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New Study Links Arsenic Exposure to Higher Risk of Fatty Liver Disease

Analysis by Dr. Joseph Mercola | November 13, 2025

STORY AT-A-GLANCE

- Fatty liver disease (FLD) develops when fat builds up in liver cells, straining an organ vital for energy, metabolism, and detoxification. It is now the leading chronic liver disease worldwide and affects four in 10 U.S. adults
- A new study in the Journal of Translational Gastroenterology found higher urinary arsenic levels were strongly associated with a greater risk of FLD in the U.S. population
- Arsenic disrupts liver health by driving oxidative stress, impairing mitochondria, activating fat-storing pathways, and interfering with glucose regulation, all of which accelerate fat buildup and insulin resistance
- Rice and drinking water are the main everyday sources of arsenic exposure, with contamination often exceeding health-based safety limits and posing risks even at "low" levels
- Reducing seed oils and alcohol, improving choline intake, and avoiding arsenic-contaminated foods and beverages are key steps to protect your liver and lower your toxic burden

Fatty liver disease (FLD) develops when fat accumulates in your liver cells, gradually straining an organ that is central to your energy, metabolism, and detoxification. It has become the most common form of chronic liver disease worldwide and a leading cause of liver-related deaths.[1] In the United States alone, FLD affects four in 10 adults.[2]

Conventional medicine divides FLD into non-alcoholic fatty liver disease (NAFLD) and alcoholic fatty liver disease (ALD). The only difference is in the cause — ALD results from alcohol consumption, while NAFLD is linked to metabolic dysfunction.[3] In 2023, NAFLD was renamed metabolic dysfunction-associated steatotic liver disease (MASLD) to emphasize that connection.[4]

However, all three names describe the same illness. Since the added terminology is just medical jargon that does not change the underlying condition, I will use the simpler and clearer term FLD throughout this article.

Although FLD often shows up alongside obesity, diabetes, and high cholesterol, these conditions don't fully explain its rapid rise. Researchers have turned their attention to hidden environmental factors, with arsenic emerging as a major concern. Case in point, a recent study published in the Journal of Translational Gastroenterology set out to determine whether higher arsenic exposure is linked to a greater risk of FLD in humans.[5]

New Study Reveals How Everyday Arsenic Exposure Raises FLD Risk

Your liver is central to nearly every aspect of health. It produces bile to digest fats, regulates blood sugar, stores essential nutrients, and filters toxins from your blood, which makes it especially vulnerable to toxic exposures such as arsenic. To examine how this might be linked to FLD, the featured study drew on data from the National Health and Nutrition Examination Survey (NHANES), which provides a representative snapshot of the U.S. population.[6]

- **How the study was designed and who was included —** The researchers analyzed information collected between 2011 and 2020, focusing on 6,386 adults who had measurements of urinary arsenic levels and liver enzyme activity. People with other major causes of liver disease, including hepatitis B, hepatitis C, or significant alcohol intake, were excluded to make the results more specific.

- **Arsenic exposure was measured in urine samples —** This method allowed researchers to capture exposure levels from food, water, and other environmental sources common in everyday life. To account for differences in hydration that affect urine concentration, arsenic values were adjusted for creatinine, a standard approach in environmental health research.

- **Higher arsenic levels were linked to greater liver injury —** Participants with FLD had higher mean urinary arsenic levels (5.92 micrograms per liter) than those without the condition (5.59 µg/L), and liver enzyme activity rose steadily across arsenic exposure categories.

  Alanine aminotransferase (ALT), an enzyme commonly used as a marker of liver injury, increased in step with arsenic levels. Statistical models confirmed a significant upward trend, even after adjusting for age, sex, body mass index (BMI), smoking, alcohol use, and socioeconomic factors.

- **FLD risk increased steadily with higher arsenic exposure —** When participants were grouped by arsenic exposure quintiles, the odds of having FLD surged with each increase in exposure. Compared to those in the lowest quintile, individuals in the highest quintile had a 55% greater likelihood of FLD.

