



REPRODUCTIVE ROULETTE

Declining Reproductive Health, Dangerous Chemicals, and a New Way Forward

By Reece Rushing

July 2009

Contents

Introduction

Part I: Declining Reproductive Health

- I. Fertility problems on the rise
- II. More premature births and infants with low birth weight
- III. More birth defects and disabilities

Part II: Dangerous Chemicals

- I. Overview of chemical dangers
- II. Phthalates
- III. BPA (bisphenol A)
- IV. PBDEs (polybrominated diphenyl ethers)

Part III: A New Way Forward

- I. Stronger standards, safer chemicals
- II. Knowledge for action
- III. A new foundation
- IV. Conclusion

INGREDIENTS / INGRÉDIENTS
NITRIDE, TALC, DIMETHICONE,
POLYMETHYL METHACRYLATE, Z
RATE, POLYETHYLENE, POLYGLYCE
STEARATE, DIMETHICONOL, ME
AURYL PEG/PPG-18/18 METHICOM
TEARYL MALATE, LECITHIN, AC
OPOLYMER, SILICA SILYLATE, PH
HANOL, METHYLPARABEN, ETH
N, PROPYLPARABEN MAY COI
UT CONTENIR [+/-: MICA, BISMUT
LORIDE (CI 77163), CHROMIUM
EENS (CI 77288), IRON OX
7491, CI 77492, CI 77499), ULTI
S (CI 77007), BLUE 1 LAKE (CI 4
OW 5 LAKE (CI 19140), FERRIC FER
E (CI 77510), CARMINE (CI 75470),
SE VIOLET (CI 77742), TITANIUM [77891)] 21727

PART II

Dangerous chemical exposures

U.S. chemical production has increased dramatically over the last half century, with 80,000 chemicals now approved for commercial use.

Americans are exposed to these chemicals in a variety of ways, including through industrial releases, contaminated food, household products and cosmetics, and workplaces where chemicals are used. Tests of blood and urine confirm widespread exposure to chemicals that are dangerous to reproductive health.

The following slides provide an overview of this problem and spotlight three chemical groups—phthalates, Bisphenol A, and polybrominated diphenyl ethers—that are linked to reproductive health consequences, including miscarriages, endometriosis, male genital defects, low sperm count, and others. Phthalates and BPA are found in toys, food containers, cosmetics, and many other consumer products. PBDEs are used as flame retardants in household furniture and electronics. Other chemicals also threaten reproductive health, but these three are among the most prevalent in the daily lives of all Americans and are just starting to receive serious attention from the U.S. Congress and federal regulators.

I. Overview of chemical dangers

Americans are widely exposed to dangerous chemicals. The data in the following slides show:

- The number of chemicals registered for commercial use now stands at 80,000—a 30 percent increase since 1979.
- The bodies of most Americans contain a chemical soup according to testing by the Centers for Disease Control and Prevention.
- Exposure to chemicals occurs *in utero*—testing found 287 industrial chemicals present in newborn umbilical cords.
- Poor and minority children are exposed to lead and other dangerous chemicals at the highest levels.
- Polluters released a reported 4.1 billion pounds in toxic chemicals to the air, water, and soil in 2007 alone.
- Chemicals contaminate the environment—in 2006, there were a total of 3,852 state advisories against eating fish because of chemical contamination.
- Chemicals bioaccumulate in the food chain—more than 95 percent of human exposure to dioxin comes from food consumption.
- Consumer products are a major source of exposure. Adolescents are widely exposed to hormone-disrupting chemicals found in cosmetics as their reproductive systems mature.
- Workplaces can be dangerous—one study found that women plastics workers more frequently sought treatment for infertility than the general population.

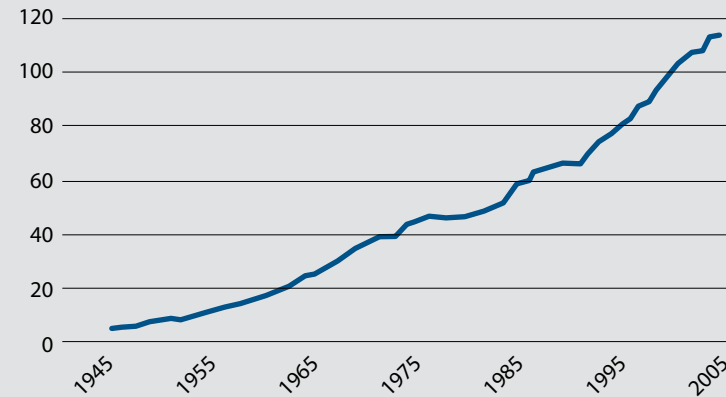
Chemical production is rising

U.S. chemical production has increased dramatically over the last 60 years. The number of chemicals registered for commercial use now stands at 80,000—a 30 percent increase since 1979.

Source: UCSF Program on Reproductive Health and the Environment, "[Shaping Our Legacy: Reproductive Health and the Environment](#)" (September 2008).

U.S. chemical production, 1947–2007

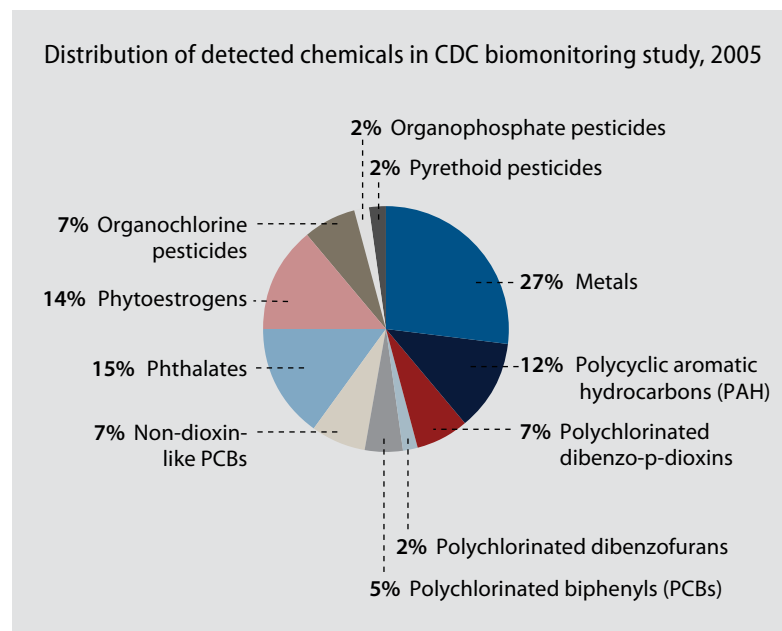
Production index (100 = year 2002)



Americans are exposed to a chemical soup

Americans are exposed to a multitude of chemicals, which accumulate in the body over time. The Centers for Disease Control and Prevention conducts “biomonitoring” to measure chemicals in people’s blood and urine. This chart shows the distribution of chemicals found in a random sample of the U.S. population. Chemicals are generally evaluated—to determine their safety and whether regulation is necessary—in isolation from each other, one at a time. The reality, however, is that people are exposed to many chemicals at the same time. Very little is known about how multiple chemicals interact to affect human health.

Source: Centers for Disease Control and Prevention, *Third National Report on Human Exposure to Environmental Chemicals* (July 2005).



Chemical exposures occur *in utero*

Pregnant women pump blood through the umbilical cord from the placenta to the fetus. This blood provides the essential nutrients for life. It may also expose the fetus to dangerous chemicals contained in the mother's body. A 2004 study tested blood samples from 10 newborn umbilical cords. These samples found 287 industrial chemicals present in the cords (out of 413 chemicals tested for), including pesticides, consumer product chemicals, and wastes from burning coal, gasoline, and garbage. The chart shows the percentage of newborns whose umbilical cords contained at least one chemical from the chemical families listed. Also shown is the number of chemicals in each chemical family tested for and the number detected.

