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SARS-CoV-2 spread in Northern Italy: what about the pollution role?

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Abstract The recent epidemic of the new SARS-CoV-2 in the northern regions of Italy is putting the organization of the Italian health system under serious attack. The current emergency requires all possible efforts to stem the spread of the virus. In this context, it is clear that we have the urgent need to rely upon etiopathogenetic data, in order to do all possible efforts to block the epidemic. However, observing the trend of the infections in China and the geographic areas of the main outbreaks, it could be hypothesized that air pollution plays a role. In particular, it has been previously demonstrated, in specific populations, a role of particulate matter in worsening clinical presentation of virus infection in airways. Without prejudice to the ascertained virus spread by air droplets or contaminated surfaces, the factors that could have favored its spread remain to be investigated. Moreover, if these observations were to be confirmed, when the health emergency is resolved, it will be mandatory to redesign an economic-productive model in balance with the environment.

Keywords SARS-CoV-2 · COVID-19 · Pollution · PM-10 · PM-2.5

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Recent SARS-CoV2-2 outbreak in China and Italy cast many doubts about possible mechanisms underlying its spread and diffusion in the environment.

It is well known that the SARS-CoV-2 possesses a high pathogenicity and transmissibility. Indeed, droplets and inter-human contacts represent the preferred way of this virus transmission (Han and Yang 2018, Han and Yang 2020), and the reported high resistance of the SARS-CoV2-2 in the air as well as on the hard surfaces (i.e., copper or plastic) (Van Doremalen et al. 2020; Kampf et al. 2020) enhances the virus ability to infect a high number of subjects. However, there is a growing interest with respect all possible factors capable to increase its pathogenicity in response to the observed difference in the outcome of the infected patients as well as in the geographical distribution of the virus in China and, particularly, in Italy.

Accordingly, there are well-known pre-existing conditions which can predispose to a worse outcome. Undoubtedly, smokers have been identified as a high-risk category and more prone and susceptible to

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MERS-CoV infection (Seys, 2018), probably due to both dipeptidyl peptidase-4 mRNA and protein overexpression, inversely correlated with lung function and diffusing capacity parameters. More recent data on SARS-CoV-2 disease (COVID-19) pointed out that the oxidative stress could alter the pulmonary air-blood barrier, thus creating a substrate for a more serious acute respiratory distress syndrome in smokers (Cai, 2020).

Besides the smoking habits, air pollutants' exposure might play a pivotal role. Indeed, air pollution is responsible for between 3 and 7 million deaths worldwide per year, and it still represents a serious public health issue due to increasing industrialization and the rapid expansion of urban environments. (Niemann, 2017). Particularly, the urban pollution is a complex cocktail of chemicals which is broadly characterized into gases, semi-volatile liquids, and particles. During the last few years, many reports dealing with this topic have been published. In a relatively recent study, conducted in Lombardy (Carugno, 2016), it has been shown that some pollutants are associated to an increased risk of complications and hospitalization for respiratory syncytial virus bronchiolitis (RSV) (Carugno, 2016). The same study found a close association between short- and medium-term particulate matter 10 (PM-10) exposures and increased risk of hospitalization due to RSV bronchiolitis among infants. These data strengthened another report by Ye Q. and colleagues (Ye, 2016) where it has been demonstrated that air pollutants significantly increase the risk of RSV infection with dosage, lag, and cumulative effects. Similarly, Carugno et al. have previously demonstrated the dangerous exposition of the Northern Italy population to air pollutants (Carugno, 2018); in their study, they described the short-term effects of PM-10 and NO_2 exposure in Lombardy, where increasing concentrations of air pollution were associated with increased mortality and hospital admissions. Accordingly, it is reasonable to assume that the prolonged cellular oxidative stress induced by the inhaled pollutants should be considered a predisposing condition for the severe impact of respiratory viruses on respiratory system. In such a context, it might be conceivable that some air pollutants, specifically of PM-2.5 and PM-10, might favor not only the virus pathogenicity but also its spread. Indeed, as it survives for several hours, even days, on inert surfaces (Van Doremalen, 2020), it could be hypothesized that particular atmospheric conditions constitute further facilitate of diffusion. Supporting the abovementioned hypothesis, the empirical observation that geographical areas with very high levels of pollutants in the air, such as Hubei region in China and Northern Italy, are also those with the highest number of infected and, consequently, of deaths. The rigid measures undertaken in China have resulted in a drastic reduction of contagions by inter-human contact; however, it is conceivable that the reduction of pollutants, consequent to the stop of industrial production and human activities, may have guaranteed a further reduction in the spread of contagion. In fact, during the quarantine, established by governments, the concentrations of pollutants were measured by the satellites of the European Space Agency, and the results have been compared with the concentrations detected in the same period of the last year and in the period before the quarantine, finding a significant reduction in the concentrations of pollutants (McMahon, 2020, Bartels, 2020).

These data could be really useful to focus health system effort on avoiding the spread of SARS-CoV-2 in specific seasons or in particular geographic areas.

All considered, when the public health emergency is resolved, we must not waste time, and we must pursue all the necessary health and economic policies to create an environmental balance for maintaining health and human activities and a more physiological air substrate to avoid all potentially lethal consequences of a new virus presence.

Compliance with ethical standards

Conflict of interest All authors declare that they have no conflict of interest.

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