Hazards of Fast Food

In the article "Another Fast-Food Fear," Fields (2003) discussed the possible contaminants such as perfluorooctanoic acid (PFOA) in cardboard containers used to serve fast foods. The possible impurities, such as PFOA, are not likely to be high-risk products because they are not ingested by the consumers. It seems that the emphasis is misplaced. The real risk is the fried meat itself, which contains heterocyclic amines. Heterocyclic amines are documented mutagens and carcinogens in animal models (Nagao and Sugimura 2000; Weisburger 2002), and for which there is human evidence not only of several types of high-incidence cancers, such as colon, breast, and prostate, but which also affect the heart muscle (Butler et al. 2003). Documentation on these facts were reported at the "8th International Conference on Carcinogenic/Mutagenic *N*-Substituted Aryl Compounds" (Snyderwine et al. 2002).

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Asbestos and International Organizations

More information is available on the harmful effects of asbestos, and more incontestable epidemiologic and experimental evidence is available on its carcinogenicity, than for any other environmental agent. The first reports of its use date back more than 2,000 years. Herodotus and Plinium mention it (Castleman 1986; McCulloch 1986; Selikoff and Lee 1978). Despite early awareness of the harmful effect of inhaled fibers, it was only in 1902, and only in the United Kingdom, that asbestos was first included among the dusts known to be harmful to humans (Selikoff and Lee 1978). Cooke reported on fibrosis of the lungs caused by asbestos inhalation in 1924, but the term "asbestosis" was first used to describe it in 1927 (Cooke 1924, 1927). In 1930, dust abatement was officially recognized as the best way to eliminate the damage caused by asbestos fibers (Merewether and Price 1930); a few years later a detailed study was conducted on the pathogenesis of asbestosis (Mottura 1939). This awareness notwithstanding, production and use of asbestos continued and expanded undisturbed, with no measures being taken to protect exposed workers.

A causal association with carcinoma of the lungs was first reported in the 1930s in the United States (Lynch and Smith 1935) and in the United Kingdom (Gloyne 1935). In 1938 lung cancer was recognized in Germany as an occupational disease of workers who had been exposed to asbestos (Nordman 1938). In 1942, again in Germany, lung cancer associated with asbestosis was recognized as a compensable occupational disease (Proktor 1999). Isolated case reports of tumors of the pleura in people exposed to asbestos were published in the 1930s and 1940s, and the causal relationship between exposure to asbestos and mesothelioma could have been already established by the mid-1950s. The final proof of a causal relationship is, however, generally attributed to Chris Wagner, who in 1960 reported on 30 cases of histologically confirmed mesotheliomas in miners exposed to crocidolite (Wagner et al. 1960). In 1976, a working group convened by the International Agency for Research on Cancer (IARC) concluded that asbestos in all its commercialized forms is carcinogenic to humans and that no level of exposure could be considered safe (IARC 1977).

In spite of the overwhelming evidence of its carcinogenicity and of the enormous amount of harm it has inflicted on miners, workers in a variety of industrial sectors, and members of the general population exposed nonoccupationally, the use of asbestos is still increasing in many parts of the world. Under pressure to find solutions that satisfy both health and safety as well as economic concerns, economic considerations often prevail, in particular in developing countries where job opportunities are few and poverty and unemployment are widespread (Harris and Kahva 2003).