Chemicals found in 10 newborn umbilical cords

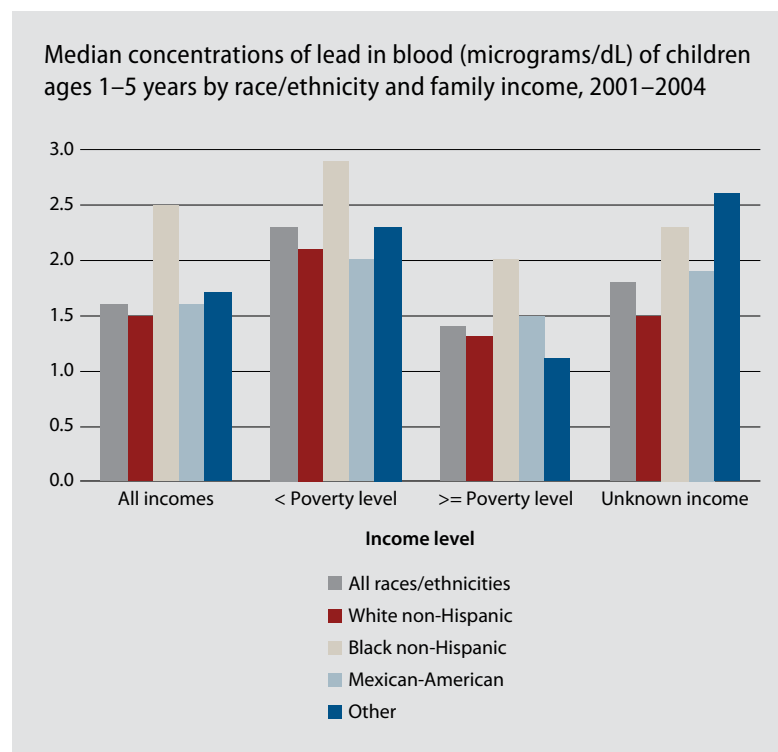
Chemical family	Source/use	Percent detected in newborns	Chemicals found/chemicals tested for
Mercury	Emitted from coal-fired power plants, other industrial facilities	100%	1/1
Polybrominated diphenyl ethers (PBDEs)	Fire retardants used for furniture, electronics	100%	32/46
Polyaromatic hydrocarbons (PAHs)	Waste from burning gasoline and garbage	100%	9/18
Polychlorinated dibenzodioxins and furans (PBCD/F)	Byproducts of PVC production, industrial bleaching and incineration	100%	11/17
Polybrominated dibenzodioxins and furans (PBDD/F)	Found in brominated flame retardants; byproducts from plastic production and incineration	70%	7/12
Perfluorinated chemicals (PFCs)	Used for fabric and carpet protectors, food wrap	100%	9/12
Organochlorine pesticides (OCs)	Includes DDT; largely banned, but persists in environment	100%	21/28
Polychlorinated Naphthalenes (PCNs)	Wood preservatives, machine lubricating oils	100%	50/70
Polychlorinated biphenyls (PCBs)	Industrial insulators, lubricants; banned since 1976, but persist in environment	100%	147/209

Source: Environmental Working Group, "Body Burden—The Pollution in Newborns. A benchmark investigation of industrial chemicals, pollutants and pesticides in umbilical cord blood" (July 14, 2005).

Poor, minority children are exposed to higher levels of chemicals

Poor and minority children are generally exposed to chemicals at higher levels. Poor black children have the highest concentrations of lead in their blood. Lead exposure is down sharply following the removal of lead from gasoline and paint, but it still poses reproductive and developmental risks. About 310,000 U.S. children between ages 1 and 5 have blood lead levels above CDC's "safe" level.

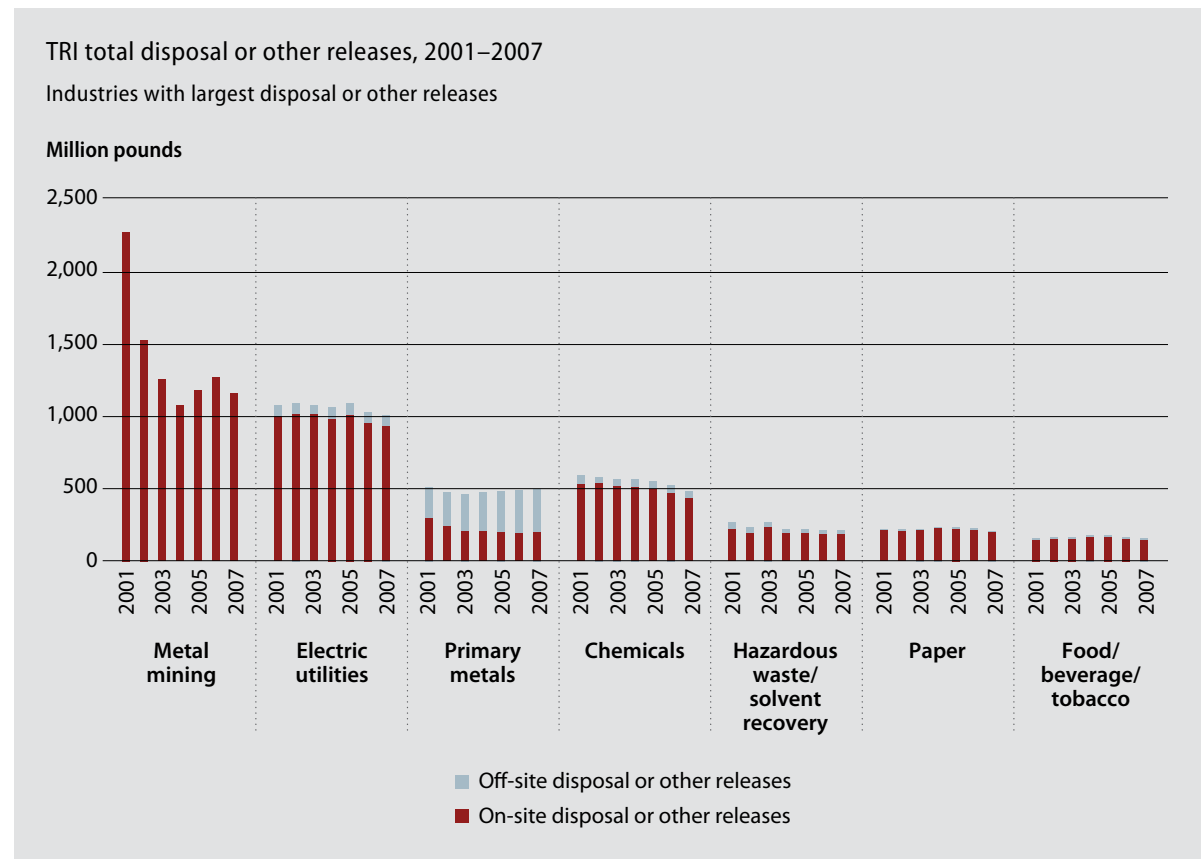
Source: Environmental Protection Agency, *America's Children and the Environment, Measure B-2*; Centers for Disease Control and Prevention, National Center for Health Statistics, *National Health and Nutrition Examination Survey*.



U.S. industries release billions of pounds of chemicals each year

In 2007, U.S. polluters reported a total of 4.1 billion pounds in toxic releases to the air, water, and soil, according to the EPA's Toxics Release Inventory, or TRI. Metal mining and electric utilities accounted for the greatest share, followed by chemical and primary metal facilities.

Source: Environmental Protection Agency, *2007 TRI Public Data Release, Section A* (March 19, 2009)

