



Pollutants



Clinical Information for Professionals

volatile solvents
parabens
phthalates

Environmental pollutants have been linked to a variety of neurological and endocrine problems.

About Environmental Pollutants

In the past, environmental concerns focused mostly on the acute effects of pollution. These concerns helped result in a ban on DDT pesticides, and the removal of lead from gasoline and paints. According to Rick Smith and Bruce Lourie, authors of the bestselling *Slow Death By Rubber Duck*, we have transitioned from mostly local and acute environmental threats to more global and largely invisible threats. Chronic exposure to low levels of toxins means the effects of pollution can accumulate and contribute to chronic disease. Toxic chemicals are found to varying degrees in everything from cosmetic and skin care products to cookware and children's toys. Because the human body metabolizes these pollutants and eliminates them in the urine, measuring urine metabolites is an effective way to assess the level of exposure to the various pollutants.

Parabens

Parabens are chemical preservatives that prevent growth of bacteria and mold and increase the shelf life of numerous consumer products. It is estimated that parabens are present in 75 to 90% of skin products including: moisturizers, cleansers, shampoos, conditioners, sunscreens, perfumes and toothpastes. Parabens easily penetrate the skin and can mimic estrogens. Their weak estrogenic effect has a potentially disruptive effect on the endocrine system of both men and women. Allergic skin reactions to parabens have also been reported.

Phthalates

Phthalates are a class of chemicals commonly used as plasticizers (softening agents) in the manufacture of soft vinyl (also known as polyvinyl chloride (PVC)). PVCs are used to make many consumer products, including soft vinyl children's toys and child care articles. Phthalates do not bind to the soft vinyl, but are present as mobile components of the vinyl. The harmful effects of phthalates are directly related to the amount of phthalates that leach out of soft vinyl and are absorbed into the body. [Health Canada] Another phthalate, diethylphthalate (DEP), is added to skin products to help lubricate other ingredients, allow lotions to penetrate and soften the skin, and improve the longevity of added fragrances.

Exposure to phthalates has been linked to asthma, birth defects, hormonal changes, thyroid irregularities, skin allergies and increased risk of diabetes.

Volatile Solvents

Also known as volatile organic compounds, or VOCs, volatile solvents include chemicals like xylene, toluene, styrene and benzene. These chemicals are found in household products like: paints, varnishes, paint stripping products, and adhesives. VOCs are air borne particles that contribute to poor air quality and are a major contributor to smog. Vapors from photocopiers and printers, automobile exhaust, cigarette smoke, fingernail polish and fuelling stations are a few common sources of exposure. Exposure can also occur as a result of out-gassing of solvents from building materials, furniture, packing materials, shoes and other manufactured products.

All VOCs are toxic to the nervous system, and some are carcinogenic. The health effects of different VOCs range from damage to the reproductive, neurological and respiratory systems to birth defects and impaired kidney and liver function.

Environmental Pollutants



Pollutant	Effects
parabens	<ul style="list-style-type: none"> • allergic contact dermatitis • parabens exhibit weak estrogenic activity • animal studies show decreased testosterone levels and sperm count
phthalates	<ul style="list-style-type: none"> • phthalates are endocrine disrupting chemicals (EDC) • may cause developmental and morphological abnormalities, including deficits in behavior and cognition • phthalate esters perturb tryptophan metabolism causing accumulation of the metabolite quinolate (QA). QA in the CNS is markedly elevated after trauma or inflammation, and has been implicated in neuronal injury via activation of the NMDA receptor. In theory, the combination of toxic phthalate levels and consumption of tryptophan-rich foods could increase risk of some neurological disorders.
Volatile Solvents	Effects
benzene	<ul style="list-style-type: none"> • skin and eye irritation • decreased hematocrit, hemoglobin, erythrocytes, leukocytes, platelets • bone marrow depression: aplastic anemia, leukemia, thrombocytopenia • carcinogenic, genotoxic • CNS depression, death
styrene	<ul style="list-style-type: none"> • impaired balance and manual dexterity and reaction time ; dizziness, lightheadedness, headache, drowsiness, nausea, difficulty concentrating • irritation of mucous membranes, dermatitis, nausea, fatigue • genotoxicity • CNS depression
toluene	<ul style="list-style-type: none"> • CNS depression or excitation <ul style="list-style-type: none"> • euphoria followed by disorientation, tremulousness, labile mood, tinnitus, diplopia, hallucinations, dysarthria, ataxia, convulsions, coma • irritation of mucous membranes (i.e. eyes, nose, throat), dizziness, taste and olfactory fatigue • drowsiness, headache, impaired cognitive & motor function, insomnia, anorexia • deliberate inhalation (sniffing) may lead to gross disorientation, neurological impairment and death
trimethyl benzene	<ul style="list-style-type: none"> • irritation of mucous membranes, dermatitis, dizziness, fatigue, headache, anxiety, nervousness, 'drunkenness' • diarrhea, abdominal pains, nausea, blurred vision • low frustration tolerance, lack of initiative, apathy, depression, irritability ("painter's syndrome") • carcinogenicity • glomerulonephritis, renal dysfunction • decreased erythrocyte, leukocyte and platelet counts • neurotoxicity • cyanosis, cognitive and motor impairment, apnea, bursts of perspiration, cardiac arrest
xylene (mixed isomers)	<ul style="list-style-type: none"> • irritation of mucous membranes, dermatitis, nausea, fatigue, headache, anxiety • neuropsychological and neurophysiological dysfunction • anemia, thrombocytopenia, renal damage • dyspnea, cyanosis • CNS depression

