during the winter months in Delhi to the illnesses their children suffered from. In all six FGDs, the majority of women stated that their children experienced extended episodes of upper respiratory infection, including cough, cold, and breathlessness, during January and February of 2024. Severe cases of pneumonia were also reported in all localities, but numbers were higher in areas near the landfill, i.e., Bhalswa and Shabad Dairy. In both these areas, children as young as 3-4 months were reported to be admitted to intensive care units (ICUs) for several days. However, most mothers thought this was common to all young children of this age and attributed it to the severe cold weather. Many also suggested that the children contracted it from them, as they mostly

worked with cold water throughout the day and believed that breastfeeding would transmit the infection to their child. Even though there is substantial epidemiological evidence connecting air pollution to hazardous impacts on human health, particularly for young children and the elderly, there appears to be little concern within the community. This may be because upper respiratory infections are considered commonly occurring health issues and hence are not seen as a problem. Dr. Shah, Director of NIHF, explained this in his interview when he stated, ***“Air pollution is not new. It is increasing progressively year after year but has always been there. It's not something that started suddenly. Health issues are happening with everybody, and when it is happening with everybody, you don't perceive it to be a problem.”***

Interviews with senior medical practitioners associated with public hospitals further highlighted that the majority of health conditions associated with air pollution can also occur due to other factors. For example, cold, cough, watery eyes, skin rash, or even asthma can occur due to infection, some deficiency, or even a genetic condition. Hence, it is difficult to clearly establish that a particular condition is only happening

because of air pollution. This also tends to dilute the perceived severity of the problem. Dr. Shah from NIHFWS stated that this difficulty in establishing a connection between air pollution and specific health conditions also leads to diluted policy interventions in terms of mitigating the problem. He explained, ***“The problem of air pollution is linked to many reasons. At one level, it is difficult to establish air pollution as a causal factor for many health outcomes; at another, any kind of mitigation strategies may have a grave impact on issues such as people’s livelihoods. This sometimes makes it difficult even at the policy level to bring in clear intervention strategies to mitigate the problem.”***

However, discussions with Dr. Pratima show that there have been symptomatic strategies adopted by the government to deal with air pollution. She says, ***“When the AQI levels in Delhi rise very high in winters, when the air pollution reaches very severe levels, the Delhi government orders the closing down of schools for young children. They do this because young children are worst affected by air pollution, and therefore they need to be protected.”*** The practice of declaring holidays for schools, especially for primary and middle school classes, is usually seen every year in Delhi during December and January. This symptomatic intervention strategy does not aid in a comprehensive mitigation of the problem.

How does one understand or assess the impact? Our interviews with doctors highlighted that while it is impossible to assess the impact of air pollution without complex scientific studies that analyze large datasets over several years to assess disease patterns or through controlled studies, their years of experience working at public hospitals highlight that cases of upper respiratory issues drastically increase during the winter months. Dr. Sindhura, who works with a Primary Health Centre in

East Delhi, stated, ***“Mothers with very young babies, 2 or 3 months old, are a common sight at our centre and mostly complain of cough and cold issues with the child.”***

Thus, the study highlighted that even though there is substantial awareness among the community regarding air pollution and its hazardous impacts, there appears to be less regard or concern for the problem. This is mostly because the common health issues that are evidently caused and worsened by air pollution may also have other causal factors, making it difficult to pinpoint a particular health condition as being solely due to air pollution. However, as pointed out by scientific evidence and research, the increase in the number of cases of upper respiratory conditions, their frequency, and duration specifically during the winter months in Delhi clearly highlights that air pollution is having a significant impact on human health.

3.2 How air pollution impacts children’s health?

In all six communities where we conducted FGDs with mothers, all respondents reported that their children suffered from upper respiratory infections during the winter months (November-February). This included persistent cough, cold, nasal blockage, and sneezing, which lasted for several days and, in some cases, a few weeks. Skin rashes, bloody diarrhea, nosebleeds, and vomiting were other issues highlighted by the community. In all localities, at least 2 or 3 mothers reported that their children suffered from pneumonia, persistent fever, and breathlessness, which resulted in hospitalization. However, in Bhalswa, the area near the landfill, cases of pneumonia, high fever, and hospitalization increased significantly. This was prevalent even

among infants as young as 2 to 3 months.