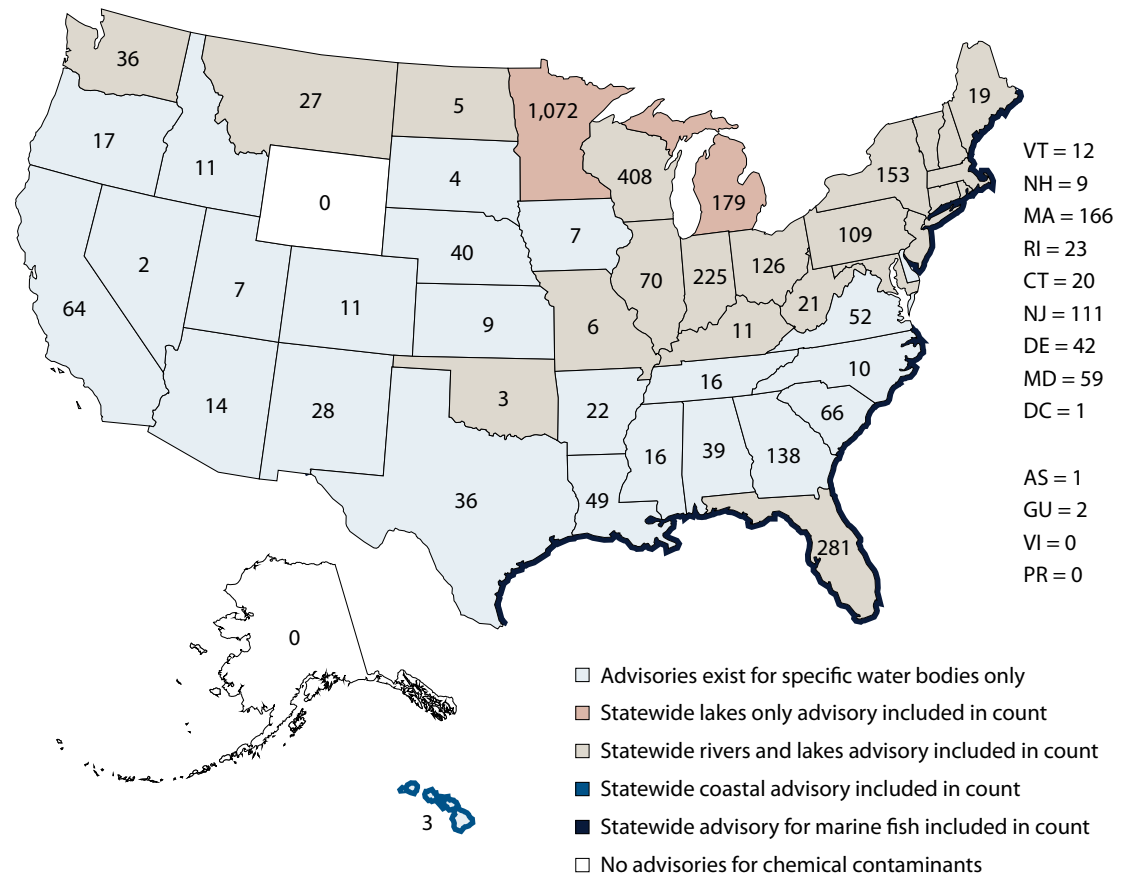


Chemicals contaminate the environment and food chain

States have issued an increasing number of advisories against consumption of fish because of chemical contamination. As this map shows, there were a total of 3,852 fish advisories in 2006, covering 38 percent of the nation's total lake acreage and 26 percent of the nation's total river miles. Of these advisories, 3,080 were the result of mercury. Mercury emissions from coal-fired power plants and other sources contaminate the water and bioaccumulate in the food chain, sometimes making fish dangerous to eat. Pregnant women who eat mercury-contaminated fish are at greater risk of having children with neurological disorders.

Source: EPA, National Listing of Fish Advisories, *Technical Fact Sheet: 2005/06 National Listing* (July 2007).

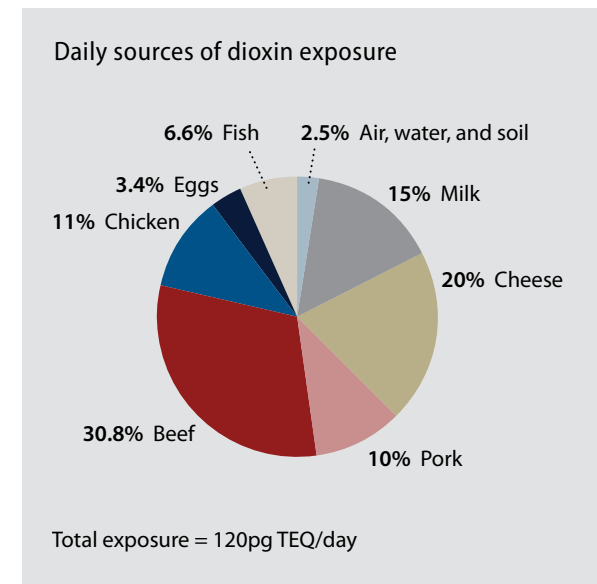
Fish advisories by state, 2006



Chemicals are part of the daily diet

Avoiding certain fish may reduce mercury exposure, but chemicals are found throughout the food supply. More than 95 percent of human exposure to dioxin, for example, comes from food intake. Dioxin refers to a group of toxic chemicals that include polychlorinated biphenyls, or PCBs, polychlorinated dibenzo dioxins, and polychlorinated dibenzo furans. These chemicals accumulate in animals' fat stores from contaminated air, water, and soil. Americans are exposed to dioxin as part of the daily diet, with beef as the leading source. Dioxin exposure, like lead exposure, has declined significantly over the last several decades as a result of stronger regulation. But even at lower levels, dioxin is linked to a number of reproductive health problems, including miscarriages and birth defects. An EPA reassessment of dioxin's health effects has been in the works since 1991. This reassessment is [available in draft](#), but the Bush administration held up its completion, seemingly because the findings point to stronger regulation. Environmental groups are urging the Obama administration to [release the reassessment without delay](#).

Source: Agency for Toxic Substances and Disease Registry, "[Toxicological Profile for Chlorinated Dibenzo-p-dioxins](#)" Chapter 5, p. 464 (December 1998).



Consumer products are a major source of chemical exposure

Americans are exposed to dangerous chemicals in consumer products. The following sections highlight chemicals found in furniture and plastics used for toys, food containers, and a host of other products. But cosmetics are another area of concern. A 2008 study tested 20 teenage girls for hormone-disrupting chemicals found in cosmetics. The chart shows the percentage of girls tested whose blood and urine contained at least one chemical from the chemical families listed. Also shown is the number of chemicals in each chemical family tested for and the number detected. Adolescents are at particular risk because their reproductive systems are in the process of maturing. Consumers can [view safety ratings](#) for 42,000 personal care products through the Environmental Working Group's website.

Chemicals found in 20 teenage girls

Chemical family	Use/source	Percent found in teen girls	Chemicals found/chemicals tested for
Phthalates	Ingredient in nail polish, other cosmetics	100%	7/7
Triclosan	Preservative in liquid hand soap, toothpaste	100%	1/1
Nitro- and polycyclic musks	Artificial fragrance in soap, shampoo, deodorant, and cosmetics	70%	2/11
Parabens	Preservative in cosmetics	100%	6/6

Exposure to these chemicals may also come from sources besides cosmetics. Phthalates, for example, are found in many plastics.

Source: Environmental Working Group, "[Teen Girls' Body Burden of Hormone-Altering Cosmetics](#)" (Sept. 24, 2008).

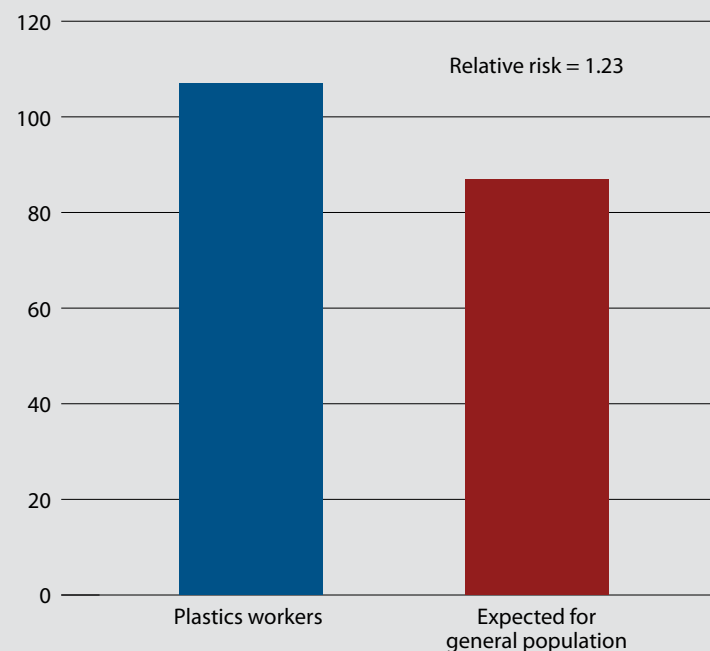
Workplaces can be dangerous

Chemical exposures are often highest in occupational settings, putting workers at risk of reproductive health problems. A recent study examined infertility among Danish workers in the plastics industry from 1995–2005. Women plastics workers between the ages of 20 and 39 more frequently sought treatment for infertility than women in the general population.

Source: Karin S. Hougaard, et al., "Increased Incidence of Infertility Treatment Among Women Working in the Plastics Industry," *Reproductive Toxicology* 27 (Jan. 21, 2009): 186–189.

More infertility treatment among women in plastics industry

Cases of infertility treatment out of 27,445 person years*



*"Person years" is the sum of the number of years that each person in the study was under observation

Chemical protections are inadequate

Industrial chemicals. The Toxic Substances Control Act, enacted in 1976, places the burden of proof on the Environmental Protection Agency to demonstrate that a chemical is unsafe. Companies have no responsibility to test for safety before bringing a chemical into commerce. Thus, the guinea pigs turn out to be people in the real world. Regulation occurs only after terrible health consequences have occurred and all reasonable doubt has been removed. Indeed, since the TSCA's adoption, the EPA has mandated restrictions on just five substances—halogenated chlorofluoralkanes, PCBs, dioxin in certain wastes, asbestos, and hexavalent chromium.

