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International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Risk of Ischemic Stroke and Mortality from the Air Pollution

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A B S T R A C T

Air pollution cause mortality all over the world every year. Being exposed to pollutants like airborne particles matter and ozone has increased mortality and also hospital admissions due to issues with cardiovascular and respiratory organs and ischemic stroke. These effects are found in both long term and short-term exposure of air pollution. In this paper we discuss air pollution and its effects on human health especially the concern of Ischemic stroke.

Keywords: Air pollution, Ischemic Stroke, Mortality

1. Introduction

Efforts in understanding and controlling air pollution has an interesting history [2-4]. For the extreme exposure to air pollution there is a history of mortality and morbidity [5]. The association between air pollution particulate matter and cardiovascular issues is proven by many studies. There has been multiple discussions about up to what levels we can get exposed to PM matter and what levels would be harmful to human beings. Some studies proved that there is no particular health effects that are proved with low to moderate PM exposure. [6,7]. But there are other researchers who did not agree to it. United states reported apparent health effects at unexpectedly low concentrations of PM. Some studies reported association between air pollution particulate matter exposure and daily mortality rates in multiple cities [10,11,12].

2. Particulate Matter Characteristics, Exposure and Mortality

Particulate matter of air pollution is a mixture of solid and liquid particles, which are of different size, shape and surface area, and origin. Depending on the size and distribution these PM particles are classified in to three types coarse particles, fine particles. Coarse particles are derived particularly from dust farming, mining, roads, volcanoes, Windstream etc., coarse particles will have a diameter greater than 2.5μm. Fine particles are released as a result of combustion processes, that is from the vehicles gasoline, wood burning, power generation cement plants, paper mills. The common way of representing fine particles in $PM_{2.5}$The aerodynamic diameter of the fine particles is less than or equal to 2.5 micrometers. Ultra-fine particles will have diameter less than 0.1 micrometers [13,14].Ultra-fine particles are constantly released in to the air from urban and industrial environments, and this is due to combustion like vehicle exhaust. Studies proved that fine particle effect human health more than other because they include sulphates, nitrates metals and acids and also contains particles with various chemicals. $PM_{2.5}$ particles can be deeply inhaled inside of body into the lungs and they remain suspended there for long periods of time. With the reasons that cause indoor air pollution they penetrate more readily into lungs. Several studies focused on exposure to severe

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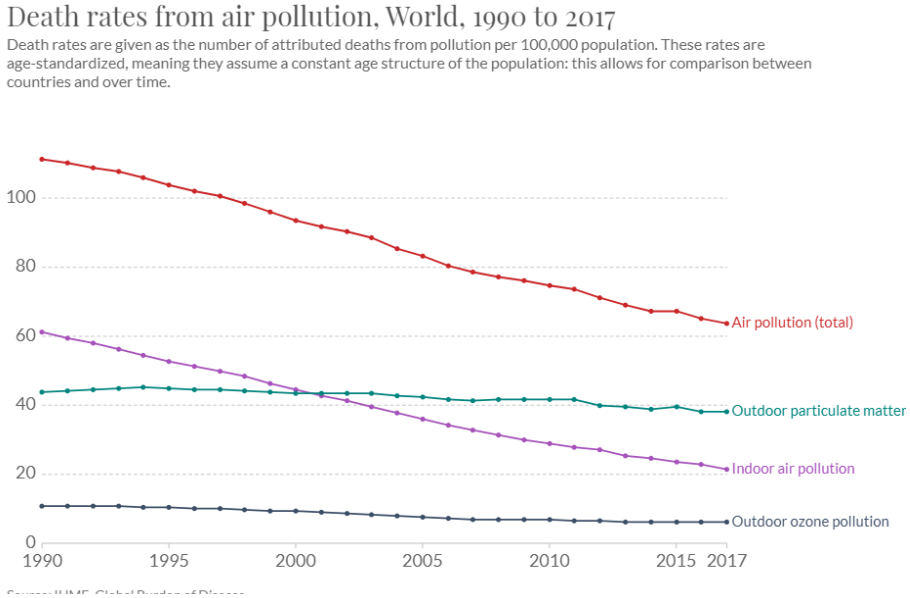
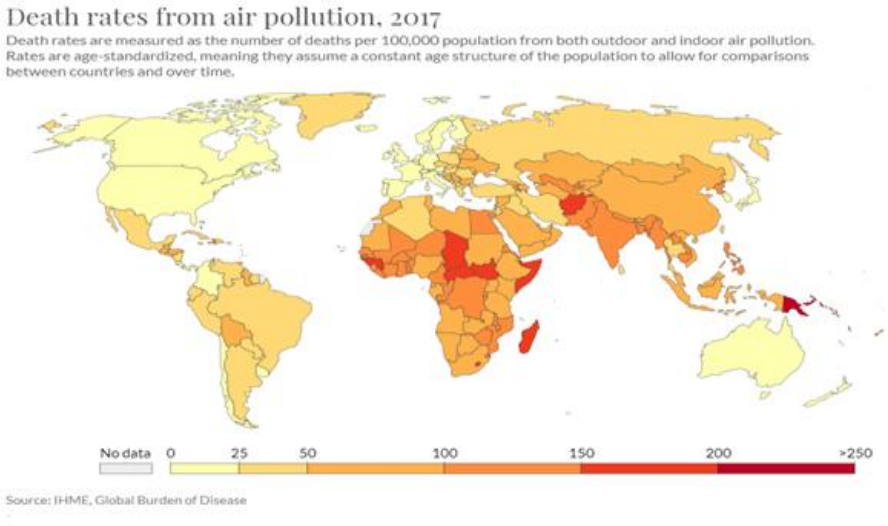
air pollution for short term. The papers [4,5,6] compared the death rates before and after being exposed to air pollution. Some studies like [10] did not evaluate mortality when exposed to high levels of air pollution, but they evaluated daily changes in the air pollution and daily mortality counts with relatively low levels of air pollution exposure. And the mortality rates observed in this research matched the mortality rates observed in many other cities with different climates, weather conditions, demography and mixes of pollution [15,16].

