**The Right Chemistry: Environmental chemicals and children’s health**

More and more concerns are being raised these days, but establishing cause and effect remains complicated.

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“Children are not small adults” is one of the tenets of toxicology. Some substances that may be totally innocuous in adults can affect children dramatically. Young livers and kidneys are less adept at removing toxins, and susceptibility to hormone-like chemicals is greater during development than in adulthood. Children also inhale more air, and consume more liquids and food per kilogram of body weight than grownups and therefore are more prone to the effects of air pollution and potential toxins in foods or beverages.

Embryos are even more susceptible to developmental interference, as was vividly illustrated by the thalidomide case in the 1960s, when mothers who took the drug to ease morning sickness were themselves unaffected but were more likely to give birth to children with malformed limbs.

More and more concern is being raised these days about environmental effects on children’s health because epidemiological studies have documented increases in childhood asthma, obesity, Type 2 diabetes, leukemia, autism, learning difficulties, brain tumours, genital malformation in boys, earlier puberty in girls and testicular cancer in young men. Since these changes have been observed over a relatively short time frame, suspicion has focused on substances that have been introduced into the environment roughly since the Second World War. Novel plastics, electronics, food additives, insecticides, herbicides, building materials, fire retardants, personal care products, synthetic fabrics, dyes, paint strippers, medications, detergents, cleaning agents, cookware, adhesives and packaging materials have ushered thousands of chemicals into the environment, hundreds of which have been shown to be present in human blood and umbilical cord samples. Many of these have been shown to have potentially toxic effects in cell culture, animal studies or occupational settings.

So what, if anything, can we do? Unfortunately, we have to contend with the fact that science has limits and cannot solve all problems. Every day we are exposed to thousands of chemicals, both naturally occurring and synthetic, that engage in a myriad chemical reactions inside our body, the most complex machine on the face of the Earth.

To illustrate how multifaceted and basically undecipherable the problem of the relationship between our environment and health is, it is enlightening to consider some basic concepts.

The cornerstone of toxicology is the age-old dictum first introduced by the medieval alchemist, doctor and philosopher Paracelsus more than 500 years ago: “Only the dose makes the poison.” While this doctrine is sound, it must be pointed out that in some cases that dose can be extremely small. A tenth of a millionth of a gram of botulin, the toxin produced by the clostridium botulinum bacterium, can be lethal! Some hormone-like chemicals, bisphenol A and phthalates being classic examples, are detectable in the blood in trace amounts that would seem to be irrelevant. However, their concentration may actually be in the same range as naturally occurring hormones and therefore a possible effect cannot be dismissed. Consider that growth hormone, critical for children’s development, is in the range of 5 × 10-9 grams per mL, an incredibly small amount.

However, there are also vast differences in hormone-like behaviour that have to be considered. For example, preservatives in the parabens family have been shown to have estrogen like-effects in the lab, and have been detected in human blood. But butylparaben, the most potent estrogenic paraben identified, is still 10,000 times less potent than estradiol, the body’s natural estrogen. Can it have some subtle effect? Virtually impossible to determine.

Another point is that people are not giant rodents and a substance that has a toxic effect in an animal may not affect people the same way. For example, 2-butoxyethanol is a solvent in a variety of commonly used cleaning agents that in high doses is carcinogenic in rodents, but the mechanism of action involves the rodents’ forestomach, which humans lack. Also, as we know, chocolate contains theobromine, which is toxic for dogs but fortunately not for humans.

It also must be remembered that associations do not establish cause-and-effect relationships. There is an association between an increase in childhood asthma and an increase in the sales of kale. I think it is safe to say that kale does not cause asthma. In the same vein, finding that obese children have higher levels of bisphenol A or phthalates or perfluorinated compounds in the blood does not mean that these chemicals cause obesity. Indeed, they may, by some mechanism, but it may just be that they are more likely to be present in processed foods that are higher in calories.

Yet one more consideration, that I call the “study effect.” Examine any chemical in depth in the lab or in rodents and chances are that at some dose, some toxic effect will be revealed. This may have no relevance for humans, but can instil worry if presented without proper context by alarmists.

In view of these confounding notions, it is obviously challenging to come to any conclusion about environmental chemicals and health. Nevertheless, recent recommendations by the American Academy of Pediatrics to prioritize fresh fruits and vegetables, limit processed meats and avoid heating foods in plastic are sensible and simple to follow.

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