Personal care products. The introduction of new cosmetics does not follow the same process as drugs, which must receive approval from the Food and Drug Administration after a safety review. Rather, according to the FDA, the Food, Drug and Cosmetic Act “contains no provision that requires demonstration to FDA of the safety of ingredients of cosmetic products...prior to marketing the product.” Again, people end up as the guinea pigs.

Consumer product safety. In 2007, millions of popular Chinese-made toys, including Big Bird and Elmo toys, were found to contain lead paint, which led to massive recalls. A year later, President Bush signed the Consumer Product Safety Improvement Act, which phases out lead and phthalates in toys and other children's products and requires pre-market chemical safety testing of such products. This law represents significant progress, but the Consumer Product Safety Commission, which is responsible for implementation, still operates under cumbersome regulatory procedures and lacks resources to adequately protect consumers. The CPSC had not adopted a new toy standard for a decade prior to the act, and the former acting CPSC chairman, Nancy Nord, expressed resistance even after the recalls of Chinese-made toys. “Noticeably absent from the majority of your public remarks is an emphasis on protecting consumer safety, which happens to be the mission of the agency you lead,” wrote Sen. Richard Durbin (D-IL) in a recent letter rebuking Nord. The Senate recently confirmed President Obama's choice as new chair of the CPSC, Inez Moore Tenenbaum.

Occupational safety and health. Federal laws and standards permit higher chemical exposures for workers than for the general population. The difference in protection is frequently substantial. For some dangerous chemicals, such as BPA, there are no workplace exposure limits at all.

II. Phthalates

Phthalates are a group of chemicals used to soften plastics for a variety of products, including toys, blood bags, IV tubes, cosmetics, and food containers. About a billion pounds of phthalates are produced worldwide every year.

Phthalates are linked to the following reproductive health problems:

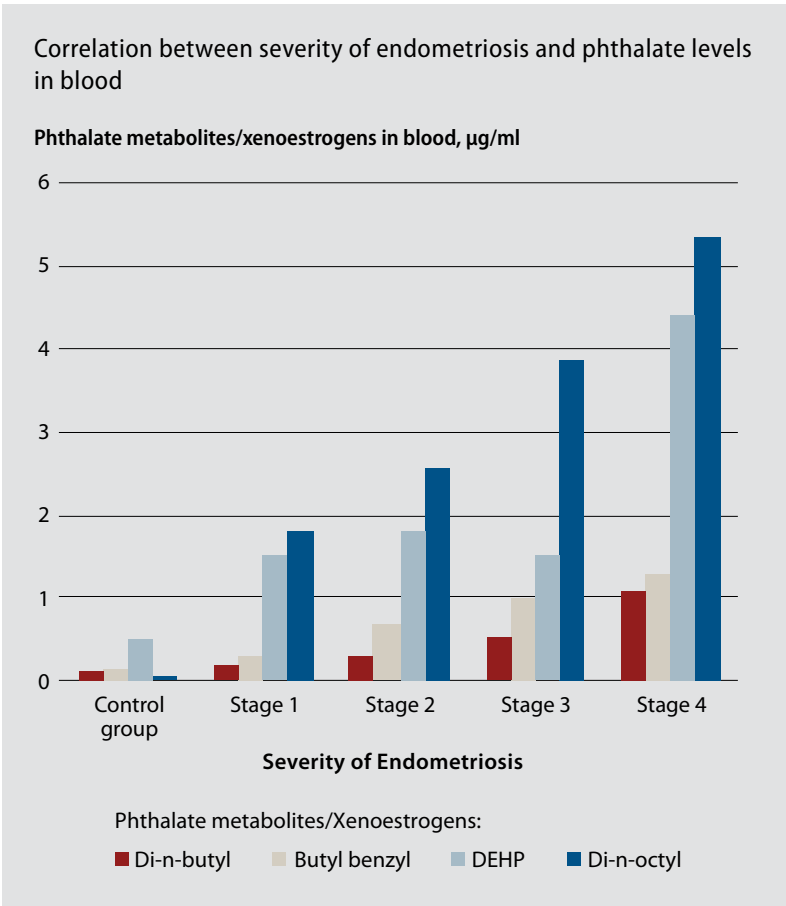
- Premature births
- Endometriosis
- Genital abnormalities in boys
- Sperm damage and reduced sperm count

Testing shows that virtually everyone has some phthalates in their bodies. Particularly high levels are found in children.

Phthalates are linked to endometriosis

Phthalates are linked to a host of reproductive health problems in both men and women. A study of Indian women, for example, found that as the severity of endometriosis increases (stage 4 being the most severe), there tends to be an increase in the presence of various phthalates in the blood. Control subjects without endometriosis had the lowest levels of phthalates in the blood.

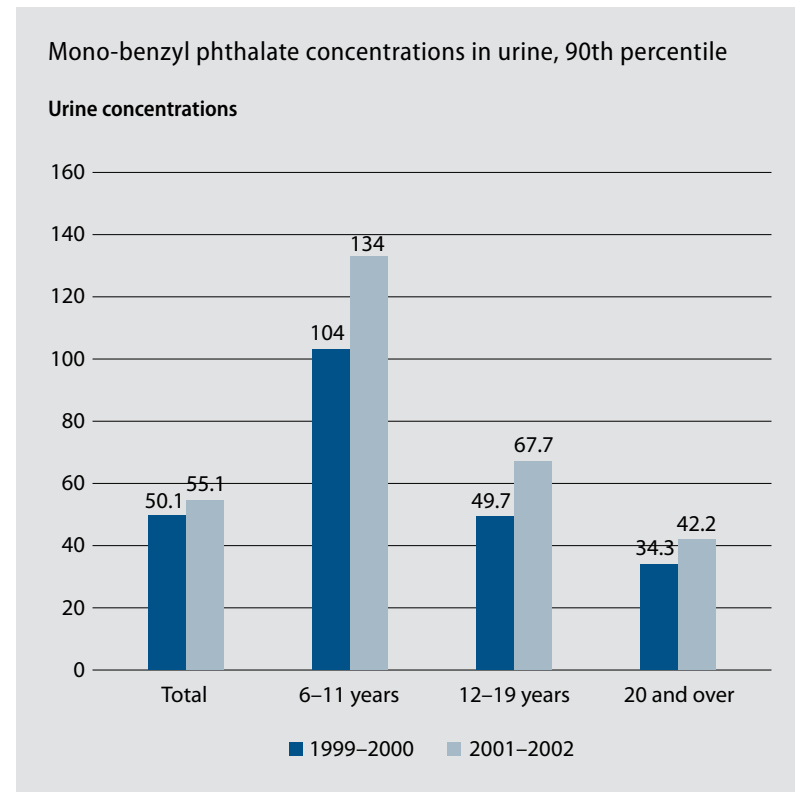
Source: B. Satyanarayana Reddy, et al, "High Plasma Concentrations of Polychlorinated Biphenyls and Phthalate Esters in Women with Endometriosis: a Prospective Case Control Study," *Fertility and Sterility* 85 (3) (March 2006): 775–779.



Americans are widely exposed to phthalates

The CDC tested the urine of hundreds of Americans for phthalates from 1999–2002. Virtually everyone had phthalates in their urine. The chart shows concentrations of mono-benzyl phthalate found in the survey's 90th percentile. Mono-benzyl phthalate is a metabolite for the industrial solvent benzylbutyl phthalate, which is used in adhesives, vinyl flooring, and car care products. Younger age groups had the highest levels in their urine. The CDC's testing also found concentrations increasing over time—and not just for mono-benzyl phthalate, but for all phthalates. More biomonitoring is needed, however, to determine whether this is a long-term trend.

Source: Centers for Disease Control and Prevention, *Third National Report on Human Exposure to Environmental Chemicals* (2005).



Exposure to phthalates comes from a variety of sources

Phthalates are most commonly used to soften polyvinyl chloride (PVC or vinyl). Exposure can occur orally (children chewing on toys, for example, or from leaching food containers), through dermal application of personal care products, or through inhalation of dust and air—that “new car smell” partly comes from phthalates. The following are just some of the products that contain phthalates.