Since the participants in this study represented the general U.S. population, exposed through everyday routes such as food and drinking water, the results are especially relevant to you. They suggest that even low to moderate arsenic levels — those considered typical in the environment — may influence your risk of developing FLD.

How Arsenic Compromises Your Liver Function

The Journal of Translational Gastroenterology study emphasized that arsenic disrupts liver health through several well-documented biological mechanisms. These pathways explain how exposure contributes to fat buildup in your liver and why the association with FLD is biologically plausible.[7]

- **One of the primary effects is the induction of oxidative stress —** Your liver is constantly balancing the production of reactive oxygen species (ROS) with antioxidant defenses. Arsenic drives that balance toward damage by increasing oxidative byproducts and overwhelming the liver's natural protective systems. This creates a biochemical environment that promotes inflammation and injury to proteins, DNA, and cell membranes.

- **Mitochondrial dysfunction is another central mechanism —** Arsenic interferes with the mitochondria's ability to produce energy efficiently. With energy production impaired, liver cells shift toward less efficient pathways that encourage fat accumulation. Mitochondrial stress also signals inflammation, adding to the burden of injury.

- **The study also pointed to activation of lipogenic pathways —** Arsenic upregulates transcription factors such as PPAR-γ and SREBP-1c, which are master switches for fat metabolism. When these pathways are stimulated, the liver synthesizes and stores more fat than it can manage. The result is steatosis (fat buildup) that sets the stage for metabolic disease.

- **In addition, arsenic disrupts glucose handling —** It reduces glucose transporter 2 levels, which limits the liver's ability to take up and regulate blood sugar. It also decreases glycogen synthesis (the process of storing excess glucose as glycogen for later energy use) by activating the inflammasome, a protein complex that amplifies inflammatory signaling. These changes contribute to insulin resistance, a key driver of FLD progression.

Together, these mechanisms show how arsenic acts as more than just a background contaminant and highlight why it deserves recognition as a metabolic toxin. It actively reshapes the metabolic environment of your liver, making it more vulnerable to fat accumulation, inflammation, and long-term damage.

This Staple Grain Is a Major Source of Arsenic Exposure

Rice is one of the most significant dietary sources of arsenic exposure. The plant grows in flooded conditions that make arsenic more available in the soil and water, and rice roots absorb it more readily than many other crops.[8] Once absorbed, the metal accumulates in the grain, meaning it ends up in the food you put on your table.[9]

- **Testing confirms that this is not a rare occurrence —** Investigations by Healthy Babies Bright Futures (HBBF) found arsenic in every single one of 145 rice samples purchased from U.S. grocery stores. On average, rice contained nearly 85 parts per billion (ppb) of arsenic, while alternative grains such as barley or quinoa contained 69% less heavy metal.

  More than one in four rice products exceeded the U.S. Food and Drug Administration's (FDA) limit for infant rice cereal, a standard designed to protect the youngest and most vulnerable.

- **The type of rice and where it is grown make a difference in contamination levels —** Brown rice, which retains its outer layers, consistently carries more arsenic than white rice because the husk stores higher concentrations of heavy metals. Rice grown in the southeastern United States, especially brown varieties, tested among the most contaminated, reaching 129 ppb of arsenic in some cases.

- **Products made from rice pose additional risks, especially for children —** Rice cereals, rice milk, and snack foods often contain enough arsenic to push exposure well beyond safe thresholds.

  HBBF found that infants and toddlers in Asian American and Latino households consume two to four times more arsenic from rice than the general population because rice is a staple food in these communities. Arsenic also crosses the placenta, exposing unborn children during pregnancy at a time when the brain and kidneys are especially vulnerable.

- **The contamination is not limited to arsenic alone —** Cadmium was found in nearly every rice sample tested, and lead and mercury appeared in smaller amounts. While arsenic remains the most abundant and harmful of these metals, the combination

adds to the toxic burden your body has to process. Over time, this increases the risks for kidney damage, reduced bone strength, developmental delays, and certain cancers.

