

Air Pollution leads to Heart Attacks

**A Review Based Study with a
Novel Synthesis by
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Abstract

Heart attacks, also known as myocardial infarctions, reign in our society because of air pollution.

Every 40 seconds, an American citizen dies from heart attacks. Our population is constantly suffering from heart attacks, and the escalating air pollution from climate change is the leading cause behind them.

In this research, I discuss the impacts of air pollution on our cardiovascular systems as well as the importance of heart attacks and avoiding them. I also highlight the specific statistical similarities between air pollution in Pakistan and their myocardial infarction rates.

To churn up the information, I used graphs and condensed biological/environmental information, as well as logical inferences/connections between biological systems. The information concludes that suspended particulate matter (SPM) is constantly being inhaled, travelling through our body, and affecting our cardiovascular health.

Every action we take has an impact on our health, and here's why.

Introduction

Background

Heart attacks, or our cardiovascular health, aren't just impacted by our eating decisions or exercise, but they're also being negatively impacted by our **environment**. As we breathe the suspended particulate matter (SPM) in our air, also known as air pollution, our body slowly induces it, leading to an eventual heart attack. Through **diffusion, thrombophlebitis, and ingestion**, we are slowly converting these microscopic floating dust particles into deadly blood vessel plaque—the root of heart attacks.

The Question

Is air pollution negatively reacting in our body when inhaled? Is it the leading cause behind alarming rates of heart attacks worldwide?

What if all the medications and their side effects aren't helping your health at all? What if the air you breathe is the actual issue for your cardiovascular diseases?

The Researcher's Purpose

With this research, we found a medical answer. We found an answer on why our labour workers, students—people who are in contact with the outside's air—are constantly undergoing heart attacks. This research illustrates a medical response on how the particulate matter we respire behaves in our body and how it reacts to be the root cause of a heart attack. The microscopic dust we inhale is turning into a problem—a problem for our cardiovascular health.

What's the point of controlling our food and exercise if we're not treating the root cause of this problem?

Research Methods

- Graphs of a variety of statistics (bar graphs, pie charts, line graphs)
- Articles (Research reports, Clinical Studies)

Thesis Statement

The suspended particulate matter (air pollution) in our air is causing heart attacks when respired by building plaque in our blood vessels through diffusion and systemic inflammatory response.

We need to control our environment through sustainable practices so the environment's air pollution doesn't take control over one of the leading diseases in our world—heart attacks.

Do *you* want to make a change for your future?

Literature Review

Air Pollution

Our atmospheric scientists have constantly studied our air and have specifically discovered how dangerous **suspended particulate matter (SPM)** is for our healthy living.

They've researched how these small dust particles (SPM), which are fine solid or liquid substances suspended in our atmosphere, can penetrate deep into our respiratory system. They've observed how suspended particulate matter comes in various sizes, but all the sizes are microscopic and are easily inhalable. They've understood how particulate matter is divided into 2 sizes: **large particles for inhalation**, which have a diameter of 2.5 microns to 10 microns (PM₁₀-PM_{2.5}), and **small particles** with a diameter up to 2.5 m (PM_{2.5}), which are often found in smoke or fog.

Origin

A lot of the suspended particulate matter we inhale is a mixture of organic and inorganic particles such as dust, pollen, soot, smoke, and liquid droplets.

The Pakistan National Conservation Strategy (NCS) says most of these particles come from excessive human activities such as vehicles (driving), industry, burning of solid waste, brick kilns, and natural dust. Pakistan is one of the most attractive areas for air pollution, where their main cities, such as **Lahore, Rawalpindi, and Islamabad**, had average suspended particulate matters exceeding 6.4 times higher than WHO guidelines and 3.8 times higher than Japanese expectations.

Statistics

A lot of air pollutant information comes from statistics.

From 1998 to 2021, the average annual particulate pollution in Pakistan increased by 49.9 percent, excessively reducing life expectancy by 1.5 years. Pakistan has already been suffering from the effects of air pollution, where over 165.5 million residents, or 69.5 percent of the Pakistani population, are on the path of losing 3.7 to 4.6 years of their lives because of air pollution.

Are the Studies reliable?

While most of these articles are stating factual information and statistics of air pollution and its damage to our health and life expectancy, they're all sourcing their information from one organization: the World Health Organization (WHO).