Studies (Patil & Chari, 2005) have increasingly correlated the presence of landfills with heightened rates of respiratory ailments, particularly pneumonia, among nearby residents. The proximity to landfills exposes individuals to a cocktail of air pollutants, including particulate matter, volatile organic compounds, and hazardous gases, emanating from decomposing waste materials. These pollutants can irritate the respiratory tract, compromise lung function, and weaken the immune system, making people more susceptible to respiratory infections such as pneumonia (Guo, Hu et al., 2018). The microbial composition within landfill sites, often including pathogens and bacteria, may contribute to the proliferation of respiratory illnesses in surrounding communities. Socioeconomic factors exacerbate this issue, as marginalized communities are disproportionately burdened by the presence of landfills in their vicinity, leading to disparate health outcomes. Our primary data also substantiates this. Dr. Vinod, who has a private practice in Bhalswa Dairy, says, ***“People here are exposed to a variety of pollutants which penetrate air, water, and soil. These pollutants contribute to respiratory illnesses such as asthma and bronchitis, cardiovascular diseases, skin conditions, and neurological disorders. Children, with their developing immune systems and smaller body sizes, face heightened risks. Prolonged exposure to landfill emissions leads to stunted growth, cognitive impairments, and developmental delays. The contaminated soil and water also cause gastrointestinal problems.”***

Dr. Vinod further adds, ***“The socio-economic dynamics have an impact on the health of people living near landfills, with marginalized communities disproportionately bearing the burden. Limited access to clean water and nutritious food further compounds the***

health challenges, perpetuating a cycle of poor health. Living in environments surrounded by noxious odors, pests, and constant pollution affects children badly.”

This was also corroborated by the interviews that were conducted with the doctors. Dr. Pratima, a pediatrician associated with a public hospital, stated, ***“The cough allergic symptoms which are in the form of sneezing, nasal blockade, respiration, difficulty in breathing, and difficulty in playing sports or climbing stairs and having that broncho-kind of suffocation feeling; those symptoms are lasting a lot longer. We say that viral infections are normal in an infant or under one year of age in India or in other countries. But what happens is that after going viral, the illness, which should subside in 5 to 7 days, is now getting prolonged, perhaps because of AQI worsening. The illness is not actually resolved before 2 to 3 weeks.”***

In terms of disease patterns, it was explained that in younger children, episodes of both upper and lower respiratory diseases have drastically increased and remain persistent. Since the immune system of young children is in the developing stage, they have lymphoid glands, the adenoids, which are present in the throat and are normally responsible for their immunity against any allergen, foreign body, or infection. However, prolonged exposure to allergens and persistent respiratory infection may lead to adenoids remaining enlarged for long periods, which could result in nocturnal disturbed sleep patterns, mouth breathing, snoring, and difficulty in breathing as the airways become narrow. Dr. Pratima added, ***“To say that a particular disease pattern is only due to air pollution is difficult to establish and may require a complex scientific study, but, from my experience as a practitioner, I can say that in the last 5-6 years, in the months between August and March, the requirement of nebulization, bronchodilators, and severity and duration of the stay in the hospital have all significantly increased among young infants. These are also months when***

cases of flu increase. But seasonal flus and seasonal viruses have always been there, but the presence of allergens augments the chances of prolonged episodes of these infections.”

It is also essential to observe that even though there has been a significant decline in Infant Mortality Rate (IMR) and the prevalence of life-threatening diseases among children in India, ‘the burden of diseases is not going away.’ Dr. Shah, Director NIHF, explained, “Our medical facilities have improved significantly. We have more effective medicines, improved vaccination programs, better healthcare facilities, awareness programs and all of this has decreased the severity of cases. Cases of infectious diseases such as polio and measles have gone down, and so have several bacterial diseases. IMR has gone down, and overall lifespan has increased. But the burden of respiratory diseases is definitely increasing. The prevalence of latent infections remains.”

Apart from the direct impact on children's health in terms of the occurrence of diseases, several other impacts were also identified, which further lead to the vulnerability of young children. The persistent episodes of nasal blockage, cough, and cold not only impact the sleep patterns of the young child but also their nutritional intake. Many mothers reported that their child was not able to take proper feed due to infection or would vomit the milk due to blockage. Many mothers also believed in the myth that it was their breast milk which had caused the transfer of infection to their infant from them and would, therefore, avoid breastfeeding. Routine vaccinations were also impacted. Mothers, as well as care workers (ASHA), reported that routine vaccinations were not given to a child if the child was found to be suffering from an infection. Since most children suffered from prolonged episodes of respiratory infection, their vaccination got delayed. Doctors informed that ideally, vaccines should not be delayed if there is

