Lithium in Drinking Water

Comparison of exposure sources, regulatory guidelines and public discussion of risks and benefit

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1. Executive Summary

This report reviews information on potential human health effects from exposure to lithium in drinking water. Lithium is a natural element that is found in rocks, soils and water in varying concentrations throughout the world. Drinking water from groundwater sources can contain lithium; a recent study found higher levels of lithium in groundwater in dry regions in the western U.S.

There is a large medical and toxicological literature on effects from high therapeutic intakes of lithium (over 150,000 µg/day), and the dose levels at which significant health effects occur have been thoroughly documented. Side-effects of therapeutic doses include gastrointestinal, neurological, psychiatric, renal, and cardiovascular effects. However, naturally occurring lithium levels in drinking water are many (thousands) of times lower than the very high levels in prescription lithium drugs. There is no comparable research into health effects of lithium at the lower levels to which people would be exposed from water and food (estimated to be less than 80 µg/kg/day).

Recent interest in beneficial health effects of lithium at low levels is likely driven by two sources of information. One is results from ecological epidemiology research that is suggestive of a link between higher natural lithium concentrations in drinking water and lower population suicide rates. As suicide is a complex and multifactorial phenomenon, this body of evidence needs cautious interpretation. The other source of information for public consumption is a significant online presence of marketers of low-dose lithium supplements, citing selective and often erroneous benefits claims, which may influence public awareness of lithium.

A graphic showing representative levels reported with various sources is provided, with all levels expressed in the common metric of µg/day (micrograms per day) to enable comparison.

2. Introduction and background

Lithium (Li) is a natural element that is found in rocks, soils and water in varying concentrations throughout the world. Drinking water also frequently contains some lithium, in a range of concentrations depending on the amounts in the groundwater source. Higher levels are found in groundwater in dry regions in the western U.S.

Lithium is not regulated in drinking water in the U.S., and there is no regulatory value against which to evaluate the lithium concentrations in drinking water. However, The U.S. Environmental Protection Agency (EPA) plans to require that drinking water utilities measure and report the concentrations of lithium in the drinking water supplies that they manage. Accordingly, water utility managers will need to be prepared to communicate with the public on the presence of lithium in their water, its possible health impacts, and the significance of the levels to their health.

This document summarizes the sources of lithium in drinking water, primarily from groundwater, and what is known of the health significance of the levels at which it may be present in drinking water. It also presents an overview of some more accessible online information about lithium that may be circulating among the public, to support communication on the subject.

A note on metrics and values referred to in the documents

The documents reviewed use a number of metrics and units in reporting different aspects of lithium, as appropriate to the context of the evaluation. This review reports concentrations in the units that are used in the source under discussion; however, in many cases these are then expressed in micrograms (µg), and in some cases as a daily intake in µg/day. The levels illustrated in Figure 2 (a graphic showing representative levels reported with various sources) are all daily intakes expressed as µg/day.

Below are some key metrics, symbols, and alternative units for expressing them found in the sources reviewed, with distinctions that non-scientists may find confusing. In addition, the range in values noted makes it challenging to interpret what a safe (or optimum) level of lithium in water would be.

Source concentrations of lithium in drinking water:

- Directly measured in the source, as a concentration within a standard volume, usually micrograms per litre (µg/L).
- The Environmental Working Group uses parts per billion (ppb), which is equivalent to µg/L.

Lithium amounts ingested from drinking water or food sources:

- Calculated estimate of population-level intakes, based on 1) measured or average lithium content in water or food source, and 2) assumptions of the food or water amounts consumed; a standard assumption is 2L water/day for an adult, including beverages prepared at home. The derived estimate of lithium intake is expressed as µg/day; or as micrograms/kilogram of bodyweight/day - µg/kg/day - using a standard adult weight of 70 kg (156 lbs).

Doses of lithium in medicinal products:

- Drugs are manufactured and used in precise dosages, in milligrams (mg) - a thousand times greater than the units (micrograms, µg) in which lithium is reported in water and food sources.

