

TECHNICAL UNIVERSITY OF BERLIN
RESEARCH ON COVID-19 CONTAGION VIA AEROSOL PARTICLES
February 2021 - GCF summary

The Technical University of Berlin – which includes several US National Academies members, two National Medal of Science laureates and ten Nobel Prize winners amongst its alumni and professors – published a new research in February 2021 entitled “COVID-19 contagion via aerosol particles - Comparative evaluation of indoor spaces with regard to the situational R-value”. A summary of the research [can be download here](#), in German.

The study looked into COVID-19 contagion via aerosol particles. Its main objective was to compare how aerosol particles containing the virus circulate in different indoor spaces and assess an infection risk depending on the type of location.

The research highlighted that the risk of infection depended on the inhaled dose of particles. Which in turns depends on four elements:

- the number of particles emitted by the infected person;
- the breathing activity (whether you talk, sing, shout or exercise);
- the particles concentration in the room (which can be reduced by good air ventilation);
- and finally the duration of the stay in the room.

Because it is not yet possible scientifically to assess absolute infection risk, the researchers decided for this risk assessment study to rely on relevant standards and guidelines as well as recognized, existing evidence related to air circulation, ventilation, respiratory flows, etc. That way, they could determine quite precisely and scientifically the amount of aerosol particles circulating in different indoor spaces depending on the situation.

The researchers compared the reproduction number – or the so called R value – with or without wearing a mask and taking into account different occupancy limits. Their model was based on the principle that an infected person was always present. As a reminder, it is generally considered that if the R value is lower than one, then the disease will eventually stop spreading, because not enough new people are being infected to sustain the outbreak.

The key conclusion of the research is that the R value is lower in cultural venues (such as cinemas, theaters or museums) than it is in restaurants, classrooms or offices.

As you can see from the table included in the annex, it came out that the R value is lowest for cinemas and other cultural venues with mask wearing and a 30% occupancy rate, where it is only at 0.5 – meaning that an infected person will only infect 0.5 other individual maximum. Hair stylists with mask come second at 0.6, and cultural spaces with mask and 40% occupancy rate come third with 0.6 as well.

In comparison, going to the supermarket with a mask has a R value of 1;
Going to the restaurant with a 25% occupancy cap has a R value of 1.1;
A gym without mask and a 30% limit is at 1.4 / rising to 3.4 with a 50% limit;
And an office with mask and 20% occupancy is at 1.6 – rising to 8 without mask and 50% occupancy.

It's worth pointing out that according to the research, wearing a mask reduces risk by almost 50%. Based on that, without masks, a cinema with a 30% occupancy will have a R value of 1 / which rises to 1.1 at 40% occupancy - so it is still lower than most other indoor spaces.

To clarify, the reason why cinemas are also included in this table as separate lines without mask wearing is because, in Germany, rules related to mask-wearing have evolved over time, with only a few states making it temporarily mandatory at different points in 2020. Therefore, the researchers decided to specifically consider the possibility of movie-going without masks.

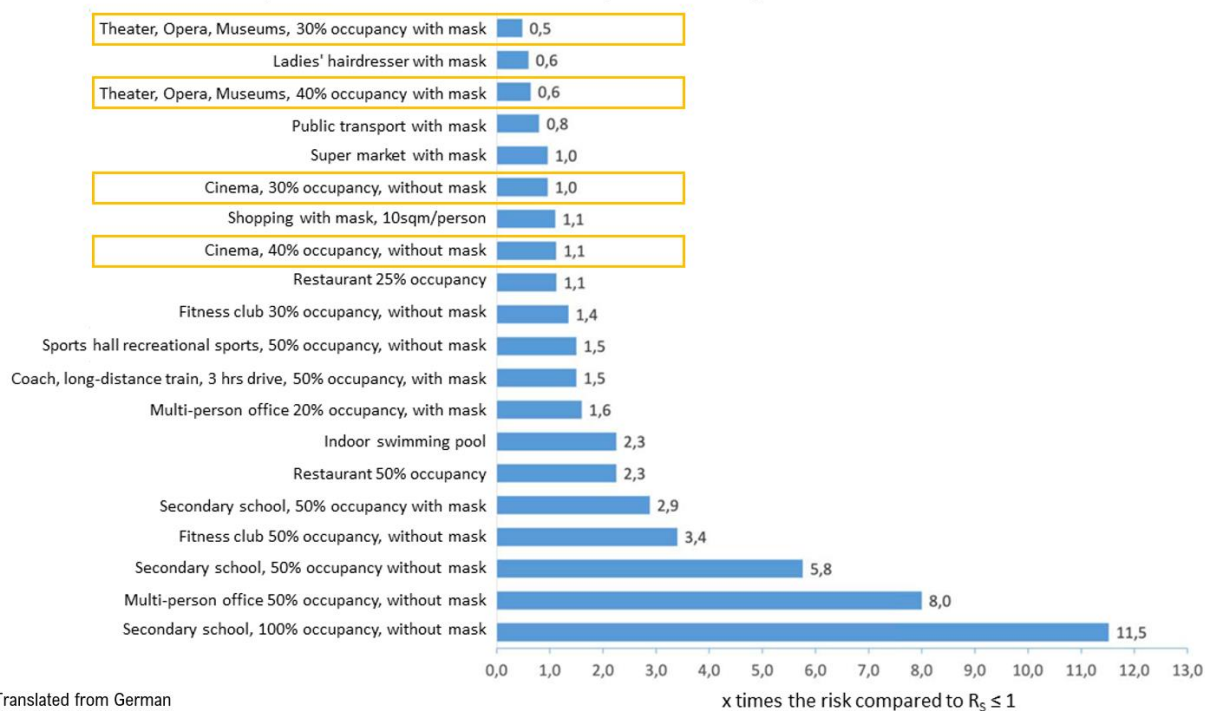
As mentioned earlier, the activity performed and time spent inside different spaces also has an impact on infection risk. This is something that was highlighted by several other scientific research published since the start of the pandemic.

Based on that, the study provides some sort of emission rate or activity score per space. The lowest possible score being 1, where you lie and breathe, and the highest being 4, where you perform a heavy physical activity.

As you can see from the table included in the annex, cinemas and cultural space score 2 in that ranking, while supermarkets score 3 and gyms score 4, which again underlines the safety of cultural venues such as cinemas, compared to other environments – especially because cinema-goers remain seated, breathing normally and facing the same direction without interacting with each other.

ANNEX

Covid-19 contagion via aerosol particles – comparative evaluation of indoor spaces with regard to the situational R-value



Indoor environment	Duration of stay in hours	Supply airflow volume m3/h per person	Activity score: breathing volume / emission rate
Office	8	30	II
High school	6	25	II
Public transport	0,5	20	II
Supermarket	1	25	III
Hair stylist	2	20	II
Shopping	2	20	III
Restaurant	1,5	20	II
Theatre, Opera and Museum	2	30	II
Cinema	2	30	II
Gym	1,5	40	IV
Sport hall	1	30	IV
Swimming pool	2	40	IV
Train/bus	3	30	II

Translated from German