**“Health impacts of Ambient Air Pollution in South Asia: current status, challenges, and future directions”**

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**Abstract**

Air pollution is recognized as the fourth largest global risk factor for mortality. Similarly, ambient particulate matter pollution is a significant cause of premature death and ill health worldwide. The elevated level of air pollutants and their long-term exposure increases the susceptibility to several chronic/acute diseases. In recent years, cities in India and Pakistan have been highlighted alternatively as the cities with the worst air quality during winter smog episodes. Considering the severity of the issue and fragmented research carried out in South Asia, this review paper aims to address the burden of disease attributable to air pollution. Diseases such as lower respiratory infection, Ischaemic heart disease, stroke, chronic obstructive pulmonary disease, and diabetes type 2 are increasing the burden of disease in South Asia. Policy gaps are also identified in the study. The current review will help in improving the public health of south Asian countries.The study findings suggest that policymakers at the local, national, and regional levels should devise feasible policies by considering all the relevant parameters, including the country's economic status, local meteorological conditions, industrial interests, public lifestyle, and national literacy rate.

**Keywords:** Particulate Matter, Household air pollution, Health Impacts, Air pollution, South Asia, Policy

**Outline:**

1. Introduction
2. Major Sources of Air Pollution
3. Mortalities (annual) Attributable to Air Pollution
4. Current Policy structure (directly related to air pollution mitigation i-e Pakistan Clean Air Program
5. Recommendations
6. Conclusion
7. Acknowledgment
8. References

| **Country** | **Location** | **Sampling Period** | **Subject** | **Pollutants** | **Health Impacts** | | **References** |
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| Pakistan | The Salt Range, Kallar Kahar | 2018 | All age groups |  | **Mortality** | **Baseline Incidence (per 100000 pop.)** | (Nasir et al., 2022) |
| PM 2.5 | Mortality due to Lung Cancer in adults age 25+ | 44.25 |
| Mortality due to Lung Cancer in adults age 30+ | 44.25 |
| All-cause of mortality in adults age 30+ | 15,900 |
| PM 10 | Post Neonatal infant mortality | 5386 |
| NO2 | All-cause mortality | 750 |
| O3 | Respiratory disease mortality | 181 |
| Islamabad | March-April 2018 | All age groups | Heavy Metals bounded to PM | Maximum cancer risk value was observed for children via inhalation of Cd  Children were observed at higher risk compared to adults | | (Khan et al., 2020) |
| Karachi  (Karachi University and Makro) | October 2009- August 2010 | All age groups | PM 2.5 | The estimated number of deaths  were higher in the fall and winter seasons at the Makro (4329 and 4425) and KU (2739 and 2348) sites. The annual estimates of the expected deaths were 3592 at the Makro site and 1971 at the KU site. Seasons with the highest average PM2.5 concentrations at Makro (winter) and KU (fall) recorded the highest expected  number of deaths. | | (Moyebi et al., 2023) |
| Bhutan | Rural Villages |  | Children |  |  | | (Wangchuk et al., 2015) |
| Bangladesh | Dhaka | January 2005- December 2014 | Children | PM2.5 | We found a 3.2% increase in pneumonia diagnoses per 10 μg/m3 increase in PM2.5 among children under five in urban Dhaka. | | (Sherris et al., 2021) |
| Dhaka | 2011 | All age groups | PM 2.5 | Short-term exposures to PM2.5 increases the daily number of emergency room visits at a major CVD hospital in Dhaka. The variation in the nutritional status of patients and seasonal variations may play an important role in this association. | | (Khan et al., 2019) |
| Dhaka | 2014-2017 | Female | 5 Air Pollutants | with the shift from wood to natural liquid gas as a major source of cooking fuel in Bangladesh, the impact of indoor air pollution was assumed to be quite minimal on birth outcomes in comparison to ambient or outdoor air pollution  Our data show a linear increase in prevalence of LBW (Low Birth Weight) and PTB ( Pre-term birth)with higher exposure to air pollution | | (Nahian et al., 2023) |
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Mortalities attributable to Air Pollution in South Asia (WHO)