Ladou (2004) rightly points to the inadequacy of international organizations such as the International Labour Office (ILO) and the World Health Organization in addressing the worldwide problem that asbestos poses for public health. These organizations certainly are responsible for not having acted earlier and more efficiently; however, part of the reason for their inadequacy must be sought elsewhere. There is a considerable gap between the stated goals of these organizations, which are theoretically and demagogically supported by their founder states, and what they actually can do. They were never given the power such that their deliberations, recommendations, and evaluations would automatically be considered as the basis for legislative measures. On the contrary, their recommendations, typically those of the ILO with regard to asbestos and aromatic amines, have been blatantly disregarded by most industrialized countries. Although they are indisputably useful, international organizations are not supranational authorities that can in all instances deliberate autonomously and independently from the pressures exerted by the individual countries that established them. Several countries claim to support public health–oriented initiatives fully, but they do not favor programs that might have a negative impact on short-sighted nationalistic interests or go against the lobbying of powerful corporations. If this were not so, how, as Ladou (2004) reminds us, could many countries, conspicuously including Canada and the Russian Federation, continue to produce and export asbestos? How could many virtuous industrialized countries export their risks, such as ship breaking, to developing countries where the work is carried out in poorly or unregulated conditions? And how could asbestos-containing replacement brake parts still be used in the United States?

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Exceeding the Methyl Mercury Reference Dose: How Dangerous Is It?

The methyl mercury exposure data presented by Hightower and Moore (2003) with regard to San Francisco fish consumers illustrates how regular consumption of certain species of fish can lead to an exposure that exceeds the current U.S. Environmental Protection Agency (EPA) reference dose (RfD). However, in spite of the impression given by the cover headline "High Health Cost of Eating Expensive Fish," the study sheds little light on the question of whether the health of the authors' patients was affected by their methyl mercury exposure. Hightower and Moore investigated the relationship between methyl mercury exposure, fish consumption, and the U.S. EPA RfD—not the relationship between methyl mercury and health effects.

Not all readers of *EHP* will appreciate the difference between documenting exposure levels and providing evidence for health effects, and not every reader will have followed the ongoing international controversy over the health effects of methyl mercury for fish consumers. The Science Selections published in *EHP* can help to bridge these gaps by providing clarification of important issues and context.

Unfortunately, the Science Selection on the Hightower and Moore article (Hood 2003) simply reinforced the impression left by the authors that the methyl mercury exposures in their patients were extraordinarily and dangerously high and that such exposure levels can result in symptoms of fatigue, headache, decreased memory, and joint pain in adults. In fact, methyl mercury exposures many times higher than the U.S. EPA RfD are common in fishing populations around the world, and there has been little epidemiologic investigation into the relationship between exposure levels in fishing populations and these symptoms [Agency for Toxic Substances and Disease Registry (ATSDR) 1999; National Research Council 2000].

The U.S. EPA RfD of 0.1 μg/kg body weight/day is derived on the basis of the health effects of prenatal exposure (U.S. EPA 2001), as historically scientists believed the developing fetus to be most sensitive to methyl mercury. Two recent large prospective epidemiologic studies in fishing populations in the Seychelles (Myers et al. 2003) and Faroe Islands (Grandjean et al. 1997) have given mixed results, however, such that the question of neurologic impairment in children of mothers who consume large amounts of fish during pregnancy remains open. With regard to adults, the epidemiologic evidence for adverse effects at the exposure levels documented by Hightower and Moore (2003) is even more uncertain.

Because of this uncertainty, the determination of the appropriate level for the methyl mercury RfD represents a subjective policy decision, as well as a calculation based on scientific data. The policy element is most apparent in the choice of an uncertainty factor, which sets the RfD many times lower than the exposures that have been associated with prenatal effects. Policy is also reflected in the decision to apply one guideline to all members of the population. Many scientists, physicians, and regulators consider that, given current evidence, a guideline of 0.1 μg/kg body weight/day is too low, particularly for men and older women.

Regardless of whether one agrees with the specific level set by the U.S. EPA for its methyl mercury RfD (U.S. EPA 2001) in the context of the agency's mandate for environmental protection, it is important not to forget how this dose was determined and its potential shortcomings as a dietary guideline. The current RfD may be appropriate for Hightower and Moore's patients, who have a wide range of high-quality food available to them. However, for many individuals, in the United States and around the world, fishing remains an important economic and cultural activity, and the dietary alternatives to the fish they catch are of much poorer nutritional value. For these individuals, adhering to the U.S. EPA RfD may not be the best advice.

