Plastic containers and BPA (/poison-prevention-by-substances#plastic containers and bpa)

BPA and the Controversy about Plastic Food Containers

Plastic Containers: Are They Harmful?

The Bottom Line

Bisphenol A (BPA), a chemical used to harden plastic, is found in a number of consumer products, including hard plastic drinking containers and the linings of infant formula and food cans. In animal studies, BPA imitates effects of estrogen. There is controversy about whether animal studies are relevant to humans. Some scientists and consumers suggest reducing exposure to BPA.

The Full Story

Bisphenol A (BPA) is a chemical used to harden plastic. It is found in a number of consumer products, including hard plastic drinking containers, hard plastic baby bottles and drinking cups, and the linings of infant formula and food cans. It is also found in the environment. In the United States, nearly everyone has measurable levels of BPA in their bodies.

In animal studies, BPA is an endocrine disrupter that imitates effects of the hormone estrogen. In animals, BPA is associated with estrogen-like effects, including changes in fetal/neonatal prostate glands and breast tissue. There is controversy about whether animal studies are relevant to humans. Some scientists and consumers are concerned enough that they suggest taking steps to reduce exposure to BPA.

Background information

Endocrine disrupters are synthetic substances that, when introduced into the body, either imitate or block the effects of the body's natural hormones. Naturally-occurring hormones include estrogens, androgens (e.g. testosterone), thyroid hormone, and pancreatic hormones. Therefore, artificial interference with hormone actions prompts concerns about reproductive effects and developmental effects, the body's ability to regulate metabolism, and the body's ability to use insulin, among many other possible effects. In animal studies, BPA has been shown to affect estrogens.

When a drug or chemical is introduced into the body, it is absorbed into the blood stream and circulated through the liver. Most substances are metabolized in the liver, that is, they are broken down into different or smaller chemicals that circulate in the blood stream and affect other body organs. Eventually, these metabolites, and any of the original unchanged substance left, are eliminated from the body. Many substances and metabolites are eliminated in the urine, though the gastrointestinal tract, skin, and lungs sometimes play a role in elimination.

Exactly what happens in the liver, how a substance affects body organs, and when and how it is eliminated, depend on many factors. When considering whether drugs, chemicals, and/or their metabolites can cause human harm, several factors are considered. Among them are:

- How much is introduced into the body? By what route? And under what circumstances? For some substances, the potential danger might be different if it is swallowed, inhaled, or absorbed through the skin.
- How old is the individual?
  - Young children, older children, and adults may absorb some chemicals and drugs differently. In infants, for example, gastrointestinal tract enzymes may be immature. Their skin is thinner. They breathe more quickly and so absorb air-borne substances more rapidly than adults.
  - The liver's ability to metabolize, or break substances down, varies with age. The liver employs many types of enzymes in metabolism. Age is a significant factor in the maturity of the liver's enzyme systems and how efficiently it can break down toxic substances.
  - Age also affects the ability of the kidneys to eliminate substances, including chemicals and their metabolites.

The fact that a chemical is introduced into the body does not necessarily mean it is harmful. On the other hand, studies to absolutely rule out harm to humans are difficult to perform and may need to continue for decades for any conclusions to be drawn. For this reason, animal research is often used as the closest surrogate available to anticipate whether a substance may cause harm to human health.

What is Bisphenol A (BPA)?

BPA is a chemical with several industrial uses. Among other applications, it is used:

- To harden plastics. Common examples are polycarbonate drinking bottles, hard plastic baby bottles and infant drinking cups.
  - These are hard, clear, plastic bottles, usually with a recycling code "7" inside the triangle.
  - Since 2009, most baby bottles made in the U.S. have NOT contained BPA.
- In the epoxy resin linings of cans for food and infant formula.
- In some medical equipment, dental sealants, compact disks, and thermal paper (used in some sales receipts, fax paper, and lottery tickets).

How are humans exposed?

Human exposure is primarily through eating food and drinking liquids that were in contact with BPA. BPA can leach from the plastic container or food can liner into foods and beverages. This seems to happen to a greater degree when the liquid is heated or the container is scratched and rough. BPA is absorbed readily when ingested, but the liver quickly metabolizes the chemical. It is excreted in the urine within 24 hours and does not accumulate in the body. In other words, if someone had a single exposure, it would be entirely gone from the body after a day. Repeated exposures are necessary to have measurable levels on a regular basis.

The majority of people in the United States have measurable quantities of BPA in their urine. In 2003-2004, the U.S. Centers for Disease Control and Prevention (CDC) assessed 2,517 US residents aged six and older. BPA was detected in the urine of 93 percent of samples.[1] CDC notes that these data do not mean that adverse health effects occur; they are intended for use as a baseline for the general population.

There can be some environmental exposure, for example from industrial processes and recycling, but these exposures are not considered to be significant under usual circumstances.

There are some studies of BPA levels in particular populations.