Different values reported and benchmarks used:

- Researchers report very different beneficial lithium concentrations in water, depending on (for example) whether they were observing population effects associated with ranges of lithium levels in water, or relating water concentrations and ingestion levels to standard therapeutic doses.
- Publicly oriented sources, mostly those promoting supplements, cite the claimed benefits of higher lithium levels in water but with no specific levels;
- The Environmental Working Group presents lithium as a natural and industrial contaminant and reports concentrations in U.S. water utilities, but without any reference level, including the USGS HBSL, or average dietary intakes.

3. Lithium in groundwater and drinking water sources

The predominant source of lithium in drinking water is groundwater that resides in rocks and soil, and which serves as the source for a drinking water supply. This can be either private wells or community water systems that treat and supply the water. Industrial uses of lithium represent possible sources of contamination of surface water that may be used for drinking water. These sources include lithium mining, the manufacture of batteries and other products using lithium, and recycling of batteries and other products. These industrial sources are currently not common in the US, though they may be in the future as lithium batteries are increasingly used and disposed.[1] Though there is one lithium mine in the U.S., in Silver Peak, Nevada, water contamination from lithium mining is not yet a serious concern in the U.S., as most lithium mining occurs in the South American Andes.[2] Therefore, the main focus of this backgrounder will be on natural lithium in drinking water that originates from groundwater.

Lithium occurs naturally in some groundwater, in varying concentrations throughout the world, as a result of interactions between water and minerals. Lindsey et al.[1] recently evaluated untreated water samples collected from public- and domestic-supply wells across the U.S. The highest levels were found in some aquifer systems in the western U.S., which collectively serve as the drinking water source for almost 10 million people.[3] Concentrations of lithium in public supply wells in the U.S. range from less than 1 µg/L to 396 µg/L, with a median of 8.1 µg/L.[1] The distribution of the lithium concentrations found in public-supply wells is shown on the map in Figure 1.

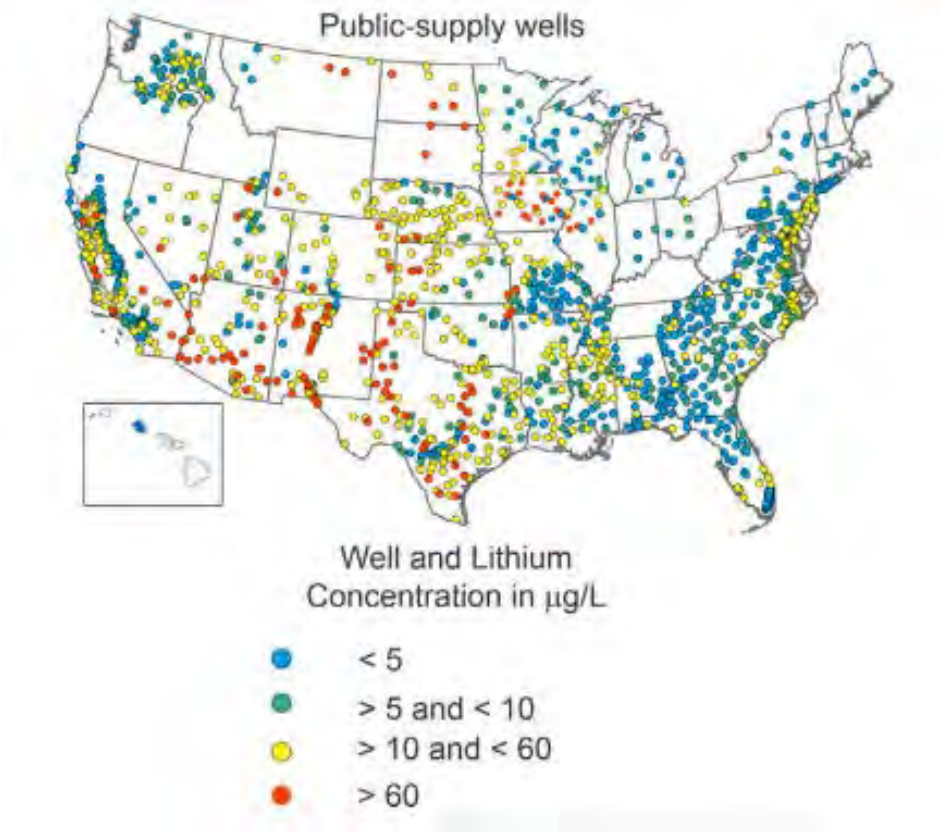

Figure 1. Distribution of lithium concentrations in US groundwater. Lindsey et al., 2021.