only a common cold and cough. This is also what the government ruling regarding vaccination states. However, the common practice was not to give the due vaccine if the child was suffering from infection due to fear of resultant complications. Dr. Sindhura from East Delhi PHC explained, ***“Cold and cough is not a contraindication for not giving vaccines. However, if the child seems very lethargic and sick, then it is a valid reason to stop the vaccine for a while, but not mere cold and cough, that we would not suggest. In case there is a fever, then also we avoid it as vaccines are nothing but attenuated or dead microorganisms, so there will be a little immune reaction which will give them fever or slight inflammation around the site of injection. If the child already has a fever, and the body's immune system is struggling with another infection, we can't give another dead microorganism to the baby. In that case, we tell the mother to bring the child for the vaccine once the fever subsides. But usually, mothers forget and then they bring the child after a month or so. So, it gets delayed, but this much delay is insignificant; it should not cause any trouble, but if in between even the breast milk is not given, then there can be some issue. If breast milk is not given and immunization is also not happening, then the child is susceptible to many infections.”*** She also reported that mothers were not exclusively breastfeeding as they were also falling sick, were anemic in most cases, and hence were not able to produce enough milk.

Lifestyle and dietary changes within the community were also highlighted by doctors and some of the women respondents as major factors in terms of compromised immunity. Young mothers in their FGDs stated that they mostly eat processed snacks from outside rather than cooking regular meals. Children as young as 2 years were also found to be consuming packaged snacks (biscuits, chips, momos, noodles) on a regular basis. Interviews with doctors highlighted that this change in

food intake was also leading to prolonged episodes of illness, anemia, and malnutrition due to resultant compromised immunity.

The study also tried to understand and assess the impact of air pollution on pregnant women. Many of the women respondents stated that they suffered from extended episodes of cough during the winter months of their pregnancy, but mostly no one complained of any serious complications. However, FGDs with women respondents did highlight that the cases of infertility and miscarriages had significantly increased in their areas/localities. While literature (Mahalingaiah et al, 2016) may indicate that high levels of air pollution may lead to increased cases of infertility, complicated pregnancies, and miscarriages, interviews with doctors highlighted that since most of these issues are also multifactorial, it is difficult to establish the role of air pollution in any of these conditions without complex scientific investigation and research. Dr. Sindhura from East Delhi PHC explained, ***“As far as the rate of miscarriage is concerned, yes, I would agree as out of 10 patients every day at least 5 or 6 have a history of miscarriage, but there can be many reasons for it. Women's physique, her health, family issues, or even lifestyle issues. Lifestyle has changed a lot, the food we eat. Everything is processed, we have a lot of cheaper options. Even poor people have cheaper options for filling their stomachs in the community instead of making it in the home.”***

3.3 Are the poor more susceptible to the impact of air pollution?

While there is no doubt that air pollution affects everyone, the study highlighted that the poor are more vulnerable to its impact due to their socio-economic conditions. People from poor and marginalized

sections often reside in densely populated urban areas characterized by high levels of pollution. These areas often lack basic infrastructure, such as paved roads and adequate housing, which can exacerbate pollution levels.

Interviews with doctors and care workers highlighted that people living in slums, resettlement areas, or near industrial areas, landfills, or roadsides face additional challenges in protecting themselves from overexposure to air pollutants. Their exposure to additional environmental hazards, such as industrial pollution or waste dumping, further increases their health risks. They also often lack access to adequate healthcare services, nutritious food, and clean living environments, which further compromises their resilience to the effects of pollution. Economic constraints also limit their ability to afford protective measures such as air purifiers.

All the localities selected for the study, barring one, were congested poor urban areas with inadequate waste disposal and sanitation systems. The sixth locality was a construction site with temporary provisions made for migrant labourers to stay. Roads were narrow and dusty with open drains, and houses were packed tightly together. Piles of waste were a common sight in most places. Houses mostly comprised one room, part of which was also used as a kitchen. The lack of proper ventilation, overcrowding due to space constraints, and inadequate sanitation and waste disposal mechanisms made the residents of these localities and their children more vulnerable to the toxins and allergens present in the air. The high level of traffic also added to the problem. Apart from this, a lack of awareness among the community and low hygiene levels were highlighted as major problems.

Children residing in construction sites are exposed to air pollution generated by construction activities like excavation, demolition, material transportation, and



Localities visited for fieldwork for the study

machinery operation. Creche workers reported that, in addition to common colds, coughs, and fevers affecting children during the winter, asthma, bronchitis, and other respiratory infections were also prevalent. Fine particulate matter and dust can penetrate deep into the lungs, causing long-term health complications such as reduced lung function and cardiovascular diseases. Furthermore, children living in construction sites are also exposed to noise pollution. The constant noise from heavy machinery, construction activities, and traffic can disrupt sleep patterns and impair cognitive development.