- In a study of BPA levels in 40 women at the time of giving birth, all had measurable blood levels. There was no association between BPA levels, length of the pregnancy, or the infants' birth weight. The authors note that long-term study of these children would be required to determine if any health effects were associated with their fetal exposure to BPA.[2]
- In a study of premature infants in neonatal intensive care units, researchers found urine BPA levels higher than in the general population. Levels were highest in infants who were most exposed to medical products containing BPA, including bags for IV fluids and feeding tubes. (This was not a study of possible health effects.)[3]
- In a study of college students who drank almost all of their cold beverages from polycarbonate bottles for one week, their urinary BPA levels increased 69 percent.[4]

Animal studies

Most of the information we have about possible health effects of BPA exposure is from studies in animals. Published animal studies number at least in the hundreds and perhaps in the thousands. The National Toxicology Program (NTP) of the National Institute of Environmental Health Sciences published its evaluation of the potential for adverse effects on human reproduction and development, based on a review of the available literature.[5]

NTP summarized what it considered to be relevant animal studies. In assessing these studies, "high" and "low" daily doses, based on the animals' body weight, were determined. Following is an abbreviated summary of NTP findings from *animal* studies:

- In some studies, but not all, fertility was decreased in adults exposed to BPA.
- At high doses, there were changes in the periods of fertility in female rats and effects on testis cells in male rats.
- There were some negative behavioral effects in how female rats given low doses treated their offspring.
- High doses given to pregnant rats decreased fetal weight and increased fetal death.
- In some studies, high doses given to pregnant rats delayed the onset of puberty in their female offspring, though different studies showed the opposite effect. The same holds true for male offspring.

- Malformations have generally not been identified, though one study showed possible delay in bone formation and another showed some changes in liver cells.
- A preponderance of evidence for low doses of BPA given to pregnant rats suggests changes in brain development and behavior in their offspring.
- There is some evidence of low-dose effects on brain processes involving the neurotransmitter dopamine, thyroid hormone, and regulation of ovulation.
- Some studies have implicated low doses of BPA in behavior changes related to aggression, pain response, anxiety, motor activity, and others.

After evaluating hundreds of studies, NTP noted that enough studies point to effects of BPA on the brain, reproductive tracts, and behavior to raise concerns for possible risks to humans. It further notes that there are so many different types of studies and study designs that their actual relevance to humans cannot be entirely characterized.

Studies in humans

NTP also evaluated studies in humans seeking to determine if BPA exposure affects reproduction or development. It noted that there are only a small number of studies; these cannot be directly compared because of dissimilar study design, small sample sizes, and other factors.

Of the small number of published studies, there are a few which report associations between BPA exposures, as measured in blood or urine, and health effects, such as:

- Higher levels of testosterone in men and women (2 studies);
- Polycystic ovary syndrome (1 study);
- Recurrent miscarriage (1 study);
- Chromosomal defects in fetuses (1 study).

NTP concludes that available studies do not provide enough evidence to determine if BPA causes effects on reproduction in adults. It also concludes that there is not enough evidence to determine if there are developmental effects on children who are exposed to BPA prenatally or during early life.

Areas of controversy

There are differences of opinion among researchers, health care providers, and parents and consumers about how much weight to accord the many different types of research findings.

The chemical industry argues that BPA has been used in consumer products for more than fifty years, it has been approved for food applications by many developed countries, and that human health effects have not been documented.[6]

Some scientists argue that there are too many differences among studies, and too many differences between humans and the animals studied, to draw conclusions. They note, for example, that rats metabolize BPA differently from humans and that infants, children, and adults metabolize BPA differently from each other. Some highlight the fact that hormones produced naturally in the body have different effects at high and low levels and that studies of BPA administered at high levels may not accurately reflect toxic effects of low-level exposure. They also note that comparing studies with different purposes, designs, subjects, amounts and routes of BPA exposure, and endpoints does not lead to convincing data.

Other scientists, along with some health care providers, parents, and consumers argue that the animal data are sufficiently compelling to act aggressively to limit human exposure. They note that the absence of documented effects does not mean that there are no effects, and further note that proving "no effect" is a very high standard, especially when discussing human health, and – more particularly – the health of children.

What steps are being taken to reduce BPA exposure in humans?

The plastics industry has already eliminated BPA in most baby bottles. It is also now possible to buy drinking bottles labeled "BPA free". There are efforts to develop linings for food and formula cans that do not contain BPA.

It's important to note, though, that maintaining canned food in a condition safe for human consumption remains essential. In addition, the U.S. Food and Drug Administration (FDA) recognizes that a safe source of nutrition for infants is a priority that currently outweighs possible concerns about BPA in infant formulas or foods for children.

What are the next steps?

Since most human exposure to BPA is through food sources, FDA is working with the NTP to research the potential effects of BPA on the brain, behavior, and prostate glands of fetuses, infants, and young children. While this evaluation is occurring, FDA is also taking steps to limit human exposure to BPA by supporting of industry efforts to limit or eliminate BPA in food can linings and infant bottles.[7] It has prohibited use of BPA in baby bottles and sippy cups.[8]

How can consumers avoid BPA?

