

Does COVID-19 have an internal clock? Or is Pandemic development anthropic?

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During the last two weeks some attention in the international press has been given to the suggestion made by the chairman of the Israel Space Agency, Yitzhak Ben Israel, according to which statistics would show that the pandemic ends by itself, after a cycle of 70 days and after having reached its peak in about six weeks, irrespective of the mitigation actions put in practice by the governments¹.

The faith in this analysis, strengthened by the consideration of the low Israel lethality, would have as immediate consequence that one could question whether it is reasonable to sacrifice an estimated 20% fraction of the GNP, as consequence of those measures.

The problem of finding a compromise between health safety and economic development is largely debated everywhere, and specifically in Israel has been object of other interesting contributions². This might explain the interest of the suggestion that has been received, despite the fact that the first paper was in Hebrew, as soon as a TV debate broadcast on 15 April became known to a larger public, having been commented on Israel English-language press the next day³.

It is a debate which eventually led to political decisions. For them the opinion of experts is important, even if the eventual decision does not belong to the experts. However, this makes necessary that theoretical models be verified, checking, whenever possible, if they really correspond to the data.

It is not surprising that in view of the implications, many international comments welcomed the suggestion of Ben Israel as a possible one in a rather neutral form, and not all of them mentioned that the idea was strongly attacked by a former General Director of the Ministry of Health, Gabriel Barbash, who stated that in absence of the measures taken the deaths would have been much more.

Obviously, the interest was reinforced by the high position of the author, who is also professor of the prestigious Tel Aviv University, even if in a very particular area.

A few days after the full paper has been published in English¹. Basically, it is divided in two parts, one refers specifically to Israel, and the other analyzes eight countries, adding some considerations about another small group of Asian countries.

In this paper we shall discuss the general methodology and its application to the specific case of Israel.

One should separate two aspects of the suggestion. One is the idea of an internal time development whose fixed duration would be specific to the characteristics of this virus, and the other is that the pandemic is bound to reduce the number of new contagions, to deviate at some moment from an exponential development and eventually to end.

Even if mitigated by the acceptance of not having an explanation of the first feature, the former statement is of scientific nature and as such it deserves investigation.

There is no doubt that it is questionable. Not only because of the absence of an explanation of why the virus should behave that way, but also, for a methodological basic reason. It is not clear from when the 40 (or 70) day period has to be calculated. Is it from the first case observed in a country? Perhaps in small countries, for example Singapore and San Marino, this might make sense, but it is hard to imagine that 70 days after a first case is discovered in Santa Clara or wherever in United States, all of that country would be virus-free.

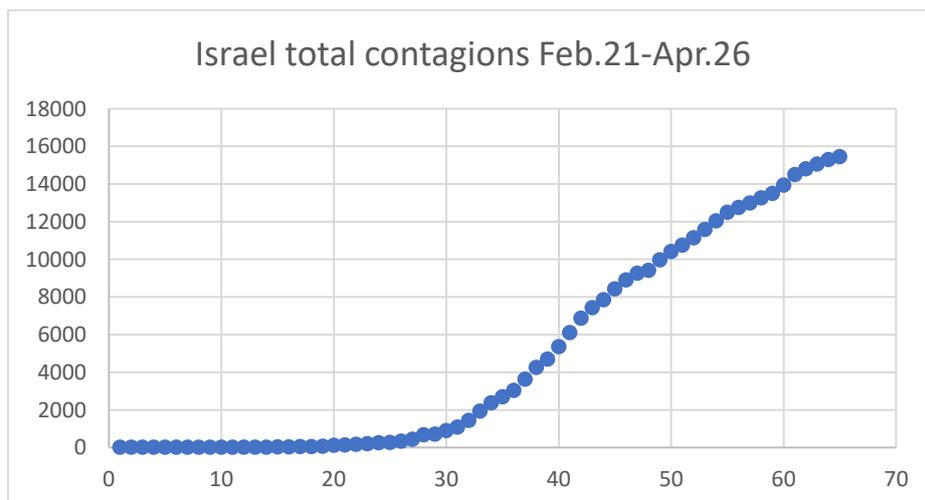
Indeed, this is an intrinsic weakness of any country-based reasoning applied to large countries. It should be obvious, but it seems useful to recall it, that infection is transmitted locally with great micro-zone differences. Country analyses can only give rough indications about the situation of the country. This makes quite hard to imagine a mechanism by which the virus might have a geographical life span.

