SIMA SOCIETÀ ITALIANA DI MEDICINA AMBIENTALE

ALMA MATER STUDIORUM UNIVERSITÀ DI BOLOGNA
CENTRO INTERDIPARTIMENTALE DI RICERCA INDUSTRIALE FONTI RINNOVABILI, AMBIENTE, MARE ED ENERGIA - FRAME

UNIVERSITÀ DEGLI STUDI DI BARI ALDO MORO

POSITION PAPER

Report on the effect of air pollution and the spread of viruses in the population

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ELEMENTS OF SCIENTIFIC KNOWLEDGE

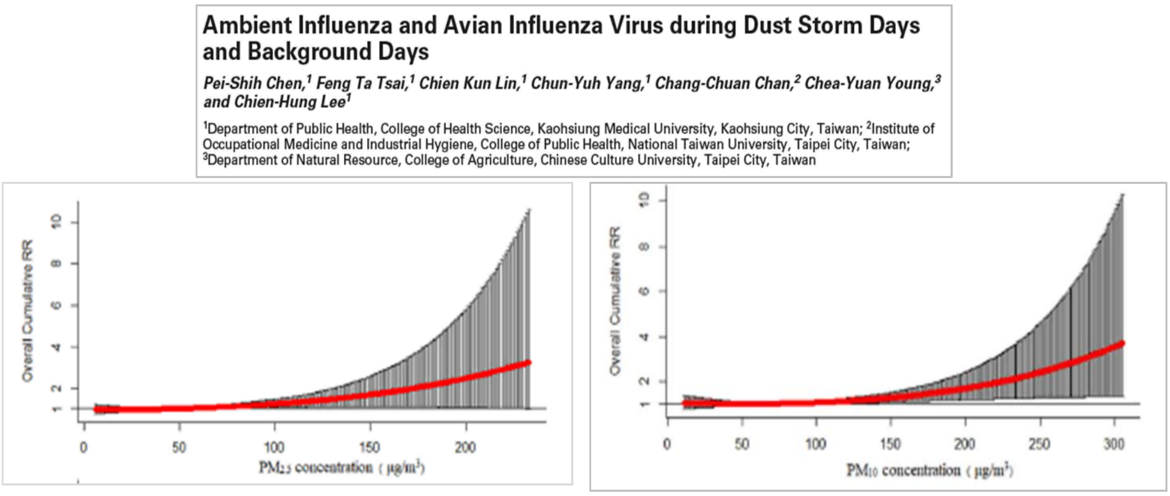
With regard to studies on the spread of viruses in populations, there is a solid scientific literature that correlates the rate of cases of viral infection with concentrations of atmospheric particulate (es. PM_{10} e $PM_{2,5}$) (1, 2).

It is known that atmospheric particulate acts as a carrier, for many chemical and biological contaminants, viruses included. Viruses stick (through a coagulation process) to atmospheric particulate, made up of solid and / or liquid particles which can remain in the atmosphere for hours, days or weeks, and which can spread and be transported even for long distances.

Atmospheric particulate is not only a carrier but, it also represents a substratum which can allow the virus to remain alive for a certain period, from hours to days.
The rate by which viruses are inactive depends on environmental conditions: an increase of temperatures and solar radiation positively affects the speed of viruses inactivity, a relative humidity can favor an higher rate of viruses spread, namely virulence (3).

In previous cases of viral infections, scientific research highlighted some characteristics of viruses spread in relation to atmospheric particulate concentrations. Here below, some results and conclusions:

- (2010) the Avian Influenza can be spread for long distances through Asiatic powders storms which carry the virus. Researchers showed that there is an exponential correlation between the quantity of infection cases (Overall Cumulative Relative Risk RR) and the concentrations of PM_{10} e $PM_{2.5}$ ($\mu g\ m^{-3}$) (4).