- **Cooking methods influence how much arsenic ends up on your plate —** Researchers found that boiling rice in six to 10 parts water to one part rice, then draining it before serving, removed up to 60% of arsenic content. Soaking rice overnight beforehand enhanced the effect.

  Rinsing rice alone made little difference, and instant or prepackaged rice products carried additional risks from processing and packaging. For families unable to afford lower-contamination varieties, cooking rice this way provides one of the simplest ways to lower exposure.

- **Safer choices exist if you know what to look for —** California-grown white rice, Indian basmati, and Thai jasmine consistently tested lowest in arsenic and cadmium, with some samples testing at about half the levels of southeastern U.S. brown rice, though they tend to cost more than standard rice. Rotating in other grains such as quinoa, barley, or farro also reduces your toxic load.

  For infants, avoiding rice-based cereals altogether is important, since even homemade versions made from brown rice often exceed safety limits. By choosing varieties with lower contamination and preparing them carefully, you can keep rice in your diet while protecting your liver and overall health.

For a deeper look at how widespread this problem has become, along with practical guidance on choosing safer varieties and preparing rice to reduce your exposure, read "**High Levels of Arsenic Discovered in US Rice**."

How Water (and Even Wine) Adds to Your Arsenic Burden

When it comes to arsenic exposure, what you drink is just as important as what you eat. Water and even wine have been shown to carry levels of arsenic that matter for your long-term health, and both deserve close attention.[10,11]

- **Groundwater contamination is the primary way arsenic enters drinking water —** Naturally occurring deposits in the earth's crust dissolve into aquifers, and in some areas, levels rise far above what regulators consider safe. In the United States, the highest risks occur in regions that rely heavily on private wells, including parts of the Midwest and southwest regions, as well as New England.

  Globally, arsenic-contaminated groundwater is a recognized public health crisis in South Asia, particularly in Bangladesh and India, where millions are exposed to concentrations many times higher than U.S. standards.[12]

- **Health risks linked to contaminated water —** Epidemiological studies show that long-term exposure to contaminated drinking water is linked to a wide range of chronic diseases. Beyond cancer, which has long been associated with arsenic, recent research points to increased risks of heart disease and liver dysfunction.[13]

  The California Teachers Study, which followed nearly 100,000 women for more than two decades, found that even exposure to arsenic levels between 5 and 10 micrograms per liter increased the risk of ischemic heart disease by 18% to 20% compared to women exposed to less than 1 microgram per liter. Importantly, these risks were evident even below the federal drinking water limit.[14]

- **Why the U.S. Environmental Protection Agency (EPA) limits fall short —** The EPA set the maximum contaminant level for arsenic in public water supplies at 10 ppb. But evidence from both cardiovascular and liver studies shows that this threshold is not protective enough. Health effects occur at lower levels, highlighting the gap between regulatory standards and biological reality.

  For people who rely on private wells, the risks are greater still, since testing and regulation are often absent. Reverse osmosis systems and certified filtration technologies remain the most reliable ways to remove arsenic from drinking water. Learn more about this in "**Arsenic in Water: A Hidden Heart Health Threat**."

- **If you drink wine, you could be unknowingly increasing your arsenic intake too —** Testing has revealed that many popular brands contain inorganic arsenic at levels several times higher than the EPA's limit for drinking water. Of more than 1,300 bottles analyzed, nearly one-quarter exceeded the 10-ppb water standard, with the highest levels reaching four to five times that amount. The wines most often flagged were lower-cost labels widely sold in supermarkets.[15]

- **The concern is not limited to numbers on a label —** Inorganic arsenic is a powerful carcinogen and toxicant, and when combined with alcohol, which already stresses your liver, the effects may be magnified. Alcohol accelerates oxidative stress and weakens the body's detoxification systems, creating conditions where arsenic does more harm. Over time, this combination increases your vulnerability to metabolic liver disease and other chronic illnesses.[16]

- **A 2015 lawsuit exposed gaps in wine arsenic regulation —** In 2015, a class-action lawsuit was filed against wineries that sold arsenic-contaminated wines without proper warnings.

