

Aluminum and Alzheimer's disease

Does aluminum play a role in causing Alzheimer's disease?

Thinking about whether aluminum plays any role in Alzheimer's disease has evolved over the 40 years that researchers have been exploring this question. The theory that aluminum might be involved emerged in the 1960s after scientists discovered that exposing rabbits' brains to aluminum caused nerve cell damage with some similarity to Alzheimer pathology. Physicians also noted that people undergoing long-term dialysis sometimes develop a non-Alzheimer form of dementia caused by a buildup of aluminum in the bloodstream. These observations raised the specter that aluminum might be one of the first substances implicated in triggering Alzheimer's.

However, studies since then have failed to document a clear role for aluminum in causing Alzheimer's. Every perspective from which researchers have explored the question has yielded contradictory data. For virtually every study suggesting that aluminum may be linked to Alzheimer's, there is another study failing to confirm those results.

The vast majority of mainstream scientists now believe that if aluminum plays any role at all in Alzheimer's, that role is small. If aluminum exposure had a major impact on risk, scientists would have gained a clearer picture of its involvement over the decades that they have been studying the issue, even though certain factors hamper research.

One such issue lies in the widespread occurrence of both aluminum and Alzheimer's, which complicates the effort to characterize their relationship. Aluminum is Earth's third most common element after oxygen and silicon, and Alzheimer's occurs frequently in older adults. Another factor is the lack of an animal model in which to study aluminum's effects.

The best animal models of Alzheimer's disease are mice that are genetically engineered to mimic human Alzheimer

pathology, but mice lack sensitivity to aluminum. Rabbits have the necessary sensitivity, but there is no transgenic Alzheimer rabbit model.

Although research into the Alzheimer's/aluminum connection continues, most mainstream health professionals believe, based on current knowledge, that exposure to aluminum is not a significant risk factor. Public health bodies sharing this conviction include the World Health Organization (WHO), the U.S. National Institutes of Health (NIH), the U.S. Environmental Protection Agency (EPA) and Health Canada. Further, it is unlikely that people can significantly reduce their exposure to aluminum through such measures as avoiding aluminum-containing cookware, foil, beverage cans, medications and other products. Even if aluminum were clearly implicated in Alzheimer's, these routes of exposure account for only a small percentage of the average person's intake. Most experts encourage people to focus wellness efforts with a proven impact on health or quality of life — avoiding smoking, exercising regularly, eating moderately, maintaining social connections, and remaining intellectually active.

What kinds of contradictory data have emerged over the years?

The following points summarize some of the conflicting findings about aluminum and Alzheimer's disease:

- Aluminum is known to be toxic to the nervous system, but its effects differ from those of Alzheimer's disease.
- Some studies show elevated aluminum levels in the Alzheimer brain, but others do not. These studies include both "bulk" investigations measuring amounts of aluminum by weight and advanced analysis using laser microprobes.
- There is some evidence that in laboratory cultures of nerve cells, aluminum promotes aggregation of the protein fragment beta-amyloid into the amyloid

plaques that are a hallmark of Alzheimer abnormality. However efforts to correlate aluminum levels with plaque density in people with Alzheimer's have been inconclusive.

- Research has failed to document a clear elevation of Alzheimer risk in individuals with occupational exposure to aluminum.
- Studies finding the most consistent link have examined elevated levels of aluminum in drinking water and increased incidence of Alzheimer's. However, there is no evidence that Alzheimer's disease is more prevalent in cultures that traditionally drink large amounts of tea, even though tea is one of the few plants whose leaves accumulate large amounts of aluminum that may leach into the brewed beverage.

Where can I get more information about aluminum and Alzheimer's?

The Alzheimer's Association Green-Field Library has compiled a comprehensive reading list on Aluminum and Alzheimer's Disease that offers five pages of relevant print and electronic citations. To request a copy, please contact the library at 312.335.9602.

The Alzheimer's Association, the world leader in Alzheimer research, care and support, is dedicated to finding prevention methods, treatments and an eventual cure for Alzheimer's.

24/7 Helpline **1.800.272.3900**

TDD Access **312.335.8882**

Web site **www.alz.org**

e-mail **info@alz.org**

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This fact sheet answers the most frequently asked health questions (FAQs) about aluminum. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It is important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Everyone is exposed to low levels of aluminum from food, air, water, and soil. Exposure to high levels of aluminum may result in respiratory and neurological problems. Aluminum (in compounds with other elements) has been found in at least 606 of the 1,678 National Priority List (NPL) sites identified by the Environmental Protection Agency (EPA).

What is aluminum?

Aluminum is the most abundant metal in the earth's crust. It is always found combined with other elements such as oxygen, silicon, and fluorine. Aluminum as the metal is obtained from aluminum-containing minerals. Small amounts of aluminum can be found dissolved in water.

