The unexpected spectacular 2020 October COVID-19 boost in European countries correlated with the latitude, but not with the temperature.

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Abstract :

Many European countries underwent an unexpected spectacular boost of the daily reported new COVID-19 cases between September 20th and October 18th, imposing in emergency new confinement rules in order to prevent hospitals saturation. The present study shows no correlation between the country COVID-19 boost date and its 2 weeks preceding temperature, but shows an impressive correlation with the country latitude. As the daily UV insolation earlier decreases in autumn for higher latitudes, this is an additional observation supporting the impact of low vitamin blood D level on the respiratory impairment in COVID-19 disease.

Introduction

Many European countries underwent an unexpected spectacular boost of the daily reported positive COVID-19 cases between 2020 September 20th and October 18th (Fig. 1), imposing in emergency new confinement rules in order to prevent hospitals flooding.

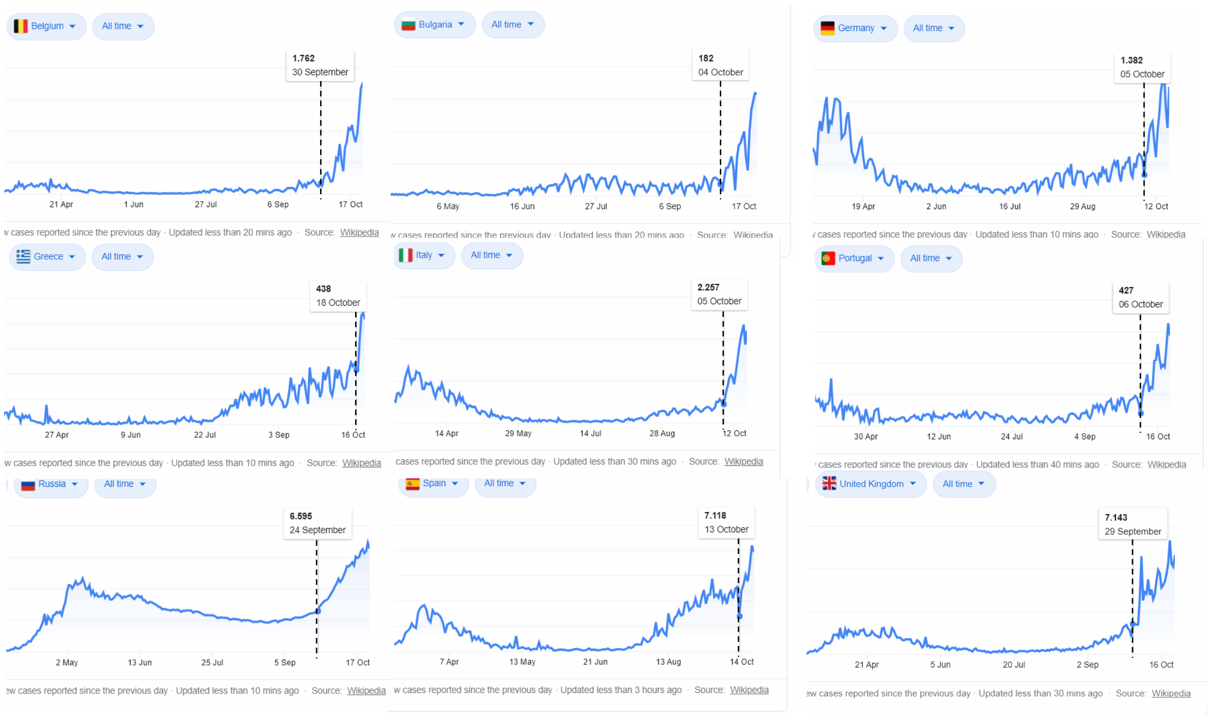

Figure 1: Examples of reported European countries daily new COVID-19 cases (extracted from the Google home page when searching “covid”, homepage using itself Wikipedia data). All curves exhibit a clear boost of the growing rates between 2020 September 20th and October 18th.

The most common explanation provided by the European epidemiologist experts in the medias is the temperature decreasing. The aim of this data analysis study is to challenge this assumption against a pure country latitude impact.

Material and method

Data sources

The daily reported country new COVID-19 cases were obtained by digitalizing the curves from the Johns Hopkins coronavirus resource center (https://coronavirus.jhu.edu/map.html) using DigitizeIt (www.digitizelt.de).

The country population weighted center (PWC) latitudes were obtained from the Baylor University population resource (http://cs.ecs.baylor.edu/~hamerly/software/europe_population_weighted_centers.txt)

The averaged 2 weeks temperatures preceding the boost dates were derived from weather.com.