4. Health effects of lithium

Most of what is known about the health effects of lithium ingestion is clinical information related to its use as a prescription drug; there is very little information on the effects of average intakes from food and water.

Lithium carbonate is an established therapy for bipolar disorder and several other mental illnesses. For therapeutic purposes lithium is administered at very high doses, relative to naturally occurring sources. Therapeutic doses vary, depending on the nature of the illness that is being treated; dosages are reported as ranging from as low as 85 mg/day to as high as 2400 mg/day, with 600-1200 mg/day being a common range cited.[1,4,5,6,7] It is well known that therapeutic doses of lithium have mood stabilizing and other mental health benefits; however, these high doses are also associated with a range of significant health risks, such that patients are routinely monitored for a set of known adverse side-effects. The EPA[8] cites many side effects from therapeutic doses, including gastrointestinal, neurological, psychiatric, renal, and cardiovascular effects; decreased thyroid function; acneiform skin eruptions; and benign leukocytosis.

Dietary intakes result from very diverse concentrations in water and common dietary plants, which take up lithium from the soil. Average daily intakes of lithium from water and dietary sources vary regionally with natural source levels, but are "typically less than 0.1% of therapeutic doses."[6] Estimated regional daily lithium intakes range from 8.6 µg/day in Belgium, to 16 µg/day in the UK, and to 48.2 µg/day in France.[9] The WHO[6] estimated U.S. dietary intakes as 60 – 70 µg/day, while the EPA (2008: 23)[8] cites estimates of 0.24 – 1.5 µg/kg/day, and also of 33 - 80 µg/kg/day from both water and dietary sources, acknowledging that "the source of the discrepancy between these estimates is unknown."

The concentration of lithium in plants usually ranges from 0.2 mg/kg to 30 mg/kg. The main sources are cereals, potatoes, tomatoes, and cabbage, as well as some spices such as nutmeg, coriander seeds, or cumin, though these contribute negligible amounts in many geographic regions. Tea, a common beverage throughout the world, contains varying levels of lithium: the content in tea leaves in 250 mL (approximately 1 cup) of brewed tea can range from 0.07 to 1.70 µg/g.[7]

The WHO[6] stated that "toxicity from dietary lithium is unknown" as intake levels are much lower than therapeutic "potentially toxic doses." The EPA[8] observed that "since the clinical literature has focused on the therapeutic treatment of patients, information on effects observed below the minimally effective dose is lacking" and expresses only low-to-medium confidence in the evidence.

Possible benefits, rather than risks, of low levels of lithium are better studied. There are many suggestive reports of lower suicide rates in populations that use drinking water with higher levels of natural lithium. Many of these are ecological studies that compare regional suicide rates with lithium concentrations in water, and need to be interpreted cautiously.[10,11,12] Other recent studies have assessed the bioavailability of lithium at a range of concentrations in spa water in Germany[13] and reviewed the various dietary and water sources of lithium to determine if intakes from those sources might approach effective dose levels.[7]

Conclusions of these studies vary with the analytical purpose and criteria used. Schrauzer and Shrestha[14] reported higher rates of suicide, homicide, and rape in Texas counties with low levels of lithium in the water, relative to those with lithium concentrations of 70 – 170 µg/L. Memon et al.[11] conducted a meta-analysis that found a protective effect on suicide rates associated with water with higher lithium concentrations (at or above 80 µg/L). Others, using therapeutic dose levels as their benchmark for an effective lithium intake level from water, concluded that levels in water are not likely to be large enough to have any mental health effect. For example, a protective effect was not observed below lithium concentrations in water of 31 µg/L,[15] and it was determined that even higher levels found in drinking water supplies would not reach effective doses at usual intake levels.[7] Parker et al.[16] found that "high lithium did not confer any significant benefit for bipolar disorder [or] dementia"; in fact, they report a lack of any association "across the entire lithium distribution." They determined that an individual would need to consume 1000 L/day of water with a high lithium concentration (141.3 µg/L) in order to reach the minimum effective therapeutic dose of 150 mg.

