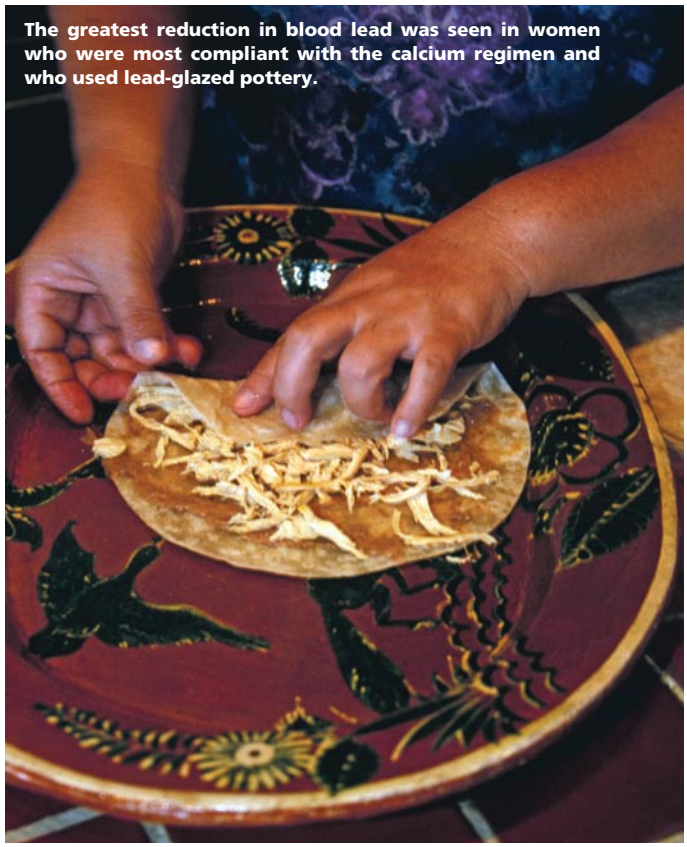
Extra Protection for Pregnant Women

Calcium Supplement Reduces Blood Lead

Lead, like calcium, is stored in bones and generally does not circulate throughout the body. But the demands of pregnancy and lactation trigger the release of calcium, which also releases lead into the maternal blood stream. Researchers previously showed that daily calcium supplementation during lactation reduced maternal blood lead by 15–20% and lead in breast milk by 5–10%. A new study by the same team shows that taking inexpensive calcium supplements daily also reduces blood lead levels during pregnancy [***EHP* 117:26–31; Ettinger et al.**]. Such supplementation could help mitigate the adverse effects of prenatal lead exposure, which include low birth weight, lower intelligence scores, and impaired motor and visual skills.



The greatest reduction in blood lead was seen in women who were most compliant with the calcium regimen and who used lead-glazed pottery.

The study included 557 women recruited in the first trimester of pregnancy from prenatal clinics in Mexico City. The women were recruited from 2001 to 2003; Mexico completed the phase-out of leaded gasoline in 1997, so women enrolled in the study had been exposed for many years to high environmental lead levels prior to becoming pregnant. In addition, just over one-third of the women used the traditional lead-glazed pottery that is common in Mexico. Half the women received 1,200 mg of calcium daily and the others received placebos.

Blood lead levels were checked in the first (baseline), second, and third trimesters of pregnancy. The Mexican women enrolled in the current study had an estimated average dietary calcium intake of 900 mg per day, which parallels national surveys of U.S. women. (The U.S. Institute of Medicine advises 1,000 mg of calcium daily for pregnant and lactating women aged 19–50 years and 1,300 mg/day for pregnant and lactating women under age 19 years.)

Blood lead levels declined more in the second trimester than in the third, with reductions averaging 14% and 8%, respectively. Women who were more compliant with the calcium regimen had higher reductions in blood lead relative to the placebo group. The most compliant women—those who took at least 75% of their calcium supplements—showed a 24% drop in blood lead levels over the course of pregnancy, with the greatest reduction (31%) occurring in women who were most compliant and who also cooked, served, or stored food in lead-glazed pottery, and who had the highest bone lead levels. The investigators conclude that calcium supplements should be considered as a low-risk, cost-effective means for lowering fetal lead exposure. –Carol Potera

PCBs Make Their Mark

Review Pinpoints Cognitive Profile of Prenatal Exposure

Prenatal exposure to polychlorinated biphenyls (PCBs) impairs cognitive development in infants and children, according to numerous studies of these ubiquitous environmental pollutants. Studies of PCB damage have considered many different end points, but the results of these different studies have never been coordinated to pinpoint the neuropsychologic functions most likely to be damaged by prenatal exposure to PCBs. However, a review of longitudinal birth cohort studies in the medical literature reveals that impairment of executive functions—high-order brain processes responsible for planning, flexible thinking, abstract reasoning, problem solving, and inhibition of inappropriate actions—most consistently reflects prenatal PCB exposure [***EHP* 117:7–16; Boucher et al.**].

The review authors selected nine longitudinal birth cohort studies performed between 1959 to 2008 in North America, Europe, and Japan. Consumption of fish, whale blubber, and dairy products by pregnant women was the main source of prenatal PCB exposure as reflected by maternal serum concentrations that ranged from 23 to 450 ng/g of fat. All combined, about 4,000 children were monitored at different ages, from as early as 3 months to as late as 11 years, depending on the study. The types of tests conducted in the various studies included assessments of mental and psychomotor development of infants, IQ tests, and specific measures of verbal skills, visual–spatial ability, memory, attention, and executive functions. No one study measured all these neuropsychologic skills. Such a comprehensive evaluation would require a battery of complicated and expensive procedures.

