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Can exposure to PM_{2.5} particles increase the incidence of coronavirus disease 2019 (COVID-19)?



Respiratory diseases caused by ambient air pollution are a contributing factor to prolonged bronchial inflammation leading eventually to hyper-activation of innate immune system, morbidity and mortality all over the world (Conticini et al., 2020; Liu et al., 2019). Severe Acute Respiratory Syndrome Corona Virus 2 (SARS-CoV-2) is the pathogenic agent of the coronavirus disease (COVID-19), previously known as 2019 Novel Coronavirus (2019-nCoV) (Lu et al., 2020). Recently it has gained a global importance after its emergence from the Chinese city Wuhan in December 2019. COVID-19 causes rapidly developing acute respiratory distress syndrome (ARDS), acute respiratory failure, and other life-threatening diseases (Liu et al., 2019; WHO, 2020). The source of COVID-19 is still not confirmed; however, the initial cases were reported from Huanan South China Seafood Market, in Wuhan, China.

Currently, research regarding the clinical features and epidemiology of pneumonia caused by COVID-19 is limited. However, it is noted that the pollution of particulate matter ≤ 2.5 μm in diameter (PM_{2.5}) impairs the first line of defense of the upper airways called cilia (Yongjian et al., 2020). Studies by Cui et al. (2003) conducted during the SARS epidemic in China revealed that SARS, caused by a virus genetically identical to COVID-19, lead to a high mortality rate in areas with deteriorated air quality. A substantial relationship seems to exist between PM_{2.5} and COVID-19 infection spread over 120 cities. A 10 $\mu\text{g m}^{-3}$ increase in pollution concentration caused a statistically significant increase in daily counts of the confirmed Corona-positive cases. Wu et al. (2020) have suggested that an increase of just 1 $\mu\text{g m}^{-3}$ of PM_{2.5} corresponded to a 15% increase in COVID-19 deaths. Thus, populations exposed to a high concentration of PM_{2.5} particles are more prone to developing chronic respiratory diseases favorable to infective agents. Long-term exposure to PM_{2.5} develops a chronic inflammatory stimulus, especially in children and unhealthy population (Conticini et al., 2020), while a short-term PM_{2.5} exposure may also increase susceptibility to infections (Chen et al., 2020), because the particulate pollution damages human airways, potentially facilitating viral infections. Also, human exposure to PM_{2.5} pollutants weakens the immune response, making human body less effective in fighting against the virus-caused diseases (Chen et al., 2020; Li et al., 2019; Liu et al., 2019; Sedlmaier et al., 2009). In an experiment conducted in a small cohort of mice exposed for three months to PM_{2.5}, interleukin-4 (IL-4), tumor necrosis factor (TNF- α) and transforming growth factor (TGF)- β 1 were found to occur substantially in the lung parenchyma, leucocytes, macrophages and serum (Yang et al., 2019). Noticeably, a large systemic inflammation damages heart function too, as confirmed by another cohort of mice exposed to PM_{2.5} (Radan et al., 2019). All these phenomena have been extensively reported to occur in humans also, as PM_{2.5} is known to contribute to a systemic inflammation in healthy, non-smoker, and young populations

(Pope et al., 2016). Apparently, both the short- and long-term PM_{2.5} exposures contribute to a higher incidence of lethality of COVID-19. According to the WHO official data on COVID-19, China is the first affected country by COVID-19, with more than 84,652 infected cases and 4645 deaths. Globally, COVID-19 cases are reported to be 8,750,480 with more than 461,813 deaths. According to the Chinese government's senior medical adviser, threat of a second wave of infections is looming large. We believe that epidemiological and experimental researches are urgently required to estimate the impact of PM_{2.5} incidence on the exposed population in almost every country. Further, the government and researchers of different countries should take into account the PM_{2.5} exposures in regions with higher levels of atmospheric pollution, while formulating policies to mitigate the incidence of COVID-19.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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