Ambient Influenza and Avian Influenza Virus during Dust Storm Days and Background Days

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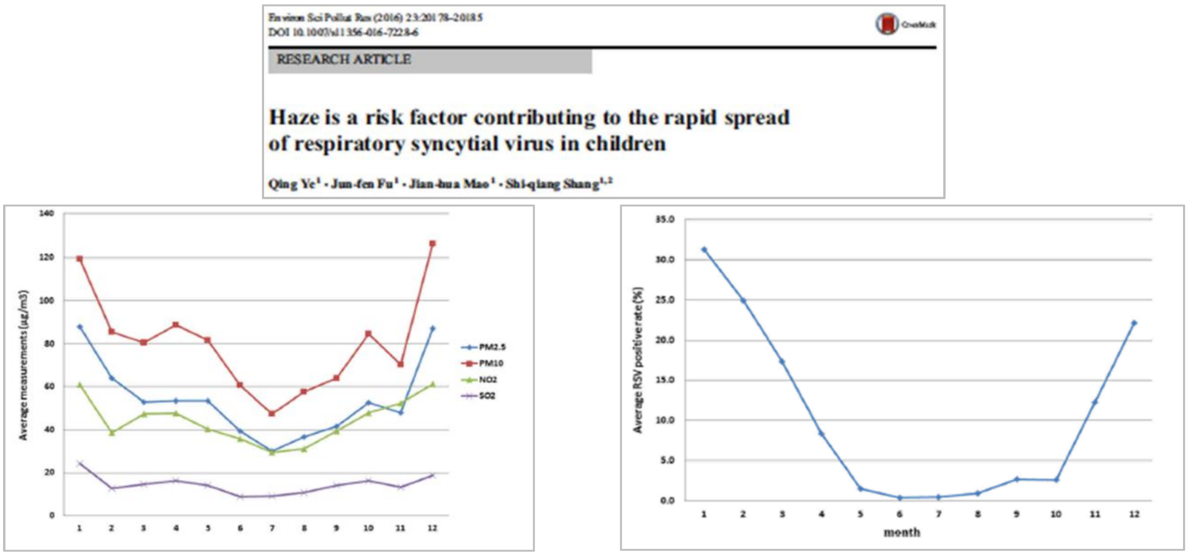
- (2016) there is a relation between the spread of human respiratory syncytial virus (HRSV) in kids and the particulate concentrations. This virus causes pneumonia and is carried through particulate in depth in the lunges. The speed in infection spread is linked to the concentration of PM_{10} e $PM_{2.5}$ ($\mu g\ m^{-3}$) (5).

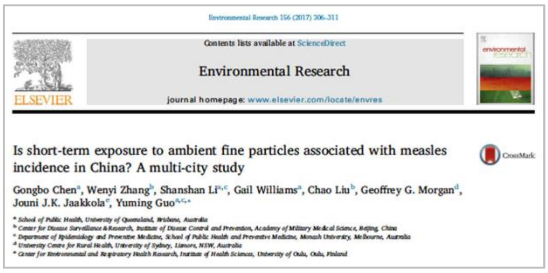

Environ Sci Pollut Res (2016) 23:20178–20185
DOI 10.1007/s11356-016-7228-6

RESEARCH ARTICLE

Haze is a risk factor contributing to the rapid spread of respiratory syncytial virus in children

Qing Ye[1] · Jun-fen Fu[1] · Jian-hua Mao[1] · Shi-qiang Shang[1,2]

- (2017) The rate of measles cases in 21 Chinese cities between 2013 and 2014 varies according to concentrations of $PM_{2.5}$. Researchers show that an increase in $PM_{2.5}$ concentrations equal to 10 μg/m^3 considerably affects the increase in number of measles cases (6).
  Researchers suggest reducing the concentrations of $PM_{2,5}$ to decrease the infection spread.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Is short-term exposure to ambient fine particles associated with measles incidence in China? A multi-city study

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- One of the major causes of daily spread of measles virus in Lanzhou (China) are the levels of atmospheric particulate (7). In relation to the evidence that the incidence of measles is associated with exposure to environmental PM2.5 in China, researchers suggest that effective atmospheric pollution reduction policies can reduce the incidence of measles.


