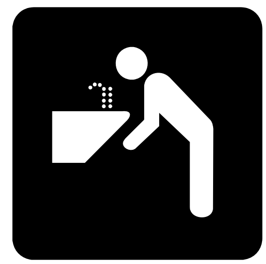
CT Department of Public Health

November 2008

Questions & Answers About Uranium in Drinking Water in Madison CT Schools

Background



Recent testing of the water supply for the Ryerson Elementary (Grades 1-4) and Brown Middle (Grades 5 and 6) Schools in Madison found an elevated concentration of uranium. The detected result was 110 ug/L (or parts per billion - ppb), which is consistent with the uranium result from a nearby community well. Since this is the first uranium test of this water supply, there is no way to know how long uranium has been at this level and whether it has fluctuated over time. The water supplies for the other schools in Madison have also been tested. In those cases, the uranium level was not elevated.

In coordination with the local and state health departments, well water usage at the Ryerson and Brown schools has been stopped for drinking and cooking purposes and replaced by bottled water. This has ended student and staff exposure to this source of uranium. Community members have raised questions about what this incident can mean to the health of those who have been exposed, and whether medical monitoring is needed. This fact sheet is designed to address those questions.

What is Uranium?

Uranium is a radioactive element that naturally occurs in certain types of bedrock. It decays to radium and radon, and in so doing, can give off radiation. Uranium can dissolve in groundwater and become available for human consumption as groundwater is used for private and public wells. Uranium can also enter the environment from its mining and processing associated with nuclear power plants. The uranium in the groundwater in Madison is from naturally occurring sources in bedrock.

How Can Uranium Affect My Health?

Uranium is radioactive and radioactive materials have the potential to cause cancer. However, the greater risk for health effects is from the chemical toxicity of uranium to the kidney. Preventing this toxic effect also protects against the low level cancer risk associated with this element. The main source of exposure to uranium is via ingestion of contaminated water. It does not cross the skin well and does not form a gas so inhalation exposure is not a concern.

How do the Uranium Levels at the Madison Schools Compare to Health Standards?

USEPA has established a federal drinking water standard, called the MCL, for uranium. It is set at 30 ug/L to ensure protection of the general public including young children, from the effects of uranium on the kidney. As shown in the chart below, uranium causes a graded response in the kidney with high doses causing damage that over a long period of exposure could lead to kidney disease. Most of the data come from animal studies in which high, medium and low doses can be given and a wide range of effects can be studied. These very sensitive studies have detected milder forms of kidney toxicity at lower doses, with the MCL set based upon the lowest effect level found in any of the animal studies. The MCL includes a 100 fold buffer to make sure that no one will come remotely close to the effect level seen in animals.

Uranium effects on the kidney have also been studied in people exposed on the job or from their drinking water. This has involved measuring biomarkers of kidney function in the urine (e.g., glucose, albumin, other proteins). Normally these biomarkers are relatively low and are increased by kidney damage or disease. While some drinking water studies have shown an association between uranium exposure in drinking water and increases in kidney biomarkers (Zamora, et al. 1998; Mao et al. 1995, Kurttio, et al. 2002), others have not (Kurttio, et al. 2006). Where there was an association, the changes were typically small and still within the normal range of a typical human population. This means that uranium was unlikely to have damaged the kidney. Rather it altered kidney function in a manner similar to other factors that affect these markers such as body weight, exercise, blood pressure, time of day (biorythym), urine pH, and age (Stengel et al. 1999). Given that the uranium results from epidemiology studies do not signify kidney damage, they have not been used by USEPA to set the drinking water MCL. The results from these studies are shown in the left column of the chart below (shaded area), but the animal studies (center column) are the basis for the MCL. That is because they are more definitive in showing the dose where actual kidney damage begins to occur.

The chart below also shows the level of uranium exposure possible for a child drinking the water at the Madison schools where uranium was found. In estimating this exposure, we assumed that a 6 year old's entire water intake for the day comes from the school and that he is at the high end of water consumption (95th percentile) for his age. This exposure is 3 to 4 fold higher than the uranium MCL but still 10 fold below the starting level where mild toxicity is seen in the animal studies. The school exposure is also in the range where changes in kidney biomarkers have been seen in several human studies. However, as described above, these kinds of biomarker results are highly variable and the results with uranium were generally within normal limits and reversible. This is the reason why the federal MCL is not based upon the human data. Thus, the uranium detection at the Madison schools is unlikely to produce a clinical illness or disease response, even when considering that the school exposure involves children.

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URANIUM EFFECTS AND EXPOSURE LEVELS

	ug/kg/d[a]	ug/L[b]
Severe Kidney Damage in Dogs Exposed for 30 days	**83,000**	**1,500,000**
Mild Kidney Damage in Rabbits Exposed for 91 days	880	16000
Slight Kidney Effects, Rabbits, 91 days Slight Kidney Effects, Rats 91 days[c]	50-60	1000
Level of Exposure in Madison Schools	6	110
Federal Maximum Contaminant Level (MCL)	1.6	30

Human Studies
--Kidney marker changes
--Reversible,
--W/in Normal Range

[a]Daily dose given in animal studies or calculated for students in Madison based upon a 6 yr old child at the upper 95th percentile of water ingestion.
[b] Drinking water level associated with the exposures shown in the previous column.
[c]This rat kidney effect is basis for the federal MCL as shown by arrow

HAVE THERE BEEN HEALTH STUDIES OF URANIUM EXPOSURE IN CONNECTICUT?