References

Canadian Occupational Health and Safety Website

Health Canada website

Smith R, Lourie B. *Slow Death by Rubber Duck*. 2009. Random House Canada

<http://www.davidsuzuki.org/issues/health/science/toxics/chemicals-in-your-cosmetics---parabens/>

US BioTek Laboratories. Environmental Pollutants Quick Reference Guide

Pollutant <i>metabolites measured</i>	Metabolism
parabens <i>para-hydroxybenzoate</i>	<ul style="list-style-type: none"> alkyl esters of para-hydroxybenzoic acid and parabens are hydrolyzed to para-hydroxybenzoate, (the main metabolite of parabens) via tissue esterases found in skin, subcutaneous fat, liver and kidney
phthalates <i>monoethylphthalate</i> <i>phthalic acid</i>	<ul style="list-style-type: none"> monoethylphthalate (MEP) excreted in urine reflects exposure to diethylphthalate (DEP), with 70% being excreted in urine as its free monoester DHEP (di (2-ethylhexyl)) phthalate is used in manufacture of plasticizers and is eliminated in urine as phthalic acid phthalates are hydrolyzed in gut by pancreatic lipases, yielding phthalate esters. phthalate esters are metabolized in the liver by cytochrome p450 dependent multifunction oxidase enzymes and excreted as glucuronide derivatives phthalates and metabolites accumulate in lipid depots; bioaccumulation may result from chronic exposure
benzene <i>trans, trans-muconic acid</i>	<ul style="list-style-type: none"> most benzene is excreted as sulphate or glucuronide conjugates of phenols. About 20% is metabolized to muconaldehyde, a hemotoxic intermediate, prior to hydroxylation to muconic acid following inhalation exposure, most benzene is exhaled unchanged benzene and benzene metabolites can accumulate in lipids
styrene <i>mandelate</i> <i>phenylglyoxalate</i>	<ul style="list-style-type: none"> styrene is metabolized into epoxide derivatives via cytochrome p450 dependent multifunction oxidase enzymes in the liver. major metabolic pathway involves sequential oxidation to mandelic and phenylglyoxylic acids, styrene oxides also conjugate with glutathione styrene and metabolites accumulate in lipid tissues; and their slow elimination means bioaccumulation is possible with chronic exposure the sum of mandelate and phenylglyoxylate in urine correlates better with styrene exposure than either metabolite alone; therefore the sum is reported as well
toluene <i>hippurate</i>	<ul style="list-style-type: none"> toluene is metabolized in the liver via cytochrome p450 dependent multifunction oxidase enzymes; conjugates primarily with glycine, and is excreted in urine as hippuric acid some toluene conjugated with glucuronic acid small amounts are hydroxylated to cresols, which are excreted in urine as sulfate or glucuronide conjugates chronic exposure may result in toluene uptake into lipid-rich tissue (CNS, adipose) and bioaccumulation toluene interferes with biotransformation of other volatile solvents in liver
trimethylbenzene <i>3,4-dimethylhippurate</i>	<ul style="list-style-type: none"> metabolized in the liver via cytochrome p450 dependent multifunction oxidase enzymes; conjugates with glucuronic acid, glycine or sulfates for excretion in urine lipophilic and therefore may accumulate in fat and fatty tissues
xylene (mixed isomers) <i>2-methylhippurate</i> <i>3-methylhippurate</i>	<ul style="list-style-type: none"> xylene is metabolized in the liver by cytochrome p450 dependent multifunction oxidase enzymes; conjugates primarily with glycine minor amounts conjugate with sulfur and glucuronide excreted in urine as methylhippuric acids 2-methylhippurate has longer half-life, but 3-methylhippurate correlates more strongly with exposure xylene does not accumulate significantly in tissues

This information is not inclusive and is provided for educational purposes only. The physiological effects from exposure to environmental pollutants depend on a number of factors including: amount and duration of exposure, route of exposure (air, water, food, skin, consumer products), and presence of additional chemical that exacerbate the effects. The treating clinician is in the best position to discern the degree to which pollutants are affecting patient health. Rocky Mountain Analytical does not diagnose, treat or prescribe for any health condition. Testing is conducted for investigational and research purposes only. © 2011