Dr. Verma from Dakshinpuri emphasized in his interview that families belonging to low socio-economic groups are the worst sufferers as they lack access to basic infrastructure, nutrition, appropriate hygiene, and basic awareness. He highlighted that, in order to tackle the severity of the cold weather, residents of the locality often collect and burn waste lying on the roadsides during late evenings to keep warm. The lack of support systems for the poor and marginalized to tackle the severity of the cold weather and the intense pollution in the city during the winter months was also highlighted by Dr. Vandana Prasad, a Community Paediatrician and Public Health Professional. She stated, ***“We’ve had very, very severe winters. Really severe, it’s a***

case of staying alive or staying comfortable for that night as compared to losing some five years of your life in the long run... What would you expect poor people to do? We have heaters, we use geysers for hot water. What can they do? Some of the shelters have closed down, the remaining are already overcrowded; so, it’s a whole different ball game of conversation that needs to happen, for what are the support systems that are available to people?”

The study also highlights that apart from the problem of lack of access to basic infrastructure, sanitation, drainage, and waste disposal systems, the strategies adopted by poor families to tackle the health issues of their children further exacerbate their chances of becoming more susceptible to the hazardous impact of the polluted air they breathe, as the following discussion clearly indicates.

FGDs with women respondents highlighted that when their child falls sick, they prefer to take the child to a local private practitioner rather than a government dispensary or primary health centre. They responded that this was because the medicine given by the local private doctor would provide relief much faster than the medicines given in public healthcare centres. Our interviews with ASHA workers and doctors highlighted that the local

doctors most mothers prefer to take their children to are not qualified doctors; in most cases, they have started practicing as doctors as an extension of their pharmacy shops. Further probing revealed that these local doctors often gave young children antibiotics and steroid medication through nebulization to provide instant relief. This was despite the government issuing strict guidelines regarding what kind of medication can be given to young infants. Dr. Sindhura from East Delhi PHC explained, **“For all diseases, there are guidelines on how we start antibiotics or when we start. We also have guidelines in terms of our primary health centre, how much treatment we can give and on how serious cases can be referred to higher facilities. For example, in pneumonia, if there is fast breathing and fever and if it is for more than 14 days, then we give the first dose of antibiotics and refer them to the higher centres. If it is less, say there is fast breathing and nothing more, we prefer home-based treatments, not with antibiotics but just with ORS (Oral Rehydration Solution) or steaming. We are also not supposed to give cough syrups to children under 5 years of age, but yes, private doctors give a lot of antibiotics.”** An interview with the doctor of a Mohalla Clinic located in Shabad Dairy highlighted that patients demand medicines that provide quick relief. Since, as government medical practitioners, they can give antibiotics and steroids only as per given guidelines, the majority prefer to take the children to private clinics for instant relief. It is only when the case becomes complicated that they would take their child to a government hospital.

During our interaction with mothers, we found that initially all of them preferred to take the child to a local practitioner. Sometimes they even self-medicated the child by purchasing antibiotics over the pharmacy counter as per a previous prescription. This was because extended episodes of illness not only increased their



Clinics of Local Private Doctors

care burden but also impacted family income and expenses. Mothers who were mostly employed as domestic workers, found it difficult to take leave and this increased the stress and pressure on them when their child was unwell. Thus, to mitigate care burden and loss of income, parents often relied on getting quick relief measures, which often resulted in preferring the use of antibiotics and steroids.

Thus, it was found that the strategies used by parents to tackle the problem of extended episodes of illness amongst their children was leading to overuse of antibiotics and steroids on very young children. This in turn may result in long term implications on their health.

Interviews with doctors highlighted that the reliance on quick relief measures, such as antibiotics and steroids, in response to frequent illnesses can contribute to antibiotic resistance and compromised immunity in infants. Overuse or misuse of antibiotics fosters the development of resistant bacterial strains, diminishing the effectiveness of antibiotic treatments. And prolonged exposure to steroids can suppress the immune system, leaving infants more susceptible to infections and long-term health complications.

However, from the parents' perspective, frequent and prolonged episodes of illness result in increased health cost and pay cuts

for care leave. Poor families cannot afford to sit at home for days to look after their child. They require quick relief measures so that their family income is not impacted.

The case study of Farah¹ given below, provides a poignant illustration of the potential health consequences of air pollution on infants. By closely examining Farah's experiences, including her socio-economic background, living environment,

access to healthcare, and caregiving practices, the study gained insights into the specific pathways through which air pollution affects infant health. Moreover, Farah's case study helped this research to explore the broader contextual factors that shape vulnerability to air pollution-related health risks, such as housing conditions, exposure to indoor and outdoor pollutants, and socio-economic disparities.