Since 1990, there are more than 100 published articles that report about short term exposure to air pollution particulate matter and mortality. Most of these studies are single city, daily evaluated studies. Over the time, some authors collected all these single city papers and did a meta-analysis studies [17,18,19]. Addition to this some papers tried to understand the differences in the city specific responses. Daily mortality counts were observed to be associated with PM_{10}, $PM_{2.5,}$ and sulphates, but the strongest association was seen with $PM_{2.5}$.



Source: IHME Global Burden of Disease

Fig 1: Mortality rates in the world due to Air pollution



Source: IHME Global Burden of Disease

Fig 2: Mortality rates in the world due to Air pollution in 2017

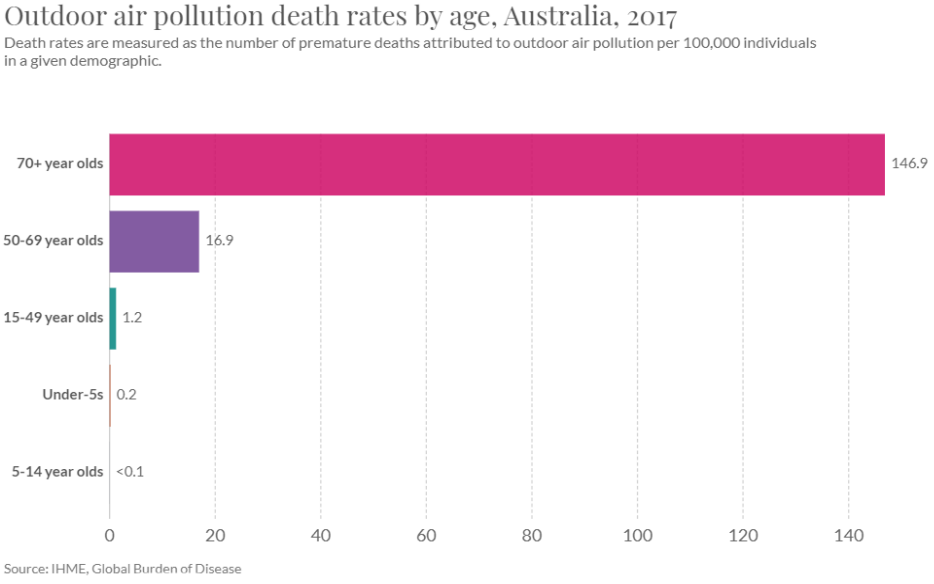
Fig 1 shows world death rates due to air pollution and , there is a decline in the death rates in 2017 compared to 1990s.

3. Cardiovascular Issues and Ischemic Stroke due to Air pollution

Data collected from Global Burden of Disease, which is collected from 1990 to 2017, demonstrated that air pollution is the reason for 29% of stroke [20]. There are several other studies which also proved the association between long term and short-term exposure to air pollution and stroke occurrence and mortality [21,22]. Another study found that there is 19% increase in the risk of stroke that is associated with 5μg/m^3Increase in $PM_{2.5}$ annually, and a strong association is found in the people who has never smoked. This study has shown that the risk has increased in the places in Europe where air pollution levels are below European air quality standards [23]. For the myocardial infarction, the risk is more for the the air pollution levels below European standards. A strong ischemic stroke was observed in people who are living within 75 meters away from main road and are getting exposed to air pollution [25]. Even if there is variation in the hourly and daily changes of air pollution, the risk of stroke has increased with a strong association of ultrafine particles and mortality [26]. Short term studies also found to have increased stroke issues, and even for the ozone exposure for a short term , the risk of stroke has increased [27].