Environmental Science and Pollution Research
https://doi.org/10.1007/s11356-020-07903-4

RESEARCH ARTICLE

The effects of air pollution and meteorological factors on measles cases in Lanzhou, China

Lu Peng[1,2] · Xiuge Zhao[1,2,3] · Yan Tao[1,2] · Shengquan Mi[4] · Ju Huang[1,2] · Qinkai Zhang[5]

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On the basis of this concise introduction and scientific overview, historically retraced, it can be deducted that atmospheric particulate (PM10, PM2.5) is an efficient carrier for the transport, spread and proliferation of viral infections.

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FIRST ANALYSIS ON THE COVID-19 SPREAD IN ITALY IN RELATION TO THE EXCEEDING OF PM_{10} LIMITS.

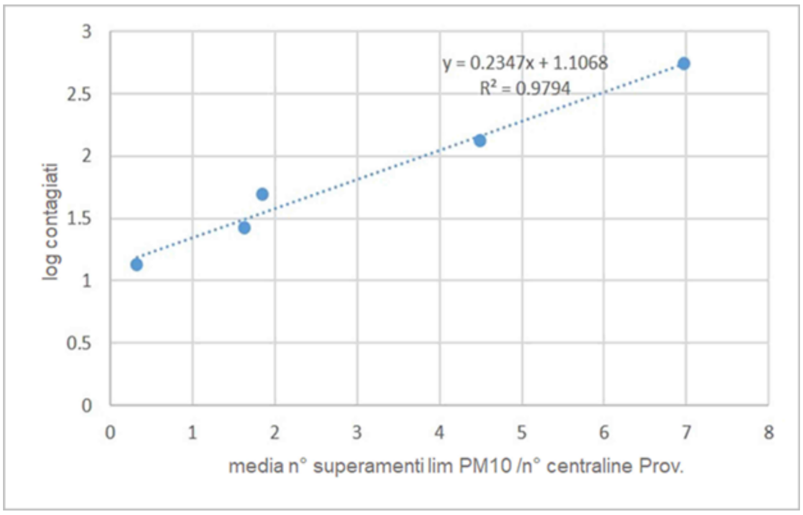
To assess a possible correlation between the levels of atmospheric particulate pollution and the spread of COVID-19 in Italy, for each province, were analyzed:

- daily concentration data of PM10 gathered by the Regional Environmental Protection Agencies (ARPA) throughout Italy. The data published on the ARPA sites relative to all the measurement stations, active in the territory, were examined. In the examination, they considered the number of times in which the legal limit (50 µg m-3) for the daily concentration of PM10 was exceeded, compared to the number of measurement stations active per province (number of daily PM10 limit exceeding / number of measurement stations per province)

- data relative to **the number of COVID-19 infection cases** reported on the Civil Protection website (COVID-19 ITALIA).