Toys



Food containers



Flooring and wall coverings



Medical devices such as blood bags and IV tubes



Air fresheners



Cosmetics and personal care products, including baby products

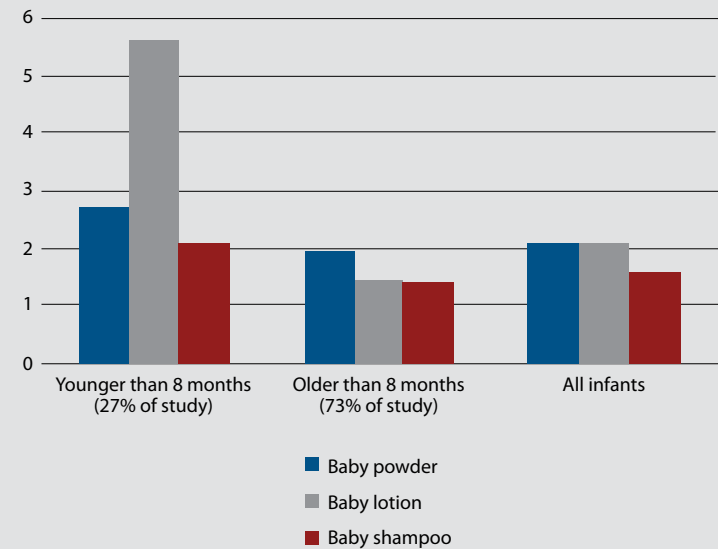
Infants are exposed to phthalates from baby products

Public and political attention has recently focused on baby products that contain phthalates. This chart shows the results of a study that examined the levels of phthalates in infants exposed to baby powder, baby lotion, and baby shampoo. This study found that in all children, in particular those younger than 8 months old, there is a correlation between their exposure to these products and an increased number of phthalates present in their urine samples.

Source: Sheela Sathyanarayana, et al., "Baby Care Products: Possible Sources of Infant Phthalate Exposure," *Pediatrics* 121 (Feb. 2008): e260-e268.

Significant correlation between presence of phthalates in infants and products used

Correlation (z score—all significant within 95% confidence interval)



New limits on phthalates

Limitations on phthalates are starting to be put in place. On August 14, 2008, President Bush signed into law the Consumer Product Safety Improvement Act, which bans three types of phthalates in children's products and temporarily outlaws three others while their effects are studied. Congress overwhelmingly supported the act, which also sets new limits for lead.

Independent of the legislation, Wal-Mart, Toys R Us, Lego, Evenflo, and Gerber also agreed to phase out children's products containing phthalates by Jan. 1, 2009.



Sen. Mark Pryor (D-AR) and House Speaker Nancy Pelosi (D-CA) congratulate each other after passage of the Consumer Product Safety Improvement Act. (Photo courtesy Public Citizen)

III. BPA

Bisphenol A, or BPA, is a plastic monomer and plasticizer that ranks among the highest-volume chemicals worldwide, with over 6 billion pounds produced each year. Many products contain BPA, including toys, food and drinking containers, medical equipment, and electronics.

BPA has been linked to the following reproductive health problems:

- Reduced sperm count
- Development of later-life health problems, including prostate and breast cancer, due to prenatal exposure
- Altered reproductive tract development
- Abnormal brain development in offspring
- Miscarriage

BPA is harmful even at low doses

This table, adapted from the [Environmental Working Group](#), shows that BPA may have serious reproductive health consequences even at low exposures. These studies were all rated as “very useful” or “useful” by an expert panel of the [Center for Evaluation of Risks to Human Reproduction](#) within the National Institutes of Health.

Daily BPA exposure (µg/kg body weight-day)	Toxic effect	Reference
0.025	persistent changes to breast tissue, predisposes cells to hormones and carcinogens	Muñoz-de-Toro 2005
0.025	permanent changes to genital tract	Markey 2005
2	increased prostate weight 30 percent	Nagel 1997
2.4	earlier puberty, differences in genital development	Howdeshell 1999 , Honma 2002
2.5	breast cells predisposed to cancer	Murray 2007
10	prostate cells more sensitive to hormones and cancer, malformation of urethra	Ho 2006 (infant), Timms 2005 (fetal)
10	decreased maternal behaviors	Palanza 2002
50	EPA's safe exposure level, based on outdated high dose studies	EPA 1998

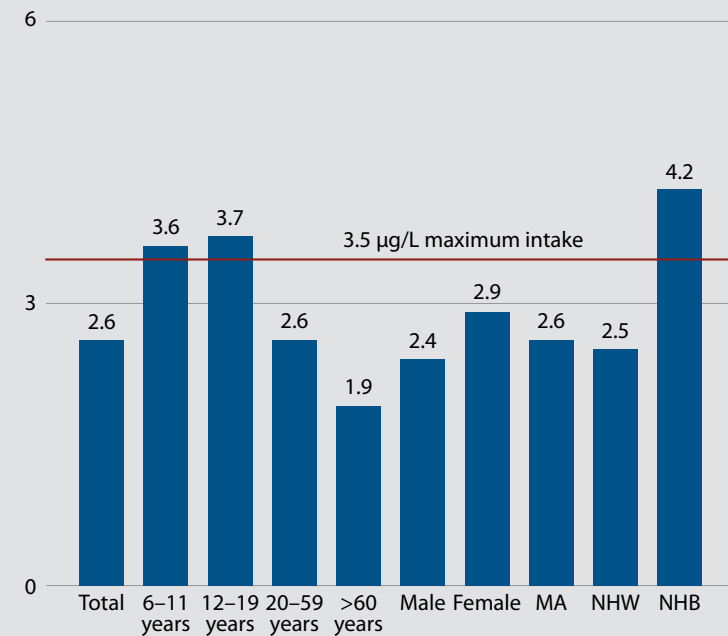
BPA is present in most Americans, but highest among younger age groups

A biomonitoring study in 2003–2004 found BPA in 92.6 percent of its research subjects. Concentrations were measured in $\mu\text{g/L}$, which denotes BPA weight per liter of urine. Younger age groups had mean concentrations above even the Food and Drug Administration's outdated safety threshold, which does not incorporate recent studies showing harmful effects at lower doses. Non-Hispanic blacks, or NHB, had significantly higher levels of BPA than Mexican-Americans, or MA, and non-Hispanic whites, or NHW.

Source: National Center for Environmental Health, "Exposure of U.S. Population to BPA: 2003–2004" (January 2008).

Exposure to BPA, 2003–2004

Geometric mean BPA concentration

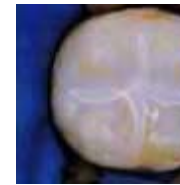


BPA exposure comes from a variety of sources

Exposure to BPA typically comes from ingesting food or fluids stored in containers or packages made with BPA. BPA also contaminates the environment and is found in drinking water supplies as well as indoor and outdoor air. Workers with manufacturing jobs involving BPA have been found to have higher exposure levels than the general adult population. The following are just some of the products that contain BPA.



Foods stored in cans with epoxy resin linings



Dental products containing resin-based monomers



Polycarbonate bottles and food containers



Plastic dinnerware



Papers and cardboards used for food packaging

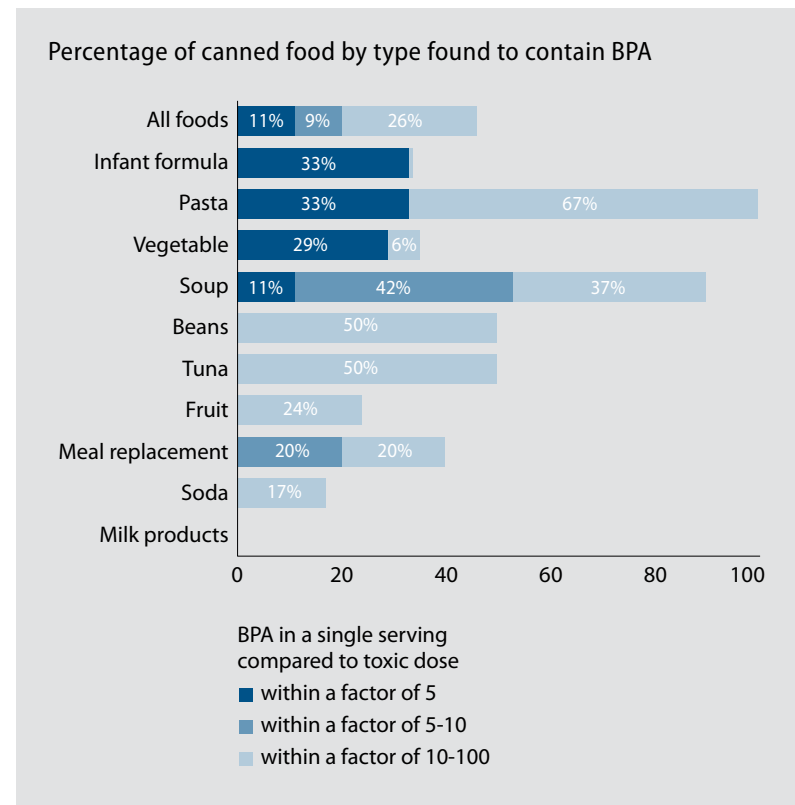


Compact discs

BPA is found in canned food

An estimated 17 percent of the U.S. diet comes from canned food, which is a primary source of BPA exposure. The Environmental Working Group detected BPA in 55 of 97 cans of name-brand food purchased in March 2006. The chart shows the percentage of cans by food type that contained potentially dangerous levels of BPA. In some cases, a single serving contained BPA levels less than five times lower than doses that caused reproductive problems in lab animals. The government usually mandates a much larger margin of safety. The chart shows the proximity of BPA levels in cans to the “toxic dose” of 2 µg/kg/day. Instant baby formula and canned pasta and vegetables contain some of the highest levels of BPA per dose.