While WHO is one excellent source to get research, it's important that studies conduct their information from a variety of sources. When studies only base their information on one source, it can put their reliability at risk because we don't know if the one source they've based all their information on is actually correct. Relying only on WHO is an issue because the World Health Organization conducts its research globally, so it takes the general statistics worldwide instead of focusing on what specific diseases air pollution causes to the populations for the mortality rate to drastically increase.

For example, WHO's recent statistics on ambient/household air pollution state that ambient/household air pollution causes over 7 million premature deaths annually, but they are not stating what specific diseases air pollution is causing in prematures for their increasing death rate.

Research from the University of Chicago has contradicted this dependency on WHO by also stating statistics nationwide instead of relying on worldwide information (WHO), which provides more analytic information on the diverse issues between nations causing these differences in mortality rates.

Instead of depending on WHO for our information, studies should also base their information on secondary data such as their national government statistics (Government of Canada, Government of USA, etc.).

How should Governments respond?

Multiple studies agree on air pollution shortening life expectancy and diverse SPM sizes, as well as their root causes; however, studies disagree on how countries can resolve the issue.

Pakistan being an example, different studies and articles say that Pakistan should join with other countries to completely eliminate fossil fuels.

On the contrary, the official government of Pakistan as well as other studies say they should independently work on eliminating air pollution, where the Pakistani government spent over 1,089.10 million rupees (\$18,070,456.11 CAD) on continuing air monitoring stations and mobile laboratories in five cities (Karachi, Lahore, Peshawar, Quetta, and Islamabad), upgrading analytical laboratories in five EPAs, establishing air and water surveillance, and more.

The issue, or blank space, in this argument is the intense focus on political parties instead of healthcare, the main issue with air pollution (SPM).

Myocardial Infarction (Heart Attack)

Summarising Past Research

Myocardial infarctions, also known as heart attacks, are one of the deadliest diseases in the world, taking over 17.9 million lives each year.

Heart attacks are a cardiovascular disease where the heart stops beating due to the muscles dying from lack of blood. The blockage of blood to the heart is usually caused by blood clots, inflammation, and plaque buildup in the arteries.

In Pakistan, 240,720 people died from coronary disease, representing 16.49% of their total fatalities. INTERHEART studies have also shown that most high-stress jobs, such as labour workers and medicine careers, were associated with double the risk of coronary heart disease.

Medical doctors have understood these medical processes:

- Diffusion of oxygen to blood
- Suspended particulate matter entering our body through impaction
- Pulmonary and Systemic Inflammatory Responses
- Blood clots

But what are the relationships between all of these medical processes? Are they leading to something...maybe a myocardial infarction?

The Foundation & Understanding Gaps

All of our scientists and medical members have understood the medical processes above; however, it's important to understand the connections between them. Are they interconnected to lead to a heart attack? Instead of researching independent medical processes, this research clearly interconnects these processes in a step-by-step format in order to aid people to understand how air pollution can lead to a heart attack. It's also important to understand how

Another gap in multiple statistics is the relation of air pollution in Pakistan and their elevating heart attack rates. Pakistan is the third most air-polluted country in the world, with an air quality index of 164. They also have 240,720 people (16.49% of their total fatalities) of their population dead because of heart attacks. This research emphasizes this unidentified relationship in order to better illustrate the effects of air pollution on heart attacks.

Results

A clear explanation from our research of how small dusts we inhale from air pollution can become a serious problem—heart attacks (myocardial infarction).