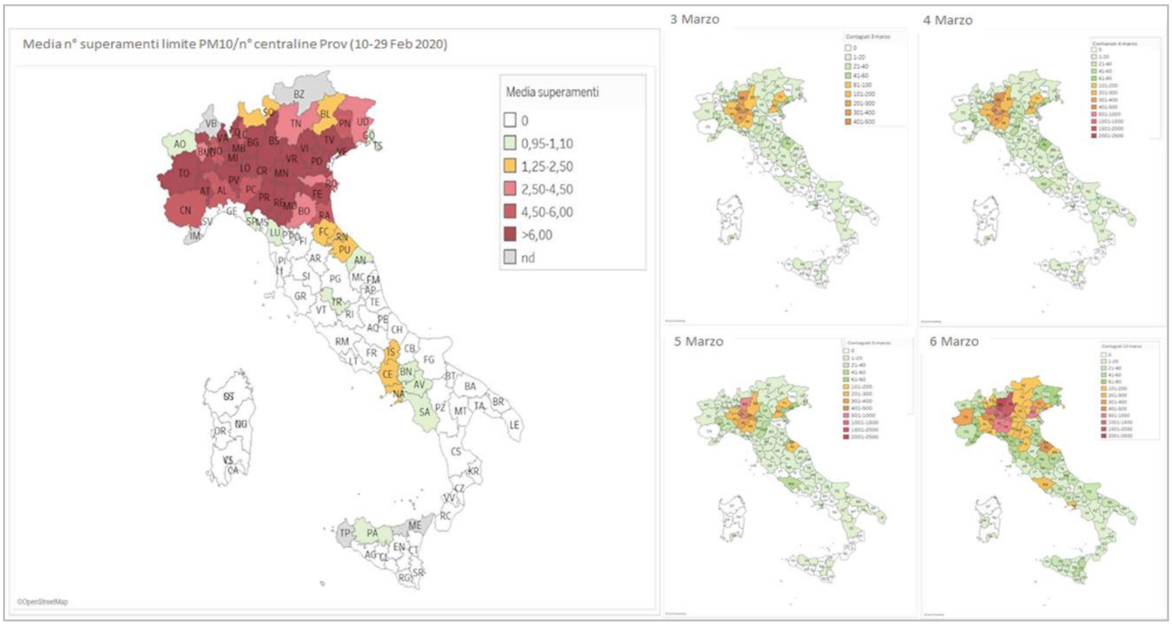
In particular, it should be noted the relation between the exceeding of law limits in PM_{10} concentrations recorded in the period from 10^{th} to 29^{th} February and the number of COVID-19 infection cases updated on 3^{rd} March (considering an intermediate time delay relative to the period from 10^{th} to 29^{th} February of approximately 14 days equal to the incubation time of the virus until the identification of infection contracted).

Below, the chart which highlights a linear relationship (R^2=0,98), by grouping the provinces in 5 classes on the basis of infected cases on a logarithmic scale: log infected) in relation to exceeding in the limits of PM_{10} concentrations for each of the five provinces' classes (average per class: average PM_{10} limits exceeding/no. measurement stations prov.)(**Chart 1**)



Such an analysis seems to show a direct relationship between the number of COVID-19 cases and the territories level of PM_{10} pollution. This is in accordance with what had been described by the recent scientific literature for other viral infections.

The relation between COVID-19 cases and PM_{10} gives an interesting consideration on the fact that the concentration of greater outbreaks has been registered in Po valley while lesser infection cases has been registered in other areas of Italy. (**Chart 2**).



Considering the latency time in which COVID-19 infection is diagnosed, on average 14 days, it signifies that the virulent phase that we are monitoring from 24th of February (data gathered by the COVID-19 Civil Protection) to 15th March can be positioned around the period between 6th February and 25th February.

The infection expansion curves in regions (**Chart 3**) show trends perfectly compliant with the epidemic models, typical of a person-to-person transmission, in southern Italy regions while show an abnormal acceleration those located in Po valley where the outbreaks results particularly virulent and let reasonably suppose to a spread mediated through carrier.