  The California Court of Appeals ultimately dismissed the case, ruling that wineries met their obligations under Proposition 65's "safe harbor" requirements, which outline how toxic exposures have to be disclosed. Even so, the litigation drew national attention to a regulatory gap — unlike water, wine has no federal arsenic limits.[17,18]

Arsenic exposure through what you drink is easy to overlook. Whether it comes from the water you rely on every day or the wine you enjoy on occasion, these exposures add up. By testing your water, using proper filtration, and being selective with the beverages you buy, you reduce the toxic burden your body has to handle and give your liver the protection it needs.

5 Strategies to Improve Liver Health

Lowering arsenic exposure is only part of protecting your liver health — you also need to supply it with the nutrients it needs to rebuild. Combined with steady daily habits, these targeted strategies create the foundation for lasting repair:

1. **Dietary choline sources —** Choline is the cornerstone of liver recovery, and food remains its most important source. Egg yolks, in particular, are the richest and safest way to meet your needs.[19] Muscle meats and fish provide moderate amounts of choline and can be part of a balanced diet when paired with other nutrients.[20]

   Some plant foods, like soybeans and cruciferous vegetables, like cauliflower, broccoli, and Brussels sprouts, provide smaller amounts of choline.[21] While they contain less than meat or eggs, they still help support intake, especially for those eating vegetarian or vegan diets.

2. **Efficient choline supplementation —** Consider supplementing if your diet falls short, but keep in mind that not all forms of choline supplements are created equal. I recommend citicoline (also known as CDP-choline) because it is highly bioavailable and increases both phosphatidylcholine (PC) and phosphatidylethanolamine (PE).

   These two phospholipids strengthen liver cell membranes, support mitochondrial integrity, and enable the export of triglycerides from your liver through very low-density lipoproteins (VLDL).[22] Unlike some other choline forms, citicoline does not significantly raise trimethylamine N-oxide (TMAO), a metabolite linked to cardiovascular risk.

   At daily doses of 500 to 2,500 milligrams, citicoline does more than optimize your liver function. It also supports your brain by increasing acetylcholine, the neurotransmitter that drives memory, focus, and mental clarity. If you struggle with fatigue, brain fog, or early signs of liver stress, citicoline offers targeted support for both your liver and your mind.

3. **Supportive nutrients for PC/PE balance —** Your liver needs certain nutrients called methyl donors — folate (B9), vitamin B12, and methionine — to run a vital repair process. This process, known as the PEMT pathway, takes PE and converts it into

PC. PC also plays a key role in packaging fat so it can be moved out of your liver instead of being stored there.

If you don't get enough of these methyl donor nutrients, this conversion slows down, PC levels drop, and fat begins to build up in your liver. To keep this process running smoothly, make sure you're getting them regularly from your diet:

- **Folate (B9) —** Beef liver, dark leafy greens such as spinach and kale, and asparagus[23]
- **Vitamin B12 —** Animal sources like wild-caught Alaskan salmon, pastured eggs, and grass fed dairy and beef; for vegetarians or vegans, consider taking a B12 supplement[24]
- **Methionine —** High-protein foods like eggs, chicken, turkey, beef, and lamb[25]

4. **Stay physically active —** You don't need intense workouts to make a difference — a 10- to 20-minute **brisk walk** after meals, daily stretching, and a couple of sessions of strength or bodyweight training each week are enough to support your liver. These steady habits improve insulin sensitivity and keep blood rich in oxygen flowing through your liver.

   Pay close attention to your waist size — more than 40 inches for men or 35 inches for women signals excess **visceral fat**,[26] which is strongly tied to liver scarring. Shifting your focus toward losing inches around the waist, rather than just the number on the scale, gives you a more accurate measure of progress.