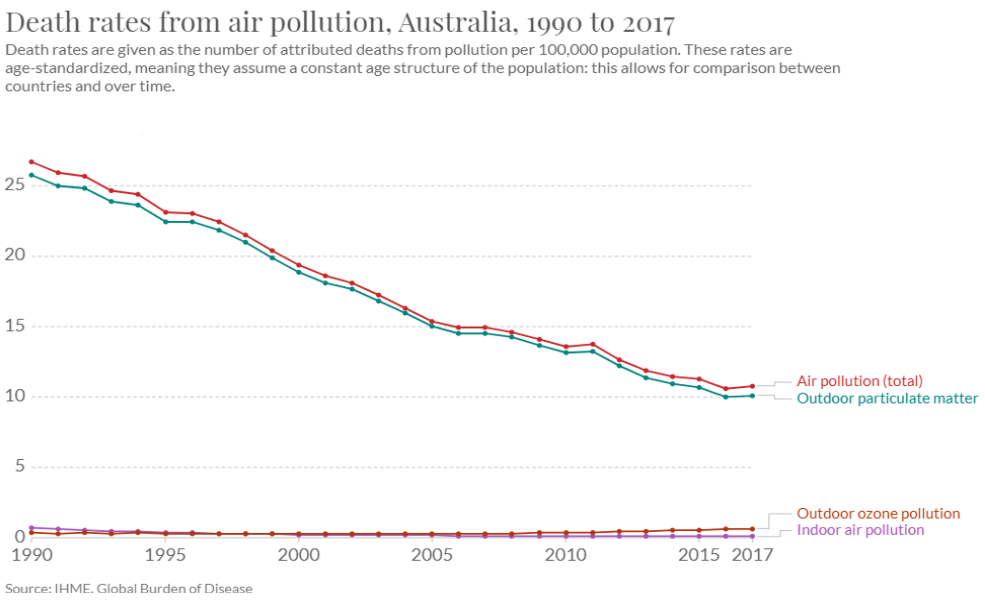
Another meta-analysis found that there is an association between short term increase in PM and increase in risk of hospitalization and mortality from congestive heart failure [28]. All the pollutants like NO_2 , SO_2, are associated with increase in ischemic stroke except o_3 . Majority of epidemiological studies that were published that showed association between air pollution and stroke are based on high income countries.The author [29] estimated the relation between hospital admissions for ischemic stroke and short term air pollution exposure in nine united states counties. An increase of ischemic stroke admissions 1.0%,2.83%,2.94%,1.35% is seen with association of increase in particulate matter increase of particulate matter with aerodynamic diameter less than, CO, NO_2, SO_2. In the French cities there is no association of stroke is found with short term exposure to particulate matter air pollution [30]. Another study that was done in New Zealand and Australian cities did not find any association between short term exposure to air pollution and stroke in elderly people [31].Recent coronavirus has also increased the risk of cardiovascular issues in the people who already had heart issues, and also in people who does not have [24].In another study on the acute effects of air pollution on stroke,[32] estimated that there is an increase in hospitalization due to stroke in an association with 10 μg/m^3 increment of $PM_{2.5}$; O_3; and 1 ppm increment of CO were 1.1%, 0.1% (95% CI, 0%–0.2%), 10 ppb increment of SO_2, NO_2, 1.6% (95% CI, 0.4%–2.8%), 1.2% (95% CI, 0.5%–1.8%), and 1.1% (95% CI, −0.1%–2.3%), respectively. And this inconsistency between different studies might be due to variation in air pollution levels, weather conditions, how populated it was, etc., The levels of NO_2 has reduced significantly all over the world in 2020 due to reduction in traffic [33]. When controlling for the effect of other air pollutants, the association of ischemic stroke with SO_2 and NO_2 remained significant. Two studies mad eon 272 Chinese cities has found that significant effects of SO_2 and NO_2 on mortality in regards to cardiovascular issues after controlling CO and $PM_{2.5}$ [34,35]. In as ingle pollutant model author Liu has reported a considerable association between CO and mortality due to stroke. Similar to it in a two-pollutant model the association of SO_2 and $NO_2$with ischemic stroke remained stable after adjusting CO and $PM_{2.5}$, but after controlling SO_2 and NO_2 the association for CO and PM_{10} became nonsignificant [36].

NO2 servers as measure for pollution through vehicles as it has close association with vehicle exhaust emissions [37]. SO2 is mostly from combustion of sulfur containing fuels like oil and coal. In China from the vehicle exhaust emissions most portion of PM2.5 is released into air [38]. Few studies that have noticed relation between air pollution and ischemic stroke might be possibly due to small number of study sites. Some studies also proved that high temperatures could cause increase in effects of air pollution on mortality [39]. South region of China has a higher portion of patient who are older than 75 years and are more susceptible to adverse effects from air pollution.



Source: IHME Global Burden of Disease

Fig 3: Mortality rates in Australia due to Air pollution in 2017



Source: IHME Global Burden of Disease

Fig 4: Mortality rates in Australia due to Air pollution from 1990 to 2017

Fig 3 shows affects of air pollution in Australia, and most of the people that are affected are above of age 70 years. And the next affected people are of age more than 50 years to 69 years.

4. Conclusion

Since 1990 many studies and research have been conducted that proved the relation between breathing combustion related particulate matter and its affects to human health. And these studies have helped us connect the gaps in our knowledge. These studies reported that exposure to air pollution increases long term and short term cardiovascular mortality through an increase in myocardial infarction, stroke and heart failure. Ultra fine particles have more association with cardiovascular issues. Plans to reduce the exposure to air pollution should be intensified urgently and should be supported by everyone.

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