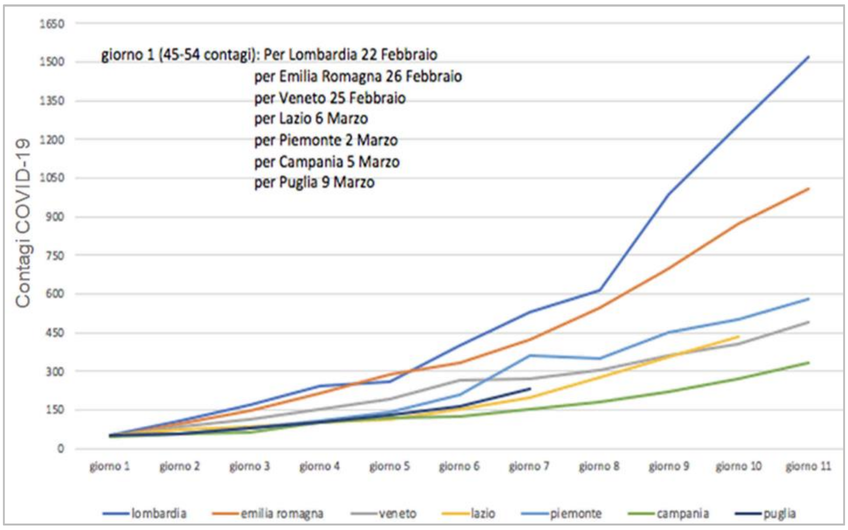
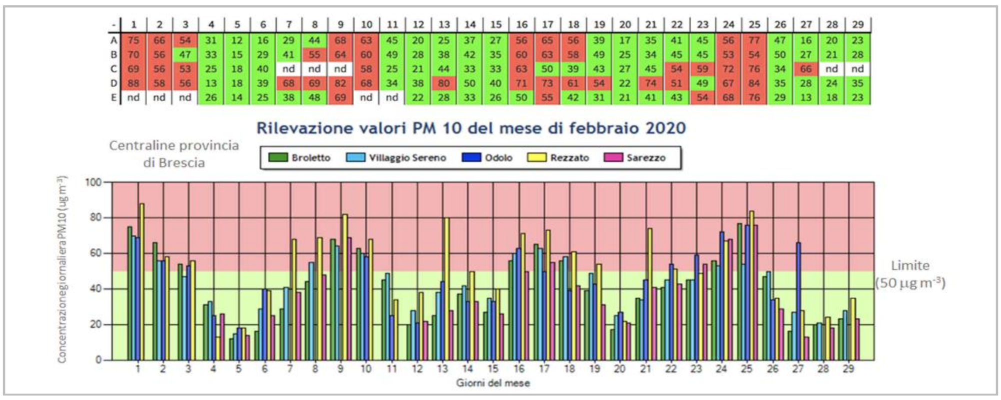


Chart 3

The phases in which boosts occur are concomitant with the presence of high atmospheric particulate concentrations. In Lombardia region, particulate concentrations have shown a series of PM10 concentrations far beyond the limits (**Chart 4**: Brescia province example).



-	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
A	75	66	54	31	12	16	29	44	68	63	45	20	25	37	27	56	65	56	39	17	35	41	45	56	77	47	16	20	23
B	70	56	47	33	15	29	41	55	64	60	49	28	38	42	35	60	63	58	49	25	34	45	45	53	54	50	27	21	28
C	69	56	53	25	18	40	nd	nd	nd	58	25	21	44	33	33	63	50	39	43	27	45	54	59	72	76	34	66	nd	nd
D	88	58	56	13	18	39	68	69	82	68	34	38	80	50	40	71	73	61	54	22	74	51	49	67	84	35	28	24	35
E	nd	nd	nd	26	14	25	38	48	69	nd	nd	22	28	33	26	50	55	42	31	21	41	43	54	68	76	29	13	18	23

Such analyses seem to demonstrate that in relation to the period from 10th to 29th February, the high particulate concentrations, superior to the PM_{10} limit, in some regions of northen Italy might have exerted a boost action, an impulse to the virulent epidemic spread in Po Valley. A virulent spread not seen in other areas of Italy which registered infection cases in the same period. On this matter, it is emblematic the Rome case in which the presence of infected people was already evident in the same days of Po Valley regions but without causing a virulent phenomenon.

In addition to atmospheric particulate concentrations as virus carrier, in some territorial areas even adverse environmental conditions might have influenced the rate of viral inactivation. The working group is examining in depth these perspectives to contribute to a more detailed comprehension of the phenomenon.

CONCLUSION AND SUGGESTIONS

It has been shown how the specificity of the speed in the increase of infected cases, which affected in particular some areas of northen Italy, can be linked to the pollution conditions of atmospheric particulate. Atmospheric particulate exerted a carrier action and a boost action. As already reported in previous cases of high spread of viral infection in relation to high levels of contamination from atmospheric particulates, it is suggested to take this contribution into account by calling for restrictive measures to contain pollution.

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