| **South Asian Countries** | **Total** | **Lower respiratory infections** | **Trachea, bronchus, lung cancers** | **Ischaemic heart disease** | **Stroke** | **Chronic obstructive pulmonary disease** |
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| Afghanistan | 20642 | 3886 | 238.1 | 11292 | 4052 | 1174 |
| Bangladesh | 75686 | 8908 | 2201 | 28564 | 25736 | 10277 |
| Bhutan | 339.6 | 38.05 | 5.1 | 158.3 | 53.43 | 84.8 |
| India | 882638 | 119117 | 16847 | 404141 | 136976 | 205557 |
| Maldives | 80.3 | 4.41 | 2.16 | 50.18 | 14.49 | 9.06 |
| Nepal | 14582 | 1646 | 543 | 4840 | 2230 | 5323 |
| Pakistan | 137005 | 22674 | 1859 | 64292 | 27753 | 20427 |
| Sri Lanka | 9518 | 1103 | 190.2 | 5804 | 969.8 | 1451 |

**References**

1. Nasir, A. H., Nawaz, R., Haider, R., & Irshad, M. A. (2022). Modeling Air Pollution Health Risk for Environmental Management of an Internationally Important Site: The Salt Range (Kallar Kahar), Pakistan. *Atmosphere*, *13*(1). https://doi.org/10.3390/atmos13010100
2. Khan, S. A., Muhammad, S., Nazir, S., & Shah, F. A. (2020). Heavy metals bounded to particulate matter in the residential and industrial sites of Islamabad, Pakistan: Implications for non-cancer and cancer risks: Evaluation of heavy metals bounded to particulate matter for non-cancer and cancer risks. *Environmental Technology and Innovation*, *19*. https://doi.org/10.1016/j.eti.2020.100822
3. Moyebi, O. D., Fatmi, Z., Carpenter, D. O., Santoso, M., Siddique, A., Khan, K., Zeb, J., Hussain, M. M., & Khwaja, H. A. (2023). Fine particulate matter and its chemical constituents’ levels: A troubling environmental and human health situation in Karachi, Pakistan. *Science of the Total Environment*, *868*. https://doi.org/10.1016/j.scitotenv.2023.161474
4. Wangchuk, T., Mazaheri, M., Clifford, S., Dudzinska, M. R., He, C., Buonanno, G., & Morawska, L. (2015). Children’s personal exposure to air pollution in rural villages in Bhutan. *Environmental Research*, *140*, 691–698. https://doi.org/10.1016/j.envres.2015.06.006
5. Sherris, A. R., Begum, B. A., Baiocchi, M., Goswami, D., Hopke, P. K., Brooks, W. A., & Luby, S. P. (2021). Associations between ambient fine particulate matter and child respiratory infection: The role of particulate matter source composition in Dhaka, Bangladesh. *Environmental Pollution*, *290*. https://doi.org/10.1016/j.envpol.2021.118073
6. Khan, R., Konishi, S., Ng, C. F. S., Umezaki, M., Kabir, A. F., Tasmin, S., & Watanabe, C. (2019). Association between short-term exposure to fine particulate matter and daily emergency room visits at a cardiovascular hospital in Dhaka, Bangladesh. *Science of the Total Environment*, *646*, 1030–1036. https://doi.org/10.1016/j.scitotenv.2018.07.288
7. Nahian, M. Al, Ahmad, T., Jahan, I., Chakraborty, N., Nahar, Q., & Streatfield, P. K. (2023). Air pollution and pregnancy outcomes in Dhaka, Bangladesh. *The Journal of Climate Change and Health*, *9*, 100187. <https://doi.org/10.1016/j.joclim.2022.100187>