

The Impact of Workplace Exposures on the Fetus and Children

(focus on Air)

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Exposures

Having Faith: An Ecologist's Journey
to Motherhood
by
Sandra Steingraber, Ph.D.

Objectives

- To understand the vulnerability of the fetus and children to occupational exposures
- To review examples of workplace exposures of women who may be pregnant
- To review situations where children may be exposed secondarily to work exposures



Gender Differences in Reproductive Exposures



Women:

- Born with eggs already formed
- Eggs formed during first trimester
- Female fetuses vulnerable to toxins in first trimester
- Eggs exposed to environmental contaminants from time of conception
- Can "down-load" toxins to offspring during pregnancy and breastfeeding

Women and the Environment

- Women's bodies are the first environments for the developing fetus
- Critical periods:
 - In utero
 - puberty
 - pregnancy
 - menopause
- 75,000 - 85,000 synthetic chemicals in North America
- Mass production of chemicals started during WW2
 - Eg. Agent Orange marketed as pesticide post-war.



Gender Differences in Reproductive Exposures



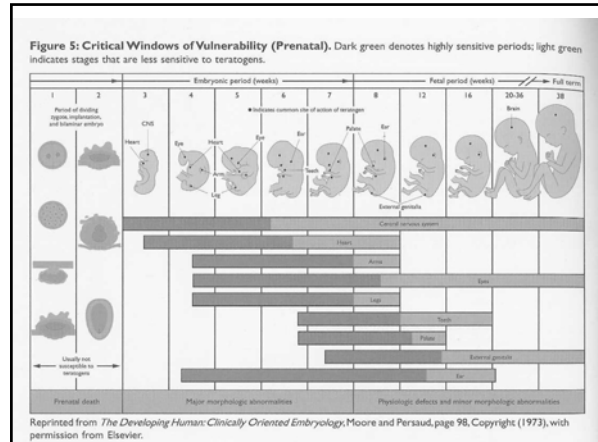
Men:

- Sperm develop continually throughout life
- Male fetuses affected by hormones resembling estrogen
- Less body fat & store toxins differently

Impact of Toxic Exposures on Reproduction

Environmental contaminants affect human reproductive cycle at many points:

- Before conception
- At conception
- During pregnancy
- Post-natally
- Long term effects



Exposures vs. Hidden Exposures

Common Routes of Exposure

(all can come from air)

- Ingestion
- **Inhalation** => contaminated dust, vapours, particulate suspensions, off-gassing
- Absorption (skin)

Adverse Reproductive and Developmental Health Effects

- Infertility/reduced fertility
- Spontaneous abortions/miscarriages
- Structural or functional birth defects
- Chromosomal damage
- Hormonal disruption
- Menstrual problems

Windows of Vulnerability

- Exposure during first 3 months of pregnancy might cause birth defects or result in a miscarriage (major fetal organs are formed) = normal pop 2-3% born with major birth defects.
- Exposure during last 6 months of pregnancy could slow the growth of the fetus, affect brain development or cause premature labour (fetal organs mature and fetus grows rapidly).

Environmental Health and Trends

- 80,000 chemicals in commercial use in US...but less than 1% tested
- 2000-3000 new chemicals released/year
- 71% of top 20 chemicals released into environment are known or suspected neurotoxins
- 10-15% US Children - Learning Disabilities
- 25% increase in childhood cancer over last 25 years
- Asthma increased four-fold in past 15 years

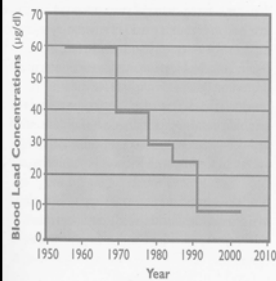
Substances of Concern

- Metals (lead, mercury, cadmium, arsenic)
- Industrial chemicals, including solvents (toluene, benzene, perchloroethylene, trichloroethylene)
- Pesticides
- Endocrine disruptors (dioxin, PCB's, some pesticides, alkylphenols, phthalates)
- EMFs (VDT, cell phone towers)

Limitations of Risk Assessment

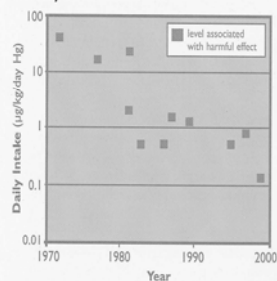
- Research unavailable
- Doesn't consider
 - synergistic or cumulative effects
 - timing (windows of vulnerability)
 - population wide effects
 - multigenerational risk
- Difficult to gauge true exposures
- Effects of exposure may be delayed
- "Uncertainty" or "safety" factors inadequate (based on healthy adult male)
- Slow, costly and complex

Figure 14: Blood Lead Concentrations Considered to be Elevated



Source: Centers for Disease Control, 1991.

