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7
MILLION
Worldwide deaths a year attributed to ambient air pollution

4.2
MILLION
Low and middle-income country deaths a year attributed to ambient air pollution

7.8
THOUSAND
Sri Lanka deaths a year attributed to ambient air pollution.


Image courtesy of Getty

Is it safe to breathe in Sri Lanka: the case for data

Exposure to poor air quality is ranked among the top 10 leading global risk factors for disease. The lack of visibility of air pollution often results in delay in public policy and personal responses, till the problem is acute. Improving the collection and access of air quality data is the first step, to making it safe to breathe in Sri Lanka.

The WHO in 2016 attributed approximately seven million premature deaths globally each year to exposure to polluted air.[1] The larger share of these deaths (4.2 million) is estimated to be occurring in low-income and middle-income countries. Why is it possible for the air we breathe to compromise health and life expectancy, and how do we know how we might be impacted?

How can it be unsafe to breathe?

The most potent air pollutant, in making it unsafe to breathe, is known as Particulate Matter (PM). It is usually a mixture of solid particles and liquid droplets. The content of PM can change, but is primarily made up of chemicals such as black carbon, certain hydrocarbons, heavy metals, organic compounds, inorganic ions and biological materials.

PM is categorised by its aerodynamic diameter (the diameter of a sphere with a 1g/m3 density with similar aerodynamic properties). There are two categories that are widely studied for impact on health risk. One is PM10 (10 micrometres or smaller in diameter), which makes it an inhalable particle. The other is PM2.5 (2.5 micrometres or smaller in diameter), which is a particle so fine that it can additionally be absorbed into the blood stream. PM2.5 can also disseminate over large distances and become stagnant in the

1. Thangavel, P., Park, D., Lee, Y.C. Recent Insights into Particulate Matter (PM2.5) – Mediated Toxicity in Humans: An Overview. Int. J. Environ. Res. Public Health 2022, 19, 7511

atmosphere for longer. It is considered a high health risk pollutant, and widely studied in terms of its impact.

Knowing if it is safe to breathe in Sri Lanka

Two things are important in knowing if it is safe to breathe in Sri Lanka. The first is to understand the link between PM2.5 and health risks. The second is to have a constant measure of the localised concentrations of PM2.5 in the ambient air in Sri Lanka. The research that is evaluated in this article shows how health consequences due to PM2.5 are being assessed and how the ability to measure the PM2.5 concentration in the air, on a continuous localised basis, is integral to assessing, more accurately, the safety of the ambient air.

For Sri Lanka, WHO estimated in 2016 that 7,792 deaths occur annually due to particulate matter outdoor air pollution.[2]

However, as PM2.5 concentrations begin to rise again amidst the renewed post COVID economic activity and public mobility in Sri Lanka, policies that target air quality controls will be important in controlling and reducing the resulting increase in mortality and morbidity. Increased public consciousness of air quality levels, and personal responses that limit exposure to unhealthy air, can also play an important role in reducing the health consequences from deteriorating air quality in Sri Lanka.

Presently in Sri Lanka there is poor ability to formulate either public policy measures or suitable personal responses, due to the lack of robust air quality data gathered on a widespread and continuous basis. AirQuality.lk is a pioneering, highly collaborative, technological and scientific data gathering initiative to expand the availability and access of air quality data – to better answer the question: "Is it safe to breathe in Sri Lanka?"

Understanding the health consequences of PM2.5 air pollution

Global studies link health consequences from air pollution particularly to elderly people and those with pre-existing cardiopulmonary diseases, where PM2.5 exacerbates the conditions of the disease. The specific negative health consequences are related to the type of exposure.

Short term exposure to PM2.5 pollution has been linked primarily to cardiovascular diseases such as increased rates of myocardial infarction and ischaemia, and also to increased risk of respiratory issues such as wheezing and the exacerbation of asthma.

Long term exposure to PM2.5 over a number of years has been linked to both cardiovascular and respiratory diseases, notably an increased incidence of lung cancer and pneumonia as well as the development of new asthma. Recent advancements in the literature have also linked long term PM2.5 exposure to reproductive diseases and neurological conditions such as the increased risk of Alzheimer's and Parkinson's.

Understanding the link between excess PM2.5 exposure and negative health consequences continues to be heavily investigated. Assessments that try to estimate the cost of the increased health risks, such as a report written by the Centre for Research on Energy and Clean Air, estimated the global cost of pollution due to emissions from fossil fuels at USD 2.9 trillion in 2018, which accounted for 3.3% of the world's GDP at the time.[3] This cost was a result of work absence due to morbidity, the cost of healthcare and reductions in economic productivity and welfare. The prevalence of PM2.5 was estimated to have resulted in 1.8 billion days of work absence, four million new cases of child asthma and two million preterm births.

Reducing generation and exposure is an integral part of the solution

The clear connection between PM2.5 and increasing health risks backed by studies conducted globally have resulted in WHO guidelines that demarcate acceptable levels of PM2.5 exposure. These guidelines have been updated over time as new evidence

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comes to light on PM2.5 concentration levels and health outcomes.

The WHO PM2.5 guidelines recommend an annual average exposure of not more than five $\mu g/m^3$ and a 24-hour average exposure of not more than 15 $\mu g/m^3$. These guidelines are helpful in setting global and local policies that can minimise pollutant exposure, and thereby reduce premature mortality and morbidity due to bad air quality.