The author is an independent consultant currently working under contract for the Cree Board of Health and Social Services of the James Bay (CBHSSJB); this work includes a literature review of the health effects of methyl mercury. Her views in this letter are her own and do not represent the CBHSSJB.

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Methyl Mercury Reference Dose: Response to Schoen

Mercury symptoms have been documented in the literature from many different exposures: from the "blue pill" used in the treatment of syphilis (Hirschhorn et al. 2001), to the mercurials used in teething powders causing acrodynia (or pink disease) (Dinehart et al. 1988), the mercury nitrate in hatters (O'Carroll et al. 1995), methyl mercury in fish in Japan (Fukuda et al. 1999; Harada 1995), and methy mercury–tainted seed grain in Iraq (Bakir et al. 1973). Goldsmiths, tinsmiths, mirror makers, and miners also had symptoms caused by occupational exposure to mercury vapor (Ramazzini 1983). Recently, contact lens solutions containing ethyl mercury (thimerosal) caused blepharoconjunctivitis and punctate keratitis in many contact lens wearers. As a result, thimerosal was removed from the solutions (Campbell et al. 1992).

It is clear that the side effects of mercury at lower exposure levels vary between individuals. This was evident in acrodynia, a debilitating and sometimes deadly condition of infants and children. Although the disease was recognized as early as 1890, the cause—multiple forms of mercury compounds—was not confirmed until after 1948. It was later thought to be a type of "hypersensitivity reaction" because some children with the same exposure were not noticeably affected (Dinehart et al. 1988).

The variation of effects seen when comparing the Seychelles (Myers et al. 1995 2003) and Faroese (Grandjean et al. 1998) cohorts may be simply because of genetic differences. It is possible that an isolated population exposed to mercury for generations could, by natural selection, tolerate higher amounts of mercury.

Recent articles have shown an association with increased myocardial infarction and death from myocardial infarction with mercury levels close to the current reference dose (RfD) set by the U.S. Environmental Protection Agency (EPA) (Guallar et al. 2002; Rissanen et al. 2000; Salonen et al. 1995, 2000). Other researchers have identified an accumulation in the hearts of those

with idiopathic dilated cardiomyopathy thousands of times higher than even the surrounding tissues of the same individual (Frustaci et al. 1999). Induction of cardiomyopathy in laboratory rats with mercury exposure has also been demonstrated (Bachmaier et al. 1999; Ilback et al. 1996, 2000; South et al. 2001).

In a recent article on carotid atherosclerosis, Salonen et al. (2000) concluded that of 20 risk factors, mercury had the best predictive value for intimal wall thickness and was associated with progression of carotid atherosclerosis. Cerebral arteriosclerosis was seen in infants suffering from Minamata disease (Harada 1995).

A correlation between mercury and autoimmune phenomena is of tremendous concern. Mercury-induced autoimmunity is one of the few animal models in which administration of a chemical induces a specific loss of tolerance to self-antigens. Autoantibodies elicited include antiglomerular basement membrane, anti–single-stranded DNA, anti–double-stranded DNA, antithyroglobulin, antiphospholipid, and anticollagen I and II (Bagenstose et al. 1999; Bernier et al. 1995; Bigazzi 1994; Nielsen and Hultman 2002; Stejskal et al. 1999; Stejskal and Stejskal 1999; Via et al. 2003).