There are steps that concerned parents and consumers can take to limit exposure to BPA.

- Use baby bottles made of non-BPA plastic.
- Consider purchasing powdered formula rather than canned formula.
- Serve canned formula at room temperature or warm it in a non-BPA baby bottle. Do not heat the formula in the can.
- Use drinking cups and water bottles labeled "BPA free".
- Do not heat liquids or foods in containers that do or might contain BPA, as heat increases the amount of BPA that leaches into food. BPA-containing plastics typically have the recycling code "7" on the bottom.
- Consider using fresh and frozen foods instead of canned foods.

SUMMARY: Bisphenol A (BPA) is a plastic found in some hard plastic (polycarbonate) water bottles, baby bottles, infant cups, and metal can linings, including the linings of some canned baby formula. It has been used since at least the 1960s but lately there have been conflicting stories in the media about the safety of BPA. Should you be concerned?

Some groups have stated that this chemical is harmful to humans, especially children. Others state that there is a long history of safe use and that concerns are exaggerated.

Is BPA harmful?

- In November 2006, the European Food Safety Authority concluded that studies of BPA in rodents did not demonstrate clearly that there was harm that could be reliably quantified. It was also noted that humans who swallow BPA eliminate it very quickly compared to the rodents that were studied.
- In August 2008, the U.S. Food and Drug Administration (FDA) reported that, based on currently available research, the amount of exposure to BPA from food sources was safe.
- In September 2008, the National Toxicology Program Center for the Evaluation of Risks to Human Reproduction, National Institutes of Health, issued a report based on very low-level exposures in laboratory animals. Based on these studies, the National Toxicology Program raised the need for further study to determine if BPA might affect the brain, behavior, and prostate gland in fetuses and young children.
- In 2009, the American Chemistry Council, Inc. stated that BPA is safe and compiled a list of international agencies which ACC states have ruled on the safety of BPA.
- In the fall of 2009, FDA issued a review of studies of low-dose exposure to BPA and asked government scientists to evaluate this review document.
- In January 2010, the U.S. Centers for Disease Control and Prevention noted that almost everyone tested in the U.S. has some BPA in their urine, and that human health effects at the levels found are unknown.
- In January 2010, FDA announced that it is seeking additional research into possible human health effects and taking steps to decrease the amount of BPA that humans are exposed to.
- In March 2013, FDA's assessment was that "BPA is safe at the very low levels that occur in some foods."

Where does this leave the average consumer? In some cases, it's getting easier to avoid BPA, as manufacturers are discontinuing its use. Here are guidelines for people who are trying to avoid BPA.

- Baby bottles and sippy cups manufactured in the U.S. since 2012 are BPA-free by law.[8] Most baby bottles manufactured between 2009 and 2012 were also BPA free. Contact the manufacturer if you're not sure about the older brands.
- Look for reusable water bottles labeled "BPA-free". More and more like this are coming on the market.
- Plastics marked with recycle codes 1, 2, 4, 5, and 6 are unlikely to contain BPA, according to FDA.
- Discard scratched baby bottles, infant feeding cups, and water bottles. Minute amounts of BPA might leak into the contents; in addition, damaged areas could provide a hiding place for germs.
- Canned baby formula may or may not have BPA in the lining. In fact, different lots from the same manufacturer may have differences in the BPA content (though very small amounts are involved). FDA believes that the benefits of consistent,

complete nourishment for infants not being breast-fed outweigh any slight risk of as-yet undetermined health effects. Manufacturers are seeking non-BPA-containing liners that can withstand the heat used to process cans of formula.

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Prevention Tips

There are steps that concerned parents and consumers can take to limit exposure to BPA.

- Use drinking cups and water bottles labeled "BPA free".
- Use baby bottles made of non-BPA plastic. (Hard plastic baby bottles have not contained BPA for several years.)
- Consider purchasing powdered formula rather than canned formula.
- Serve canned formula at room temperature or warm it in a non-BPA baby bottle. Do not heat the formula in the can.
- Do not heat liquids or foods in containers that do or might contain BPA, as heat increases the amount of BPA that leaches into food. BPA-containing plastics typically have the recycling code "7" on the bottom.
- Consider using fresh and frozen foods instead of canned foods.

For More Information

Limiting consumer exposure to BPA (https://www.niehs.nih.gov/health/topics/agents/sya-bpa/index.cfm) (National Institute of Environmental Health Sciences)

State-by-state restrictions on the manufacture, sale, and/or use of BPA in consumer products (https://www.ncsl.org/research/environment-and-natural-resources/policy-update-on-state-restrictions-on-bisphenol-a.aspx) (National Conference of State Legislatures)

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Items of interest:

Poison Statistics (https://www.poison.org/poison-statistics-national) | Jingles (https://www.poison.org/jingles) | Spike Program (https://www.poison.org/spike)