



Frequently Asked Questions:

Study on dental floss and other behaviors associated with exposure to PFAS

We recently published a [study](#) in which we found an association between blood levels of PFAS (per- and polyfluoroalkyl substances) and different exposure-related behaviors, including flossing with certain dental flosses. We also tested some common brands of dental floss to see which ones are likely to be made with PTFE (a PFAS polymer also known as Teflon). Scientists are concerned about widespread exposure to PFAS in the population because the chemicals have been linked with health effects including kidney and testicular cancer, thyroid disease, high cholesterol, low birth weight, decreased fertility, and effects on the immune system. This study was conducted to identify potential sources of exposure to PFAS. Recent media coverage and online discussions regarding our new study have raised a number of important questions. To inform future discussions on the subject, we prepared the following FAQ:

Why did we test dental floss?

- We chose to test a range of dental flosses to determine which products are likely made from polytetrafluoroethylene (PTFE). PTFE is a PFAS polymer and is best known by the brand name “Teflon.”
- We suspected that certain dental flosses are made with PTFE based on various lines of evidence:
 - Glide floss is a product developed by Gore (known by consumers for its waterproof “GORE-TEX” technology), which makes a variety of consumer and industrial products using PTFE.^{1,2}
 - Oral-B says on its website that PTFE is one type of dental floss.³
 - Colgate Total dental floss is marketed as “a single-strand Teflon® fiber.”⁴

How did we determine that some flosses were likely made from PTFE?

- PFAS are characterized by their strong carbon-fluorine bonds. To detect PFAS in dental floss, we used an analytical technique called particle-induced gamma-ray emission (PIGE) spectroscopy, which measures fluorine as a marker of PFAS. This technique, developed by researchers at the University of Notre Dame, has been used in other studies to detect PFAS in consumer products, including fast food packaging and textiles.^{5,6}
- Our PIGE analysis detected high levels of fluorine in 6 of the 18 dental floss products we tested. The products that tested positive included three types of Glide floss, one Colgate product marketed as “a single-strand Teflon® fiber,” and two store-brand flosses with the statement “compare to Oral-B Glide” included on the packaging.
- Although we can't rule out that some fluorine we measured could have come from a fluoride coating that was added for dental health, the levels of fluorine in the products that tested positive were so high that they are unlikely to be explained by a fluoride coating alone. The fluorine levels were consistent with levels measured in commercial Teflon tape.

Do women who use Oral-B Glide have higher levels of PFAS?

- In our study, we found a statistically significant association between women who reported flossing with Oral-B Glide and higher blood levels of one PFAS chemical called PFHxS (perfluorohexanesulfonic acid). As we noted in our paper, we were surprised to find an association between flossing with Oral-B Glide and higher body burden of this particular PFAS chemical (PFHxS) because previous testing of PTFE-based dental floss extracts detected a different PFAS chemical called PFOA (perfluorooctanoic acid).⁷

Does Oral-B Glide contain PFHxS?

- Procter & Gamble, which owns Oral-B Glide, asserts that none of the substances measured in the blood samples in our study are used in their products. This does not mean that the company's floss is not made from PTFE.
- PTFE is a large PFAS polymer. The PFAS chemicals that were tested for in the women in our study are smaller PFAS chemicals, including PFHxS. As we noted in our paper, proprietary production practices and formulations limit our ability to understand why we found higher blood levels of PFHxS associated with the use of Oral-B Glide.
- At this time, our understanding of what chemicals are used to produce the floss and what chemicals leach from the product is limited. It's possible that PFHxS may be present in floss as an impurity, may be used in the manufacturing, or may be created as a byproduct during manufacturing. Further studies and more information from manufacturers are needed to understand this process.

Why do we think that higher blood levels of PFHxS came from floss?

- Because people are exposed to PFAS from multiple sources, we used a mutually adjusted multiple regression model to find out how much exposure can be attributed to each of the sources that we included in our study. This type of analysis is designed to isolate the specific contribution of flossing with Oral-B Glide (and each of the other sources, as well) to a person's PFAS level apart from the contributions of the other exposure sources.
- Our model showed that there was a statistically significant association between flossing with Oral-B Glide and higher blood levels of PFHxS. This suggests that some of the exposure came from flossing.
- Our statistical model also found associations between other behaviors and higher blood levels of PFAS. For instance, having stain-resistant carpet or furniture and living in a city served by a PFAS-contaminated drinking water supply were associated with higher body burden of certain PFAS. Additionally, among African American women, those who said they frequently ate prepared food in coated cardboard containers, such as French fries or takeout, had elevated blood levels of some PFAS compared to women who rarely ate such food. All the behaviors we considered in our study were predicted to be sources of exposure to PFAS based on previous research.
- Other potential sources of exposure that we did not measure in our study include the use of cosmetics containing PFAS, working in a manufacturing facility that uses PFAS, or using firefighting foams containing PFAS. However, the latter two occupational exposures are unlikely to have been common among the women in our study.

Reference: Boronow, K.E., J.G. Brody, L.A. Schaider, G.F. Peaslee, L. Havas, B.A. Cohn. 2019. [Serum concentrations of PFASs and exposure-related behaviors in African American and non-Hispanic white women](#). *Journal of Exposure Science & Environmental Epidemiology*. DOI: 10.1038/s41370-018-0109-y

¹ Gore. "The Gore Story" (<https://www.gore.com/about/the-gore-story>, accessed January 16, 2019) and "Applications of ePTFE: Fluoropolymer Fibers" (<https://www.gore.com/about/technologies/applications-fluoropolymer-fibers>, accessed January 17, 2019).

² Ellison, S., "Procter & Gamble To Buy Glide Floss." *Wall Street Journal*. September 17, 2003. (<https://www.wsj.com/articles/SB10637558338169300>, accessed January 16, 2019)

³ Procter & Gamble. "Dental Floss Types - The Pros and Cons." (<https://oralb.com/en-us/oral-health/solutions/floss/dental-floss-types-pros-cons>, accessed 16 January 2019)

⁴ Colgate-Palmolive Company. "Colgate Total® Dental Floss Overview." (<https://www.colgateprofessional.com/products/colgate-total-dental-floss/overview>, accessed 15 January 2019)

⁵ Robel, A.L. et al. 2017. Closing the Mass Balance on Fluorine on Papers and Textiles. *Environ. Sci. Technol.* 51 (16): 9022–9032

⁶ Schaider L.A., et al. 2017. Fluorinated compounds in US fast food packaging. *Environ Sci Technol Lett.* 4: 105-111.

⁷ Guo Z, Liu X, Krebs KA, Roache NF. Perfluorocarboxylic acid content in 116 articles of commerce. Office of Research and Development, National Risk Management Research Laboratory, EPA. 2009.