Bottled water may also contain lithium, often at higher levels than tap water, and is sometimes drawn from springs that are known for a high mineral content. Orquidia Neves et al.[10] studied the lithium and other mineral content of 18 brands of bottled water available in Portugal, some of which contained lithium levels above 1500 µg/L. One American brand of bottled spring water[17] claims that its water contains 500 µg/L of lithium.

Due to its potentially higher lithium content, bottled water may be a greater concern than tap water, and "the association between exposure to lithium via bottled water and suicide has not been studied."[11,7] Orquidia Neves et al.[10] found that consumption of bottled water with high lithium levels can contribute significant amounts to an individual's daily intake and should be taken into account in intake calculations. In addition, bottled waters with higher lithium concentrations contained other minerals such as sodium and fluorine, which can have adverse health effects.

5. Existing proposed exposure limits

No reference doses or standards were found for lithium content in water, or for human intakes from other sources. The EPA[8] noted that there is no reference dose for lithium in any U.S. or international agency that it consulted. While the European Union has standards for natural mineral and spring waters, lithium is "one of the elements for which no potable water standards are defined."[10]

The EPA undertook its *Provisional Peer Reviewed Toxicity Values for Lithium*[8] "for use in the Superfund Program," reviewing reports from clinical literature on adverse effects associated with therapeutic doses in humans, and from animal studies on effects of oral exposures on development of cancer and adverse effects on the kidneys, thyroid and reproductive systems, as well as developmental effects.

A key conclusion of the EPA's review was that there is an inadequate amount of dose-response data for humans based on serum lithium concentrations associated with prescription lithium for the development of a provisional sub-chronic and chronic reference dose (p-RfD). Occupational and environmental oral exposure studies are also not available, and the animal data are "not suitable" as a basis for the p-RfD.

Accordingly, the derivation for the provisional sub-chronic and chronic RfD was based on the "lower bound of the therapeutic serum lithium concentration range of 0.6 mmol/L".[8] The p-RfD was "derived from the LOAEL [lowest observed adverse effects level] of 2.1 mg/kg/day for adverse effects in several organs and systems." EPA divided this by an uncertainty factor of 1000 to arrive at a sub-chronic and chronic p-RfD of 0.002 mg/kg/day (2 µg/kg/day).[8]

The composite uncertainty factor of 1000 used in the EPA RfD is composed of three uncertainty factors of 10 each. These are a factor of 10 to extrapolate from a LOAEL to a NOAEL [no observed adverse effects level] and a 10 to protect susceptible individuals. A third uncertainty factor of 10 was used to account for database insufficiencies, related to the absence of quantitative information on the human variability of response, and database uncertainties due to an absence of information on cardiovascular, neurological, endocrine, and developmental effects. The EPA (2008:23) cautions that it has only "low-to-medium confidence in the p-RfD", as "information regarding the dose-response relationship of lithium to the development of adverse effects is lacking" for non-therapeutic dose levels.

The provisional chronic and sub-chronic reference dose of 0.002 mg/kg/day (2 µg/kg/day) is higher than most estimated dietary intake amounts (except the highest cited above, 80 µg/kg/day); for the standard 70 kg (156 lb) adult, this reference dose equates to 140 µg/day.

The United States Geological Survey,[3] in collaboration with the EPA, calculated a nonregulatory Health-Based Screening Level (HBSL) for lithium in drinking water, based on the EPA's 2008 provisional reference dose of 2 µg/kg/day,[1,18] to provide context for evaluating lithium concentrations in groundwater. HBSLs are "non-enforceable water-quality benchmarks" that can be used to evaluate if a contaminant is at a level that may pose a human-health concern, and to prioritize monitoring efforts.[19] The HBSL for lithium is 10 µg/L or parts per billion. A second "drinking-water-only" lithium benchmark of 60 µg/L was defined, and can be used where it can be assumed that drinking water is the only source of lithium intake, such as when other common dietary sources are not consumed.[3]

In the recent survey of lithium levels in U.S. water supplies[1] the HBSL was exceeded in 45% of the public well samples, and the higher drinking-water only level was exceeded in 9% of samples from public-supply wells.

