

Traffic-related air pollution and the coronavirus pandemic: shadows and lights

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Motor vehicle traffic is widespread in high-income countries but does not spare middle and low-income countries, because many persons spend a considerable amount of their daily lives in the middle of traffic, not only when they travel by car and bus but also when riding a bicycle or a motorbike. Traffic exposure is not limited to people who travel, because residential or occupational living in proximity to major roads or motorways is another relevant source. Traffic makes people vulnerable to multiple risk factors for health such as accidents, noise and stress, but the ensuing ambient air pollution is likely to play a most detrimental role. There are multiple harmful components of traffic-related air pollution: gaseous and particulate, primary and secondary. Primary pollutants stem from the direct emission by motor vehicles of gaseous substances such as nitrogen oxides (NO/NO₂) and soot particles of elemental carbon.^{1,2} Secondary pollutants are particulate matter (PM), that forms in the ambient air from volatile organic compounds and from the primary pollutants, mainly nitrogen oxides (NO_x). Furthermore, the traffic-related air pollutome (TRAP) is not only due to fossil fuels released into the ambient air as combustion exhaust by motor vehicle tailpipes, but also to non-exhaust sources such as the wear of brakes, tyres and the resuspension of road dust due to traffic-induced turbulence.^{1,2}

NO_x are the epitome of traffic-related pollutants stemming from the combustion of the most widely employed fuels, whether diesel or gasoline, so that they are a valid and measurable proxy of ambient air pollution produced by motor vehicle traffic, owing to a high correlation with other combustion by-products, including PM. A few epidemiological time series studies found a positive association between short-term (hours and days) exposure to NO₂ and such adverse effects on health as all-cause mortality and cardiovascular and respiratory morbidity.^{3,4} That exposure to traffic and thus to NO_x is within one hour of exposure a trigger of acute myocardial infarction as established by the

seminal study of Peters et al.,⁵ but long-term effects (months and years) are less firmly consolidated.^{6,7} Furthermore, it is still incompletely understood whether or not the adverse effects on human health of NO_x are directly linked to this class of pollutants, because it is somewhat difficult to disentangle their effects from those of such other related components of TRAP as PM, particularly PM_{2.5}.

In this issue of the journal, a large and well-designed study from Israel,⁸ based on data obtained from the prospective analysis of four different and large prospective cohorts, including patients with pre-existing coronary artery disease (CAD) and ostensibly healthy people from the general population taken as controls, shows in the frame of a long-term evaluation that TRAP, measured as NO_x with adequate satellite-based methods, is positively associated with all-cause mortality and incident cancer.⁸ These outcomes reached statistical significance in the more vulnerable members of the cohort with objectively documented evidence of previous CAD but not in the matched non-CAD controls from the general population of Israel.

Owing to this accrual of evidence on the harmful long-term effects of TRAP on mortality and morbidity, an important issue looming large is what is warranted to mitigate the dimension as well as the impact on human health of this risk factor. Some hints that it is possible to tackle this formidable task stem paradoxically from a current quasi-experimental, naturally occurring setting associated with the pandemic of COVID-19 due to severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).

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This scourge has dramatically changed the scenario of air pollution due not only to motor vehicle traffic but also other anthropogenic sources (domestic and public heating, energy production, airliners, industrial activities). The whole planet is on lockdown: pedestrians have taken over city streets, flying has stopped almost entirely, skies are blue: China, that is, the country that, together with India has the highest burden of NO_x emissions due to traffic but also to the massive use of coal to produce energy and of wood to cook food and warm homes, reduced transiently by at least 30% the emissions of this and other pollutants owing to the stringent restrictions on human activities enforced in the first few months of 2020 due to the coronavirus epidemic in the region of Wuhan, as shown in Figure 1 by NASA satellite images. On the basis of a prediction modelling exercise based on the degree of reduction of ambient air pollution and mortality previously observed by He et al.⁹ at the time of the enforced restriction of anthropogenic activities during the 2008 Olympic Games in Beijing, it is postulated that the current lockdown due to COVID-19 should

spare in 2 months the lives of 6000 children and of 73,000 senior citizens.¹⁰ Another quasi-experimental example of TRAP reduction at the time of COVID-19 is documented by the ESA satellite Sentinel 5P, showing a marked decrease of NO_2 in the Po plain of northern Italy (Figure 2), one of the most polluted areas of the world, during the current curbing of human activities in a region characterised by both high traffic density and high prevalence of COVID-19.