Although Minamata disease sufferers were thought to have extremely high mercury levels in hair, other studies in Japan looked at lower-end chronic methyl mercury exposures. Subjective complaints analyzed in a population living in a methyl mercury–polluted area showed an increase of symptoms after several years of exposure and had atypical and subclinical features unlike those of "classic Minamata." Exposed individuals reported higher prevalence of many complaints than the internal and external controls. Symptoms that were statistically significant are as follows: muscle stiffness, dysesthesia, hand tremor, dizziness, loss of pain sensation, muscle cramps, upper arm muscular atrophy, arthralgia, lumbago, leg tremor, tinnitus, muscular atrophy, chest pain, palpitations, fatigue, visual dimness, and staggering. Symptoms with statistical significance for men only were difficulty with urination and thirst. Those with statistical significance only in women were muscular weakness, urine incontinence, forgetfulness, and insomnia (Fukuda et al. 1999).

Adverse affects after low-level methyl mercury exposure were reported recently in the area of neuropsychiatric functioning in adults (Yokoo et al. 2003).

The U.S. EPA's RfD was defined in the *Mercury Study Report to Congress* as the amount of methyl mercury that, when ingested over a lifetime, is anticipated to cause no adverse health effects to humans, including those in sensitive populations (U.S. EPA 1997). The dose is 0.1 μg/kg body weight/day and corresponds to a blood level of 4–5 μg/L or a hair level of 1.0 μg/g. The benchmark dose lower limit is the intake of methyl mercury associated with the lower bound on a 95% confidence interval of a dose producing a 5% prevalence of adverse effects (in addition to a background effect of 5% adverse effects) (U.S. EPA 1997). The benchmark dose lower limit calculated using the Faroese study, which used fetal exposure outcomes, was 58 μg/L [National Research Council (NRC) 2000]. The NRC, through review of a vast amount of literature, concluded that the U.S. EPA's RfD was justified and recommended application of an uncertainty factor of at least 10 in setting the U.S. EPA's RfD for methyl mercury (NRC 2000).

A benchmark dose for cardiac and autoimmune disease has not been identified and could be lower than that set for fetal exposures.

The best advice is still to consume no more mercury than the RfD set by the U.S. EPA to avoid accumulation over a lifetime. Education for consumers and health-care professionals can result in lower mercury levels, despite high fish consumption.

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Arsenic in Food

Lasky et al. (2004) provided a notable contribution to the evaluation of the public health impacts of the use of arsenicals, among the

many antimicrobials permitted by the U.S. Food and Drug Administration (FDA) for administration in feed. To date, concerns have focused on the association between the use of these drugs and the prevalence of drug-resistant pathogens in beef, poultry, and pork products (Levy 2001). These concerns have prompted the European Union (EU) to ban the use of antimicrobial drugs for nontherapeutic purposes in food animal production (Sorum and L'Abee-Lund 2002), and the FDA has initiated processes to stop fluoroquinolone use in poultry and to reform its procedures for evaluating new drug applications for use in food animals.

There has been less concern, internationally or nationally, over the potential public health risks associated with residues of growth promoters in meat products, although the discovery of chloramphenicol in Asian shrimp in 2002 resulted in a requirement that all shrimp be tested before sale in the EU (Delegation of the European Commission to Thailand 2002). Arsenicals—arsanilic acid and roxarsone—are permitted for nontherapeutic uses as growth promoters in animal feeds in the United States [National Research Council (NRC) 1999]. Lasky et al. (2004) serve notice that we must re-evaluate this use of arsenicals not solely for environmental impacts (Jackson et al. 2003) but also for their role in human dietary exposures to arsenic. It is noteworthy that most studies of dietary sources of arsenic exposure do not examine fresh poultry or pork products (e.g., NRC 2000; Ryan et al. 2001).