A comparative view of levels of exposure from different sources and regulatory guidance values is shown in Figure 2, below.

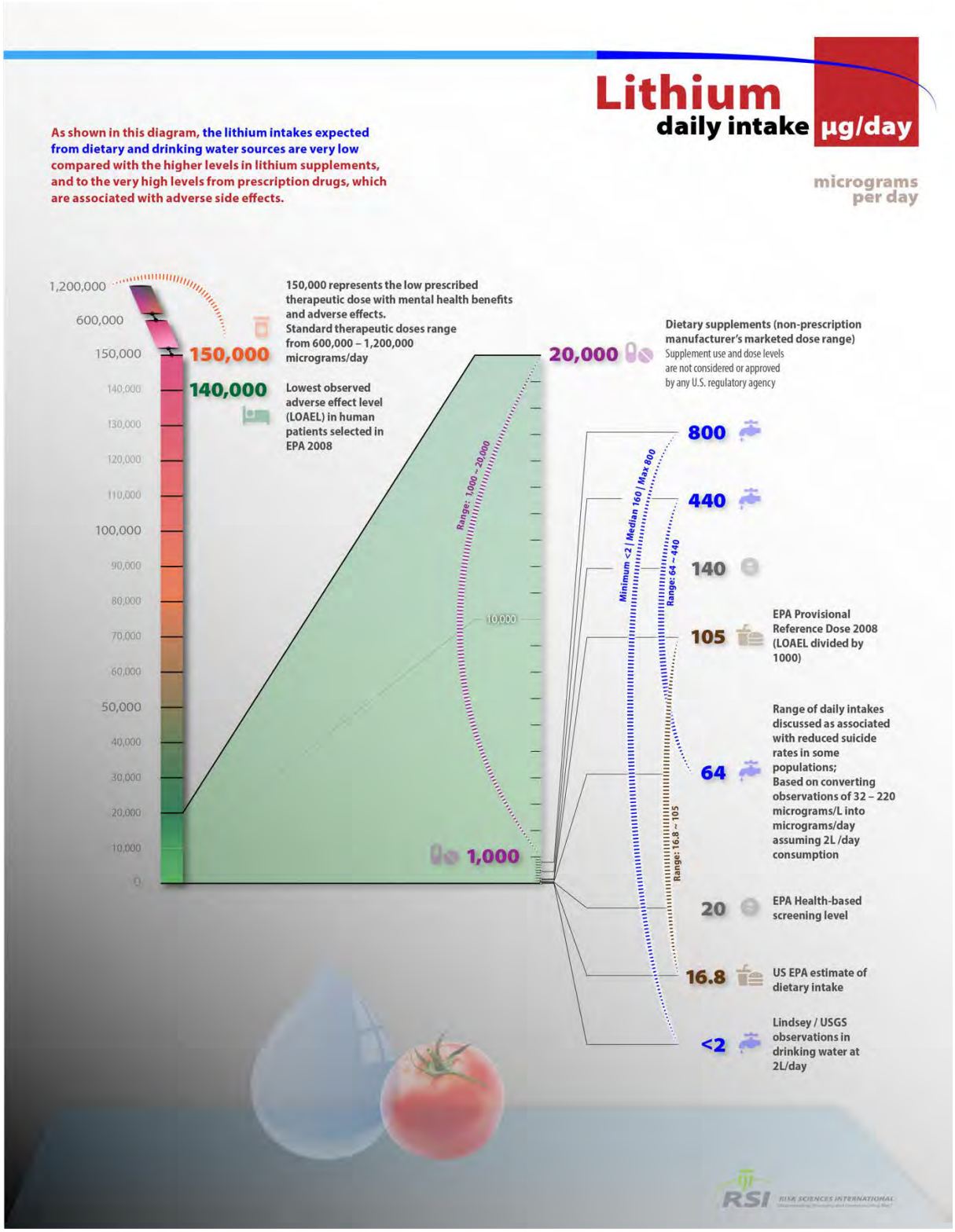

Figure 2. Levels of exposure from different sources of lithium and regulatory guideline levels. All values are expressed as daily intake levels, in µg/day. Water intake levels assume 2L/day consumption. Regulatory guidelines have been converted to µg/day using a 70 kg body weight.