Along the same line of thought, this model would probably meet difficulty to explain collective phenomena like those that took place in South Korea or Malaysia, and possibly in Italy and Iran⁴.

For what concerns Israel, the first confirmed case was registered on 21 February. Until 6 March the total number of registered cases was only 21. It was only after 6 March that the epidemic grew and a rapid development of confirmed contagions was registered. Obviously, this growth reflected the infections originated by contacts in the previous two weeks, since the typical times of incubation range between few days and two weeks⁵.

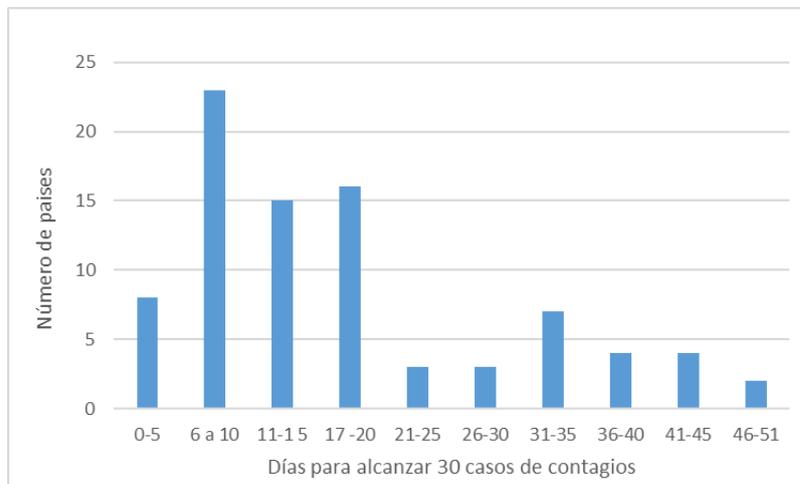
The daily evolution until 26 April of the confirmed cases in Israel is presented in Figure 1. The shape of the curve is the typical to that of a pandemic, with a first period of few cases, then a rapid development, well described by an exponential growth, followed by a reduction in the number of the new cases.

This reduction, according to Ben Israel would manifest itself anywhere about seventy days after the first case, and having exhibited a peak around the sixth week. Whereas one can agree about the qualitative shape of the curve, the case for the specific number of days is clearly untenable.



In this specific case, the first difficulty to accept the argument comes from the pandemic behavior during the first 27 days. The quantitative predictions were an essential part of Ben Israel's conclusion. But what would have happened if the first case or two had not been detected, thus shifting the first point by five - ten days?

It is a fact that the initial outbreak exhibits a tremendous variability in different countries. Some weeks ago, we compared (Fig.2) the time spent by the first 81 countries that reached 30 contagions to reach that level, after the first case had been reported.⁶



It is clear that in front of such a variability, to draw a general conclusion based on the time elapsed after the first case is impossible. The 15 (17) days elapsed in Israel to reach 21 (39) contagions could have been much less or much more with no effect on the subsequent development.

This should be sufficient to reject the idea that the virus has an internal clock and after 70 days is taught that it must disappear.

However, this does not mean that a period of about 70 days cannot be a reasonable period of the average time required to a specific country to control the pandemic, but this under the specific conditions and as consequence of the mitigation measures put in place in that country. It is essentially what happened in Hubei, China, even if one should recall that the pandemic data from China started to be registered at a rather advanced stage of development. In any case, such a development can only be the result of specific anthropic actions.

Despite the impossibility of accepting the 70-day rule, the analysis of Ben Israel deserves attention to analyze whether the current status of the pandemic and its actual development may give some light on its forthcoming development in Israel. Therefore, let us move to analyze it.

From inspection of Fig.1 everybody would agree that in its initial phase the data can be well described by an exponential growth which ended around 9 April, and was followed by a slower growth.

