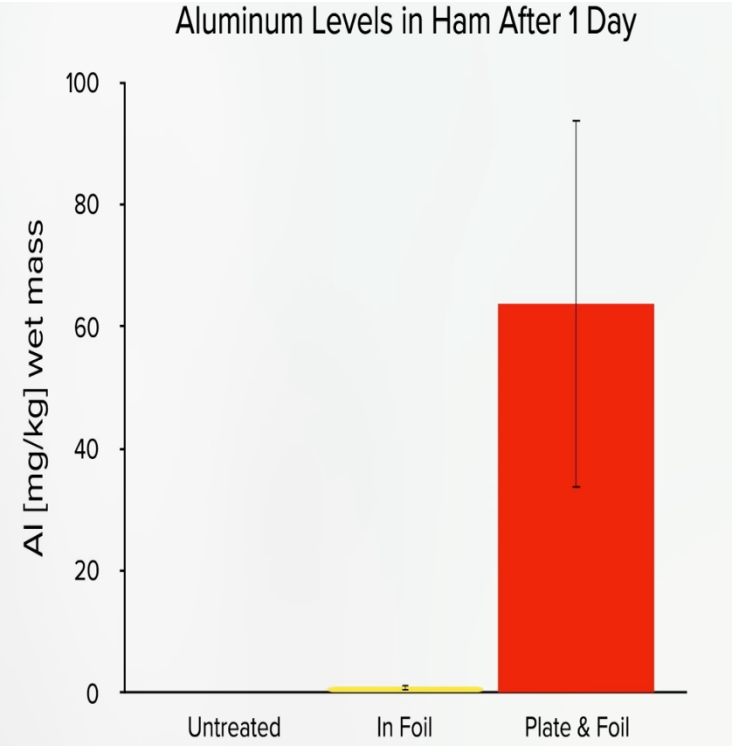
Aluminum

DISCLAIMER: the following is not meant to treat anyone with advice or tell you what you should do, such as relative to use of medication, exercise, or changing your diet. The information in this handout is merely offering what has been published in the research literature, as well as based on my professional experience. Talk to a doctor or other appropriate professionals as to what is best for your own specific needs.

It should also be appreciated that everyone has their own perspective on how to improve health. Nutritionists do it through food. Physicians do it through medicine. Psychologists do it through changing thoughts, feelings, and behaviors. Consequently, what is offered here is a reflection of my own bias and perspective.

Aluminum has no purpose in the human body, meaning it is not needed. It is the third most abundant element in the earth's crust and it occurs naturally in food and water. It is also used in

- pots, pans, and baking trays. There was a small study done in India (Indian Journal of Public Health, "Usage of aluminum vessels in various types of cooking procedures by subjects age 60 years and above residing in Urban Vadodara and its correlation with Alzheimer's disease" Mini Sheth et al, April-June 2022) on 90 people who had severe or mild-to-moderate Alzheimer's, or were normal, and who were age 60 or older. Those who used aluminum cookware the least were in the normal category, and those using them the most in the severe category. Frying, boiling, and roasting/sauteing in them was significantly associated with Alzheimer's. This does not prove there was causation, but it again offers reason to give pause and thinking about whether use of such cookware is advised. Use of steel utensils on aluminum cookware can scrape aluminum into food, causing additional toxicity. There is some research that has found that about 20% of the daily intake of aluminum comes from use of such pots & pans, trays and kettles. (Clinical Biochemistry, "The relationship between plasma aluminum content, lymphocyte DNA damage, and oxidative status in persons using aluminum containers and utensils daily" Hakim Celik et al, Dec. 2012). Acidic foods like tomatoes and citrus can dissolve aluminum, but the article notes that just boiling water can release significant aluminum. The study found that the aluminum cookware using group had roughly twice as much aluminum in their blood as the non-using group. There was also significantly more DNA damage being done, and significantly lower levels of antioxidants in the aluminum group.