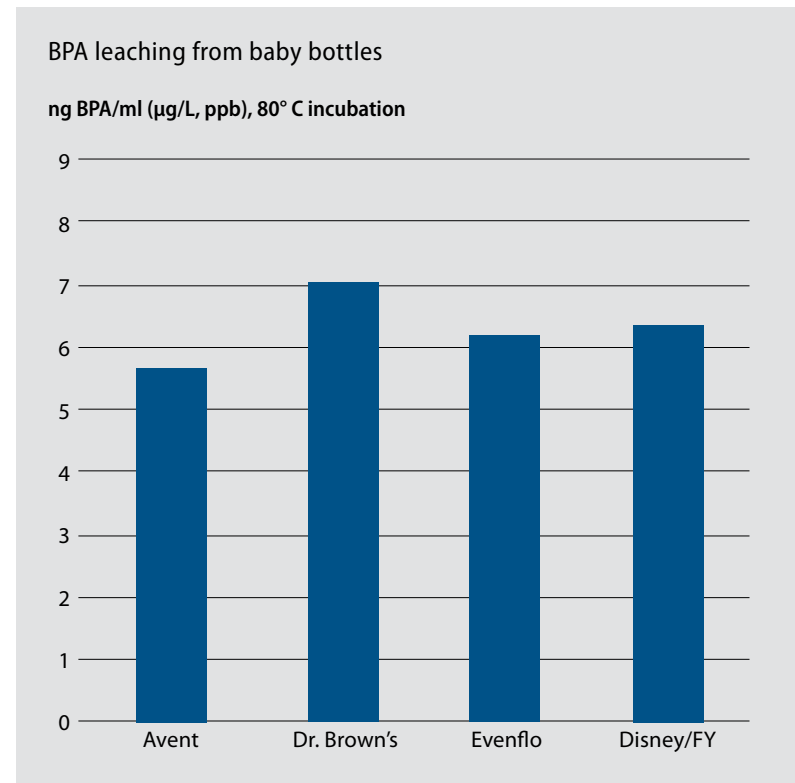
Source: Environmental Working Group, “Bisphenol A: Toxic Plastics Chemical in Canned Food” (May 2007).



Drinking containers may contain BPA

Many baby bottles contained BPA until recently. This chart shows the leaching results from baby bottles, purchased in December 2007, of the most popular U.S. brands. When repeated washing was simulated, each brand showed a high level of BPA leaching into the liquids they held. Manufacturers stopped using BPA in baby bottles in response to growing public concern. But BPA is still used in other drinking containers. [A recent study](#) measured BPA levels in 77 Harvard students who spent one week drinking from polycarbonate bottles, which contain BPA. BPA levels in the urine of these students increased 69 percent by the end of the week.

Source: The Work Group for Safe Markets, "[Baby's Toxic Bottle: Bisphenol A Leaching from Popular Baby Bottles](#)" (Feb. 2008).



Action on BPA

- April 2008** Canada banned BPA in all baby bottles.
- May 2008** John Dingell, then chairman of the U.S. House Committee on Energy and Commerce, and Bart Stupak, chairman of that committee's Oversight and Investigations Subcommittee, wrote to four major companies requesting voluntary removal of BPA from their products.
- Sept. 2008** The National Toxicology Program at the U.S. Department of Health and Human Services released a monogram expressing "some concern" that BPA has adverse effects on the prostate gland, brain, and behavioral development in fetuses. The monogram contradicted the Food and Drug Administration's determination that BPA was not harmful. A scientific advisory panel later criticized the FDA for failing to consider a wide variety of studies that link BPA to reproductive problems.
- March 2009** The chemical manufacturer Sunoco announced that it would no longer sell BPA for use in products meant for children aged 3 and younger. This decision marked the first time a member of the American Chemistry Council (a major industry trade association) acknowledged BPA hazards.
- Rep. Ed Markey (D-MA) and Sens. Dianne Feinstein (D-CA) and Chuck Schumer (D-NY) introduced legislation to ban BPA in all food and beverage containers.
- Suffolk County, NY, became the first jurisdiction to ban BPA in baby bottles and cups.
- May 2009** Minnesota and Chicago banned BPA in baby bottles and cups—the first state and city to do so.
- June 2009** Connecticut banned BPA in infant formula and baby food cans and jars, as well as reusable food and drink containers.

IV. PBDEs

Polybrominated diphenyl ethers, or PBDEs, are used as flame retardants in many household products, including couches, fabrics, and electronics. They are bioaccumulative and are present in breast milk and food. PBDEs are linked to the following reproductive health problems:

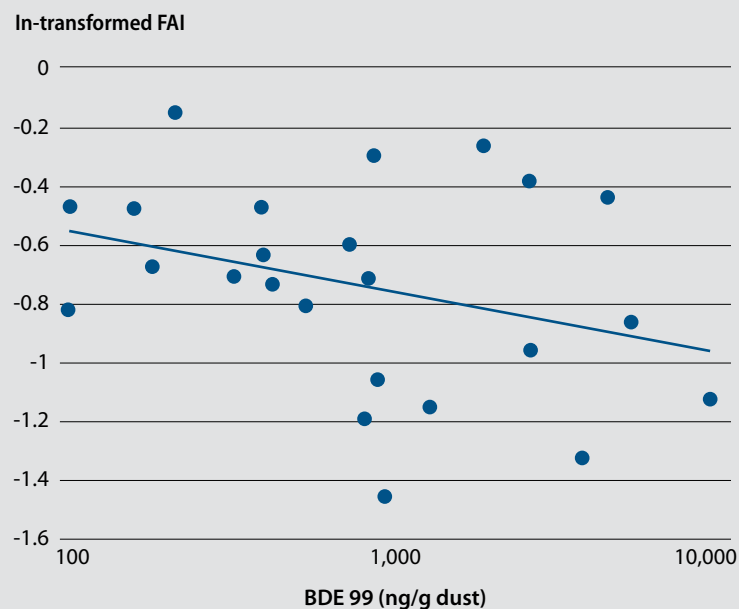
- Disruption in maternal and fetal thyroid hormones, which are important to brain development
- Lower sperm count
- Behavioral disorders in offspring
- Inhibition of endogenous androgen activity, a potential cause of reproductive failure

PBDEs alter hormone levels

PBDEs have been found to affect hormone levels in both men and women. One recent study compared the testosterone levels of 24 men to PBDE levels found in dust in their homes. Testosterone levels were significantly lower in men exposed to higher levels of BDE 99, a type of PBDE.

Source: John D. Meeker, et al, "Polybrominated diphenyl ether (PBDE) Concentrations in House Dust Are Related to Hormone Levels in Men," *Science of the Total Environment* 407 (10) (May 1, 2009): 3425–3429.

Correlation between testosterone levels in men and PBDE levels in household dust

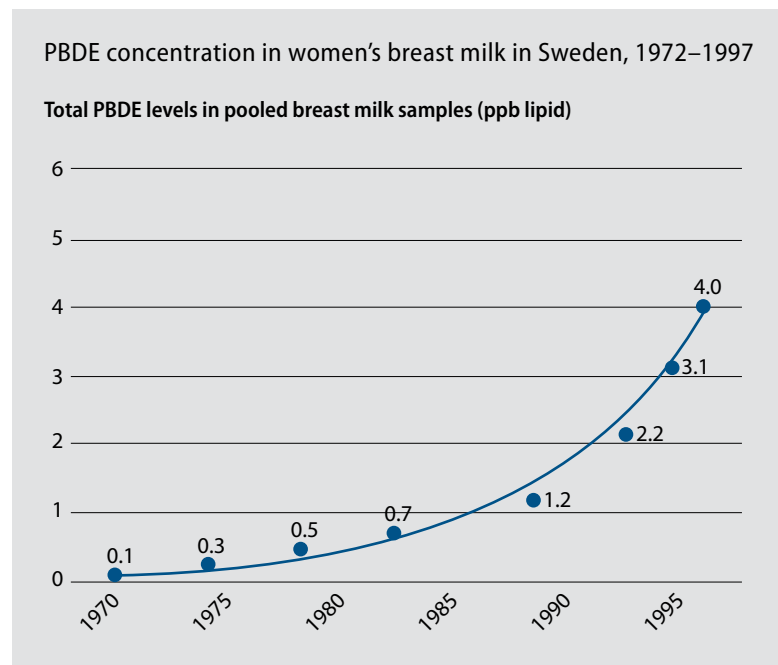


FAI refers to "free androgen index," which is based on a calculation involving levels of testosterone and sex hormone binding globulin, or SHBG.