6. Societal discussion of lithium in drinking water

6.1 Sources reviewed and key themes

This section presents the findings of web searches for easily accessible information on the health effects of common exposures to lithium, as a reflection of information that may influence public awareness of the effects of lithium in drinking water. The findings from these searches are described below, summarizing general awareness of lithium as an element and its presence in drinking water, then discussing the messages that may be taken from researchers on potential benefits of lithium in drinking water and from promoters and marketers of over-the-counter lithium supplements.

A web search of representative publicly accessible information sources (i.e., not subscription research literature or technical sources) was conducted using search terms for basic health effects related to lithium. Most searches queried aspects of lithium in drinking water, but as mental health benefits of lithium emerged as a primary theme, additional searches were conducted on the benefits of lithium in water and safety of lithium supplements. The following search terms were used:

- general: lithium in drinking water
- risks: lithium water contamination; lithium contamination in drinking water; is lithium in drinking water dangerous; risks of lithium in drinking water; are lithium supplements safe
- benefits: benefits of lithium; lithium supplements

More than two dozen documents and websites from the search were reviewed, and many dozens more scanned from search return pages. Several more technical and regulatory documents were also consulted to gather basic information on the presence of lithium in water and other products, and to verify some claims.[1,6,8,19,20,21,22,23,11]

Three types of results were returned through this search:

- The most prevalent were websites and pages maintained by individuals or companies selling, or promoting, lithium supplements for the relief of mood instability, depression and a range of other mental health issues.
- Research studies on lithium in drinking water, published in open-source journals or reported in science blogs or commentaries. These have a range of research objectives and design; most are 8technical, and in some cases only the abstract is publicly available.
- Other results including the Environmental Working Group on drinking water, several health or medical information sites, and several sites with more professional or critical perspectives on the risks or benefits of lithium and its presence in drinking water.

6.2 Predominant perspectives on lithium found in online sources

General awareness of lithium

Most sources introduce lithium as a natural element that occurs in rocks and soils throughout the world, and that is present at varying levels in groundwater and taken up in some food plants. The sources focus

on claimed individual and population-scale health benefits of ingestion of lithium, with most being proponents of this view, and a few urging caution with the deliberate use of lithium.

Lithium content in drinking water

The research studies provide relatively detailed technical information on lithium concentrations in drinking water from different regions; most were interested in lithium concentrations in relation to proposed or observed mental health benefits.

Among publicly oriented sources, lithium supplement promoters refer to the benefits of lithium in drinking water. There is wide variation in the characterization of lithium levels, from "trace amounts" to general references to the benefits of "higher levels." Only the Environmental Working Group (EWG)[24] provided any concentrations – and these are offered with no context for an interpretation of safe levels. Only one source[25] referred to the Health Based Screening Level set by the USGS and EPA.

The EWG, a U.S. NGO with a broad interest in health and safety regulation, is the only public-oriented source that suggested that lithium could be present in drinking water at levels that are harmful. The EWG states that lithium "occurs naturally in soil and rock" and is also "a pollutant from mining and industrial manufacturing of metals, ceramics and batteries": It notes that "ingesting too much lithium can lead to symptoms like abdominal pain, diarrhea, nausea and vomiting." The site states that lithium has been reported in drinking water in four U.S. states, provided by 22 utilities serving a total of three million people. It cites average levels reported by these utilities that have lithium "contamination," at levels ranging from 1.03 ppb to 636 ppb, but provides no reference for interpreting the significance of these levels.[25]

A few sources are concerned with lithium water contamination from industrial sources, some of which may become relevant in the U.S. context as the use and disposal of lithium batteries becomes more widespread.[1] A study in South Korea[26, 27] reported on levels of anthropogenic inputs of lithium in river, waste and tap water, which the authors relate to increased population density around the city of Seoul. They suggest that the manufacture, use and disposal of electronic devices is a primary source, and also mention pharmaceutical waste from the use of prescribed lithium medications.