❖ aluminum foil including baking cups (one study found food cooked in aluminum baking cups vs. silicone ones had high levels of aluminum and at a level considered unacceptable to the WHO). There is other research which says that there is just a marginal increase in a person's body from using foil. However, if the foil is in contact with certain metal alloys like stainless steel can set up a battery effect which can cause tremendous aluminum concentrations. The graph to the left reflects one example of foil by itself or touching a metal plate and the greatly increased aluminum that gets into food as a result.

https://nutritionfacts.org/video/friday-favorites-are-aluminum-stainless-steel-cast-iron-and-teflon-safe/

- ❖ aluminum containing food packaging
- ❖ cosmetic products (e.g. antiperspirants, sun creams, toothpaste)

Table 5

Aluminum concentration in some cosmetics (Borowska and Brzóska 2015)

Products	Al content (mg/kg)
Eye shadow	20,000–50,000
Mascara	117–20,000
Lipsticks	14.2–27,032
Lip glosses	0.415–10,536
Foundations, compact powders	33.26–18,661.5
Creams	15.31–62.17
Muds from the Dead Sea	4500–7900
Hand creams	5400–8500
Facial mask	170–650
Henna	142.1
Kohl	56.75–1009.3

Table taken from "Environmental Science and Pollution Research International, "Aluminum environmental pollution: the silent killer" Reema Alasfar & Rima Isaifan, July 2021).

- ❖ drugs (e.g. antacids like Maalox, Mylanta, Gaviscon, Riopan, Alka-Seltzer, Rolaids and others, may contain ~104-208 mg/tablet, buffered aspirin which may contain 10-20 mg/tablet. It has been noted that during pregnancy many women take antacids that contain aluminum. Based on pregnant rat research it has been suggested that antacids be consumed with precautions and limitations to avoid aluminum's fetal toxicity.)

- baking powder
- anticaking agents
- antiperspirants contain aluminum chloralhydrate or other aluminum compounds to inhibit sweating. Small amounts of aluminum can be absorbed through the skin when anti-perspirants are used but given the years or decades of such usage it can accumulate. One study offered "Aluminum is neurotoxic and the concentrations of aluminum found in [the brains of those with Alzheimer's] are unlikely to be benign and indeed are highly likely to have contributed to both the onset and the aggressive nature of any ongoing Alzheimer's in these individuals. These data lend support to the recent conclusion that brain aluminum will contribute towards all forms of Alzheimer's disease under certain conditions." (Journal of Trace Elements in Medicine & Biology, "Aluminum in brain tissue in familial Alzheimer's disease" Ambreen Mirza et al, March 2017). Other research offers that it "affects the cholinergic system which has been shown to degenerate in Alzheimer's disease pathogenesis. Thus… aluminum chelation has been studied as a potential therapy for Alzheimer's disease." (Journal of Molecular Biology, "Metal toxicity links to Alzheimer's disease and neuroinflammation" Tee Jong Huat et al, April 2019).
- processed cheese
- parenteral nutrition
- bleached flour
- food dye (such as for buffered aspirin, e.g. yellow #6)
- peppermint, spearmint, and wintergreen
- pickles
- nasal sprays
- vaccines (said to be no greater than 0.85 mg/dose. Aluminum in them can cause redness, pain, and itchiness at the injection site.)

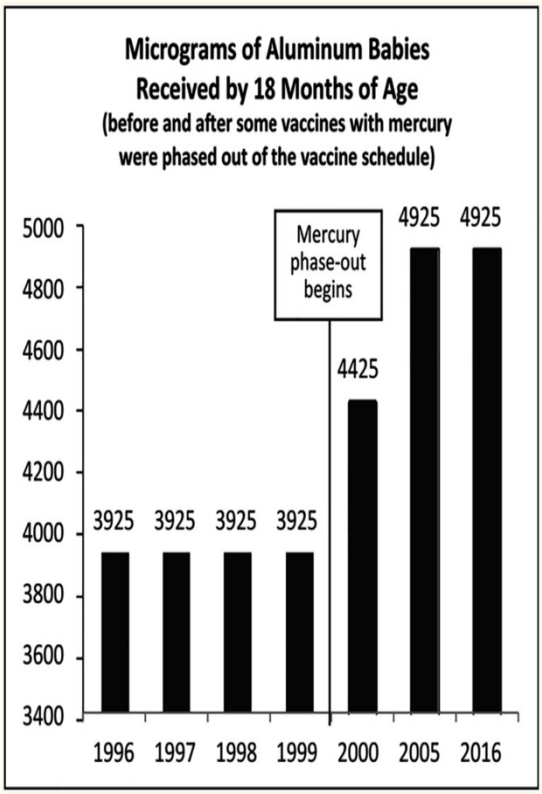


Fig. 4

Aluminum content in vaccination (1996–2016) (Miller 2016b)

Graph taken from "Environmental Science and Pollution Research International, "Aluminum environmental pollution: the silent killer" Reema Alasfar & Rima Isaifan, July 2021).