PBDEs are present in breast milk

This graph illustrates the exponential increase in the presence of PBDEs in the breast milk of Swedish women from 1972 to 1997. These findings led to the realization that women worldwide, including in the United States, were being exposed to dangerous levels of PBDEs. Breast milk is an indicator of the level of maternal exposure and thus a measure of possible exposure of the fetus.

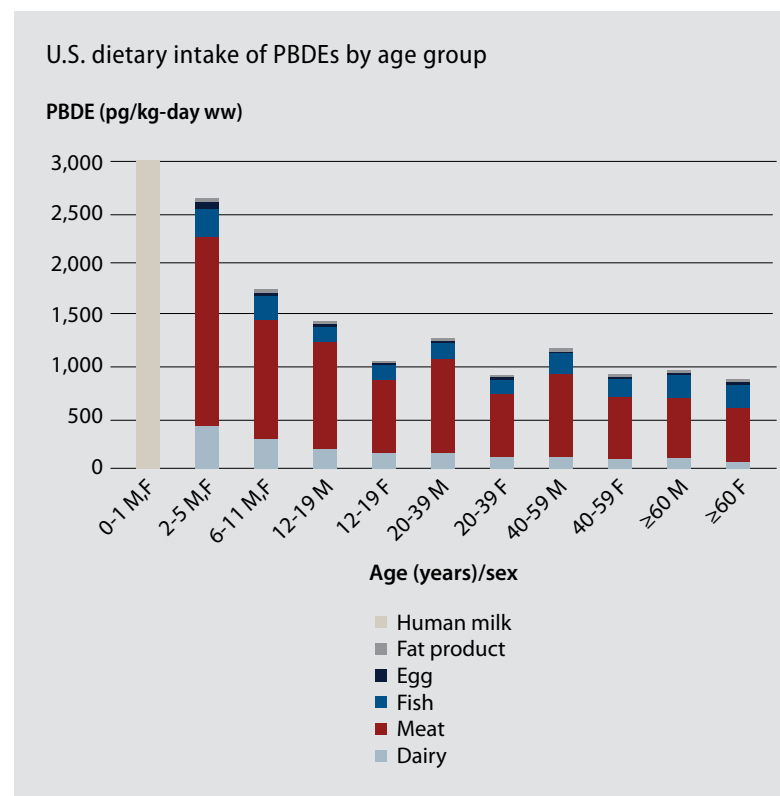
Source: Sonya Lunder and Renee Sharp, "Mother's Milk: Toxic Fire Retardants (PBDEs) in Human Breast Milk," Environmental Working Group (2003).



Americans are exposed to PBDEs in food

Household dust is not the only way Americans are exposed to PBDEs. PBDEs contaminate the environment and bioaccumulate in the food chain. This chart shows the sources of U.S. dietary intake of PBDEs by age group. Nursing infants and young children are exposed to the highest levels.

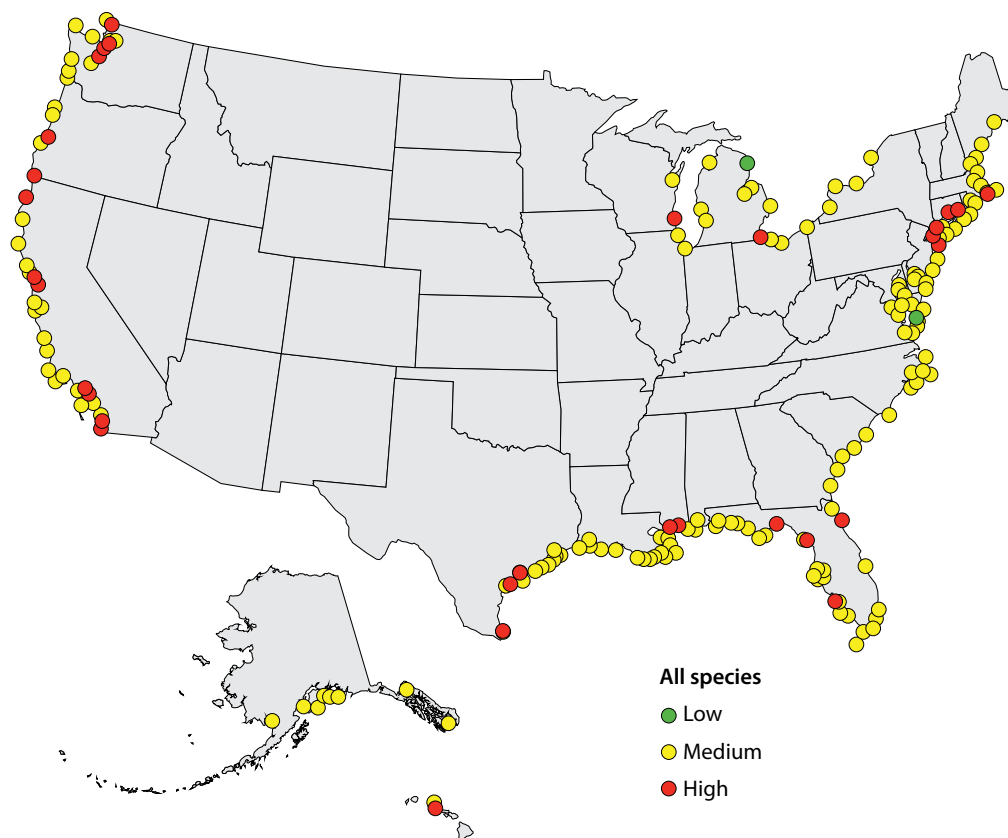
Source: Arnold Schecter, et al, "Polybrominated Diphenyl Ether (PBDE) Levels in an Expanded Market Basket Survey of U.S. Food and Estimated PBDE Dietary Intake by Age and Sex," *Environmental Health Perspectives* 114 (10) (October 2006): 1515–1520.



PBDEs are found in coastal waters and the Great Lakes

A 2008 report from the National Oceanic and Atmospheric Administration found PBDE contamination in all U.S. coastal waters and the Great Lakes. This map depicts PBDE levels found in oysters and mussels. Humans can be exposed to PBDEs by eating contaminated fish and marine life. “Scientific evidence strongly documents that these contaminants impact the food web and action is needed to reduce the threats posed to aquatic resources and human health,” said [John H. Dunnigan](#), NOAA assistant administrator of the National Ocean Service.

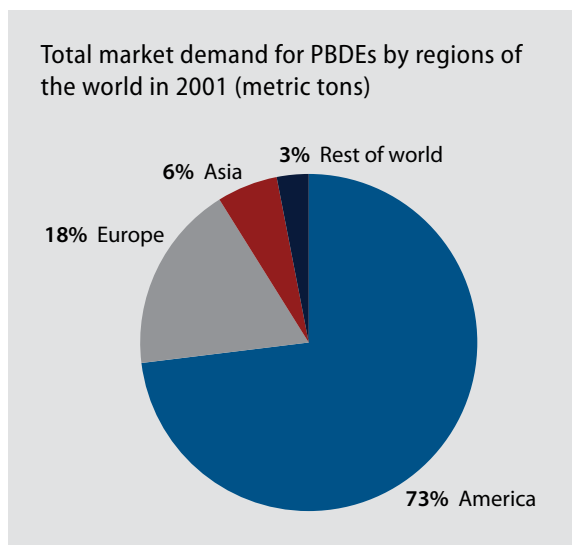
PBDE levels detected in oysters and mussels



The United States leads the world in use of PBDEs

The United States has the largest market demand for PBDEs, nearly tripling European demands. The levels of PBDEs in people's bodies have doubled every two to five years, and are 40 times higher in North America than other continents.

