

Lead toxicity: Bones tell the real story

Researchers from four collaborating institutions say they have data demonstrating for the first time that blood measurements may significantly underestimate the lead stored in a child's body. Moreover, these data suggest that blood-lead concentrations currently deemed "acceptable" for young children by the Centers for Disease Control "offer little or no margin of safety," says study director John F. Rosen of Albert Einstein College of Medicine in New York City.

Rosen's data come from an instrument his team developed, which beams low-energy (10.5-keV) X-rays at the shin bone. This radiation excites electrons in the "L" shell — the second electron shell — of bone-bound lead. As excited electrons relax, they fluoresce, emitting X-rays at a different wavelength. These emissions offer a noninvasive gauge of lead in the skeleton, where up to 95 percent of this metal is stored.

The researchers present their bone-lead measurements of 59 symptomless children, aged 1 to 6 years, in the January PROCEEDINGS OF THE NATIONAL ACADEMY OF SCIENCES. All children had blood-lead levels between 22 and 55 micrograms per deciliter ($\mu\text{g}/\text{dl}$), with an average of 34 $\mu\text{g}/\text{dl}$. These findings showed that even some children with blood-lead levels in the so-called acceptable range — 22 to 26 $\mu\text{g}/\text{dl}$ — carried lead levels of more than 12 μg per gram of bone. This is roughly three times what has been reported typical of healthy children, Rosen notes. More worrisome, he found that those children with blood-lead values of about 39 $\mu\text{g}/\text{dl}$ carried an average 37 $\mu\text{g}/\text{g}$ of lead in their bones — a concentration exceeding the 19 to 27 $\mu\text{g}/\text{g}$ usually found in adults after decades of cumulative exposure, and comparable to levels in lead workers.

The standard technique for measuring lead in bone is painful and cumbersome, and requires collecting every ounce of urine over an 8-hour period. X-ray fluorescence is simpler and painless, Rosen says. It takes only 16.5 minutes and, in combination with blood-lead assays, yields comparably reliable diagnoses of children requiring chelation therapy to remove dangerous lead excesses, he adds.

"I'm very impressed with the enormous potential of the technique for assessing lifetime exposure to lead," says Bruce Fowler, the University of Maryland-Baltimore toxicologist who chairs a new National Academy of Sciences committee to evaluate effects of low-level lead. However, he adds, there is still concern over the safety of X-ray fluorescence and the quality of data it offers. Both issues, he notes, are slated for thorough review next month at an international meeting in Columbia, Md., sponsored by the National Institute of Environmental Health Sciences.

A tuna a day makes the cat slow to play

Most cats love fish, especially tuna. But overindulging that craving could have serious repercussions — a dramatic and chronic malaise, according to veterinarian Katherine A. Houpt and her co-workers at Cornell University in Ithaca, N.Y.

Houpt fed six cats — three of each sex — off-the-shelf canned, red-meat-tuna cat food. An identical group received beef cat food only. Behavioral testing — begun after cats had spent four months on these diets, and continued for an additional two months — showed those dining on tuna were dramatically less vocal, less active and less playful than cats fed beef. The observed malaise did not affect the tuna-fed animals' performance on maze tests or their response to human handling.

Methylmercury, naturally present throughout the aquatic environment, accumulates in many fish — and can be expected in any oceanic variety, explains toxicologist Donald Lisk, who worked on the project. The tuna these cats ate contained 0.55 parts per million methylmercury — 5.5 times more than the beef but only about half the limit allowed in human food by the Food

and Drug Administration. While the research doesn't prove methylmercury caused the behavioral differences between the two groups, Houpt notes that the 10-fold higher brain levels of this neurotoxic metal in the tuna-fed cats suggests a causal association.

Ironically, although dietary selenium often prevents even the most severe effects of methylmercury poisoning — retardation or death — the tuna used in these studies was not selenium deficient. This suggests, Lisk says, that selenium may not protect against methylmercury's behavioral effects.

The findings indicate that tuna should not become a mainstay of feline diets — especially for young, growing cats, Houpt says. Human implications are less clear, Lisk says, because red-meat tuna contains a higher proportion of toxic metals than the white meat used in most canned tuna products destined for human diners.

Gut-level control of aflatoxin

Low levels of aflatoxin — the most potent natural carcinogen — contaminate many foods. Though it would be virtually impossible to eliminate all dietary sources of this toxin, produced by molds growing on grains and peanuts, there are nonbinding federal "action levels" suggesting limits on its concentrations in food and feed products. To avoid exceeding the action level of 0.5 parts per billion (ppb) for milk, farmers today must feed their dairy cows grains tainted with no more than 20 ppb of the toxin — which flourished after last year's drought and late-season rains. In the future, however, farmers may salvage more heavily tainted grains for dairy feed.

Veterinary toxicologist Roger B. Harvey and his colleagues at the Agriculture Department's Mycotoxin Research Lab in College Station, Tex., find an off-the-shelf additive — now used as an inert and nondigestible anticaking ingredient in feeds — binds aflatoxin in the bovine gut, dramatically reducing its levels in milk. When used as a 1-percent additive in heavily contaminated (100-ppb) cattle feed, hydrated sodium calcium aluminosilicate reduced aflatoxin in milk to between 0.27 and 0.65 ppb — levels 54 to 60 percent lower than those in the milk of animals fed untreated, comparably tainted grain.

Ironically, even though the aluminosilicate is an approved feed additive, farmers cannot legally use it to reduce aflatoxin levels until it gains formal Food and Drug Administration approval for this specific purpose. Harvey says the additive's manufacturer is considering seeking such approval.

More food for thought

One particularly sobering repercussion of the 1988 U.S. drought, notes Lester Brown, president of the Washington, D.C.-based Worldwatch Institute, is that last year — perhaps for the first time ever — the United States produced less grain (196 million metric tons) than it consumed (206 million tons). Moreover, he points out in *State of the World 1989*, released last week, it appears this year's U.S. stores of carryover grain (those in bins right before the next harvest) will be the lowest since just after World War II. Another bad harvest in the next few years could trigger massive starvation in any of the more than 100 nations that buy U.S. grains — unless, that is, grain is diverted from livestock to dinner tables. Brown says the third of all grain destined for livestock now "becomes the reserve we could use to feed the hungry."

Soil erosion and population growth worldwide contribute to the likelihood grain stores will not be refilled soon. Each year, Brown says, the world's farmers are asked to feed 86 million more people with 24 billion tons less topsoil. The topsoil lost in a year, he adds, is about equal to the amount present in Australia's wheat lands.