Yes, a recent case involved a family of 7 (two adults and children aged 3, 5, 7, 9 and 12 years) living in western Connecticut (Magdo, et al. 2007). Two separate tests of their well water showed uranium concentrations of 866 and 1160 ug/L. The family had been living at this location for five years prior to the discovery of uranium in their tap water. The family was thoroughly evaluated by pediatricians and environmental specialists at Mt Sinai hospital in New York City. Medical monitoring for impacts on kidney function was negative for everyone in the family except for the youngest child. The 3 year old girl had a beta-2-microglobulin level in urine that was more than 2 times greater than the normal range. This protein is a standard biomarker for altered kidney function which can be a sign of toxicity if other biomarkers are also elevated. In the case of this 3 year old girl, the other biomarker results were normal. Further, her beta-2-microglobulin level fell to near the normal range after 3 months of not drinking the water. Therefore, the effects of uranium on this child were reversible. It is noteworthy that all of the school age children in this family had no evidence of kidney changes even though their drinking water had 10 times more uranium than found at the Madison schools.

MEDICAL MONITORING

There are two approaches to medical monitoring in uranium exposure cases. One is to simply test for uranium in urine to discover whether there is an ongoing exposure that may need mitigation. The second is to perform kidney function tests using a variety of biomarkers in urine or blood. When taken together, the biomarker results can indicate whether kidney function has been compromised.

Recent uranium exposure can be detected by testing for it in urine. The background level in the population is low (CDC, 2001) so detecting an increase from uranium in drinking water is feasible. However, most of the uranium leaves the body within 5 days so it becomes more difficult to detect an increase as more time elapses since exposure. Further, the worker exposure limit for uranium in urine is quite high, far above the levels found in communities where uranium was detected in water (ATSDR, 2002). There are no other exposure guidelines for uranium in the general public.

Urine testing of Madison school children for uranium is not recommended at this time. The level of uranium in urine does not correspond to a specific level of risk and so the results are not particularly informative. Further, if uranium is found in samples of urine in the community, the only follow-up action would be to find the source and stop exposure. This has already occurred at the Madison schools via well testing and switching to bottled water, and the Madison Health Department has recommended all residents test their own wells for the presence of uranium. Therefore, there is no added benefit from testing children's urine for uranium.

Kidney function testing can involve a wide range of biomarkers, with the simpler tests involving the measurement of glucose, proteins, and electrolytes (e.g., calcium, phosphate) in urine. The kidney regulates the excretion of these constituents so that results out of the normal range can indicate altered function and possibly kidney damage where the changes are large. More detailed kidney function tests involve dosing the subject with a marker (e.g., inulin, para-aminohippurate) which is normally handled in a certain way by the kidney. Abnormal tests with these markers can show which part of the kidney has been affected.

Kidney function testing is also not recommended for Madison school children at this time. While above the MCL, the level of exposure has been low relative to what is needed to see changes in these tests beyond the normal range. As described above, there are many physiological factors that can affect the test and the background range is broad. Therefore, it is unlikely that abnormal kidney function tests would be seen in these school children. Further, any change in kidney function at these low exposures would rapidly reverse back to the normal range.

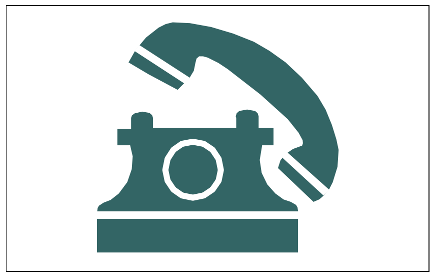
CONCLUSION

The finding of uranium above the federal MCL in two Madison CT schools raises a public health concern. This has been addressed by preventing any further consumption of the contaminated water. The MCL is important to follow to make sure that the public's exposure to uranium is kept below the point where it can be toxic to the kidney. The level of exposure in Madison school children, while above the MCL, was still well below that needed to cause kidney damage. It is possible that small changes in kidney function may have occurred in some individuals. But those changes are unlikely to have been outside of the normal range and any change would have reverted quickly back to normal. Therefore, there is no reason to consider the exposed Madison school children to be at elevated risk for kidney toxicity or long-term health effects. Medical monitoring of uranium in urine or kidney function is not indicated. Results from a family in Connecticut that had much higher uranium in drinking water and which received extensive medical monitoring, supports this conclusion. However, individual families with special questions or concerns can discuss this issue further with their family physician.

This incident demonstrates that uranium concentrations above the MCL are possible in this community. Homeowners who rely upon a private well should consider having their well tested for uranium in the near future. The local health department and the Connecticut Dept of Public Health can advise you further about private well testing.

WHO CAN I CALL FOR MORE INFORMATION?

If you have follow-up questions, please do not hesitate to contact:



⇒ **Madison Health Department: (203) 245-5681**

⇒ **Madison School Superintendent: (203) 245-6300**

⇒ **The Connecticut Department of Public Health:**

- **Drinking Water Section: (860) 509-7333**
- **Private Well Program: (860) 509-7296**
- **Environmental and Occupational Health: (860) 509-7740**

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