Agent model of Covid 19 disease spreading and its confrontation with excess deaths data explains real effects of governance strategies

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We have examined some of the origins of oscillating behaviour in agent-based models of SARS-CoV-2 infectiousness and immunisation. We discuss only the model that correctly predicts the 11-week oscillation period observed in Czechia and the mechanisms behind the successful 2020 spring virus suppression. Lockdown in the strict sense or its weaker version - oscillation dampening after the first wave - was not achieved in any European country.

The model follows this concept: (1) The agents move for a given step length in a random direction. (2) An infected agent infects all non-immune agents present in the given field. (3) The infected agent is infected for a given time, then becomes immune or dies. (4) We added the long-term attribute immunity to mucosal virus, which makes the agent susceptible to infection but not dying by the infection. (5) Third passage of the disease makes the agent immune until the long-term immunity slowly vanishes. (6) The agents have a finite lifespan and may reproduce. The starting parameters are (1) population density and (2) the initial number of infected agents.

We compared the results to the excess death numbers from the Euromomo database and Czech statistical authorities' data.

The length of the step is a simulation of lockdown. At step 0, the strict lockdown, infected agents infect only agents initially present at a given field, and the virus dies out. Step 1, which was used in all agent-based models before, leads to a heavily dampened first oscillation. Any longer step leads to dampened oscillations with a period determined by the combination of population density, duration of the disease, duration of immunity, and probability of infection. The main conclusion of this work is that we determined the period of oscillations in the Czech Republic, 11 weeks, and parameters satisfying this criterion.

The decrease of population density has a similar effect as lockdown, the heavy dampening. We suggest that the success of the spring 2020 anti-covid measure in Czechia was due to the dilution of the population by the re-location of people into countryside cottages. It is likely to be also the cause of low mortality in Scandinavian countries. In contrast, the so-called lockdown in the autumn 2020 - winter 2021 in Czechia was no real lockdown. People were locked up in high-density towns through travel restrictions and mixed up quickly in public transport. The transfer of infection from working parents to grandparents also likely contributed to excess deaths.

The model also predicted the single autumn 2021 wave that ended in the first week of January 2021. The results are consistent with recent WHO findings.