Synergistic Effects of Mercury & Other Toxic Exposures

While the additive and synergistic effects of multiple toxic exposures are well documented in the medical literature, government agencies do not take such into account in their regulation of toxic chemicals.

Synergistic Effect of Multiple Toxic Metal Exposures and Toxic Metals with Other Toxic Substances

Mercury and lead are extremely neurotoxic and cytotoxic, but their combined synergistic effect is much worse. A dose of mercury sufficient to kill 1% of tested rats, when combined with a dose of lead sufficient to kill less than 1% of rats, resulted in killing 100% of rats tested. Thus with combined exposure the safe dose is 1/100 as much as the dose individually. Studies in Australia have confirmed similar relationships hold for people, and other studies document such effects. This means most people in the U.S. are getting dangerous levels of these metals, enough to cause some neurologic effects. Consuming two toxic metals in combination, such as lead and cadmium, or lead and mercury, can have a synergistic effect, meaning one metal has the ability to enhance the toxicity of another metal in amounts smaller than what it would usually take that metal to be toxic.

Laboratory animals are often used to test the toxicity of a substance. In the case of testing lead and mercury together, rats were used. Rats were dosed with an amount of mercury that would cause death in 1% of the rat population within about 5 days. This is called lethal dose 1% or LD1. The laboratory rats were also tested with a LD1 dose of lead. What is frightening is that when mercury and lead LD1 dosages were combined, there was a 100% mortality rate; all of the rats died, demonstrating that mercury and lead together are highly synergistic in their toxic effects.

The level of mercury thimerosal in vaccines has been shown to be highly neurotoxic, but the effect was found to be much larger due to the synergistic effect with aluminum, which is also in most vaccines. Aluminum is in all vaccines and has been found to have significant adverse effects, independently of mercury. Studies using U.S. CDC data have found thimerosal from vaccines to be major factors in autism and ADHD, along with prenatal Rhogam shots which contain high levels of mercury thimerosal and are given to some RH negative women during pregnancy.

Dietrich Klighardt has found that copper, zinc, and lead are synergistic with mercury, increasing the adverse effects. Other factors found to be synergistic with mercury toxicity are cavitation toxins, stress, sleep deprivation, aspartame, vaccinations, metal dental work, and wheat. Similar is true for mercury's synergistic effect with other toxic metals like arsenic, and with other toxic chemicals like PCBs or with smoking, which greatly increased measured kidney damage effects. Mercury in combination with PCBs through diet can also have a synergistic effect. It is rather disturbing to realize that some populations of Canadian, Alaskan, and Great Lakes children are routinely ingesting chronic doses of lead, mercury, and PCBs together in their diet.

Another study found that insulin resistance increased with serum dioxins and blood mercury levels. Moreover, participants with higher serum dioxins or blood mercury were at a

significantly increasing risk for insulin resistance, and simultaneous exposure to dioxins and mercury heightened the risk of insulin resistance more than does individual exposure. A 2003 report by the National Institutes of Environmental Health Sciences (NIEHS) acknowledged that fluoride has been observed to have synergistic effects on the toxicity of aluminum. The researchers acknowledge that most drinking water is high in fluoride/aluminum complexes, which enhance neurotoxicity. Other studies have shown that cooking with fluoridated water leaches the aluminum out of the aluminum cooking pots, with different amounts being released depending on the foods being cooked, whereas cooking with non-fluoridated water resulted in no release of aluminum from the pans.

Autism has increased in the U.S. more than 10-fold in the last decade. According to the Florida Department of Education, the numbers increased from approximately 300 to over 4000 during this time period. There have likewise been large increases in the number of children with ADHD and other developmental conditions, according to the National Academy of Sciences and other sources. A major factor in this appears to be the large increase in vaccinations given to infants and other toxic metal exposures. There was an increase of over 45% in learning disabilities in Pennsylvania between 1990 and 2000. However, the study showed that Montgomery, the county highest on the Chemical Pollution Scorecard, had an increase more than double that of the rest of the state. Montgomery County had an increase in ADHD of 32.7% and an increase in autism of 310%.

There is new understanding about the effects of environmental chemicals on these processes. Developmental disabilities, including attention deficit/hyperactivity disorder (ADHD), autism, and related neurodevelopmental diseases affect millions of American children. The consequences of these disorders are often tragic. The family, social, and economic costs are immense, and the disabilities can be life-long. Studies of animals and children show subtle changes in the concentrations of normally occurring chemicals such as hormones—as well as the presence of toxic agents like lead, mercury, or PCBs—can produce profound and permanent changes in the developing nervous system. These can lead to decrements in mental performance.

Studies demonstrate that a variety of chemicals commonly encountered in industry can contribute to developmental, learning, and behavioral disabilities. Developmental neurotoxicants are chemicals that are toxic to the developing brain. They include the metals lead, mercury, cadmium, and manganese, and pesticides such as organophosphates. PCB's and dioxins bio-accumulate and are directly toxic to cells and neurotransmitters.

With widespread use and disposal of all these chemicals and metals which affect learning disabilities, it is easy to understand why learning disabilities increased in PA by 46.6%, and even in the least polluted PA counties by 40.2% from 1990 to 2000. ACE believes Montgomery County children face a chemical plague. A major factor is toxic air releases. The kinds of neurotoxins which cause learning disabilities, ADHD, and autism are emitted into the air 7 days a week from the Pottstown Landfill and Occidental Chemical. Both emit unknown amounts of dioxin. The Pottstown Landfill emits synergistic and additive combinations of nearly every neurotoxin. These can become far more toxic as they synergize. Mercury is just one example. Occidental Chemical in Pottstown has emitted 1½½ million pounds of vinyl chloride since 1988. These emissions travel downwind through many parts of Montgomery County.