VOLATILE SOLVENTS								
Source of Exposure	PARABENS	PHTHALATES	Source of Exposure	xylene	toluene	benzene	trimethylbenzene	styrene
	Parabens are antimicrobial, preservative and flavorants in food. They are used in cosmetic and pharmaceutical formulations to increase shelf life. Cosmetics with parabens include: sprays, fragrances, conditioners, shampoos, soaps, hand sanitizers, facial masks and foundations, sunscreens, self-tanners, hair removal creams, shaving gels, nail and skin creams, baby lotion. Pharmaceuticals containing parabens include: injectable drugs, antacids, suppositories, Benadryl™ cream, topical hydrocortisone, medicated pain-relieving patches, mentholated vapor rubs, lip balms, antifungal and antibacterial preparations. Food products containing parabens include: packaged meats, fish and poultry, mayonnaise, oils, salad dressings, ketchup, pickles, relishes, processed fruits and vegetables, frozen dairy products, cakes, pies, pastries, icings, jellies and jams, beers and ciders, soft drinks, fruit juices, syrups, and some candies.	PVC plastics are used in vinyl flooring and tile, wall coverings, pool liners, wires & cables, garden hoses, construction materials, weather stripping, canvas tarps, upholstery, some food containers, flexible plastic medical tubing and bags, children's toys, shower curtains, faux leather, adhesives, dyes, some pharmaceutical and pesticide formulae.	household	varnish/polish, paint, paint thinner, paint remover, shellac, rust inhibitors, lacquers, inks, dyes, adhesives, cleaning fluids, degreasing agents, cleaning products	aerosols, spray paint cans, glues, varnishes, shellac, rust inhibitors, solvent-based sanitizers and germicides, may be an additive in cosmetic products	adhesives, paint removers/strippers, degreasing agents, carburetor cleaner, rubber cement, some arts and crafts supplies	coatings, paint thinners, wood preservatives, wood preservatives, cleaners, dry cleaners, degreasers, aerosols, pesticides, inks and printing. Component of white spirit, widely used solvent in paint/coating industries	packaging materials (polystyrene), thermal and electrical insulation, fiberglass, foam cups and food containers
household			inhalation	tobacco smoke	tobacco smoke (80 to 100 mcg per cigarette)	tobacco smoke (5.9 - 90 mcg per cigarette), wood burning		
			outgassing	fabric and leather treatments		building materials, particleboard, carpet glue, textured carpet, liquid detergent, furniture wax		
			solvent	solvent for rubbers, synthetic resins, gums, inks and paints	solvent carrier in paints, inks, thinners, coatings, adhesives, degreasers, pharmaceutical products	solvent used in laboratories, industrial paints, adhesives, paint removers/strippers, degreasing agents, carburetor cleaner, rubber cements, some arts & crafts supplies	solvent in coatings, paint thinners, wood preservatives, cleaners, dry cleaners, degreasers, aerosols, pesticides, inks and printing. Component of white spirit, widely used solvent in paint/coating industries	
			waste	waste & landfill sites, local industrial waste/spillage		seepage from underground petroleum storage tanks, waste streams		emissions from styrene production and disposal procedures: chemical spills, landfill and industrial discharges
			petroleum	fuel additive, natural component of petroleum and coal tar, automotive emissions, gas stations, poor vehicle emission control	fuel additive, automotive emissions, gas stations, poor vehicle emission control	automotive emissions, gas stations, poor vehicle emission control	fuel additive, automotive emissions, gas stations, poor vehicle emission control	automotive emissions, gas stations
			industry	used in synthesis of plasticizers and manufacture of polyester fiber, film, insecticide formulations, and perfumes		used to manufacture Styrofoam, resins, synthetic fibers and rubbers, gums, lubricants, dyes, glues, paints, and marking pens. Solvent in manufacture of faux leather and rubber goods	produced during petroleum refining	
industry	industrial oils, fats, glues, shoe polishes, & textiles	used in the manufacture of plastics to make them more flexible, widely used to make polyvinylchloride (PVC) plastics	workplace	paint and printing ink industries, automobile body and related repairs, photographic processing, rubber, leather, plastics and textile industries, flooring contractor	painters, printers, leather finishing, rubber-coating, shoemaker	oil refineries, petroleum plants, tire manufacturers, paint and shoe manufacturers, gas stations, second-hand smoke	janitors, scientific laboratories, dry cleaners, auto body repairs, construction workers, house painters, ski boot finishing, telephone cable assembly, and screen cleaning processes	fabrication and application of plastics: polystyrene/styrene manufacturing, resin manufacturing, laminators, and laminate, and manufacture of synthetic rubber, boats, and automobiles
workplace		plasticizer and PVC processing plants						