However, in two respects, the conclusions drawn by Lasky et al. (2004) probably underestimate the true risks. First, as the authors carefully noted, they had to estimate the concentrations of arsenic in muscle using the only U.S. Department of Agriculture (USDA) data available, analyses of liver concentrations. It would be interesting to know why the USDA does not analyze arsenic in muscle, the tissue most commonly consumed by humans. [In 1981, Westing et al. (1981) reported higher levels of arsenic in edible muscle tissue from cattle given feeds containing poultry litter.] In the absence of real data, Lasky et al. used information from the drug manufacturer, Alpharma (Fort Lee, NJ), which supported an inference of a liver:muscle ratio of 2.9–11, depending on withdrawal time before slaughter. However, these assertions must be supported by data, particularly because broiler chickens are fed arsenicals throughout their lifespan. I was unable to find any article on the toxicokinetics of arsenic in birds under controlled conditions; however, following the guidance of the World Health Organization/Food and Agrigulture Organization (WHO/FAO) Joint Expert Committee on Food Additives (JECFA) 2000], I examined recent studies on arsenic metabolism in mammals. Hughes et al. (2003) reported that the body burden of arsenic in mice under repeated-dose exposure was significantly higher than that under acute exposures; moreover, elimination of arsenic after repeated doses was significantly slower than after an acute dose. Under repeated doses, the ratio of liver to muscle arsenic changed dramatically over time, and at day 17, arsenic in muscle was higher than in liver. Thus, it is likely that the actual concentrations of arsenic in edible portions of broiler poultry are higher than the estimates of Lasky et al. (2004).

In addition, Lasky et al. (2004) referred to a 20-year-old assessment of the human health risks of ingesting arsenic (JECFA 1983). Much more recently, in a risk assessment of arsenic in drinking water, the NRC (2000, 2001) concluded that the excess cancer risks associated with dietary exposures are considerably greater than those previously assumed by the WHO and other authorities. In its analysis of cancer risks (NRC 2001), the committee concluded that exposure to 50 ppb arsenic in drinking water could be associated with excess cancer risks on the order of 1 in 100 (all cancers). Exposure to 1.38–5.24 μg/kg/day As from chicken consumption, as estimated by Lasky et al. (2004), would be a significant addition to drinking-water exposure based on the NRC's recommended maximum contamination level (MCL) of 10 μg/L (~ 3 L/day, or 30 μg/day; for an adult weighing 70 kg, a daily exposure of 0.43 μg/kg/day).

Surely it is time for the U.S. government and international organizations to reconsider the acceptability of arsenic use in food-animal production. Arsenic contributes to the rise in drug resistance among pathogens (Liu et al. 2001), and its use contaminates the land when animal wastes are used as fertilizers (Arai et al. 2003; Garbarino et al. 2003; Rutherford et al. 2003; Wing and Wolf 2000). Also, direct consumer exposures via food may well be a significant and preventable portion of overall exposures to this human carcinogen.

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Food and Population Growth

It was a pleasure to read "Infectious Disease: The Human Cost of Our Environmental Errors" by Weinhold (2004). His article on microbes, people, and human environmental errors has encouraged me to share new and apparently unforeseen data that appear to contradict popular and even scientific ideas regarding human population dynamics. Emerging scientific evidence indicates that the absolute population numbers of species on the planet increase primarily as a function of food supply and also that microorganisms

and human organisms have common dynamics governing population.

Abundant research indicates that countries such as Australia, Canada, Italy, and Tunisia, among many others, have shown a declining trend in their rates of human population growth (United Nations Development Programme 2003). The geographically localized data need not blind us to the fact that the global population is still growing by the billions.

For too long, human population growth has been widely viewed as somehow outside the course of nature. The potential causes of human population growth have seemed complex, obscure, numerous, or even unknowable, so that a strategy to address the problem has been thought to be all but impossible. One of the consequences of this unnatural way of viewing human population dynamics is that forecasts of global population growth vary widely: Some forecasting data indicate the end to human population growth soon, and other data suggest skyrocketing numbers.

With recent correlation data from Hopfenberg and Pimentel (2001) and the current mathematical formulation of the problem by Hopfenberg (2003), it may now be possible for us to see human population dynamics as a natural phenomenon. Hopfenberg (2003) and Hopfenberg and Pimentel (2001) provided an empirical presentation of a nonrecursive biological problem that is independent of ethical, social, legal, religious, and cultural considerations. This means that world human population growth is a rapidly cycling positive-feedback loop, a relationship between food and population in which food availability drives population growth, and population growth fuels the impression that food production needs to be increased. The data indicate that as we increase food production every year, the number of people increases, too.

