

## Dr. Grandjean's responses to participant questions that we didn't get to during the webinar

1. Since most exposure is not just a single PFAS, did you look at COVID-19 severity and other longer half life PFAS exposure like PFHxS?

Grandjean: We did, we included all PFASs measurable in plasma, but only PFBA showed a significant relationship with COVID-19 severity.

2. Can you share how to get at the information from EPA on 3M studies you reference?

Grandjean: The EPA AR-226 docket is available at [www.toxicdocs.org](http://www.toxicdocs.org) site, and additional documents can be downloaded from <https://www.ag.state.mn.us/Office/Cases/3M/StatesExhibits.asp>

3. Your earlier study showed PFOS measured in blood and vaccine efficacy, whereas the recent study of COVID-19 showed PFBS retained in the lung but not other PFAS. I wonder if lung immune responses and lung inflammation depend on lengths of fluorine? and you think a causal factor in the earlier study is PFBS but PFOS showed up because of correlation between PFOS and PFBS; also why PFBS retain in the lung but not other PFAS?

Grandjean: In our earlier studies, we did not assess PFBA (or PFBS), and the best source so far on PFAS accumulation in the lungs is the autopsy study by Perez (doi: 10.1016/j.envint.2013.06.004).

4. Is there evidence that PFBA leaves the blood and goes to the lung or is it (or a precursor) being inhaled and concentrating at its point of contact? Where would PFBA be coming from in this population. We haven't seen much PFBA in RI water - its occurrence in MN is probably because of 3M disposal practices.

Grandjean: PFBA is sometimes not reported, and it may be more widespread than it appears. We don't know yet why PFBA is the PFAS that appears to be accumulated the most in lung tissue.

5. What other studies have observed immunotoxicity in association with PFBA? Why do you think there was no association with PFOA or PFOS in the COVID study?

Grandjean: There is very little evidence on PFBA immunotoxicity. We cite a Chinese study in our PLoS ONE paper that reports on PFBA interfering with vaccine response. Our COVID study was done in a Danish background population with fairly low exposures to PFOA and PFOS. I would recommend studying populations with higher levels of PFAS exposure.

6. To what degree are PFAS transmitted to developing fetuses via the placenta?

Grandjean: The transfer depends on the molecular size of the PFAS, but it seems that all PFASs to some degree pass the placenta.

7. In the Kielson study of adults, current levels of PFAS were associated with decreased immune response. Would you comment on the relationship between exposure and outcome in this study?

Grandjean: The Kielsen study was carried out in 2012, where exposures to PFOS and PFOA in Denmark were much higher than today. The study confirmed that the PFAS-associated lower antibody response was present in adults, not just in children.

8. Are pfas found in soil and plant based food?

Grandjean: I believe so, and it has been reported in cow's milk.

9. What's your opinion on covid-19 mRNA vaccines. Can they affect or interact with our DNA? Will some PFAS have the potential to reduce antibody response to this new vaccine?

Grandjean: The mRNA-based vaccines are meant to induce production of a protein that occurs in the corona virus spikes. Thus, the efficacy of the vaccine depends on the ability of the protein to induce an immune response. In tetanus and diphtheria vaccines, a specific protein is used as the vaccine. Our findings on tetanus and diphtheria are therefore highly relevant to the new corona vaccines, and I therefore suspect that PFAS exposure can lower the immune response.

10. Does PFAS lowers existing antibody levels, or do they prevent further antibody development? Also, is it generally true that shorter chain PFAS accumulate in the lungs?

Grandjean: In children, we see that early-life PFAS exposure is negatively associated with childhood responses to vaccines, but it also seems that the current serum-PFAS concentration plays a role. As PFASs remain in the body for a very long time, we should consider the PFAS immunotoxicity as a long-term effect. The detailed modes of action are unknown at present.

11. Did you see an increase in infectious disease among children in the Faroe Islands in association with PFAS?

Grandjean: We have not yet monitored the frequency of infectious disease in the Faroes, but we have seen an increased occurrence at higher PFAS exposures in Danish children, and this has been reported also from Norway and Japan.

12. My non-profit focuses on the use of sewage-sludge marketed as a fertilizer option to farmers. In 2018, the Maine farmer who discontinued sludge use for 20 years still had such high levels of PFAS in his animals and milk that the state wanted to kill off his herd. Please address the need to highlight the transfer of PFAS into our food supply regardless of where you live, such as near a PFAS source

Grandjean: I agree that the persistence of PFASs in the environment calls for abundant vigilance and prudent intervention.

13. Could you speak about preventing new exposures? As PFAS has been used at increasingly greater volumes over the last few decades, beyond reducing non-essential uses, do you think there are further opportunities for preventing the production of such high volumes of industrial chemicals known or suspected to impact human health and the environment?

Grandjean: We have seen a change in the occurrence of PFASs in human blood, and we are now concerned about the possible risks associated with non-legacy PFASs that may constitute examples of "regrettable substitution". Also, we are concerned that research on PFAS immunotoxicity began only

recently, although company records suggest that such research should have been considered necessary already 40 years ago.

14. Is there evidence that PFAS exposure contributes to risk of autoimmune diseases (e.g. arthritis, lupus, etc), or in things like Parkinson's Disease?

Grandjean: Not that I know off-hand.