They also note that "aluminum accumulates in the fetal tissue since it passes through the placenta. This means that infants are receiving a considerable amount of aluminum even before they are born. The injection of aluminum adjuvants (a chemical that increases the efficacy) repeatedly during the critical period where the child's brain is developing is of significant concern. A neonate has an immature renal system that lowers the ability to effectively eliminate the neurotoxic aluminum from the body. The FDA has established in 2004 the aluminum limit from injection sources for premature infants to be <4-5 mcg/kg of body weight/day and confirmed that above this level, there is a potential for bone and central nervous system toxicity. However, infants are receiving 14.7-18.4 times more than this FDA limit from only one dose of Hep B vaccine. Vaccine-derived aluminum has a much greater potential to induce neurological damage than that obtained through diet, even in those with effective renal function."

Foods that contain aluminum include

- apples
- bananas
- cabbage
- carrots
- cheese (which contains the most of any food as an additive as to it giving a softer texture and better slicing properties. One cheese sandwich has as much as a dozen aluminum-containing vaccines. Research has found that cheese in a serving of frozen pizza had up to 14 mg of aluminum while the same ready-to-eat restaurant pizza had 0.3-0.09 mg)
- citrus
- non-dairy creamer (up to 1.5 mg/serving)
- eggs
- fish
- ham
- infant formula (one study found that such formula is a major contributor to the high aluminum level found in baby's brains. The American Academy of Pediatrics has said there is a great need to document health hazards associated with high levels of aluminum in infant formula especially for preemies and those with impaired kidney function.)

- peaches
- pears
- plums
- potatoes
- poultry
- red meat
- seaweed
- shellfish (the food with the highest amount from natural sources)
- spinach
- squash
- tea
- tomatoes
- wine

The average American adult is said to eat 7-9 mg/day through their food. However, one research project offered that "Baking powder, some pancake/waffle mixes, and frozen products, and ready-to-eat pancakes provided the most aluminum of the foods tested, up to 180 mg/serving. Many products provide a significant amount of aluminum compared to the typical intake of 3-12 mg/day reported from dietary aluminum studies conducted in many countries." (Food Additives & Contaminants, "Aluminum content of some foods and food products in the USA, with aluminum food additives" Salim Saiyed et al, Feb. 2007).

Only about 0.1% of aluminum that is orally ingested is absorbed by the GI system and made available to the body. However, it can accumulate in the brain, kidneys, lungs, liver, and thyroid where it competes with calcium for absorption and can affect skeletal mineralization meaning weakened bone tissue (osteomalacia).

Research has found that people with Alzheimer's, multiple sclerosis, and autism spectrum disorder have elevated levels of aluminum in the brain. That does not necessarily mean it caused the disease. And interestingly, increased aluminum levels were not associated with increased age, so aluminum accumulation is not an inevitable part of aging. However, numerous research studies find that aluminum is toxic by creating mitochondrial dysfunction, being inflammatory and prooxidant, and leading to increased cell death. A French study on almost 4000 older adults found that levels of aluminum in drinking water in excess of 0.1 mg/day were associated with a doubling of dementia risk and three-fold increase in the risk of Alzheimer's (BMC Geriatrics, "Environmental risk factors for dementia: a systematic review" LOJ Killin et al, 2016).

The tolerable weekly intake (TWI) set by the European Food Safety Authority is 1 mg/kg of body weight. The estimated daily intake for some adults is slightly greater than that (0.2-1.5 mg/kg). Exceeding this TWI value does not mean there is an acute health hazard. Exposure through the GI tract or intact skin is very mild. Determining exposure through blood or urine levels is considered a better measure for assessing potential aluminum toxicity.

Occupational exposure such as aluminum welders show significantly higher levels, but neurotoxicity was not investigated. Other sources of aluminum include antiperspirants which are said to have a very low rate of penetration through the skin.

Aluminum salts are used as adjuvants in vaccines and the potential risk of this is being debated now. Research such as measuring blood and urine levels and neurotoxic effects are mostly lacking. There has been some research using neuropsychological tests on occupational workers where approximately 13 mcg/liter in plasma was measured and the neurotoxicity found was considered to be causal.