This behavior can be interpreted in terms of a difference in the duplication time, T_2 . In his paper Ben Israel estimates that the week between the 10th and 16th of April T_2 varied between 20 (on 11 April) and 60.

The duplication time can be evaluated by different methods that reflect different approaches to the problem.

Referring to our case, the simplest one is to analyze the data between March 9 and April 1, and to fit them with an exponential. The inverse of its exponent allows to calculate T_2 in a straightforward way. The result of a very good fit to the data ($R^2=0.9875$) is a

duplication time $T_2=1.4$ days. If the period is extended to April 11 the change is minor, $T_2=1.6$ days ($R^2=0.9638$).

This corresponds to the period of the initial exponential growth. What happens if we limit ourselves to analyze the last 17 days? Then we find that $T_2=11.7$ days ($R^2=0.9796$). This indicates that the initial exponential growth is over and that one already observes the typical pandemic behavior that in that phase can be described by another exponential corresponding to a larger T_2 . This larger value, however, is much less than the 30 days claimed in the paper.

There are also other methods to estimate the duplication time. A very simple one which would give a higher value (21 days) would be obtained if one looks back to the day when contagions were 50% of the actual number of contagions. While the previous method makes use of the trend of the data over a long previous period, this method focuses on the most recent ones.

A third method could be evaluating the actual duplication time of the contagions of each day. Of course, in this specific case, this can only be made until 21 days before April 26. These data can then be fitted and the result of the last month extrapolated. This procedure would indeed give a T_2 value close to Ben Israel estimate, namely 45-60 days.

The increase of the duplication time is not surprising. All epidemic models coincide in limiting the duration of the exponential growth phase. This is pretty obvious. If the exponential growth were continuing, in a time $T = 33 T_2$ the full world population would be infected.

The problem is how the exponential growth changes and why.

The answer to "how", may only come from the data. It may be faster or slower, and depends from the answer to the reasons why. There is a large consensus that mitigation measures, like lockdown, and social distancing, accompanied by other non-pharmaceutical measures contribute positively, even if the estimate of their importance varies, to that reduction. In any case, as we proved, it is hard to believe that the virus has an internal clock which turns it off after 70 days, irrespective of the modality of its initial spreading.

The second claim of ref. 1 is that the ratio between daily new cases to the total accumulated cases tends to a common value in the famous 70-day period. Does the consideration of this point make sense?

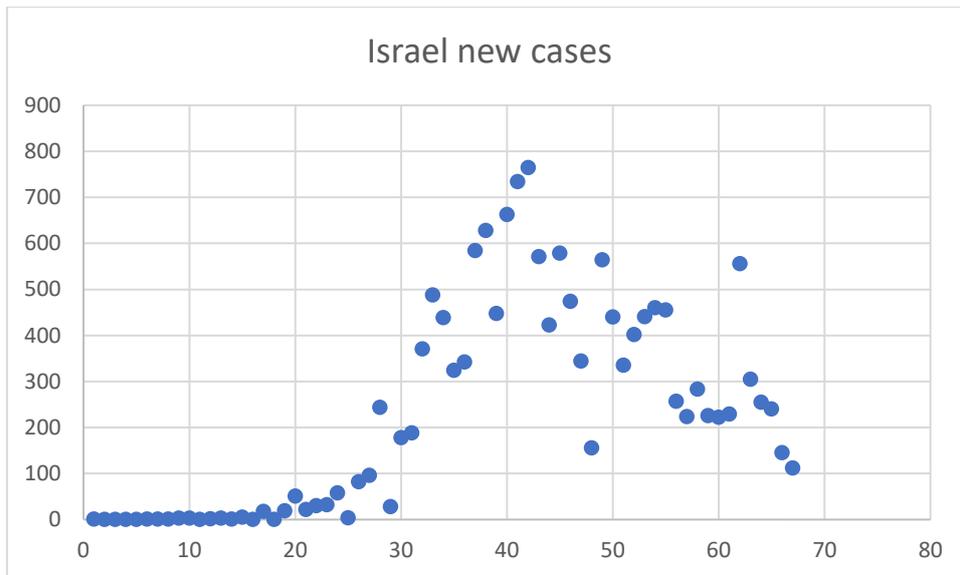
The matter of the period has already been discussed. For what concerns the specific limit, since the number of total cases is growing, any constant number of new cases will, sooner or later, make that ratio arrive at the value of 0.1, but whether this happens in 70 days counted from a suitable one, will depend on many specificities, and cannot be a general rule of behavior of the virus.