Benefits of supplemental lithium in public drinking water

A google search for "lithium in drinking water" returns many research reports on potential beneficial effects of lithium in drinking water. Many of these are ecological studies such as those summarized above, addressing a range of research questions related to various aspects of the observed association of higher levels of lithium in drinking water and lower population suicide rates.[28,11,29] Others consider plausible physiological mechanisms for beneficial effects of lithium from various sources and exposure levels, and some propose or cite provisional recommended daily intake levels for lithium.[15,24,7] Not all of the studies found a protective effect of higher lithium concentrations in drinking water (as discussed above), while some that did included cautions related to intake levels and other minerals; some also noted that these are not clinical studies and the findings should be interpreted accordingly.[9,10,11,12]

Some researchers and medical commentators[30] make a general case for the addition of lithium to the water as a public health measure, or call for more research on the benefits of the measure.[11,31]

Other researchers advise against water supplementation due to potential side effects. Araya et al.[30] argue that there is little knowledge of possible "clinically significant side effects" of higher lithium exposures, and that consultations and community-controlled trials and monitoring would be necessary to validate such a population-scale intervention.

Many people consume significant amounts of bottled water, which may not only include unknown and widely ranging concentrations of lithium but may be promoted for a high lithium content. For example, in the U.S. Lithia Spring Water is promoted as "Earth's Healing Water" that acts as an immune booster or a brain neuron booster, with 500 µg/L of lithium carbonate.[19]

In addition to research reports themselves, many publicly oriented websites refer to studies on the association of higher lithium concentrations in drinking water with lower suicide rates, with little or no attention to the studies' research questions and methods, or to cautions that are noted. These cite observations in several countries of lower rates of suicides, psychiatric admissions, homicide and aggressive crimes[32] in areas supplied with drinking water with higher lithium content. Actual lithium concentrations are not mentioned; instead, websites note the benefits of "high lithium levels in water and beneficial behavioural, legal and medical outcomes";[33] or "the higher the lithium content in water, the lower the rate of psychiatric illness in that county";[33] or that "microdoses in water could lower suicide rates and reduce the risk of Alzheimer's Disease.[34]

Supplements

The history of the use of prescription lithium drugs demonstrates their efficacy for some serious mental illnesses, but these high-dose prescription drugs are associated with many side-effects that necessitate strict medical oversight. Low-dose lithium supplements are promoted as beneficial for individuals to use as over-the-counter remedies for a range of more minor mental health issues, validated by the widely claimed benefits of lower levels of lithium in drinking water. Doses of prescription lithium are presented as 600 – 1200 mg/day,[39] while supplements are described as sold in doses of 1 – 20 mg/day.[35] Some sources promoting supplements are physicians who prescribe lithium supplements in their practice,[38] while others are supplement retailers.[36,37] Most provide extensive descriptions of the benefits of lithium supplements for a wide range of health problems, sometimes referring to common effective doses.[38,40] Advocates and promoters state that lithium supplements are free of the serious side effects of high-dose medications and "considered to be safe,"[40,41] although side effects are described on some drug information sites.[5], [38]

The lithium orotate that is used in supplements is described as low-dose natural "nutritional lithium" or a "nutraceutical" that is available in supplements without a prescription, and is said to be beneficial for a wide range of health effects including mood stability, depression, cognitive decline and brain fog, dementia and Alzheimer's Disease, autism, longer life-span due to increased telomere length, brain detoxification.[38, 35, 37, 39, 35] Lithium is described as an essential nutrient – though it has not been designated as such by relevant authorities - with supplements described as correcting a lithium deficiency. Some support this claim by stating that the WHO has included lithium as an essential nutrient "alongside zinc and iodine."[39] This is misleading: While the WHO does include lithium in its report *Trace elements in human nutrition and health*,[6] it places it in group C: "Potentially toxic elements, some possibly with essential functions," along with fluoride, lead, cadmium, mercury, arsenic, aluminum and tin.