The overall analysis found that executive functions are especially sensitive to PCB exposure. Three studies involving about 1,000 children specifically documented executive functions, and they all found that poor response inhibition was consistently related to prenatal PCB exposure. In one of these studies, children were exposed to some of the lowest doses of PCBs among the reviewed cohorts. Some of the studies reported that processes similar to executive functions—such as task planning, speed of information processing, verbal abilities, and visual recognition memory—were negatively impacted by prenatal exposure to PCBs as well. The authors conclude that executive functions in particular should be assessed in future cohort studies of the neurotoxic effects of PCBs and other organochlorine compounds. –Carol Potera

Gamete Gamble

Phthalate Alters Germ Cell Development

Di-2-ethylhexyl phthalate (DEHP), one of the most abundant phthalates produced, has been incorporated into flexible plastic products such as food containers and packaging, toys, medical equipment, and home and garden products. DEHP is being phased out of some products because of growing concern about its potential health effects. A French team has now established the first tangible link between one phthalate, the DEHP metabolite mono-2-ethylhexyl phthalate (MEHP), and altered human germ cell development [***EHP* 117:32–37; Lambrot et al.**].

The French team acquired testes from morphologically normal fetuses of women undergoing legal abortion during weeks 7 to 12 of gestation. Using an organotypic culture system, they exposed the testes for 3 days to one of three concentrations of MEHP: 10^{-6}, 10^{-5}, or 10^{-4} M. The highest concentration was 2 orders of magnitude higher than that known by the authors to occur in humans; the lowest was the same order of magnitude as that found in human milk in Finland, which reached 1,410 µg/L. Biomonitoring data for 2005 published by the Centers for Disease Control and Prevention (CDC) showed that MEHP in the urine of U.S. residents reached 52.1 µg/L (or 10^{-8} M).

At the highest concentration, the authors found that exposure reduced germ cell numbers by 40%. The sharp reduction occurred via an increase in apoptosis, or programmed cell death, without any effect on proliferation. The authors note that the plunge in numbers is crucial because the germ cells formed during fetal life—which will go on to become ova or sperm—help determine adult fertility.

The highest concentration of MEHP also significantly reduced the messenger RNA expression of anti-Müllerian hormone, which plays a key role in the development of certain cells into male reproductive organs, usually during week 8 of fetal development. The lowest concentration of MEHP tested didn't show adverse effects for the pathways analyzed.

The general population is routinely exposed to many types of phthalates, with at least one metabolite, monoethyl phthalate, documented in urine by the CDC at concentrations of 10^{-6} M. The authors suggest that researchers should investigate additional phthalates and interactive effects, other concentrations and periods of exposure, different time periods of fetal development, and additional pathways. They also note that their findings conflict with some results from animal studies. For instance, there were no MEHP effects on testosterone production in this study, but testosterone suppression has occurred in rats exposed to phthalates. Such discrepancies may be due to differences between species, they say. –Bob Weinhold

Programmed Obesity?

Study Links Intrauterine Exposures to Higher BMI in Toddlers

To date, there have been relatively few epidemiologic studies investigating the association between intrauterine exposure to chemicals and body mass index (BMI, which characterizes weight in relation to height). Now a prospective birth cohort study in Flanders, Belgium, reveals an association between prenatal exposure to environmental pollutants and elevated BMI during the first three years of life [***EHP* 117:122–126; Verhulst et al.**]. The study also found associations between exposures and birth weight and length.

Since the late 1990s, developmental biologists have amassed laboratory data indicating that exposure to endocrine disruptors such as polychlorinated biphenyls (PCBs), dioxins, and bisphenol A during critical phases of fetal development may increase the risk of obesity later in life. In addition, prenatal exposure to cigarette smoke has been linked with the subsequent development of obesity. These exposures likely alter mechanisms involved in weight homeostasis.

Certain exposures in utero can affect birth weight, birth length, and later, body mass index.

Getty Images

Using a longitudinal study design, the researchers obtained a random sample of 138 mother–infant pairs by drawing from 26 maternity wards in Flanders between September 2002 and February 2004. These wards were identified within geographic areas with varying environment and pollution characteristics (rural, urban, and industrial). The researchers collected information on the parents that included health status, smoking behavior, age, family composition, socioeconomic status, height, and weight. Children's height and weight were also analyzed, and umbilical cord blood was collected to enable measurement of levels of hexachlorobenzene, dioxin-like compounds, PCBs, and the pesticide metabolite DDE. Children were then observed over a 3-year period.

The main findings were twofold. First, higher PCB congener levels were associated with higher BMI standard deviation scores (SDS) in the children between 1 and 3 years of age. Both maternal smoking and higher PCB levels were positively associated with birth weight SDS. In addition, they showed a statistically significant combined effect. Second, higher DDE levels were associated with a slight increase in BMI SDS in 3-year-old children of nonsmoking mothers, but this effect was further increased in children of smoking mothers. Thus, simultaneous intrauterine exposure to endocrine disruptors might compound the weight-enhancing effects of maternal smoking during pregnancy.

The researchers acknowledge a number of study limitations, including the fact that maternal weight gain during pregnancy—an important risk factor for obesity in children—was not recorded in the study. Additionally, the children were only followed for 3 years. Although it remains to be seen whether BMI trends for this particular study population will persist later in life, a higher BMI during toddlerhood is known to be associated with an increased risk of obesity in adulthood.

This is the first epidemiologic study to demonstrate the impact of prenatal pollution exposure on BMI during the preschool years, and more large-scale prospective studies are certainly warranted. One research challenge will be to determine which factors mediate the effects of prenatal exposure to endocrine disruptors in terms of subsequent weight dysregulation in the offspring. –M. Nathaniel Mead