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COVID-19, CHILDREN AND AEROSOL TRANSMISSION:

CHILDREN'S LUNGS ARE PROTECTED!

The PLUS has now succeeded in identifying one of the reasons for the low rate of severe disease progression in children.

In comparison to adults, children rarely have a natural history of disease beyond harmless symptoms in the upper respiratory tract. The reason for the relatively low progression of the disease in the lower respiratory tract and deep lung (one child out of 25 but one in five adults is affected) has been unclear until now. Another related question is the role of children in infection transmission in kindergartens and primary schools. Pandemic measures to prevent infection in these facilities are aimed at individual transmission routes (hand hygiene, social distancing, masks, air filtration) or at tracing chains of infection through testing.

At the PLUS, we have now succeeded in identifying a protective mechanism in children against lung infection from airborne particles containing the virus.

Children are not small adults

People can be exposed to different forms of inoculation. This is the name given to the process by which a disease-causing dose is passed on to a healthy person. This applies to both the number of viruses and the different anatomical structures, for example the respiratory tract, with which the virus first comes into contact and where multiplication takes place. And this is where the differences between children's lungs and those of adults begin to take effect: children breathe faster, children – relative to their body mass – turn over more respiratory volume, and children have a much smaller lung structure than adults. We would expect children to be no less at risk than adults from breathing

in infectious particles. In fact, scientific studies emphasise that children's lungs are more at risk from this exposure than adult lungs – and that there are long-term effects as a result.

Sabine Hofer and Norbert Hofstätter are studying the effect of aerosols in the respiratory tract. They are both working in Professor Albert Duschl's (Speaker of the Focus Area ACBN) research group, which is investigating immune responses to inhalable nanomaterials, among other topics, and are being supported by Professor Martin Himly from the Department of Biosciences. During the COVID-19 crisis, we took the opportunity to transfer existing knowledge from nano-research in the PLUS Focus Area ACBN to the inhalation of infectious aerosols.

Computer simulation enables detailed comparison of virus-laden aerosol deposition in the respiratory tract of 3 and 8-year-old children to 21-year-old adults

Computer model simulations provide detailed insights into the respiratory tract and the distribution of the inhaled SARS-CoV-2-laden aerosols, which cannot be determined by human and animal studies or cell culture experiments. There is no alternative: human studies with children are practically impossible. Animal studies can only provide limited information on this because the anatomy of the lungs varies greatly in different species. Cell culture experiments do not reflect the complex interaction of inhaled particles and the lungs during a breathing cycle.

Direct infection in the deep lung only in adults; children are not superspreaders

Results show that SARS-CoV-2-laden aerosols in adults are predominantly deposited in the deep lung, i.e. in the sensitive areas of the lung where oxygen uptake takes place. However, this is not the case with children. In children, the special characteristics of the aerosols and the childlike structures of the respiratory tract lead to the deposition of the viral load in the upper respiratory areas - resulting in mostly harmless health consequences.

This study therefore suggests that the inhalation of aerosols in children does not lead to a direct infection in the deep areas of the lungs. However, an infection in this area is a prerequisite for severe symptoms, as the group has already presented some time ago. This also clarifies the role of children as possible superspreaders: The virus-laden aerosol production only increases with an infection of the lungs – without an infection of the lungs, children do not have much potential to be superspreaders.

What can we take from this?

Children are less likely to get infected by breathing in aerosols in enclosed indoor areas, e.g. nurseries or primary schools. Adults face a much higher risk in comparison. Safety measures should therefore focus on preventing the spread of infection via direct contact and droplets, as well as include appropriate testing strategies and vaccination as measures.

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