Case Study: Farah and Her Daughter Fatima

Location/Residence: Bhalswa Dairy, Delhi

Family Background

Farah is 19 years old and is mother to baby girl Fatima, who is now almost 6 months old. Farah resides in Bhalswa Dairy, an area adjacent to one of the largest landfills in Delhi, with her husband Aamir Khan, who is 21 years old, her mother-in-law, father-in-law, brother-in-law, and sister-in-law. Bhalswa Dairy is notorious for its high levels of pollution, emitting toxic gases and posing a risk of catching fire during the summer months. The male members of the family work as daily wage labourers, in waste collection and segregation sector, while the women stay at home as homemakers. Fatima is Farah and Aamir's first-born child. The family lives in a one-room house with no separate demarcated space for the kitchen.

Farah had an uneventful pregnancy and gave birth to Fatima at Raja Harish Chandra Hospital in Delhi through a normal, institutional delivery. Fatima weighed two and a half kilograms at birth and was healthy during her first month.

After Fatima was born, Farah went to her natal place in Bihar, where Fatima received her scheduled vaccinations. Farah and Fatima returned to their home in Bhalswa Dairy when Fatima was over 45 days old. Initially, Fatima was fine for the first 10-12 days after the move.

Health Complications

As Fatima turned two months old in January, she began experiencing health issues. January was marked by extremely severe cold in Delhi. Fatima initially developed a fever that would subside with medication but return once the medicine was stopped. After a few days of recurring fever, Fatima developed cold, cough, and breathlessness. Farah took her to a nearby private doctor, but Fatima's condition did not improve and worsened instead. Farah then sought help at Babu Jagjivan Ram Memorial Hospital, where doctors deemed Fatima's condition too serious for admission.

¹ Name changed to maintain confidentiality

Case Study: Farah and Her Daughter Fatima

Desperate for proper care, Farah took Fatima to Dr. Baba Saheb Ambedkar Hospital, another public hospital. Fatima's condition started deteriorating further and she required ventilator support. But at Ambedkar Hospital, there were no vacant ventilators. They offered to put Fatima on nebulizer instead. But Farah felt that when ventilator was required for Fatima, she would be safe only when she is put on one. Ultimately, Farah went to Kalawati Saran Children's Hospital, one of the largest children's hospitals in New Delhi. Fatima was admitted in the emergency department and immediately put on ventilator support. The baby was in ICU for two days. Her condition slowly started improving, and she started to take mother's milk, with spoon though. She was shifted to a ward and put on nebulizer and was under observation for two more days. She was discharged after four days of hospitalization. Her condition is stable now. Farah incurred an expenditure of about Rs 2500 for the treatment of her child as all the hospitals she went to are public hospitals.

Farah noticed a stark difference in Fatima's health between the time spent in her natal village in Bihar and their residence in Bhalswa Dairy. In Bihar, Fatima was healthy and showed no signs of respiratory issues. However, after returning to the highly polluted environment of Bhalswa Dairy, Fatima's health deteriorated rapidly. Farah attributes Fatima's pneumonia to the severe air pollution in their neighbourhood, especially during the cold winter months.

Since Fatima's recovery from pneumonia, Farah has been extremely cautious in caring for her daughter. She pays close attention to Fatima's diet and overall health, trying to mitigate the adverse effects of their environment. Despite these efforts, Fatima continues to suffer from a constant cough, highlighting the ongoing impact of their living conditions on her health.

This case study vividly illustrates the severe impact of air pollution on the health of children in Delhi, particularly during the first 1000 days of life, which are critical for physical and cognitive development. The conditions in Bhalswa Dairy, characterised by its proximity to a major landfill and poor indoor air quality, have significantly contributed to Fatima's respiratory problems.

Conclusion

Farah and Fatima's story is a powerful testament to the intersection of environmental conditions and public health. It underscores the urgent need for comprehensive strategies to address air pollution in urban areas like Delhi to safeguard the health and development of vulnerable children. The stark difference in Fatima's health between her time in Bihar and her time in Bhalswa Dairy highlights the critical role environmental factors play in child health. Despite Farah's efforts to provide the best care for her daughter, the severe air pollution in their living environment continues to pose a significant threat to Fatima's well-being.