Perhaps a new biological understanding is emerging with Hopfenberg's research. It is simply that the earth's carrying capacity for human organisms, like that for other organisms, is determined by food availability. As goes the food supply, so goes the population. According to these data (Hopfenberg 2003; Hopfenberg and Pimentel 2001), stabilization of food production at current levels will lead to a stabilization of absolute global human population numbers. Redistribution of world food resources and education for all children, in particular, appear in the forseeable future. Socially and culturally sanctioned humanitarian policies and programs regarding the propagation of our species will be developed and implemented. Human population growth is a huge problem, taking an ever-increasing toll on the Earth's resources; but we can take the measure of this problem and find a remedy that is consonant with universally shared human values.

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Human Testing: Sass and Needleman Respond to Industry

In the March 2004 issue of *EHP*, we reported on two examples of industry-sponsored studies that intentionally dosed human subjects with toxic pesticides (Sass and Needleman 2004). The four industry-sponsored respondents (Charnley and Patterson 2004; Chart et al. 2004; McAllister 2004; Tobia et al. 2004) focused primarily on their claims that the studies were conducted in accordance with formal ethical guidelines. Although that contention is debatable, it misses fundamental scientific criticisms we raised: *a*) sample sizes and statistical power were too small to find an effect, if one were present; *b*) study populations were inappropriate to establish no observed effect levels (NOELs) for children, the most sensitive population; *c*) outcome measures were unsuitable to establish NOELs for children; and *d*) study interpretations were biased to ignore or dismiss evidence of adverse health effects. The pesticides under consideration were organophosphate neurotoxins that are chemically related to military nerve gas.

We would like to respond to Charnley and Patterson (2004), Chart et al. (2004), McAllister (2004), and Tobia et al. (2004) in detail.

First, if there is no chance of obtaining valid conclusions, one cannot ethically expose humans to risks. A recent National Research Council (NRC) report (NRC 2004) stated that underpowered studies "cannot be ethically acceptable if [they are] scientifically invalid." The industry human experimentation studies conducted to date employed samples of < 60 subjects (AMVAC 1997; Haines 1971; Wyld et al. 1992). The calculated statistical power to find an effect was in the range of 0.2. This means that they had a one-in-five chance of detecting an effect if it were present, practically guaranteeing a finding of no effect.

Second, the outcome measures in the industry studies were peripheral red blood cell acetyl cholinesterase (AChE) levels, a symptom checklist, and blood pressure (AMVAC 1997; Haines 1971; Wyld et al. 1992). The insensitivity of these measures stands in contrast with recent literature on low-dose noncholinergic toxic effects of the organophosphate pesticides (OPs), including effects on neurogenesis and behavior (Aldridge et al. 2004; Icenogle et al. 2004; Meyer et al. 2004a, 2004b). Although the primary outcome of interest in protecting children is the effect of OPs on the developing brain, neurobehavioral toxicity was not evaluated in any of the industry reports (AMVAC 1997; Haines 1971; Wyld et al. 1992). In addition, whereas evidence of carcinogenic properties has been published on a number of OP pesticides, no attempt has been made to evaluate this or any other chronic end point.

Third, there was no urgent or compelling need for human data, given the existing evidence of toxicity from laboratory experiments. Industry sought information from human studies primarily to avoid the 10-fold safety factor when extrapolating from animal studies to human risk. Eliminating the safety factor would result in setting higher levels of allowable exposure and permit greater sales of the pesticides.