Synergistic Effects of Organochloride Chemicals and Other Estrogenic Chemicals

Studies have found that the combined synergistic effects of such estrogenic organochloride chemicals, such as endosulfan, dieldrin, toxaphene, and chlordane, are much stronger than would be expected. Combinations of endosulfan, dieldrin, toxaphene, and chlordane produced estrogenic effects 500 to 1000 times as much as their individual effects. Likewise, synergistic effects were found to beat the neurotoxic pesticide ingredient Deet and other types of pesticides and chemicals. Similar synergistic estrogenic effects were observed when small levels of estrogenic pesticides were combined with 2 types of PCBs. T. M. Gross of the University of Florida found that PCBs appear to have synergistic effects with those of other estrogenic chemicals like dioxin, DDT, mercury, etc.

Similar findings have been seen in dioxin or organochloride chemically-contaminated fish and wildlife of the Great Lakes region, Mississippi River, and other areas throughout the U.S. and Canada and in dioxin or pesticide-contaminated Florida rivers. Animal studies have confirmed that PCBs have similar feminizing and sexual mutation effects, and that there are synergistic effects between different organochloride congeners that produce effects at lower levels than for one toxic chemical alone.

Some of the common phthalates have also been found to have more adverse synergistic effects when combined with other chemicals found in the environment and food chain. For example, DEHP has been found to have synergistic effects with trichloroethylene and heptachlor for prenatal loss of fetus and maternal mortality in rats. Mixtures of low levels of organochloride chemicals were found to cause a significantly greater proliferation of tumor cells than when exposed individually. This could also explain why the distribution of toxic-waste sites in the U.S. closely parallels the sites of highest breast cancer mortality and increased birth defects.

In 2002, Kortenkamp and his colleagues tested a mix of eight xenoestrogens on yeast. These included chemicals used as plasticizers, sunscreen ingredients and others found in cooling and insulating fluids. In the mixture, each was below the level that toxicologists call the “no-observed effect concentration”—the level that should be safe. Sure enough, the combination triggered unusual effects in the yeast. Kortenkamp and his colleagues dubbed the mixture effect “something from nothing.” Kortenkamp and his colleagues found that if the doses of all eight chemicals were simply added together, after adjusting for the varying potencies, this new cumulative dose could be used to predict the effect—a principle called “dose addition.”

Since then the effect has been shown with other species, too. Kortenkamp and his colleagues now report that mixtures of xenoestrogens feminized males to varying degrees even though the individual components should have been harmless. Later, the team showed that a blend of anti-androgens—chemicals that block the effect of male sex hormones—can work in the same way. They exposed pregnant rats to two common fungicides, vinclozolin and procymidone, and the prostate cancer drug flutamide, and then screened the male offspring for reproductive deformities. At higher doses, each of these three chemicals wreaked havoc with sex hormones, via the same mechanism: they disrupted male development by blocking androgen receptors and so prevented natural hormones from binding. The researchers found that even when the chemicals were used in doses that had no effect when given individually to pregnant rats, a mixture of them disrupted the sexual development of male fetuses.

Earl Gray, an ecotoxicologist at the reproductive toxicology division of the US Environmental Protection Agency's Health and Environmental Effects Research Laboratory (HEERL) in Research Triangle, North Carolina, and his team also tried exposing pregnant rats to vinclozolin and procymidone. When they exposed the animals to the compounds individually, they too saw no effect. However, when they combined the two, half of the males were born with hypospadias. Gray calls this phenomenon "the new math—zero plus zero equals something." Gray then tried the same experiment with phthalates—the ubiquitous compounds that are used to soften plastics and thicken lotions, and are found in everything from shampoo to vinyl flooring and flexible medical tubing. Phthalates also disrupt male development, in this case by stopping the fetus from making testosterone. The mix of two phthalates that Gray used caused many of the same effects on male rat fetuses as a mixture of vinclozolin and procymidone.

It makes sense that chemicals targeting the same pathway would have an additive effect. What about mixtures of chemicals that work via different mechanisms? Surely the individual doses of such chemicals would not be additive in the same way. In 2004, Gray and his team put this to the test by mixing procymidone with a phthalate at levels that, on their own, would produce no effect. Because the chemicals work via different routes, Gray expected that the combination wouldn't have any effect either, but they did. Then the team mixed seven compounds—with four independent routes of action—each at a level that did not produce an effect. "We expected nothing to happen, but when we give all [the compounds] together, all the animals are malformed," Gray says. "We disrupted the androgen receptor signaling pathway by several different mechanisms. It seems the tissue can't tell the difference and is responding in an additive fashion."

Shanna Swan is doing something similar. In a study published in 2005, Swan showed that boys whose mothers had had higher levels of five phthalates while their babies were in the womb had a shorter distance between the anus and genitals—a marker of feminizing activity. The boys also had higher rates of cryptorchidism compared to sons of mothers with lower phthalate levels. Swan devised a cumulative score to reflect exposure levels to all five phthalates and found that score was "very predictive of ano-genital distance."

Children everywhere are experiencing unacceptable increases in learning disabilities which suggest a serious problem. These disabilities are clearly the result of complex interactions among environmental, social, and genetic factors that impact children during vulnerable periods of development.

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