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Air Pollution: An Invisible Threat to Kidney Disease

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Introduction

Air pollution is a complex mixture of gaseous components and solid and liquid particles released in the air, mostly stemming from fossil fuel utilization, is the number one environmental factor contributing to premature deaths globally and are also linked with climate change in recent years.[1] While its evidence on impact on respiratory diseases and cardiovascular diseases exists, recent studies have shown that air pollution of any form contributes significantly on the onset, development and progression of kidney diseases.[2,3] This is more alarming for Bangladesh which is one of the countries enduring some of the most polluted air in the world while having a chronic kidney disease (CKD) prevalence that is also high.

There is emerging evidence indicating that a major portion of the risk attributed to air pollution is mediated by its proximal cardiovascular kidney and metabolic (CKM) causes. CKM syndrome is a multifaceted condition characterized by cardiovascular disease, kidney diseases, obesity, and Type 2 diabetes. These four interrelated conditions have common risk factors and can lead to each other. Individuals frequently suffer from multiple of these illnesses simultaneously.[2,5]

Particulate matter (PM), which is primarily comprised of solid particles that are produced when coal, gasoline, and diesel fuels are burned.[4] Air pollution may be composed of different sized PM (e.g., PM_{10} having an aerodynamic diameter 10 µm; $PM_{2.5}$ which are ≤2.5 µm and $PM_{2.5\text{-}10}$), gaseous pollutants [e.g., nitrogen dioxide (NO_2), carbon monoxide (CO), sulphur dioxide (SO_2) and ozone (O_3)] and heavy metals [e.g., cadmium (Cd), lead (Pb) and mercury (Hg)].[5] Heavy metals are among the best-known environmental pollutants (those are also air pollutants) causing kidney disease particularly cadmium, lead and mercury, but also arsenic (As) and uranium (U).[6]

Exploring the Link between Air Pollution and Renal Disease

Kidney diseases can worsen due to air pollution. Increased risk of albuminuria and decreased GFR has been linked with exposure to $PM_{2.5}$ and heavy nephrotoxic metals and progression to end-stage renal disease. The impact of $PM_{2.5}$ is comparable to that of smoking. Its impact is more than 7 times that of HIV/AIDS, 3 times that of alcohol use and unsafe water.[7] Followings are some air pollutants which causes progressive renal diseases.

Cadmium: Environmental tobacco smoke exposure was the most important source of cadmium. Cadmium is a nephrotoxic metal which can induce renal tubular damage (polyuria, generalized tubular dysfunction, i.e. Fanconi syndrome) and progressive loss of glomerular filtration rate (GFR).[6]

Lead: Lead is a common pollutant in industrial emissions in Bangladesh, and is present in many

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industrial products, such as: sludges, mining, waste incineration, batteries a recycling, and the production of copper casting. Its exposure within low-level cause's glomerular hypertrophy and chronic intoxication causes progressive tubulointerstitial nephritis.[8]

Mercury: Mercury has been associated with CKD progression. It is exposed in the air from uncontrolled coal burning in brick kilns, cement and paint industries. All forms of Hg are toxic to the kidneys due to various processes. After inhalation, mercury is easily absorbed, and air levels are correlated with exposure as determined by excretion of mercury in the urine. Long-term exposure to mercuric substances can result in injury to the glomeruli.[9]

Traffic and Industrial pollution: Now a days, Traffic and Industrial air pollution is going to an alarming level for human health. PM of different sizes exposed in huge quantity in the air from those to sectors. It was observed that, two Pollutant ($PM_{2.5}$ and PM_{10}) were associated with lower eGFR, higher CKD prevalence and increased risk of CKD progression among the elderly.[2] A research conducted in UK found that, increased rate of mortality with kidney diseases was found in persons living within 2 km of industrial plants potentially releasing renal toxicants compared with a reference population living at 2.01 to 7.5 km distance.[10]

Air Pollution Crisis in Bangladesh: According to a report of The Business Standard, Dhaka, the capital city of Bangladesh, emerged with worst air quality index (AQI) score of 392, marking it as a "hazardous" level.[11] The result shows that Bangladesh continues to remain among the most polluted country in the world. Urban areas including Dhaka are badly hit with the amount of fine $PM_{2.5}$ air particulate matter which is so many times higher than the World Health Organization (WHO) permissible levels. The causes of this pollution are varied including, emissions from vehicles, effluents from industries, brick making as well as burning of biomass. These pollutants do not in only affect the lungs and heart but are now becoming more and more associated with systemic inflammation and oxidative stress which have been implicated in the kidney's functionality. In a large cohort study published in the Journal of the American Society of Nephrology, a significant number of patients were seen to experience a high loss of kidney function, which was consistent with their exposure to $PM_{2.5}$ for a long time.[7] The South Asia Region as a whole is also suffering from the same PM and nephrotoxic metals in its air and air quality is unsatisfactory and thus causing a greater burden on the CKD patients. In Bangladesh, the population has already some risk factors for kidney disease like diabetes, hypertension, and poor access to healthcare services further puts this region at a higher risk to vitamin K deficiency because of the air pollution. There is also the occupational exposure of workers in brick kilns and textile industries that heighten the risk of renal complications further.

Challenges and Strategies

Reducing air pollution is a public health issue; however, it will require a multi-pronged approach. Some of the most necessary measures in the meantime are to enforce existing laws regarding environmental pollution, clean technology subsidization, public education etc. From practice perspective, it has potential utility of including environmental risk factors in CKD screening and management as it can facilitate early

identification of disease and timeliness and adequacy of intervention. Moreover, studies that are focused on Bangladesh are needed immediately, to evaluate the factors of air pollution on the prevalence of kidney diseases. Policymakers should also address the social and political aspects of pollution control measures so that socioeconomically disadvantaged communities are not adversely affected by the strategies.[12]

Conclusion

Air pollution is an essential risk factor that is often overlooked in the context of developing kidney diseases in Bangladesh. With the urbanization and industrialization unfolding in the country, there is likely to be increasingly widespread environmental pollution causing Cumulative Non communicable diseases including CKD. Combating this silent scourge needs the coordinated endeavors of the government, the health care institutions and Bangladeshis themselves. Bangladesh needs to fight air pollution not just to protect the kidneys but to save the health of the whole nation.

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