Aluminum metal is light in weight and silvery-white in appearance. Aluminum is used for beverage cans, pots and pans, airplanes, siding and roofing, and foil. Aluminum is often mixed with small amounts of other metals to form aluminum alloys, which are stronger and harder.

Aluminum compounds have many different uses, for example, as alums in water-treatment and alumina in abrasives and furnace linings. They are also found in consumer products such as antacids, astringents, buffered aspirin, food additives, and antiperspirants.

What happens to aluminum when it enters the environment?

- Aluminum cannot be destroyed in the environment, it can only change its form.
- In the air, aluminum binds to small particles, which can stay suspended for many days.
- It can dissolve in lakes, streams, and rivers depending on the quality of the water.
- It can be taken up by some plants from soil.
- Aluminum is not accumulated to a significant extent in most plants or animals.

How might I be exposed to aluminum?

- Virtually all food, water, air, and soil contain some aluminum.
- Eating small amounts of aluminum in food.
- Breathing higher levels of aluminum dust in workplace air.
- Living in areas where the air is dusty, where aluminum is mined or processed into aluminum metal, near certain hazardous waste sites, or where aluminum is naturally high.
- Eating substances containing high levels of aluminum (such as antacids) especially when eating or drinking citrus products at the same time.
- Children and adults may be exposed to small amounts of aluminum from vaccinations.
- Very little enters your body from aluminum cooking utensils.

How can aluminum affect my health?

Exposure to aluminum is usually not harmful, but exposure to high levels can be. Workers who breathe large amounts of aluminum dusts can have lung problems, such as coughing or abnormal chest X-rays. Some workers who breathe aluminum dusts or aluminum fumes have decreased performance in some tests that measure functions of the nervous system.

Some people with kidney disease store a lot of aluminum in their bodies and sometimes develop bone or brain diseases which may be caused by the excess aluminum. Some studies show that people exposed to high levels of aluminum may develop Alzheimers disease, but other studies have not

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found this to be true. We do not know for certain whether aluminum causes Alzheimers disease. People may get skin rashes from the aluminum compounds in some underarm antiperspirants.

We do not know if aluminum will affect reproduction in people. Aluminum does not appear to affect fertility in animals.

How likely is aluminum to cause cancer?

The Department of Health and Human Services (DHHS) and the EPA have not evaluated the carcinogenic potential of aluminum in humans. Aluminum has not been shown to cause cancer in animals.

How can aluminum affect children?

Children with kidney problems who were given aluminum in their medical treatments developed bone diseases. We do not know if aluminum will cause birth defects in people. Birth defects have not been seen in animals. Large amounts of aluminum have been shown to be harmful to unborn and developing animals because it can cause delays in skeletal and neurological development. It does not appear that children are more sensitive to aluminum than adults.

There does not appear to be any difference between children and adults in terms of how much aluminum will enter the body, where aluminum can be found in the body, and how fast aluminum will leave the body. Aluminum from the mother can enter her unborn baby through the placenta. Aluminum is found in breast milk, but only a small amount of this aluminum will enter the infants body through breastfeeding.

How can families reduce the risks of exposure to aluminum?

- Since aluminum is so common and widespread in the environment, families cannot avoid exposure to aluminum.
- Avoid taking large quantities of aluminum-containing antacids and buffered aspirin and take these medications as directed.

- Make sure all medications have child-proof caps so children will not accidentally eat them.

Is there a medical test to determine whether I've been exposed to aluminum?

All people have small amounts of aluminum in their bodies. Aluminum can be measured in blood, bones, feces, or urine. Urine and blood aluminum measurements can tell you whether you have been exposed to larger-than-normal amounts of aluminum. Measuring bone aluminum can also indicate exposure to high levels, but this requires a bone biopsy. Tests to measure aluminum levels in the body are not usually available at a doctors office because they require special equipment.

Has the federal government made recommendations to protect human health?

The EPA has recommended a Secondary Maximum Contaminant Level (SMCL) of 0.050.2 milligrams per liter (mg/L) for aluminum in drinking water. The SMCL is not based on levels that will affect humans or animals. It is based on taste, smell, or color.

The Occupational Safety and Health Administration (OSHA) has determined that the amount of aluminum in dusts that workers breathe should not be more than 15 milligrams per cubic meter (mg/m³) of air.

The Food and Drug Administration (FDA) has determined that aluminum cooking utensils, aluminum foil, antiperspirants, antacids, and other aluminum products are generally safe.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2006. Toxicological Profile for Aluminum (Draft for Public Comment). Atlanta, GA: U.S. Department of Public Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology and Environmental Medicine, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-800-232-4636, FAX: 770-488-4178. ToxFAQs Internet address via WWW is <http://www.atsdr.cdc.gov/toxfaq.html>. ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