There is research on anti-perspirants containing aluminum and health risks (International Journal of Cosmetic Science, "Impact of shaving an anti-perspirant use on the axillary vault" G.A. Turner, et al, Nov. 2006). Shaving removes a thin layer of skin along with hair. Very little aluminum is absorbed through intact skin, after shaving there is a 6-fold increase in the amount of absorbed. There was research (European Journal of Cancer Prevention, "An earlier age of breast cancer diagnosis related to more frequent use of antiperspirants/deodorants and underarm shaving" K.G. McGrath, 2003). And shaving the armpits and using such deodorants more than three times a week was associated with an earlier age of breast cancer diagnosis. For those who started before or after the age of 16 appeared to move up their diagnosis by 10-20 years. They concluded "underarm shaving with antiperspirant … use may play a role in breast cancer."

Aluminum and fluoride can be found together in drinking water and the two minerals together are synergistic as to fluoride increasing the absorption of aluminum. The most common way aluminum gets into drinking water is through surface runoff and soil seepage, as to water flowing over rocks that high concentrations of the mineral, and traces dissolve into it. Acid rain is another common cause of high aluminum concentrations in surface water. Moreover, some public drinking water treatment facilities add aluminum to water to remove organic matter, turbidity, and microorganisms. The only accurate way to know if your drinking water contains aluminum is to test it. Fluoride has been added to water supplies for decades against tooth decay.

A Scottish study found that higher levels of the two minerals together were related to increased risk of dementia with a dose-response pattern. Dementia risk more than doubled in the highest quartile vs. the lowest. Such dementia risk was found in people who consumed relatively small drinking-water levels of both.

There has been a question about aluminum causing Alzheimer's and it has not been proven at this time. Elevated concentrations of aluminum can be found in the brains of these patients but it is not known if it is causing the disease or is independent of it. There is a concern that aluminum may be related to Parkinson's. There is also a question about aluminum lowering sperm count and quality based on some research done in the U.K. Other research suggests that toxic aluminum levels can lead to myocarditis, thrombosis and ischemic stroke, Crohn's disease, IBD, anemia, dementia, autism, osteomalacia, liver and kidney disease, breast cancer and cyst, pancreatitis, and diabetes (Interdisciplinary Toxicology, "Aluminum toxicosis: a review of toxic actions and effects" Ikechukwu Igbokwe et al, Feb. 2020).

Aluminum's neurotoxicity includes it having an affinity for protein and it can impact the brain including possibly breaking down the blood-brain barrier, as well potentially causing inflammation of the brain. Some people have shown disorientation, memory impairments and in more advanced cases dementia. Some of this is due to the aluminum being slowly removed from the brain. Aluminum also impacts the hippocampus, the center of memory for the brain. And neurons that pick up on acetylcholine, the neurotransmitter heavily involved with memory, are especially vulnerable to aluminum neurotoxicity.

There is also some research that is based on over 325,000 kids born between 2008 - 2014, and followed through 2017. Kids who received vaccines with at least 3 mg of aluminum before the age of 24 months were 36% more likely to be diagnosed with asthma compared to those who got less than 3 mg of such exposure.

The kidneys are a primary route for removing aluminum from the body. Those who have kidney disease therefore are more at risk for higher levels of the metal in the body. Patients undergoing hemodialysis are also susceptible to aluminum toxicity, and may have reduced visual memory function when high levels of aluminum are present according to some research. Brain and bone disease have been found in kids with kidney disease, which might also have arisen from the meds they were on. But aluminum can block the absorption of phosphate which is needed in the bones.

Toxicity

Aluminum in kids can prevent phosphate being absorbed which affects bone development. Aluminum has been found in breast milk, typically ranging from .0092-0.49 mg/l. It also has been found in soy-based infant formula (0.46-0.93 mg/l) and milk-based formula (0.058-0.15 mg/l).

Workers who breathe large amounts of aluminum dust can develop respiratory problems and use of breathing masks can eliminate this. Some individuals with kidney disease store more aluminum in their bodies as to it not being eliminated as well. Some of these people can develop brain or bone diseases that may be caused by excessive aluminum. Some adverse effects have been observed following long-term use of OTC oral products that contain aluminum.