3.4 Air pollution, the child of the poor and the vicious circle of vulnerability

Even though it is not possible to accurately establish a direct connection between increased air pollution and prevalence of infection or ill-health due to the multifactorial nature of various health conditions, the study has made it apparent that the nature of infections has shifted over the years. Prolonged and frequent episodes of both upper and lower respiratory infections even in children as young as 2 to 3 months have increased. It also highlights that apart from the direct impact of air pollution in terms of prevalence of illness, there are several indirect impacts such as delayed vaccination, disturbed sleep, inability to breastfeed due to nasal blockage that further compromises the immunity of the children.

The study also attempts to highlight that the socio-economic background of a family plays a significant role not only in determining the level of exposure and impact the child would have from air pollution but also in how the family tackles both direct and indirect impact of air pollution that has been highlighted by the study. We find that the children of the poor are more susceptible to compromised immunity and illness than others due to their lack of access to clean environment and basic infrastructure as well as poor nutrition levels. The study further highlights that the prolonged and frequent episodes of ill-health during the winter months further impacts the child's growth and development as it leads to delayed vaccination and disturbed sleep and feed patterns. Young infants are not able to take breast feed due to nasal blockage and congestion. All of this has a grave impact on their immunity and results in long-term

implications for their overall health. In addition, we also find that in terms of strategies to tackle the frequent episodes of ill-health, parents mostly prefer to go to the local private doctor instead of government run health centers or dispensaries. This is because they are of the view that the medication given by the private doctors gives instant relief. However, our interviews with ASHA workers, public hospital doctors and the private doctors themselves highlight that mostly those who are practicing as local private doctors are not qualified doctors; rather their practice is more of an extension of their pharmacy shops. Even though there are clear guidelines by the government on cautious use of antibiotics, steroids and even cough syrups with children under the age of 5 years; most private doctors prescribe antibiotics and nebulize the child with steroid medicines. While this provides instant relief to the child, it is also leading to antibiotic resistance and compromised immunity. Parents, however, prefer to go to private doctors because they need quick measures to get relieved from care burden and ensure that the impact of family income and expense is minimal.

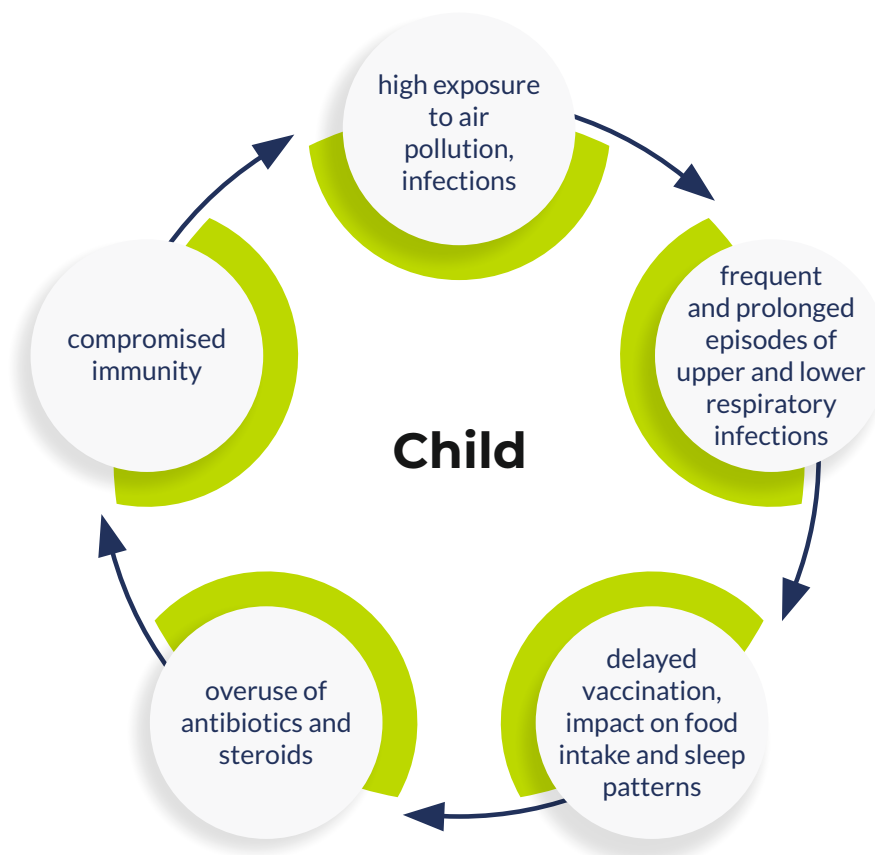
Thus, we find that while literature establishes that air pollution impacts everyone and both ambient and in-door air pollution is causing grave impact for all residing in Delhi; it is the poor and the marginalized and their young children who are worst impacted by the intense pollution that the city faces year after year during the winter months.