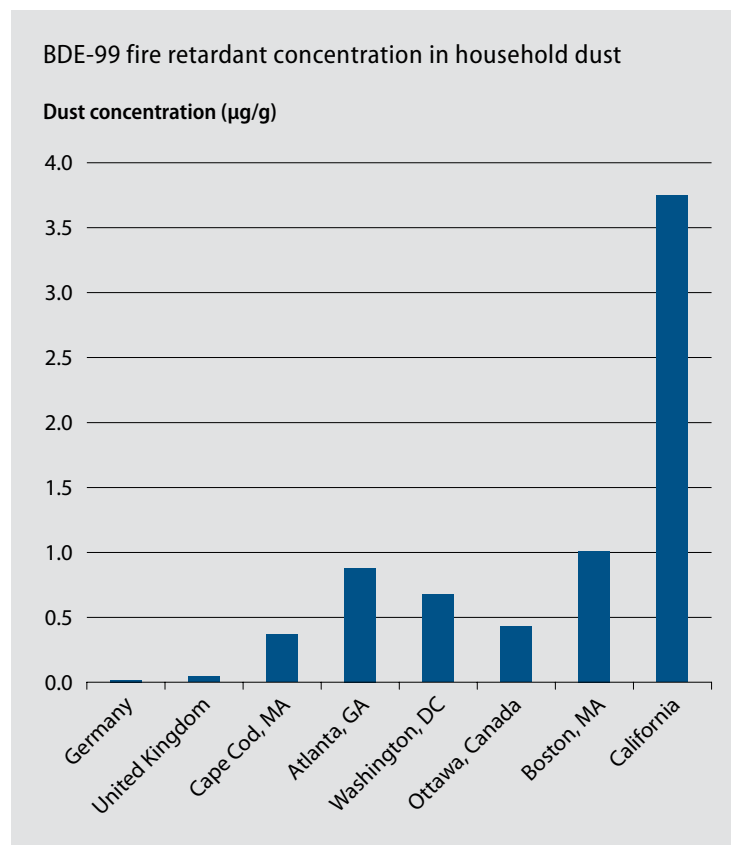
Source: Agency for Toxic Substances and Disease Registry, "Toxicological Profile for Polybrominated Biphenyls and Polybrominated Diphenyl Ethers (PBBs and PBDEs)" (September 2004); Centers for Disease Control and Prevention, "Spotlight on PBDEs and PBBs" Kellyn S. Betts, "Rapidly rising PBDE levels in North America," *Environmental Science and Technology* 36 (3) (Feb. 2002): 50A–52A.



California flammability standard leads to higher PBDE exposure

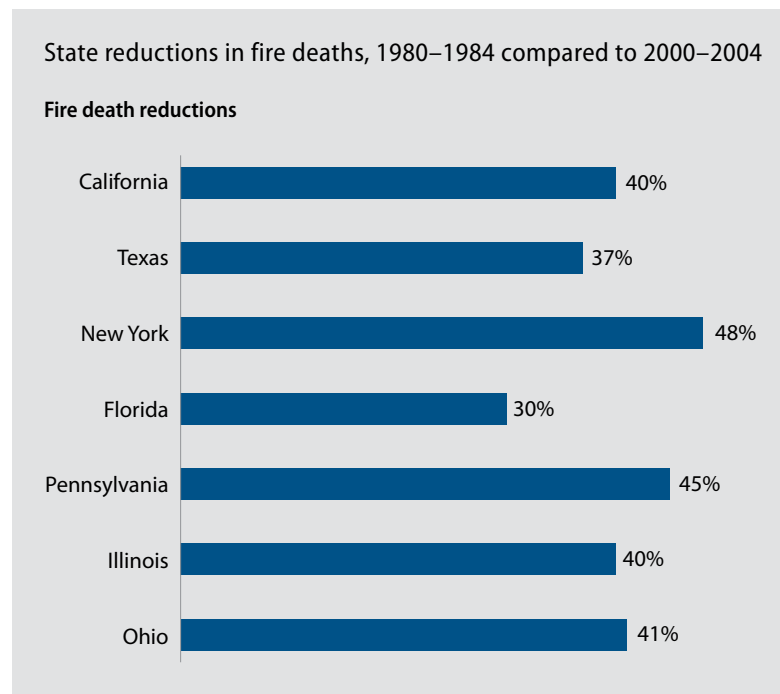
The U.S. market demand for PBDEs is driven by California, the only state with a flammability standard for home furniture. Manufacturers must use flame retardants such as PBDEs to meet this strict standard. As a result, Californians are exposed to elevated levels of PBDEs. The chart shows concentrations of household dust in various locations. California recently banned two types of PBDEs, but other dangerous chemicals are being used as replacements. Replacements include the chemical mix Firemaster 550—which is likely toxic to reproduction, according to EPA Design for the Environment—and chlorinated tris, which shows testicular toxicity, among other health consequences, and was banned from use in children's garments in 1977. The California Senate narrowly defeated legislation in 2007 to revise the state's flammability standard after a multi-million dollar campaign by chemical manufacturers to preserve it.

Source: Arlene Blum, ["Toxic Tragedy: The Fire Retardant Dilemma"](#) (Green Science Policy Institute, May 1, 2009).



Flame retardants do more harm than good

Fire deaths have declined significantly across the country, largely because indoor cigarette smoking has decreased. California's flammability standard does not appear to have delivered significant safety benefits based on a comparison to other states that have no standard. The graph shows the percent reduction in fire deaths in the most populous states over a 20-year period. The Consumer Product Safety Commission [proposed a regulation](#) in March 2008 that would supplant California's standard with a national flammability standard that could be met without using dangerous flame retardants. It will be up to CPSC's new leadership, appointed by President Obama, to issue a final standard.



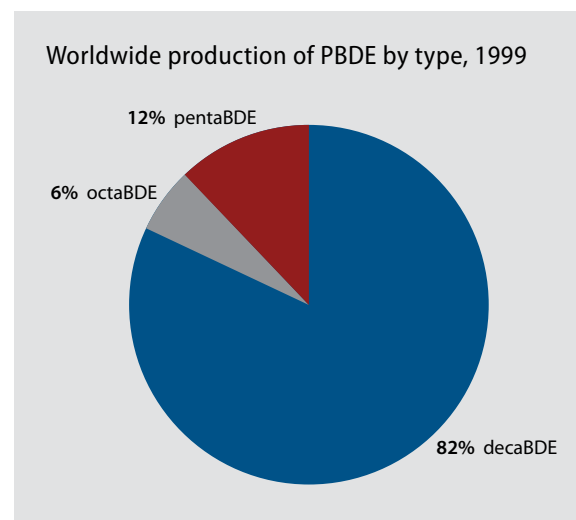
Types of PBDEs

DecaBDE. Found in high-impact plastic used for computers, TVs, and electrical appliances; upholstery and drapes; and wires, cables, and pipes.

PentaBDE. Found in the upholstery foams used in furniture, mattresses, car seats, and office chairs, as well as the solid foams used in appliances.

OctaBDE. Found in the ABS hard plastic used in computer monitors, TV housing, and circuit boards.

DecaBDE accounted for an estimated 82 percent of PDBEs produced worldwide in 1999. DecaBDE breaks down into the PentaBDE and OctaBDE forms, which are highly toxic. New restrictions have curtailed production of Penta- and OctaBDEs in recent years, but many products containing these substances remain in use. PBDEs from disposed products also contaminate the environment, persist for many years, and bioaccumulate in the food chain.



Source: Jon B. Manchester-Neesvig, et al., "Comparison of Polybrominated Diphenyl Ethers (PBDEs) and Polychlorinated Biphenyls (PCBs) in Lake Michigan Salmonids" *Environmental Science and Technology* 35 (6) (Feb. 14, 2001); Bromine Science Environmental Forum, "Major Brominated Flame Retardants Volume Estimates" (Brussels, Belgium, 2000).

Action on PBDEs

2003 The European Union banned use of Octa- and PentaBDE in all products.

California banned the manufacture, processing, and distribution of Octa- and PentaBDEs. Ten other states have since banned Octa- and PentaBDEs.

EPA established the Furniture Flame Retardancy Partnership to identify and move toward environmentally safer alternatives to PBDEs in furniture.

2004 The sole U.S. manufacturer of PentaBDE voluntarily phased out production.

2006 The EU banned electronic products containing DecaBDE.

EPA began its Flame Retardants in Printed Circuit Boards Partnership. Printed circuit boards use the highest volume of brominated flame retardants, and the partnership seeks to find alternatives.

2007 Washington state became the first state to ban DecaBDE use in household goods. Maine also banned Deca in 2007, and several other states are currently considering similar legislation.