5. **Prioritize restorative sleep to calm inflammation —** When you're chronically tired or not sleeping well, your liver loses the downtime it needs to repair and regenerate. Focus on getting quality rest in a cool, dark room, and avoid eating within three hours of bedtime to prevent late-night spikes in blood sugar. Even modest improvements in your sleep routine ease liver inflammation and improve insulin sensitivity over time.

What to Avoid for Lasting Liver Health

Protecting your liver is not only about what you add in, but also about removing the factors that quietly undermine its function, including:

- **Excess linoleic acid (LA) —** Vegetable oils such as soy, corn, sunflower, safflower, and canola are heavily concentrated sources of LA. Processed foods made with these oils drive your intake even higher.

  Once inside your liver, LA oxidizes into toxic aldehydes like 4-hydroxynonenal (4-HNE), which damage mitochondrial membranes, impair fat metabolism, and accelerate fat buildup. Avoiding seed oils and processed foods that contain them removes one of the most damaging drivers of liver disease.

- **Alcohol —** Ethanol is metabolized into acetaldehyde, a compound that disrupts mitochondrial enzymes, generates oxidative stress, and weakens your liver's ability to produce energy. Even moderate alcohol intake adds to the daily strain your liver has to handle, making recovery much harder.

- **Ineffective choline supplements —** Not all choline products provide real therapeutic benefit. Choline bitartrate and choline chloride are poorly absorbed, do little to raise phosphatidylcholine levels in the liver, and produce high amounts of TMAO. Lecithin supplements, derived from soy or sunflower, also supply some choline, but they require very large doses and also deliver excess LA, which worsens mitochondrial stress.

- **Nutrient excesses from food sources —** While whole foods remain the best way to supply choline, balance matters. Eating very large amounts of liver risks vitamin A toxicity, and relying heavily on red meat can contribute to iron overload. Excess iron accelerates oxidative stress and ferroptosis, a destructive process that kills liver cells. That's why these foods work best as part of a balanced diet, not as your exclusive sources of choline.

Overall, arsenic exposure is easy to overlook. But when combined with other dietary and lifestyle stressors, it quietly accelerates the rise of liver disease. By lowering your exposure, strengthening your nutritional defenses, and supporting your liver with targeted strategies, you can protect this vital organ and safeguard your long-term health.

Frequently Asked Questions (FAQs) About Arsenic Exposure and Liver Health

Q: How does arsenic exposure affect my liver?

A: Arsenic puts constant pressure on your liver by increasing oxidative stress, damaging your mitochondria, and switching on genes that make your liver store more fat than it can manage. Over time, these changes lead to insulin resistance and fat buildup in your liver cells — the hallmarks of fatty liver disease (FLD). Even low levels of arsenic add to this burden and quietly raise your risk.

Q: Why do low levels of arsenic matter if they're considered "safe"?

A: Regulatory limits are set based on cancer risk, but newer research shows that much lower levels can disrupt your liver's metabolism. Studies have linked arsenic below the federal drinking water limit to higher risks of fatty liver and cardiovascular disease. For your liver, "low-level" doesn't always mean harmless.

Q: What kind of rice is safest for me to eat?

A: California-grown white rice, Indian basmati, and Thai jasmine rice consistently test lowest in arsenic. Brown rice, especially from the southeastern U.S., tends to have much higher levels. If you do eat rice, soak it overnight and cook it in extra

water that you drain off to lower the arsenic content.

Q: What nutrients help my liver defend against arsenic?

A: Choline is the cornerstone — it allows your liver to package fat and move it out instead of letting it build up. Most people fall short of their needs, so eating eggs or supplementing with citicoline is one of the most effective ways to support your liver.

Q: Can I reverse liver damage once it's started?

A: Your liver has an incredible ability to heal if you give it the right conditions. By lowering your exposure to toxins, reducing harmful fats, avoiding alcohol, and providing supportive nutrients such as choline, your liver cells can rebuild healthy membranes and restore normal fat metabolism. Pair these with steady lifestyle practices and you give your liver the best chance to repair.

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