The theoretical daily sun insolation as a function of latitude and of the day of the year was extracted from the online-calculator https://www.pveducation.org/pvcdrom/properties-of-sunlight/calculation-of-solar-insolation.

Boost date determination

In order to reduce observer intervention, the date of the growing rate boost was automatically determined by fitting the two last months of the daily reported new COVID-19 cases of the country c with:

$$N_c\, e^{(\alpha_c+(\beta_c-\alpha_c)\, l(t-t_c)\,)\, t} \qquad (1)$$

where l is the logistic function:

$$l(t-t_c) = \frac{1}{1+e^{-\gamma(t-t_c)}} \qquad (2)$$

t_c is considered as the boost date of the country c, i.e. the date when the exponential coefficient, coming from the initial value α_c, crosses the value $\frac{\alpha_c+\beta_c}{2}$ before tending towards β_c when $t \to \infty$. γ is the steepness of this changing. As we search for an impact of the latitude of its own, this parameter γ was assumed country independent. This further allows to prevent an over-fitting of the data noise by a steepness tuned for each country.

Note that as the exponential coefficient varies with time, the doubling time around the boost date is not simply ln(2) divided by this coefficient.

The parameters fitting was performed in excel.

Results:

Table 1 shows the fitting results (all the data and fitting process is provided in the supplementary xlsx file

country	temp. [C]	PWC lat. [deg]	date off [day]	day	Sun [kWh/m2/day]
Greece	23.4	38.7	23.09	296.09	7.15
Portugal	19.9	39.7	25.75	298.75	6.84
Spain	17.6	39.8	29.36	302.36	6.58
Bulgaria	17.5	42.8	33.16	306.16	5.99
Italy	20.6	42.9	17.96	290.96	6.92
Serbia	16.0	43.8	21.05	294.05	6.53
Croatia	17.4	45.3	17.83	290.83	6.66
Slovenia	14.5	46.2	16.20	289.20	6.66
Switzetland	14.0	47.0	12.17	285.17	6.79
France	14.9	47.2	23.31	296.31	5.87
Austria	15.4	47.8	17.45	290.45	6.22
Belgium	18.6	50.8	3.95	276.95	6.93
Germany	14.9	50.9	15.62	288.62	5.96
netherland	18.3	52.1	3.95	276.95	6.72
UK	21.1	52.8	-1.54	271.46	7.07
Russia	15.2	54.3	-7.50	265.50	7.51

Table 1. Temp: mean country temperature during the 2 weeks preceding its COVID-19 boost date. PWC lat: latitude of the country PWC. Date off: boost date offset, 1 corresponding to October 1st. day: corresponding day of the year. Sun: theoretical sun insolation at the boost date.

A common explanation provided in the European media is the decrease of temperature the weeks preceding the boost date. Figure 2A clearly shows the weakness of this assumption. On the other hand figure 2B clearly supports an impact of the country latitude.

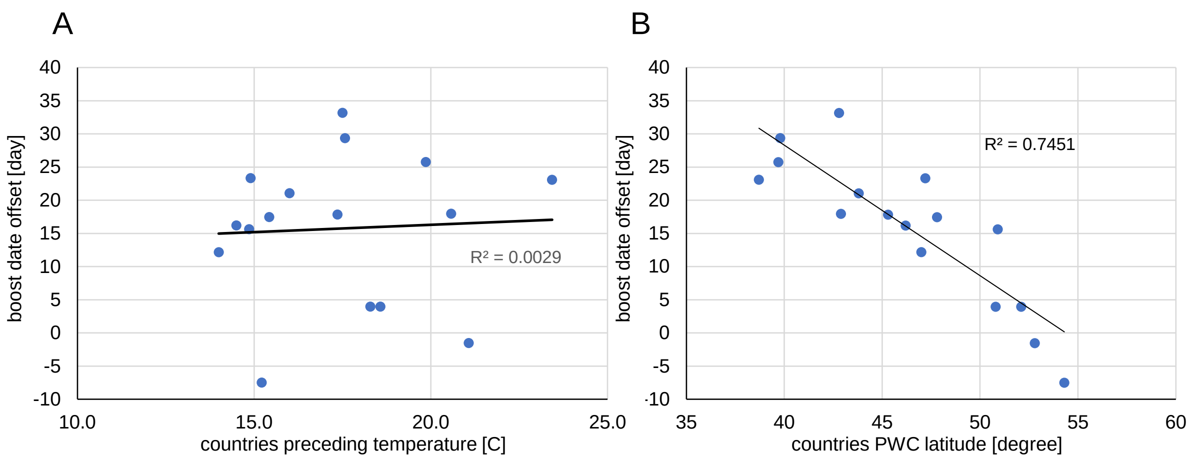

Figure 2: COVID-19 boost date offset as a function of the country mean temperature during the 2 weeks preceding its COVID-19 boost date (A), and of the country PWC latitude (B).