Needless to say, these benefits on air pollution and particularly on TRAP do not mean that the coronavirus pandemic is good for health at large because, notwithstanding the hypothetical reduction in mortality and morbidity stemming from the modelling exercise mentioned above,¹⁰ the harms of COVID-19 and the dire consequences of a global economy at a standstill definitely exceed any benefit. On the other hand, we learnt that air pollution and TRAP can be controlled by the restriction measures taken to tackle the pandemic, and that change is possible. While it is evident that we cannot continue to reduce human mobility and lock down industries and other essential

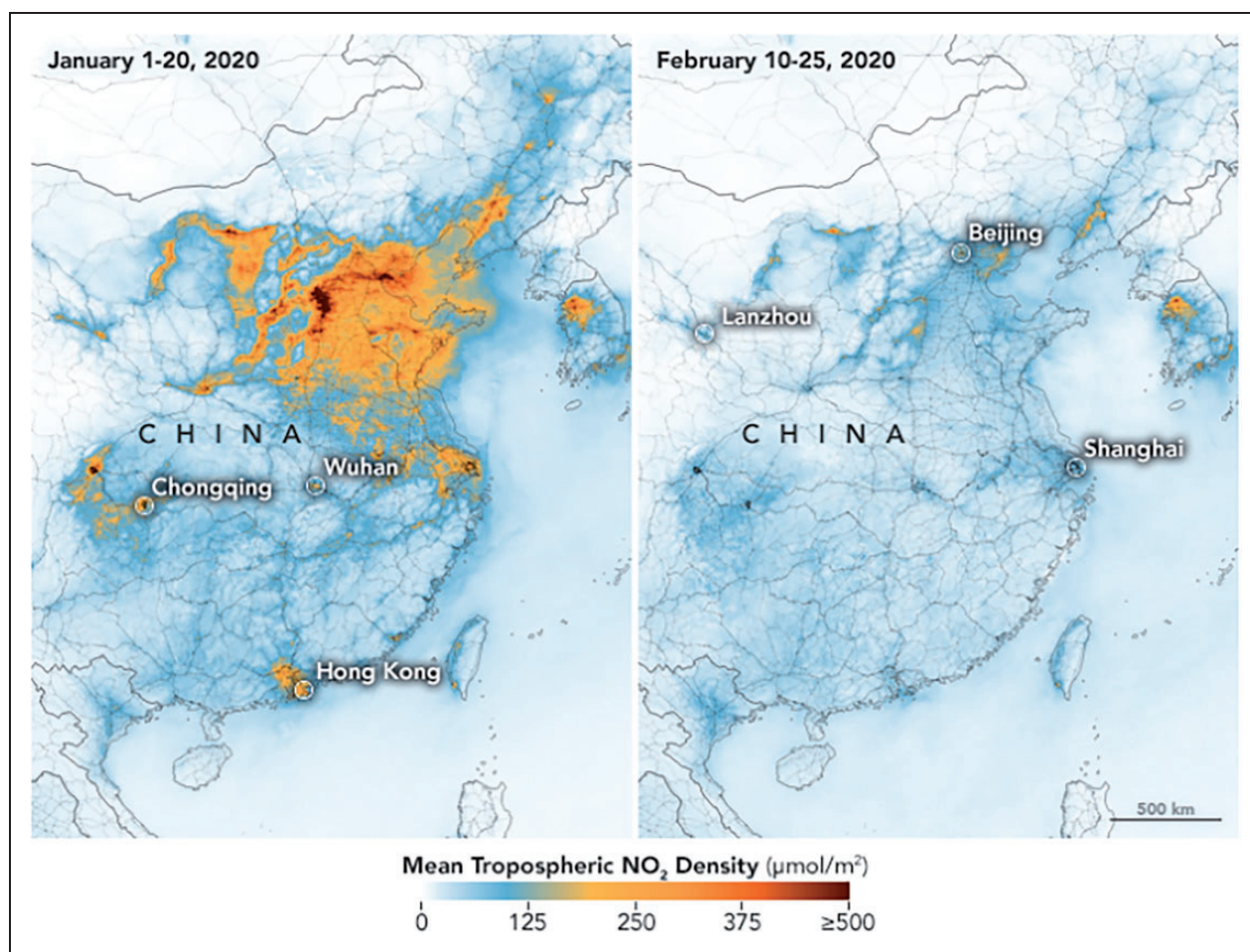


Figure 1. Nitrogen dioxide density in China before (left) and during (right) the extensive lockdown due to COVID-19.