The FDA has determined that aluminum as a food additive and in medicine such as antacids is generally safe. Others do not fully agree with such a statement. e.g. "Aluminum is a toxic metal known as a neurotoxic agent. Aluminum in vegetable, fruit or seafood groups are higher than in other groups. The GI absorption of aluminum is low, but there are many dietary sources and therefore, in some cases, the aluminum level may pose a risk. It is therefore necessary to control the level of aluminum in certain types of food, because of the toxic effects of aluminum in the human organism." (HSOA Journal of Food Science & Nutrition, "Aluminum exposure through the diet" Arturo Hardisson et al, June 2017.)

The general attitude is to keep aluminum exposure as low as possible. Blood testing for aluminum is said not to be a good indicator of total body load of aluminum because it can be stored in the brain and lung at much higher levels. Hair testing appears to correlate well with bone levels of aluminum.

It is also stored in the liver and thyroid. Levels in most tissues do not increase with age, but those in the lungs and brain show significant accumulation with age. There is said to be extensive evidence that aluminum penetrates the blood-brain barrier and is excreted in breast milk. Most plasma aluminum excretion is through urine and feces. Kidney failure is known to drastically increase aluminum toxicity. The only known drug known to increase elimination of it deferoxamine. Its use is still being evaluated. Use of the drug is not without risk because it can also reduce iron and copper levels along with aluminum.

Research is not conclusive but suggests that aluminum inhibits cholinergic functioning and may inhibit synaptic uptake of dopamine and norepinephrine. In humans, dementia resulting from dialysis is related to aluminum and results in memory loss, impaired coordination, confusion, and disorientation.

Several hair tests may be needed before it is revealed because the aluminum may be tightly bound within body tissues and several months of a nutrition program may be required to mobilize the aluminum to be eliminated.

As to removing aluminum from your body some experts voice concern that if you try to flush out toxic elements too fast, what might happen is that it goes from being locked up in your body to suddenly flushed into your blood stream and hits you with a more serious and acute poisoning. Consequently, they recommend that you first strengthen yourself nutritionally such as by looking at mineral and vitamin levels and getting them up to snuff, before you flush anything out of your system.

That said, there are some 'natural' ways that might help remove aluminum from the body. Most of such research has been done on animals rather than people. Possibilities include use of garlic, cilantro, chlorella (a seaweed that can be found in capsule form), milk thistle, turmeric, and flax seed. Vitamin C can help chelate aluminum. Extra fiber through a diet rich in organic fruits and vegetables may help too. Everything can have side effects so there is a need to be careful in use of any of these as well. Animal research suggests that deficiencies in calcium and magnesium may lead to aluminum accumulating in the brain and bone, and having higher iron levels may lead to less accumulation of it. So it is suggested that having adequate intake of calcium, magnesium and iron may protect against aluminum accumulation. Magnesium can help support the detox of aluminum. However, there is again a need to be careful about any of these minerals becoming too high and causing problems by throwing something else out of balance.

Other approaches may include use of silica which binds up the aluminum and allows it to be passed out through the kidneys. This helps reduce the amount of free aluminum available in the body to damage cells. Bottled Fiji water is one potential source of significant silica. There are other sources of silica in food but there is also a question of what percentage absorption does it have. Some foods that are high in silica and absorption include:

- green beans
- whole oats

- barley
- potatoes (including the skin)
- some beer (e.g. Indian pale ales)

Selenium is said to be protective of aluminum, but excess amounts of it can be harmful. Zinc may also be helpful in ameliorating the negative effects of aluminum in the brain, but again, excess amounts can be harmful in other ways such as reducing copper levels which is a needed nutrient. Another approach that has some research behind it is sweating through use of a steam or infrared sauna. Such sweating was found to be good in helping to eliminate heavy metals including lead, cadmium, and aluminum, along with others such as nickel (Archives of Environmental Contamination & Toxicology, "Blood, urine and sweat (BUS) study: monitoring and elimination of bioaccumulated toxic elements" Stephen Genius, et al, Nov. 2010). You should have appropriate cardiovascular health before making use of a sauna and should talk to your doctor if you are unsure about this issue. You need to drink water before or after sauna use as to dehydration as well as consider replenishing electrolytes that are lost to sweating too.

There is also chelation therapy such as through use of EDTA and zeolites. Talk to a physician about any risks they may have. Side effects might include dehydration, low calcium levels, kidney damage, elevated liver enzymes, allergic reactions, lower levels of some nutrients like zinc, and even death.