Fourth, the AMVAC Chemical Corporation, sponsor of the dichlorvos (DDVP) study we discussed (AMVAC 1997), reported that although there were statistically significant differences in cholinesterase inhibition between treated and placebo groups, "none of these differences were considered to be of biological significance," and the dose was considered a NOEL. However, the U.S. Environmental Protection Agency (EPA) rejected AMVAC's interpretation of the results, instead concluding that "the reduction in RBC cholinesterase activity was considered by the Hazard ID [identification] Committee to be biologically significant," and the dose tested was considered to be a lowest observed effect level (LOEL) (U.S. EPA 1998b). This illustrates our concern that, "when studies are sponsored by chemical manufacturers with a financial interest in the study outcome, the studies may be biased in design and in interpretation" (Sass and Needleman, 2004).

The responders from Bayer CropScience (Tobia et al. 2004) stated that in our letter we

omitted the critical fact that the Bayer-sponsored aldicarb study on human subjects had been reviewed and found "acceptable and appropriate" by a U.S. EPA Scientific Advisory Panel (SAP) in 1992 and reaffirmed in 1998. In 1992 the SAP had no ethical guidelines governing acceptance of human studies. As to the 1998 review, the statement by Tobia et al. (2004) is misleading. In fact, the U.S. EPA statement issued in 1998 to the SAP/Science Advisory Board (SAB) (U.S. EPA 1998a) reads in its entirety:

> [The U.S.] EPA is deeply concerned that some pesticide manufacturers seem to be engaging in health-effects studies on human subjects as a way to avoid more protective results from animal tests under the new Food Quality Protection Act. The government has in place very stringent standards that apply to federally funded research to ensure the protection of human subjects. [The U.S.] EPA will be asking its independent Science Advisory Board to apply these same standards to pesticide data submitted to [The U.S.] EPA by companies for review. No human test data [have] been used by [The U.S.] EPA for any final decisions about acceptable levels of pesticide under the new food safety law. The protection of public health from adverse effects of pesticides can be achieved through reliance on animal testing and use of the highest ethical standards.

The U.S. EPA SAP/SAB members were in strong agreement that neurotoxic agents should be given to humans only if there was an urgent and compelling need for the information, and if there was no other way to obtain it (U.S. EPA 2000).

There is growing literature on noncholinergic effects of organophosphates. Meyer et al. (2004a) recently reported developmental alterations in adenylyl cyclase signaling in rat pups exposed to chlorpyrifos, confirming neurodevelopmental effects through noncholinergic mechanisms. Icenogle et al. (2004) reported behavioral changes in adolescent and adult rats after low-dose chlorpyrifos administration. In humans, Berkowitz et al. (2004) reported a small but significant reduction in head circumference in infants born to mothers with detectable levels of chlorpyrifos in their blood, coupled with low maternal paraoxonase (PON1) activity. Perera et al. (2003) reported that chorpyrifos and diazinon found in mother's blood and umbilical cord blood was associated with lower infant birth weight and length, suggesting poorer predicted health outcomes. In an update, Whyatt et al. (2004) reported that regulatory restrictions on the two pesticides measurably lowered exposure and resulted in increased infant head size, providing encouragement for strict regulations to prevent or limit exposure.

The regulation of pesticides must protect against neurodevelopmental and neurobehavioral effects from even low-dose exposures during critical stages in fetal and neonatal development. Measures of cholinesterase in adult peripheral blood are a poor surrogate for these critical effects. The examples of industry-sponsored human tests of pesticides are indefensible on both the scientific and ethical grounds, and U.S. EPA acceptance of such data for setting standards opens the door to serious harm to the general public as well as the subjects of such tests.

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Correction

The November 2003 Forum article "New Data on Methylmercury and Fetuses" [*EHP* 111A753 (2003)] incorrectly stated, "The hair mercury of pregnant women in Minamata ranged from 25 to 50 ppm." In fact, there are no direct data on the hair mercury concentrations of the pregnant Minamata women whose children had health problems associated with methylmercury poisoning. *EHP* regrets the error.