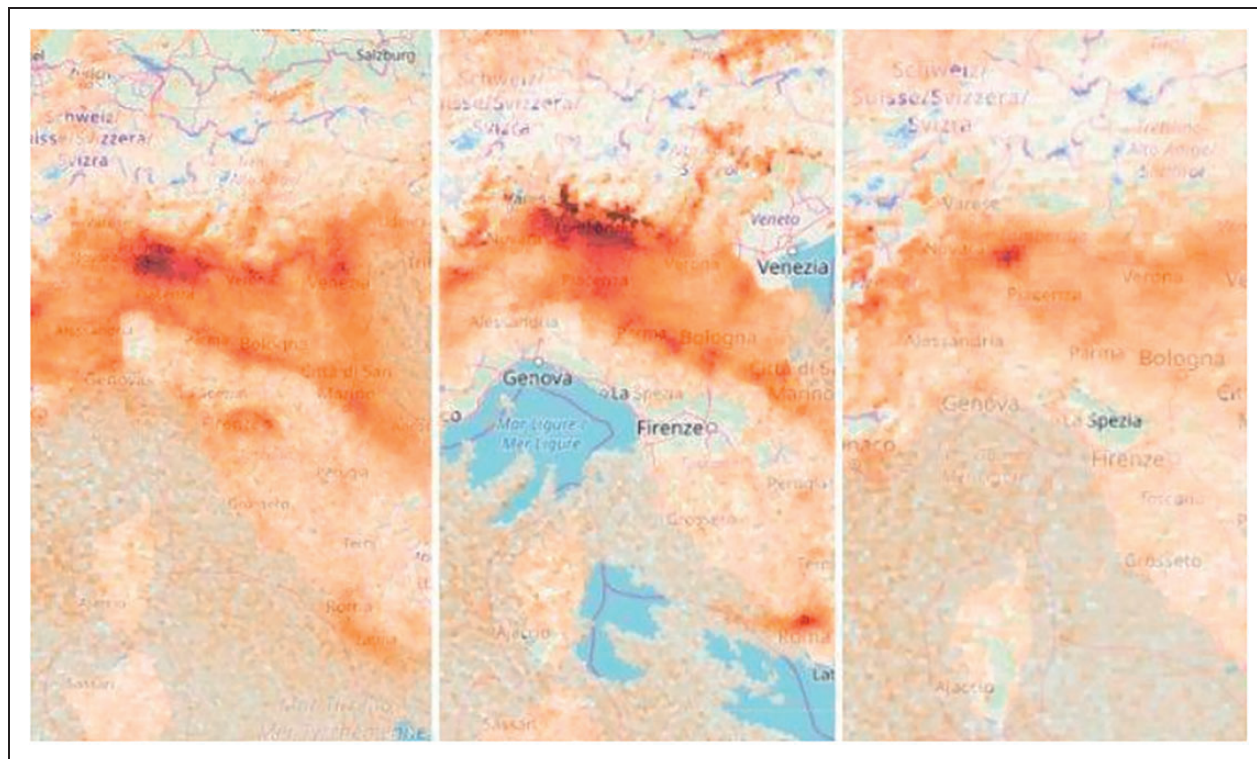


Figure 2. Nitrogen dioxide in the Po River Plain in Italy before (first and second panel) and during the lockdown due to COVID-19.

human activities, we must continue to limit individual travel by working from home, and choosing virtual conferences. On the whole, we should avoid quickly forgetting the lessons learnt during the pandemic. In the post-COVID-19 phase fossil fuel combustion should be reduced through the introduction of green technologies and sustainable activities. Furthermore, accessible and efficient public transportation and active travelling by bicycles should be facilitated, together with more and safer access to green spaces and ecosystems for resilience.¹¹

Some early hints are not particularly promising towards some maintenance of the current mitigation measures. For instance in the USA, prompted by the Trump administration the Environmental Protection Agency (EPA) announced the intention to relax or lift the current guidelines for ambient protection and air quality preservation, with the goal of compensating for the consequences of the pandemic on the economy. By the same token, in northern Italy and particularly in the Milan metropolitan area, it is being considered to stop the enforced restrictions on the use of private cars with the goal of decreasing the number of people using public transportation in an attempt to avoid crowding at the time of going to work.

In conclusion, the coronavirus pandemic should be taken as a global chance to take a different course for a healthier environment. Clear skies in Los Angeles, clear

water in Venice and in the Po river provide unwanted but compelling evidence that we can make a difference. The large sums that are being mobilised by many governments to facilitate economy recovery are a golden opportunity to direct a significant portion of these funds to truly promote renewable energy and green economy, with the goal of reducing not only air pollution but also greenhouse gas emissions and the ongoing impact of the climate crisis.

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