

V. Health Concerns Overview



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Endocrine Disruption

- Endocrine-disrupting chemicals (EDCs) can mimic estrogens (female sex hormones), androgens (male sex hormones), and thyroid hormones, which can contribute to hormonally induced cancers, including breast cancer. They can also adversely affect normal development, reproduction and neurologic function.¹⁶⁷
- Recent human studies demonstrate a decline in semen quality and male testosterone levels. Studies have shown an increase in rates of developmental anomalies of the reproductive tract, testicular cancer, thyroid cancer, congenital hypothyroidism, and neurologic development disorders.¹⁶⁸
- Studies in animals were the first to suggest that flame-retardants could affect the endocrine system. Altered male hormones and

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reduced sperm counts were found in animals exposed to PBDEs, as well as malfunctions of the thyroid hormone system.¹⁶⁹

- Studies in humans have been even more alarming. PBDE levels in maternal and cord blood tissues have been associated with the absence of one or both testes in male infants, lower birth weights, and neurodevelopmental and behavior problems in children, raising concerns about exposure of women to PBDEs during pregnancy.¹⁷⁰
- Concerns that PBDEs disrupt the endocrine system led the National Institute of Environmental Health Sciences (NIEHS) to fund studies on their health effects in people.
- A study of a predominantly Mexican immigrant population was the first to report that higher PBDE concentrations in women's blood were associated with a longer time trying to get pregnant.¹⁷¹
- A more recent NIEHS-funded study implicated Firemaster 550 as an endocrine disruptor and obesogen at environmentally relevant levels.¹⁷²
- The NIEHS is currently continuing a multigenerational endocrine disruption study using the Michigan PBB cohort, with a focus on the offspring of those exposed who show evidence of endocrine disruption.¹⁷³
- Sons of highly exposed women experienced an increased risk of genitourinary conditions and slower growth and pubertal development, and highly exposed girls had an earlier age at menarche and an increased risk of miscarriages.¹⁷⁴
- PBDEs and TBBPA have chemical structures similar to thyroid hormones that are essential for fetal development. TBBPA exhibits



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thyroid hormone activity in laboratory studies and has estrogenic activity in experimental animals.

- TBBPA-exposed animals had decreased thyroid hormones and increased weight of testes and pituitary in male offspring.¹⁷⁵ One metabolite produced by TBBPA is BPA, a known estrogen mimic.¹⁷⁶ Newer studies suggest that HBCD and Firemaster 550 also have the potential to disrupt the endocrine system.¹⁷⁷
- Organophosphate (OP) flame-retardants have been poorly studied; however, there is evidence suggesting adverse endocrine and reproductive effects.¹⁷⁸
- At a U.S. infertility clinic, a small study suggested that exposure to TDCPP and TPP from house dust could be associated with altered hormone levels and decreased semen quality in men.¹⁷⁹
- Several animal studies on OP flame-retardants show reproductive health effects, raising concerns about unknown human health effects associated with exposure to these chemicals.¹⁸⁰

Cancer

- Most of the flame-retardants in use today have not been tested for their potential to cause cancer. Two structurally similar flame-retardants, TCEP and TDBPP, have been identified as causing cancer under California's Proposition 65, and are listed as known to cause cancer. TCEP has been detected in indoor air samples and in dust in homes, offices, schools, and cars.¹⁸¹
- TDCPP is also a probable human carcinogen, based on sufficient evidence in animals. These chemicals have been detected in dust indoors, where they migrate to the surface and are released from consumer products.

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- In the only study available on TDBPP in house dust, it was detected in 75 percent of homes tested.¹⁸² TDCPP was detected in 96 percent of house dust samples collected in the Boston area.¹⁸³
- EPA considers DecaBDE to have “suggestive evidence of carcinogenic potential” based on animal studies.¹⁸⁴

Brain Function

- Organohalogen compounds such as DecaBDE, TBBPA, and HBCD are known to have neurotoxic effects on the developing brain. In pregnant women, these compounds cross the placenta to the fetus. During critical periods of fetal growth and development, organohalogen compounds may interfere with developmental processes in the brain.¹⁸⁵
- The chemical structures of organophosphate (OP) flame-retardants are similar to those of OP insecticides, which were designed to be

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neurotoxic to insects, and many are capable of inhibiting critical enzymes in humans necessary for neurological growth and function.

- Organophosphate (OP) flame-retardants (TCEP, TCPP, and TDBPP) are toxic via several different biochemical pathways, increasing the concern for neurotoxicity.¹⁸⁶
- Over the last decade, animal and laboratory studies suggest that brominated flame-retardants (BFRs) are potentially neurotoxic.¹⁸⁷ In 2009, the first study assessed their neurodevelopmental toxicity in humans, demonstrating that developmental deficits in young children were associated with prenatal exposures.¹⁸⁸
- Several small studies have subsequently associated concentrations of several PBDE congeners in umbilical cord blood of newborns with neurodevelopmental effects in early childhood.¹⁸⁹

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- A large California study investigated the neurobehavioral effects of brominated flame-retardants in humans and found an association between low-level PBDE exposure and changes in motor function and serum levels of thyroid hormones.¹⁹¹
- Findings from a 2013 NIEHS-funded study have also identified PBDEs as a possible risk factor for Parkinson’s disease and neurodegenerative diseases. The authors of the study note the importance of additional research on PBDEs as a potential risk factor for Parkinson’s disease and other neurological disorders.¹⁹²



Potential Health Risks of Common Flame-Retardants

TABLE 7

	Reproductive	Endocrine Disruption	Brain Function	Cancer	Developmental
PentaBDE	●	●	●		●
OctaBDE		●	●		●
DecaBDE	●	●	●	●	●
TBBPA		●	●		
HBCD	●	●	●		●
FM550	NS	●	NS	NS	NS
TDBPP	NS			●	NS
TDCPP	NS	●	●	●	NS
TCPP	NS			NS	NS
TCEP	●		●	●	NS
TCP	●		●	NS	NS
TBEP	NS		●	NS	NS

NS = Not studied