In fact, it appears that the children from poor and marginalized backgrounds are constantly caught in a vicious cycle of vulnerability. While their already existing compromised immunity and high exposure to air pollution makes them more susceptible to frequent and prolonged episodes of illness; the indirect impact of illness in terms of sleep and food intake patterns as well as delayed vaccination

along with over usage of antibiotics and steroid drugs further compromises their immunity and leads to grave implications on their overall health and development (Figure 1).

Addressing these challenges requires holistic approaches that integrate environmental monitoring, healthcare interventions, and public policy measures to mitigate air pollution and safeguard the health and well-being of vulnerable people, including infants and young women. Further research is needed to elucidate the mechanisms underlying these associations and inform evidence-based strategies for prevention and intervention.

Figure 1: The Vicious Cycle of Vulnerability for the Child of the Poor



4. Conclusion & Recommendations

Air pollution in Delhi has been a cause of concern for its residents irrespective of the socio-economic class that they may belong to. However, on-ground, apart from yearly symptomatic policy intervention in terms of school closures, advisories for wearing masks or suggestions for young children and elderly to stay home during winter early mornings or late evenings, there is very little that is seen in terms of policy intervention to mitigate the problem.

This study has been able to establish that while it is important to build scientific evidence on the close connection between air pollution and human health, it is imperative to assess the impact from an intersectional lens when the focus is on the poor and the marginalized. It has been able to highlight that addressing the challenges linked to air pollution requires a comprehensive approach which not only looks at building better health facilities, but also requires investment in public infrastructure to support the poor in their approach to tackle the impact and in building education campaigns so that parents are better informed to protect their children. Lastly, more research and evidence need to be generated to ensure that the challenges related to air pollution get the adequate policy attention it requires.

Some of the **policy recommendations** that have emerged from the field in the course of this study are listed below:

Targeted intervention with regard to indoor air pollution

Since most poor families in Delhi, like other cities, live in very small spaces with no or negligible ventilation and no demarcated space for kitchen, in-door pollution becomes a serious cause of concern specifically in relation to infant health. Targeted interventions through

government initiatives are required to address the problem of household in-door air pollution through promotion of clean cooking fuels. Implementing subsidy programs for making clean cooking fuel more affordable and accessible to vulnerable families can be effective in curbing in-door air pollution to a large extent.

Public awareness

Educate caregivers, parents, and communities about the detrimental effects of air pollution on infant health and on the ways to tackle it and protect them. Build awareness campaigns on the importance of taking nutritional food, keeping the surroundings clean, on waste/garbage disposal mechanisms, and on seeking professional medical care when the child is sick. Spreading awareness on the harmful effects of over usage of antibiotics and steroids is important as it has long term implications on children's health. ASHA workers and ICDS workers can play a significant role in empowering people with knowledge that can help mitigate exposure and reduce the burden of pollution-related illnesses.

Involving women in decision making and planning processes of climate mitigation policies

Many climate change policies are either gender blind or exclude women during planning and managing climate change due to parochial cultural practices. Even if there are spaces marked for women's participation, women who are at the intersectionalities of multiple marginalization are left out. On the other hand, there is no practice of including childcare provisions as measures of climate change interventions. Direct care services have remained out of policies. This has mainly happened due to exclusion of women in any planning and policy making

processes. In order to plug this gap, there is a need to build institutional mechanisms to include women in planning and implementation processes. Women's inclusion is important to visualize the need for care interventions.

Generate research and evidence

Conduct more research studies to better understand the complex interactions between air pollution and infant health, as well as reproductive health outcomes in young women. Foster collaboration among researchers, healthcare professionals, and policymakers to advance knowledge and address gaps in understanding.

Improve public infrastructure

Invest adequately in improving healthcare infrastructure, medical facilities, equipment, and trained personnel in heavily affected areas to address pollution-related health issues in infants. Ensure accessible and affordable healthcare services for timely diagnosis and treatment. Improving the public infrastructure in densely populated low-income areas like providing public parks, waste disposal systems and sanitation facilities. Take necessary action regarding disposal of industrial waste and management of landfills.

Policy interventions

Enact comprehensive policies ensuring access to clean water, nutritious food, and adequate healthcare services for pregnant women and infants. Promote breastfeeding and maternal well-being to enhance the infant's resilience against pollution-related health hazards. Ensure that the guidelines regarding the use of antibiotics and steroids are strictly implemented, as the over usage of these drugs is widely prevalent.

