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Featured Research Review:

Ding, N., Karvonen-Gutierrez, C. A., Mukherjee, B., et al. (2022). Per- and Polyfluoroalkyl Substances and Incident Hypertension in Multi-Racial/Ethnic Women: The Study of Women's Health Across the Nation

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Terms to know:

- Per- and polyfluoroalkyl substances (PFAS) – A group of more than 9,000 chemicals used in many industrial applications, including coatings and products that resist heat, oil, stains, grease, and water. PFAS are found in common household products such as clothing, furniture, and food packaging. Specific chemicals mentioned in the study include:
  - **MeFOSAA**: 2-(N-methyl-perfluorooctane sulfonamido) acetate
  - **EtFOSAA**: 2-(N-ethyl-perfluorooctane sulfonamido) acetate
  - **PFOS:** perfluorooctane sulfonate
  - **N-PFOA:** linear perfluorooctanoate
- Hypertension (or high blood pressure) – Defined in this study as systolic blood pressure greater than or equal to 140 mm Hg (millimeters of mercury), diastolic blood pressure greater than or equal to 90 mm Hg, or the use of antihypertensive medications.
- Cardiovascular disease (CVD) – A general term that includes any disease of the heart or blood vessels.
- Peripheral arterial disease (PAD) – A disease of the legs or lower extremities that occurs due to the narrowing or blocking of vessels that carry blood from the heart to the legs.
- Endocrine disruptors – Chemicals that can interfere with the endocrine system, sometimes referred to as hormonally active agents. These disruptions can lead to cancer tumor growth, birth defects, and developmental disorders.

Per- and polyfluoroalkyl substance (PFAS) exposure in humans has become an important public health issue due to its pervasiveness in the environment. In 2020, researchers determined that these man-made chemicals are often used in industrial applications, including shale gas development (SGD). In 2011, the EPA approved three chemical substances that break down into PFAS for commercial use in oil

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and gas development (including hydraulic fracturing, or fracking). Similarly named chemicals have now been found in wells in Arkansas, Louisiana, Oklahoma, New Mexico, Texas, and Wyoming.

In recent years, researchers have determined that human exposure to PFAS is greater than previously thought. PFAS have been estimated to contaminate drinking water consumed by more than 200 million Americans. Further, data collected from the National Health and Nutrition Examination Survey (NHANES) showed that nearly all Americans have detectable concentrations of at least one type of PFAS in their blood. Additionally, prior studies have looked at associations between PFAS and medical conditions such as cardiovascular disease (CVD), peripheral arterial disease, and diseases related to endocrine disruption. The authors of these studies sought to examine the effects of PFAS on blood pressure, since hypertension, a major risk factor for CVD, is a chronic condition affecting more than one billion adults worldwide.

The authors of a recent study, "Per- and Polyfluoroalkyl Substances and Incident Hypertension in Multi-Racial/Ethnic Women: The Study of Women's Health Across the Nation" (Ding, N., Karvonen-Gutierrez, C. A., Mukherjee, B., et al., 2022), examined the association between PFAS chemicals iand the risk of developing new onset hypertension. The chemicals were examined both individually and jointly as mixtures.

To explore the relationship between PFAS and hypertension, the authors identified eligible participants from the SWAN database (Study of Women's Health Across the Nation), a multiracial and multiethnic dataset with annual follow-up visits of women across the country. The authors followed blood pressure and serum PFAS concentrations of over one thousand women collected through annual visits from 1999 through 2017. They then applied various statistical analyses to identify associations.

The results of this study showed that higher serum PFAS concentrations are associated with a higher risk of hypertension.

- Of the 1,058 midlife women included in the study, 470 developed new onset hypertension.
- Researchers found that PFOS, n-PFOA, EtFOSAA, and MeFOSAA individually were associated with an increased incidence of hypertension; in the mixture analysis, overall PFAS concentrations were more likely to be associated with hypertension.
- Several limitations should be considered, including:
    - Only women with a median age of 49 were considered, as there was no data from early life PFAS exposure.
    - Hispanic women were excluded from the study due to a lack of biological samples.

The findings of this study suggest that PFAS could be a contributing factor to women's risk of developing cardiovascular disease.

To learn more about this study, explore these links:

- Agency for Toxic Substances and Disease Registry. Toxicological profile for trichloroethylene. (2021). https://www.atsdr.cdc.gov/toxprofiles/tp200.pdf
- Andrews, D. L., & Naidenko, O. V. (2020). Population-Wide Exposure to Per- and Polyfluoroalkyl Substances from Drinking Water in the United States. *Environmental Science and Technology Letters*, *7*(12), 931–936. https://doi.org/10.1021/acs.estlett.0c00713
- Centers for Disease Control and Prevention. Fourth National Report on Human Exposure to Environmental Chemicals. (2021).

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https://www.cdc.gov/exposurereport/pdf/FourthReport_UpdatedTables_Volume2_Mar2021-508.pdf

- Ding, N., Karvonen-Gutierrez, C. A., Mukherjee, B., Calafat, A. M., Harlow, S. D., & Park, S. S. (2022). Per- and Polyfluoroalkyl Substances and Incident Hypertension in Multi-Racial/Ethnic Women: The Study of Women's Health Across the Nation. *Hypertension*, *79*(8), 1876–1886. https://doi.org/10.1161/hypertensionaha.121.18809
- Horwitt, D. (2021). Fracking with "Forever Chemicals." Physicians for Social Responsibility. https://www.psr.org/wp-content/uploads/2021/07/frackingwith-forever-chemicals.pdf
- Horwitt, D., & Gottlieb, B. (2022). Fracking with "Forever Chemicals" in Colorado. Physicians for Social Responsibility. https://psr.org/resources/fracking-with-forever-chemicals-in-colorado/

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