

# PFAS Elimination and PFAS Effects on COVID-19 Vaccine Response

Akademisk avhandling

Som för avläggande av medicine doktorsexamen vid Sahlgrenska akademien, Göteborgs universitet kommer att offentligen försvaras i sal Stora Änggården, Guldhedsgatan 5A, Göteborg, den 24 oktober 2025, klockan 13:00.

av Axel Andersson

Fakultetsopponent:

Professor Agneta Åkesson, Karolinska Institutet

## Avhandlingen baseras på följande delarbeten

- I. Li Y, Andersson AG, Xu Y, Pineda D, Nilsson CA, Lindh CH, Jakobsson K, Fletcher T. Determinants of Serum Half-lives for Linear and Branched Perfluoroalkyl Substances after Long-Term High Exposure – a Study in Ronneby, Sweden. *Environ International*. 2022;163:107198. doi: 10.1016/j.envint.2022.107198.
- II. Andersson AG, Fletcher T, Xu Y, Kärrman A, Pineda D, Nilsson CA, Lindh CH, Jakobsson K, Li Y. The Relative Importance of Fecal and Urinary Excretion of Perfluorooctane Sulfonic Acid and Perfluorooctanoic Acid After High Exposure – an Observational Study in Ronneby, Sweden. *Environmental Research*. 2025;285:122487. doi: <https://doi.org/10.1016/j.envres.2025.122487>.
- III. Andersson AG, Xu Y, Kärrman A, Cederlund J, Lindh CH, Pineda D, Fletcher T, Jakobsson K, Li Y. Serum, Urinary and Fecal Concentrations of Perfluoroalkyl Substances after Interventions with Cholestyramine/Colesevelam and Probenecid – a Cross-Over Trial in Ronneby, Sweden. Manuskript.
- IV. Andersson AG, Lundgren A, Xu Y, Nielsen C, Lindh CH, Pineda D, Cederlund J, Pataridou E, Søgaard Tøttenborg S, Ugelvig Petersen K, Fletcher T, Lagging M, Bemark M, Jakobsson K, Li Y. High Exposure to Perfluoroalkyl Substances and Antibody Responses to SARS-CoV-2 mRNA Vaccine – an Observational Study in Adults from Ronneby, Sweden. *Environmental Health Perspectives*. 2023;131(8):87007. doi: 10.1289/ehp11847.
- V. Andersson AG, Lundgren A, Xu Y, Nielsen C, Lindh CH, Pineda D, Vallin J, Johnsson C, Fletcher T, Bemark M, Jakobsson K, Li Y. The T Cell Response to SARS-CoV-2 mRNA Vaccine in Adults with High Exposure to Perfluoroalkyl Substances from Ronneby, Sweden. *Chemosphere*. 2024;369:143770. doi: 10.1016/j.chemosphere.2024.143770.

**SAHLGRENKA AKADEMIN  
INSTITUTIONEN FÖR MEDICIN**



# PFAS Elimination and PFAS Effects on COVID-19 Vaccine Response

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## Abstract

**Background and aims:** Per- and polyfluoroalkyl substances (PFAS) are persistent compounds, some of which have long serum half-lives in humans. Yet, details about how PFAS are eliminated from the human body are limited. PFAS exposure has been associated with lower vaccine responses in children, but it is unclear whether this also occurs in adults. Therefore, the first theme of this thesis was to describe PFAS elimination in humans and investigate if it can be enhanced, while the second theme was to evaluate PFAS effects on COVID-19 vaccine response in adults. The studies were conducted in Ronneby, Sweden, where drinking water had previously been highly contaminated from firefighting foams.

**Methods and results:** Firstly, PFAS were repeatedly measured in highly exposed individuals after the end of exposure, from which half-lives in serum were estimated. Shorter half-lives were associated with younger age, female sex during the fertile age, higher kidney function, higher gut inflammation, and lower gut permeability. Secondly, fecal and urinary elimination were estimated, both of which were found to be important, with variations between individuals and PFAS compounds. Thirdly, in an experimental, cross-over trial, bile acid sequestrants markedly increased PFAS elimination, substantially lowering serum PFAS levels.

Finally, in an mRNA COVID-19 vaccination study in adults aged 20-60 years, no associations were found between PFAS levels and serum anti-spike antibody and T cell responses.

**Conclusions and implications:** PFAS serum half-lives vary between individuals, and PFAS are eliminated through both urine and feces. This implies that PFAS exposure models, aiming to predict serum levels from external exposure, need to properly include population characteristics and both fecal and urinary elimination routes. PFAS elimination can be substantially enhanced; however, the net health benefits of such interventions are not yet known.

The mRNA vaccine response was not reduced in adults with high PFAS exposure. Whether this indicates a more mature immune system in adulthood, a specific effect of the mRNA vaccine, or other mechanisms needs to be further explored.

**Keywords:** PFAS, elimination, COVID-19 vaccine response