The final task is to formulate both public policy measures and suitable personal responses that reduces the generation and exposure with regard to poor air quality and the negative health consequences.

See Box 1 on generation detection and transmission of PM2.5 air pollution for more details on how PM2.5 is spread and translates into health consequences in a population.

Measurement is the first step towards reducing exposure

The concentration of PM2.5 in the atmosphere is primarily measured using air quality monitors. Proper measurement requires a mix of regulatory grade monitors– that provide highly detailed measurements–and low-cost sensors that can be calibrated with these monitors to provide supplementary measurements.

One limitation when monitoring air quality is that low-cost sensors are often not useful on their own in measuring PM2.5, and should ideally

2. WHO, (2016). Ambient Air Pollution: A Global Assessment of Exposure and Burden of Disease
3. Myllyvirta, (2020). Quantifying the Economic Costs of Air Pollution from Fossil Fuels, Centre for Research on Energy and Clean Air

Exposure to PM2.5 in the air is ranked among the top 10 leading global risk factors for disease

be calibrated with regulatory grade monitors. A second limitation is the paucity of regulatory grade monitors in Sri Lanka.

There are only three regulatory grade monitors in Sri Lanka, along with a growing number of low-cost sensors. The readings obtained from the combination of these devices are integral to understanding when exposure to PM2.5 has reached unhealthy levels.

Due to the limitation of regulatory grade monitors, readings taken from low-cost sensors outside of Colombo are often calibrated using models relevant to sensors in Colombo, thereby reducing the accuracy of data. Additionally, there is a high reliance on noisy statistical models of PM2.5 concentration, using meteorological and satellite data, because the coverage of low-cost sensors also remains rather limited at present.

Reducing the poor air quality health burden in Sri Lanka

When it is not safe to breathe in Sri Lanka, then it is important that people know where and when it is not safe to breathe. Accurate monitor data is crucial to this end as it informs when and where the air is unhealthy. The platform AirQuality.lk is a new initiative that seeks to address this need, by growing the availability of air quality data in Sri Lanka and bringing all of it into a single dashboard that is freely accessible to all.

The AirQuality.lk collaboration is expected to grow in scope and reach, with expansion in the use of regulatory grade monitors around Sri Lanka, particularly in urban centres, to improve the calibration of low-cost sensors. This can also be achieved with mobile regulatory grade monitors (to overcome the cost constraints related to purchasing a large number of such monitors). Concurrently, it will set up methods for public minded citizens and corporates, to participate in improving the coverage of low-cost sensors across Sri Lanka. Such improvements in the collection and access of air quality data are necessary first steps, towards making it safe to breathe in Sri Lanka.

AirQuality.lk, launched on 28 November 2022, is a collaboration between Research Think Tanks, the Sri Lankan Government, Global Private Sector, International Development Sector, Sri Lankan IT firms as well as Sri Lankan Scientists, including those from the Sri Lankan diaspora. It seeks to make a transformative impact on the availability of air quality data in Sri Lanka, and improve the ability of government and individuals to better understand and respond, so as to minimise the resulting health consequences to the population. ◆

Box 1: Generation, detection and transmission of PM2.5 air pollution

Generation: A study in Sri Lanka related to burning biomass in traditional cookstoves to elevated levels of household air pollution. Further, burning biomass for household cooking has been attributed to an estimated four million premature deaths per year in India. The emphasis on biomass as a contributor to PM2.5 pollution is particularly important, as 76.8% of the Sri Lankan population was estimated to be relying on biomass fuels for cooking purposes in 2016. This reliance is predominantly in rural Sri Lankan households where houses that used a traditional stove without access to a chimney reported the highest PM2.5 concentrations.

1. There are two main types of PM2.5 emissions:
   a) anthropogenic emissions originating from human activity such as vehicular traffic, biomass burning, power plants, industrial emissions, residential cooking and smoking
   b) non-anthropogenic emissions originating from natural sources such as dust resuspension, sea salt, meteorological factors and the conversion of gases in the atmosphere.
2. Known sources of PM2.5 in Sri Lanka –
   a) vehicular emissions have been identified as a major contributor to ambient air pollution in urban centres such as Colombo and Kandy.
   b) burning biomass in traditional cookstoves has been identified as a major contributor to indoor air pollution. An estimated 80% of the Sri Lankan population rely on biomass fuel for cooking, and are predominantly from rural households.
3. How are the sources of PM2.5 identified?
   a) air quality monitors are commonly used to track PM2.5 sources in high pollution areas.
   b) when monitor data is inadequate, models of pollutant dispersion patterns are used to identify potential sources.
   c) the statistical analysis of PM data and its chemical composition is also helpful when identifying sources.

Transmission: The health risk attributable to PM2.5 is caused primarily by two methods of exposure. The first is through ambient exposure from travel and population mobility and the second is through household exposure from pollutant emission and collection within a household. The constant contact with PM2.5 has resulted in ambient PM2.5 and household PM2.5 exposure being ranked among the top 10 leading global risk factors for disease. Studies have revealed varying health consequences due to both short-term exposure to high PM2.5 concentrations, as well as long-term exposure at moderate levels. The medical hypothesis is that the PM in the atmosphere gets transmitted into the human body through inhalation, leading to PM accumulation in the lungs and specifically PM2.5 in the blood.