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# A Pedagogy of COVID-19: Facts from 30 Pandemic Months

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## ABSTRACT

This article presents a rapid review synthesizing the evidence regarding what we consider the facts on COVID-19, over which a large consensus has been reached by the scientific community after 30 pandemic months. As of July 2022, nonetheless, while many of these facts inform the body of knowledge in the field of COVID-19, they often still lack precise hypotheses and causes that could explain them. Mainly because of the observational nature of many of the studies that have led to their discovery. This just means we need to do more than what we have already done, if we want to know more.

**Keywords:** COVID-19's pedagogy, Transmissibility and virulence, Variants, Control measures and vaccination, Meteorological and environmental factors

## INTRODUCTION

While the scientific community, health authorities, international media and the public are still arguing about several characteristics of this virus and the patterns of its spread, after 30 months of pandemics there are now some facts, along with their dynamics, over which a scientific consensus has been finally reached. In science, it is well known that facts and observations should be explained by a hypothesis, which should be tested until it is refuted. This is not, unfortunately, still the case for many of the aforementioned agreed facts. Nonetheless, the time has come for a rapid review of them with relative data, which is the specific goal of this article, while avoiding all the myriads of logical fallacies that have pervaded the universe of discussions about COVID-19. The undisputed facts we will cite and comment include the following: mechanisms through which the virus spreads, transmissibility and virulence (i.e. the degree to which this virus sickens and kills), the role of variants and their evolution, the role of control measures and vaccination, the role of meteorological and environmental factors in the transmission. At the end, it will be evident that, even if these facts represent unchallenged and accepted truths, some of them are not still meaningfully associated with precise causes and clear underlying phenomena on any possible level, including biological, biochemical, bio-statistical, economic and social. And the conclusion is that this just means we need to do more than what we have already done so far.

In the following Section, we will review all those facts, along with relative comments and data. The final Section concludes the paper.

## **FACTS FROM 30 PANDEMIC MONTHS**

Before we can begin, it is important to stress the consideration that all the facts that will be reported and commented here are mainly concerned with the mechanisms through which SARS-COV-2, and its variants, spread and infect humans, as this can be observed from a data-centered perspective. It is out of the scope of this article, instead, to provide any medical consideration on how a COVID-19 infection should be healed, or treated, from a medical viewpoint, since this issue lies outside the field of the professional competences of the author. In particular, in the following Subsections, we will present, in order, facts and educated observations concerning mainly: i) the mechanisms through which the virus spreads; ii) the transmissibility, the virulence and the role of the SARS-COV-2 variants; iii) the role of control measures, including vaccination, and iv) the role of meteorological and environmental factors.

### **Mechanisms Through Which the Virus Spreads**

One should consider that, whatever the origin of this virus is, there are clear indications that COVID-19 transmission occurs from infected people, either through virus-laden respiratory droplets or small aerosol transmissions. In particular, the WHO organization officially maintain that “COVID-19 is an infectious disease caused by the SARS-CoV-2 virus ... the virus can spread from an infected person’s mouth or nose in small liquid particles when they cough, sneeze, speak, sing or breathe.”, (WHO, 2022a; Duval et al, 2022). With this in view, it is obvious that lack of preventive measures coupled with scarcely controlled mass gatherings (including, for example, schools, people going in mass to their offices and activities, crowded transportations and indoor public events, ...) may represent a factor for the transmission (Casini et al. 2021). Hence, indoor wearing of FFP2 masks plus massive air changing, testing and self-isolation still represent the most effective measures to reduce the transmission.

### **Transmissibility, Virulence and the Role of Variants**

WHO, again, state that: “most people infected with the virus will experience mild to moderate respiratory illness and recover without requiring special treatment. However, some will become seriously ill and require medical attention. Older people and those with underlying medical conditions like cardiovascular disease, diabetes, chronic respiratory disease, or cancer are more likely to develop serious illness”, (WHO, 2022a). Regarding the degree to which this virus has sickened and killed humans worldwide, data say that, as of July 2022, COVID-19 has caused more than 550 million people to fall ill, with almost 530 million who have already recovered, and more than 6 million deaths. Just to provide two examples, US has paid, so far, the highest toll to the virus, with almost 90 million people infected and more than 1 million deaths. Italy which is considered 7th in this sad ranking has

suffered 18 million cases and a half, with almost 170,000 deaths. It is worth mentioning that all the aforementioned data on COVID-19 infections are maintained by the Johns Hopkins University Centre for Systems Science and Engineering, (Miller, 2020). To be noticed is also the fact that China does not release its data, on a regular and reliable basis. Along these months, nonetheless, the most notable phenomenon has been that of repeated variant-driven surges of the infection. In fact, ever since it first emerged, COVID-19 has been rapidly mutating, mainly changing the shape of the spike protein. These new genetic versions of the original virus are called variants. At the beginning, major variants of concern were Alpha and Delta that have caused massive waves of infections and deaths (Hodcroft et al., 2021). The latest variants have been, instead, BA.4 and BA.5, which are closely related to the Omicron variant (first appeared during the 2021 winter's wave). One true fact is that the latest SARS-CoV-2 variants have evolved to be more transmissible (i.e. more infectious), but not as virulent (i.e. as deadly) as the earlier ones were. For example, the Omicron variant has been more transmissible, but not as deadly as Alpha and Delta, even if the intervention of vaccination, on a large scale, may raise the doubt on how Omicron would have performed, in terms of mortality, with immunologically naïve individuals (Wertheim, 2022). A final undisputed fact is that, independently of the accumulation of viral mutations, while a more transmissible virus may be less virulent, not to reduce its chance for transmission after it has killed its host, nonetheless, it may happen that virulence and transmissibility come intrinsically linked (look at the current emergence of a more virulent and transmissible variant of HIV in Netherlands, as described in Wymant et al., 2022). However, if the case would be given, when we have a 10-fold decrease in virulence, coupled with a 10-fold increase in infectiousness, the balance, in terms of seriously ill people, would remain almost unchanged. Not to count the fact that immune evasion, which is characterizing all the latest Omicron sub-lineages with a rate of re-infections surpassing 6% (COV.UK, 2022), may be a factor that contributes to the evolution of virulence, following a larger diffusion of the infection.