Fig. 3 clearly shows that the boost dates set on the theoretical daily insolation as a function of the latitude tends to be horizontally aligned rather than vertically. This supports an impact of the sun insolation.

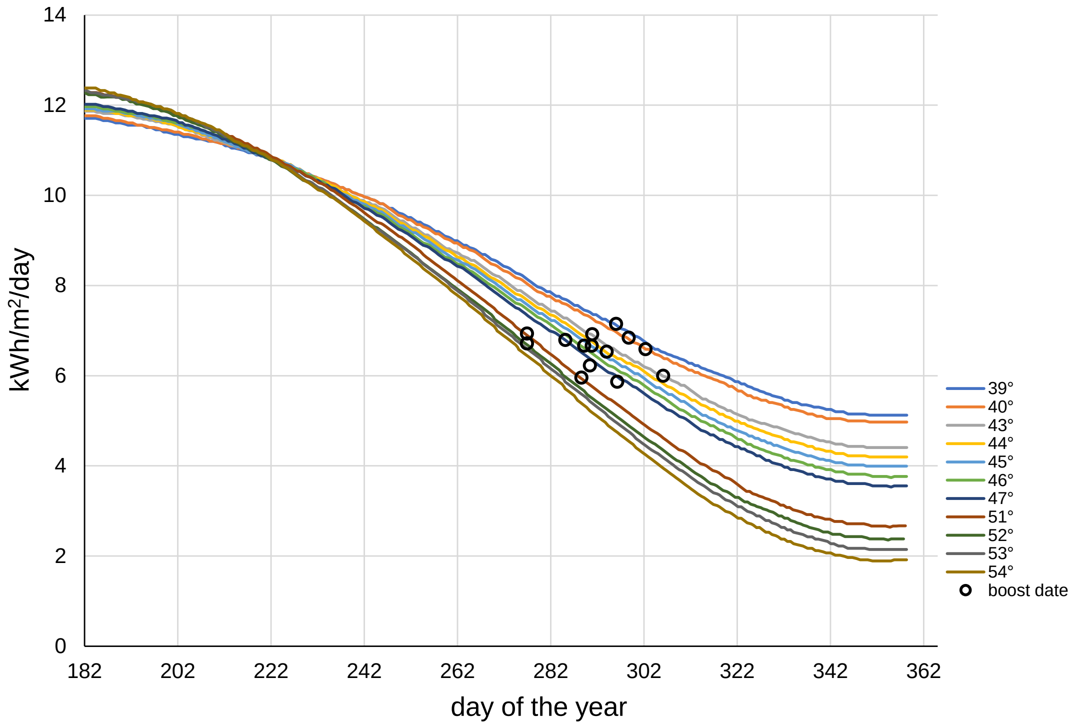

Figure 3: Solid curves: theoretical total daily sun insolation under a clear sky corresponding to the 14 PWC country latitudes. Black circles: country boost dates positioned on their corresponding latitude curve.

Discussion:

Light scattering in the earth atmosphere quickly increases with its frequency, explaining why the sun becomes red during the sunset, the solar light having then to travel thousand km of atmosphere. That also explains why sun UV is mainly harmful for the skin in summer and within 2 hours range around the sun at noon. Due to the lower maximal elevation reached by the sun, the daily UV insolation in autumn decreases earlier in countries of higher latitude, as shown in Fig. 3 for the 7 $kWh/m^2/day$ threshold.

Many observations support an impact of low vitamin D blood level [1], and also of low UV insolation [2], on the respiratory impairment in coronavirus or virus diseases. Many other observations were also recently reported for the COVID-19 pandemic [3]. Low vitamin D blood level could also be an additional factor explaining the higher COVID-19 respiratory impairment observed in aged people [4], in obese patients [5], in black people living in high latitude countries [6] and in diabetic patients [7].

Conclusion:

As the skin production using sun UVs is a major source of vitamin D for human, and that the half-life of the vitamin D reserve in adipose tissue is about 2 weeks, this study is an additional observation supporting the potential impact of low vitamin D blood level on the respiratory impairment in COVID-19 disease.

The present study suffers from the limitation that the daily new COVID-19 cases were reported on a country base, country that can extent up to 8 degrees of latitude, such as Italy. It should be highly valuable to update this study using the latitude and daily new COVID-19 cases reported for the major European country cities or regions, if such data are available.

Acknowledgments:

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