

Human Health Impacts of Polystyrene

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Most people are aware that polystyrene** or “styrofoam” is a significant environmental problem, massively overflowing our landfills and oceans; but few realize that it has serious health consequences for humans.[1,2] A petrochemical, it is found in styrofoam, natural gas, diesel fuel, coal tar, and cigarettes; the vast majority is manmade, but it does occur in minute quantities in a few foods like peanuts and cinnamon.[3] Mostly it is found in nature as a contaminant of food, water and air: it is not surprising that it is found in the tissues of 100% of Americans.[4]

Polystyrene is made up strings of styrene, a breakdown product of benzene (a known **human carcinogen**); styrene is categorized as “**reasonably anticipated to be a carcinogen**” by the EPA; according to the National Research Council, “The evidence of styrene genotoxicity in exposed humans is convincing, so a strong argument could be made to support the listing of styrene as a **known human carcinogen.**” [2]

- How do we get exposed?

First, we can eat it: warm food in styrofoam containers causes the styrene to leach out into the food; this leaching is greater with fatty or oily foods and is the most common cause of food contamination by styrene. The styrene content in food correlates with the length of storage of the products.[1] Since it is also present in cigarette smoke, automobile and industrial exhaust, humans are also exposed through air pollution and water contamination.

- What health problems does it cause?

Cancer Occupational workers exposed to polystyrene suffer from increased cancers of the blood, including leukemia and non-Hodgkin’s lymphoma [2,6] as well as solid tumors, including breast, lung, esophageal, kidney and pancreatic cancer. Risk correlates with degree and length of exposure. [2,5,9]

Neurologic disorders: Polystyrene is a **neurotoxin**, and can cause hearing loss, instability, slowed reaction time, weakness, headache, fatigue, impaired logical memory and impaired verbal learning skills. [7] Experiments in rabbits show that the possible mechanism for this may be that it decreases dopamine levels.[1]

Reproductive and developmental toxicity Styrene is associated with spontaneous abortions in occupational workers; in mice, it has been shown to be embryotoxic—even more so than benzene, toluene or xylene.[1,8]

Summary: Polystyrene is a ubiquitous environmental contaminant with serious public health impacts. It is a known carcinogen, neurotoxin and fetotoxin; by banning our most common exposure to the petrochemical—styrofoam—it is hoped that we can reduce our exposure and improve public health.

** It is better known as styrofoam, but also comes in the form of a clear plastic. It is used to package foodstuffs or as packing material.

Twenty-five communities across Massachusetts have banned the use of polystyrene.

References

- [1] WHO Regional Office for Europe, Chapter 5.12 Styrene; Copenhagen, Denmark, 2000.
- [2] National Research Council report, *Review of the Styrene Assessment in the National Toxicology Program 12th Report on Carcinogens* (2014).
- [3] IARC. 2006. Agents Reviewed by the IARC Monographs. Volumes 1–96. Lyon, France: International Agency for Research on Cancer. <http://monographs.iarc.fr/ENG/Classification/index.php>.
- [4] [National Human Adipose Tissue Survey - epa nepis nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=9100CFRU.TXT](http://www.nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=9100CFRU.TXT)
- [5] [Styrene exposure and risk of cancer - NCBI - NIH](https://www.ncbi.nlm.nih.gov)
<https://www.ncbi.nlm.nih.gov> > NCBI > Literature > PubMed Central (PMC)
- by J Huff - 2011 “a causal relationship between styrene exposure and cancer in humans is credible and is supported by the finding of DNA adducts and chromosomal aberrations in lymphocytes from styrene-exposed workers.”
- [6] Kolstad H A, Lyng E, Olsen J, Breum N (1994). Incidence of lymphohematopoietic malignancies among styrene-exposed workers of the reinforced plastics industry. *Scandinavian Journal of Work, Environment & Health*, 20, 272-278.
- [7] LILIS, R. ET AL. Neurotoxicity of styrene in production and polymerization workers. *Environmental research*, 15: 133–138 (1978).
- [8] Barall R (1991). The Genetic Toxicology of Styrene and Styrene Oxide. *Mutation Research*, Vol. 257, No. 2, pages 107-12
- Bond (1992). Mortality among workers engaged in the development or manufacture of styrene-based products--an update. *Scandinavian Journal of Work, Environment & Health*, 18(3), 145-54.
- [9] Huff et al. Styrene exposure and risk of cancer. *Mutagenesis*. 2011 Sep; 26(5): 583–584. Published online 2011 Jul 1. doi: [10.1093/mutage/ger033](https://doi.org/10.1093/mutage/ger033)