### **Role of Control Measures and Vaccination**

If we avoid discussing all the measures based on different forms of lockdown, which is still at the centre of a negative commentary due to its impact on population (see the zero-Covid policy implemented by China, for example), only vaccination remains as the most effective measure in reducing the effects of COVID-19 infection. The first COVID-19 vaccine, outside a clinical trial, was administered on December 8, 2020. As of June 30 2022, Our World in Data (Miller, 2020) reports that more than 5 billion people got at least one dose of vaccine worldwide, yielding almost the 67,2% of the world population. Fully vaccinated (i.e., double shot) are, instead, more than 4,8 billion people, achieving almost 62% of the entire world population. Unfortunately, the vaccines were distributed unequally across different countries and geographies, but with some specific country achieving very high performances. Like Italy, for example, where almost 51 million people got at least one dose (more

than 85% of the Italians) and 48 millions who got a double shot (i.e., fully vaccinated), thus reaching more than 80% of the population. With finally a 65% of the Italians who have had a third booster shot. It is also undisputed that vaccines have so far played a crucial role in preventing deaths and hospitalisations, while they have been less effective in contributing to controlling the spread of the disease, especially with the advent of the latest variants. Nonetheless, it cannot be ignored that reports of adverse events have led important portions of world population to express concerns, thus delaying or avoiding vaccination (WHO, 2022b). If we want, just for a while, to get into the estimations, we should cite a study (Watson et al., 2022) whose main finding is that vaccinations prevented 14,4 million deaths in 185 countries, in the period December 8 2020 - December 8 2021 (with a 95% credible interval, 13,7–15,9). To return to Italy, a recent study by the Italian Health Institute (ISS) has estimated that vaccines have halved the number of deaths (i.e., almost 150,000), while avoiding more than 500,000 hospitalisations and 55,000 admissions to intensive care (Parodi, 2022).

### **Role of Meteorological and Environmental Factors**

Among all the facts discussed in this article, meteorological and environmental factors are those that have ignited major discussions. With this in view, we will limit our discussion to a concise account of a few observations that seem to have reached a consensus. We start with the meteorological factors. Recently, a controversy developed about the possibility of COVID-19 following a seasonal pattern, similar to many other viral infections. This idea gained popularity, probably because of how the contagion receded during the summer months in many Western countries, reaching new peaks just during the winter. This was essentially wrong as it has been demonstrated that new COVID-19 outbreaks are likely to occur with cycles of repetition of variable lengths. Data analysis has not found evidence in favor of a seasonality recurring with a precisely fixed periodicity (Cappi et al., 2022). Not only but more precise hypotheses have been formulated on the role of temperature, UV radiations and humidity that explain the minor role of seasonality. In particular, while studying the negative correlation between the virus and higher temperatures, it has been found that sometimes this correlation comes inverted, typically corresponding to summer outbreaks (Fontal et al., 2022). Instead, while UV radiations appear promising as a barrier against the spread of the virus, concerns have been expressed concluding that this effect may be negligible when compared with the more robust impact of other control interventions, like vaccination for example (Ma et al., 2021). With humidity, the situation is even more complex, as humidity appears to have a U-shaped relation with SARS-CoV-2 spread. Low humidity, in fact, can reduce the size of aerosols by evaporation, yielding droplets smaller than 5  $\mu\text{m}$  in size that can bypass the nasal barriers and enter the human lungs. (Fontal et al., 2022). As to environmental factors, we enter a controversy, and it is the case to just mention what follows (Mirri et al., 2020; Tateo et al., 2022). In notoriously polluted areas, poor air quality easily brings humans to a state of permanent inflammation and chronic respiratory difficulties, with a hyper-activation of

the immune system. All this makes human lungs prone to be attacked by respiratory viral infections. At the end, humans living in those areas have a reduced respiratory capacity to react to airborne viruses.

## CONCLUSION

This paper has avoided to discuss other important factors, like preparedness for pandemics and the societal impact of COVID-19, over which a certain degree of consensus has been reached (Bollyky et al., 2022; Wang et al. 2022). These facts are important because they could explain the variation in infections and mortality across different countries and societies. Many of these researches emphasize facts that were well expected, like for example the disproportional impact of this virus on African Americans in the US (Vasquez Reyes, 2020); nonetheless what is interesting is that, besides GDP per capita and average age of population, high level of trust in the government and interpersonal trust, as well as less government corruption, had a larger statistically significant association with lower infection and mortality rates.

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