This does not mean that there are not indicators in the analysis of the pandemic in Israel that may be taken into account when considering when and how to weaken the mitigation measures, which possibly was the real aim of ref.1.

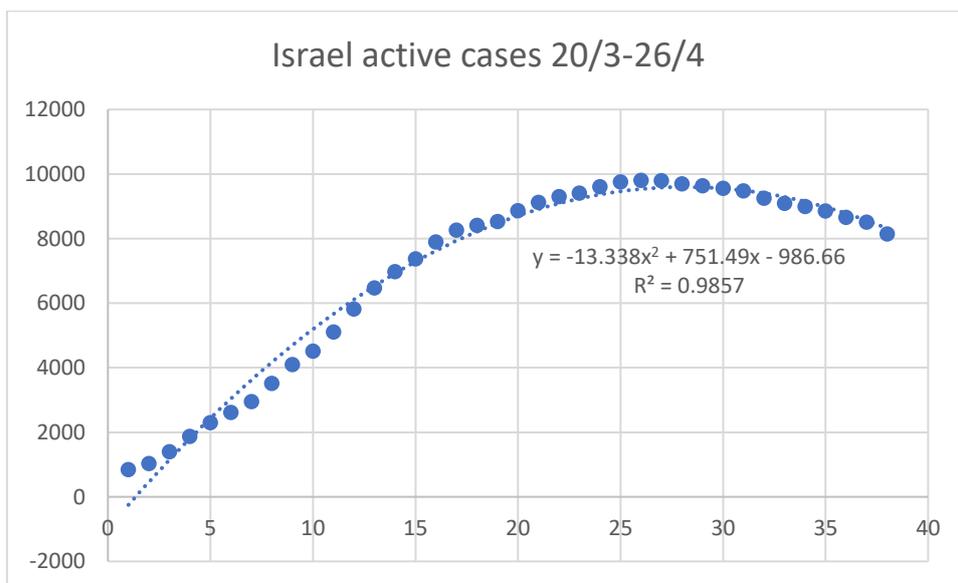
The main one comes from the consideration of the active cases, namely the difference between the total number of contagions and the sum of recoveries and deaths. Strangely enough, this indicator is much less popular than the accumulated number of the contagions, despite the fact that actually it counts the people who are contagious.

In Israel the value of this indicator is decreasing and in fact, on April 26 its value is about 0.5.

Its variation depends on three data: the number of new cases, that of recoveries and that of the deaths. In the case of Israel, the value of this indicator seems to exhibit a tendency to decrease that we saw reflected in the increase of the duplication time. This decrease is result of several factors. First of all, the decrease in the number of new cases. In the last two weeks only one day had more than 200 cases and one can appreciate a tendency towards smaller values.



However, even without a significant decrease of new cases, the active cases can decrease because of deaths and recoveries. In the case of Israel, the lethality is small and the number of recoveries reflects a rather good situation, since, during the last weeks, the values of recoveries were three-digit, whereas that for death was one-digit.



The number of active cases during the last five weeks can be fitted very well with a parabola. The quality of the fit and the stability of the data of the three indicators makes reasonable to believe that the extrapolation of the present active-case situation to the near future makes sense. This would lead to a zero-contagion day around mid-May, but

there is no need to say that such an extrapolation depends on quantities, whose values and variations are anthropic dependent and by no means can be reconducted to a virus clock that would make the evolution of the pandemic totally deterministic, whatever people do.

A similar prediction is made in a paper⁷ which forecasts a 1% of cases for 15 May, and zero contagions for July, predictions that, as it is underscored, depend not only on the data but also on several individual and governmental actions, behaviors and decisions.

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