1. Air particles (dust) with an aerodynamic greater than $10\text{ }\mu\text{m}$ enter the nasopharyngeal region of the body, such as the nose, nasal cavity, and throat, through **impaction**. When we respire, the stream of air we inhale disrupts the airflow direction of the dust particles in the air, which causes the dust to travel towards the stream of air we inhale, making the dust usually enter our nose. The changes in airflow direction inside the nose cause the dust particles to pass through our air passage.
2. When air reaches our lungs through inhalation, the suspended particulate matter reaches these air sacs located at the end of our bronchial branches called alveoli. These alveoli are surrounded by a group of blood vessels called capillaries.
3. Through diffusion, the oxygen we inhaled passes through the thin lining of the alveoli into the capillaries, which is called **diffusion**. Since we inhaled dust (our nasal hair couldn't stop the passage of dust), the suspended particulate matter with oxygen is now in our bloodstream from the capillaries.
4. The dust in our bloodstream acts as an intruder, activating the pulmonary and systemic inflammatory response. This pulmonary and systemic inflammatory response causes inflammation throughout the body, which sometimes leads to blood clots. The body's natural response is to stop inflammation from spreading through its blood vessels. It also narrows down the diameter of your arteries, which makes blood difficult to pass through; blood clots.
5. The blood flow struggles to pass through the coronary arteries because of the blood clots, which leads to the heart not getting enough blood. The lack of blood flow from the clogged coronary arteries causes the tissues in the heart muscle to die, **leading to a heart attack**.

Discussion

Summary of Key Findings

My research explicitly states the process of how tiny suspended particulate matter (SPM) enters our body through our nose and slowly reacts in our body to a heart attack.

The research explicitly simplifies a variety of clinical studies and research reports in order to create a simpler step-by-step of how air pollution can become a heart attack so the average person can fully comprehend difficult medical terms.

We inhale dust; it enters our lungs through impaction, then enters our blood through diffusion, activating pulmonary and systemic inflammatory response, leading to blood clots and eventual heart attacks.

Comparison of Existing Research

Since this research is a **review-based study with a novel synthesis**, this study condenses information from various articles and organizations and forms a direct link between air pollutants and heart attacks.

Most research is difficult to understand and often doesn't provide you a detailed description/explanation of why this phenomenon leads to this health issue. For example, lots of studies say that excessive time under the sun can lead to skin cancer, but they don't provide a scientific step-by-step explanation of what happens beneath our skin for the sun's rays to create cancer. A detailed explanation is more credible for readers and is often the most influential.

Implications

A step-by-step explanation of a medical point of how air pollutants lead to heart attacks in our bodies can significantly help the future of medicine.

Health professionals such as doctors and scientists often need direct relations between specific conflicts in order to further innovate solutions. In this study, there is a direct relation between 2 specific conflicts—air pollution and heart attacks.

This is also a detailed explanation of what air pollution does each step of its way towards a heart attack, which helps doctors and scientists understand how each action of the dust in our body can be contradicted using medications. For example, this research states in a step how dust in our blood can activate a pulmonary and systemic inflammatory response, which doctors can use to create a specific type of medication that eliminates this inflammatory response but instead releases white cells to eliminate the dust—just like diseases. Examples of medications that increase white cell count include **Neupogen, Nivestym, Releuko, and Zarxio**, which use the body's bone marrow to create new white cells. This innovation using this research will help our future medicine.

Future Research

This research is encouraging environmental scientists and medical doctors to further justify this information by testing on people who are suffering from heart attacks—especially in polluted areas such as Pakistan. They can then infer or compare this information to real-life situations in order to create a more sustainable solution and to find some outliers. Examples of outliers include exceptions—some patients have a tolerance to dust particles. Some patients might not activate an inflammatory response to dust.

It's important we apply this information to real-life situations in order to create a more realistic approach towards medications and biomedical technologies (ex., biomedical engineering).

Conclusion

This research isn't something rare, but it's a reality most of our population is suffering from, especially in South Asian countries such as Pakistan, Bangladesh, and India, where air pollution is extremely elevated. We need to put in our part of reducing air pollution by reducing particle emissions in cars, buses, trucks, and industrial plants.

While this research does encourage reducing air pollution around us to maintain our cardiovascular health, it's also important to take our supplements, which boost our immune system to fight against dust in our body:

- ★ Vitamins A
- ★ Vitamins C
- ★ Vitamins D
- ★ Vitamins E
- ★ Zinc

For people who live in polluted areas, it's important to stay indoors as much as we can.

For labour workers and school-attending students, it's important they wear personal protective equipment (PPE) when facing extreme pollution:

- ★ Masks
- ★ Eye protection (goggles, glasses..)
- ★ Shoe covers
- ★ Head covers

If you feel chest pains, cold sweats, fatigue, heartburn, lightheadedness, nausea, or shortness of breath at extreme levels, immediately call 911 or seek medical help. People realize they're undergoing a heart attack when it's too late.

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