Some sources state that the FDA considers lithium orotate to be safe[41] or that products containing lithium orotate "don't seem to be a concern" for the FDA,[39] despite the fact that Health Canada issued a warning that "they may cause serious health risks."[21] In fact, unlike lithium carbonate and lithium citrate, which the FDA has approved for use in prescription drugs, lithium orotate has not been assessed by the FDA for safety and efficacy, since supplements are not regulated in the U.S. A few less prominent sources state that the compound has not been well researched can cause side effects,[43] and has not been "officially approved by the FDA for any medical use or other health application."[22,40] The FDA[20] issued a warning letter to a supplement manufacturer for making claims for the effectiveness of its lithium orotate product that are allowed only for drugs. Perhaps with this in mind, the Lithia Spring Water website[18] includes a caveat that the product has not been approved by the FDA and is not intended to diagnose or treat medical conditions.

7. Summary and key findings

Though there is a large amount of clinical and toxicological data on the adverse health effects of therapeutic lithium at the high doses at which it is effective, there is little or none on the effects of intakes at levels relevant to drinking water, which are thousands of times lower.

However, there is a growing number of observational studies suggesting a potential population mental health benefit of lithium in drinking water, at higher natural concentrations, but at levels far lower than therapeutic doses. Suggestions that the mental health benefits of lithium may be gained from lower levels as are found naturally in drinking water have led to two types of advocacy on the benefits of lithium, with little attention to potential risks.

One is a consideration of the potential public health benefits of adding lithium to drinking water supplies; the other is marketing of over-the-counter lithium supplements, promoted as safe based on uncritical references to the observational drinking water studies.

In more detail, the following findings can be noted.

- Known health effects of lithium consumption relate to very high doses in prescription drugs used to treat mental illnesses.

Almost all data available on the health effects of lithium are from toxicological research and clinical experience with prescription lithium drugs, which are administered at doses of 600 – 1200 mg/day (600,000 up to 1,200,000 µg/day). These effective doses are associated with many significant side effects, for which patients are regularly monitored.

- Little information is available on health effects of lithium at levels relevant to concentrations in drinking water.

Toxicological and medical research has not addressed the effects of lithium at average intake levels. Citing the lack of reliable dose-response data of exposures at lower levels, as well as an absence of environmental oral exposure studies, in 2008 the EPA derived a provisional reference dose as a guideline

for use in the Superfund Program. More recently the EPA and USGS used the EPA 2008 provisional RfD as the basis for its nonregulatory Health Based Screening Level for lithium in drinking water.

While there is little toxicological data on health effects of average intake levels of lithium, many ecological epidemiology studies have indicated levels of lithium than may offer mental health benefits, based on associations of lower population suicide rates and higher lithium concentrations in drinking water – though the levels cited as effective vary. Some researchers have proposed optimum intake levels.

Research on the possible beneficial effects of higher lithium levels in drinking water has not addressed any adverse effects of those levels.

- Estimated intake levels from water vary, but are much lower than therapeutic levels

Daily intakes of lithium from water and food sources can only be estimated, as concentrations in water and foods vary regionally, as do the amounts of water individuals may consume per day. Estimates of intakes in the U.S. range from 0.24 – 1.5 µg/kg/day, to 33 - 80 µg/kg/day. These levels are thousands of times lower than the doses used in prescription lithium medications.

A recent survey of lithium concentrations in drinking water sources in the U.S. found that 45% of the wells sampled exceeded the basic HBSL of 10 µg/L.

The popularity of bottled water may challenge determinations of individuals' intake levels, as the source differs from local groundwater supplies. In addition, many brands of bottled mineral water contain higher levels of lithium than average tap water, and may be promoted and purchased for their higher lithium content.

- Experience with benefits of therapeutic lithium to treat mental illness, along with reports of population benefits of natural lithium in drinking water, have led to interest in supplemental lithium and marketing of supplements to the public.

These very different streams of evidence of mental health benefits of lithium, including at levels found in some drinking water sources, have led to two advocacy positions of which the public may be aware.

One promotes the value of adding lithium to public drinking water supplies to reduce suicide rates, citing observations of population benefits associated with higher lithium concentrations in drinking water. Further research would be required to determine the level of lithium that would be beneficial, and for which benefits, as well as the potential for adverse effects at these levels.

The other outcome of the emerging interest in lithium is the marketing of lithium supplements as easily available non-prescription remedies for individuals' mental health issues. Promotional messages include some inaccurate and misleading references to research findings.

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