Provision of context specific childcare infrastructure

Long term conditions of extreme heat, toxic air pollution or situations of persisting extreme cold climate or excessive rains

often make existing care infrastructure unsuitable for coping with the ever-changing climatic conditions. Investment in climate appropriate child care infrastructure could help in largely mitigating these issues. There is a need to assess child care infrastructure on an ongoing basis so that the infrastructure is appropriate for the environmental conditions and developed by materials that are able to withstand the present climatic conditions. In case of neglect, it may expose children and their caregivers to hazardous health conditions.

In conclusion, addressing the multifaceted challenges posed by air pollution requires a comprehensive approach that integrates environmental, healthcare, and policy interventions. By reducing pollution levels, improving healthcare infrastructure, promoting awareness, and supporting maternal and infant health, we can strive towards safeguarding the health and well-being of the most vulnerable members of our society, including infants and young women.

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Annexure: Data Collection Tools

A. Tool for Focused Group Discussions with Mothers

1. Name
2. Age
3. Educational Background
4. Occupation
5. Residential Area
6. Child's Name
7. Child's Gender
8. Child's Age
9. Any existing health conditions or allergies in the child?
10. Where does your child spend most of their time during the day? (e.g., home, school, outdoor activities)
11. What difficulties did the child have in the three months from December to February, in terms of sleep patterns; food intake, etc?
12. Have you noticed any changes in your child's daily routine and regular activity in the months of December to February?
13. How often did your child fall ill or face respiratory issues like cough, shortness of breath, asthma, and discomfort?
14. Where did you go for medical help for your child in the last three months?
15. Have you observed any delays in your child's developmental milestones? (e.g., speech, motor skills)
16. Did you find any visible difference in children's health, development, activity and daily routine between summer months and winter months (when the severity of pollution increases)?
17. What preventive measures do you follow to protect the child from falling sick in winters?
18. How do you care for the child at home when they fall sick?

B. In Depth Interview with Medical Professionals

1. Name:
2. Medical Specialization:
 - General Physician
 - Paediatrics
 - Gynaecology/Obstetrics
 - Pulmonology
 - Environmental Medicine
 - Other (please specify)
3. Years of Experience in the Field:
4. Type of Practice:
 - a. Hospital
 - b. Private Practice
 - c. Other (please specify)
5. What is specific about Delhi air pollution?
6. Are there specific age groups that are more susceptible to the effects of severe air pollution in Delhi?
7. What are the impacts of severe air pollution on young children in their first 1000 days? Is the impact similar or does it differ based on socio-economic conditions?
8. What are the most common health issues in children related to air pollution? Is there an increase in patients with respiratory issues linked to air pollution in winters?
9. Are there specific symptoms that indicate exposure to high levels of air pollution?
10. What is the typical treatment of children affected by air pollution-related health issues?
11. Is there an understanding among parents on the impacts of air pollution on their children?
12. How are pregnant women affected by air pollution?

13. What preventive measures do you recommend to protect children and pregnant women from the impact of air pollution?

C. Questionnaire For Care Workers

1. Name
2. What is your role in the healthcare/caregiving sector?
 - i. ASHA
 - ii. Anganwadi Worker
 - iii. Social Worker/Dai
 - iv. Childcare provider
 - v. Other (Specify)
3. How many years of experience do you have in your current role?
4. In winters, what are the changes that you observe in a child, in terms of their activity?
5. Have you observed any health issues or developmental delays in children during their first 1000 days? If yes, please describe.
6. How frequently do you encounter cases of respiratory illnesses or other health conditions in children in winters?
7. What are some common health interventions or treatments followed for children when they fall sick in winters?
8. What precautions can caregivers take to reduce the impact of air pollution on children?
9. Are there any community-based support programmes or initiatives in place to mitigate the impact of air pollution on children's health in your area?

D. Questionnaire for Experts (Key Informant)

1. Name:
2. What is your current role in the medical field?
Health Specialist

Public health researcher

Policy analyst

Other (please specify)

3. How many years of experience do you have in your current role?
4. How would you assess the effectiveness of existing policies or regulations in addressing air pollution-related health risks for children during their first 1000 days of life?
5. What gaps or shortcomings do you perceive in current policy frameworks regarding air pollution and children's health?
6. In your opinion, what policy measures should be prioritized to mitigate the impact of air pollution on children's health during their first 1000 days of life?
7. What additional research or data are needed to better understand the link between air pollution exposure during the first 1000 days and children's health outcomes?
8. How can policymakers better incorporate scientific evidence into decision-making processes regarding air pollution and children's health?
9. What key recommendations would you provide to policymakers to prioritize children's health in air pollution mitigation efforts?
10. How can public awareness and be enhanced to mitigate the impact of air pollution on children's health?



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