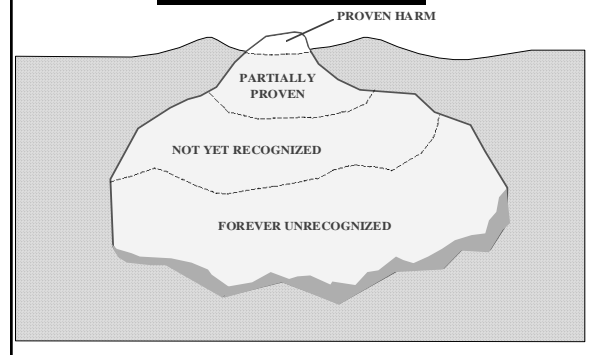
Figure 15: Declining Threshold of Harm for Mercury



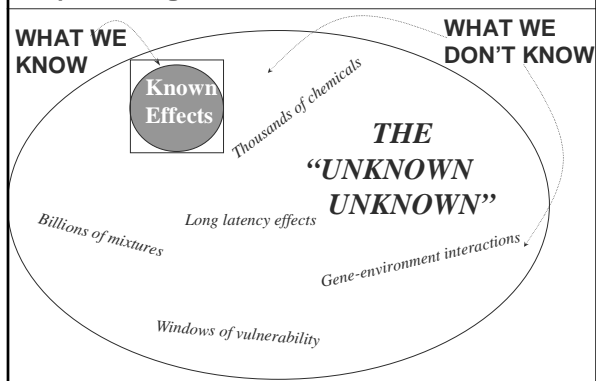
Source: Schettler, T. et al. 2000.

Figures 14 and 15 provide two examples of how exposure levels considered to be harmful have continued to drop over time as scientific evaluations have continued, including via measuring effects in exposed populations of children.

THE TOXIC ICEBERG



Under-recognition of Toxic Threats: Epistemological Bias



Exposures vs. Hidden Exposures

- Day-to-day exposures PLUS
- Occupational Exposures
 - Have been studied longer
 - Workplaces more highly regulated
 - Increased awareness
- Day-to-day and occupational exposures differ in quality and quantity
- Interaction between both

Exposures vs. Hidden Exposures

- Hidden exposures relevant for pregnancy and pre-conception couples
- People exposed to “hidden” sources of toxins
- Limited awareness of affects on pregnancy and reproduction
- Less awareness of day-to-day vs. occupational exposures

Scenarios

- Electronic and semi-conductor workers
 - => Miscarriages due to ethylene glycol ethers
- Battery makers, solderers, welders, radiator repairers, bridge repainters, firing range workers, home remodelers
 - => Miscarriage, birth defects, low birth weight, developmental disorders, childhood cancers due to lead

Level of Harm Depends on:

- **How much**
 - of the hazard they were exposed to
- **When**
 - they were exposed
- **How long**
 - they were exposed
- **How**
 - they were exposed

Scenarios

- Health care workers, dental personnel, atomic workers
 - => miscarriage, birth defects, low birth weight, developmental disorders, childhood cancers due to ionizing radiation
- Labourious/ Work with prolonged standing, heavy lifting
 - => Miscarriages in late pregnancy, premature delivery
- Shoe/dry cleaning industry
 - => spontaneous abortions due to solvents

Women at Risk (the fetus)

- Dry cleaners – solvents
- Janitorial Work – solvents, cleaners, chlorine, pesticides
- Landlords – pesticides, cleaners, molds, dusts
- Floral Industry/Horticultural – pesticides
- Dentists/Dental Assistants – mercury vapour, glues, solvents
- Engineering/Factory Workers – chemical, radiation, vibration exposures
- Farming – pesticides, zoonotics, molds
- Teaching in Schools – molds, pesticides, cleaners
- Renovated Areas – glues, formaldehyde, dusts, paints, molds
- Medical Staff – chemotherapeutics, radiation, cleaners, viruses
- Artists – paints, solvents, heavy metals

+ the fathers...

Scenarios

- Dental office workers, waste management, ore smelting
 - => developmental delays, mostly neurological with delayed motor and verbal skills, impaired hearing and poor coordination due to mercury

Preventive Measures

- Employee and Employer training
- Wash hands before eating, drinking and smoking
- Follow MSDS directions if exposure, talk to health care provider
- Monitoring programs
- Improved ventilation
- Personal protective equipment
- Change clothes and wash with soap and water before going home.
- Store street clothes in separate area of the workplace to prevent contamination
- Wash work clothing separately from other laundry (at work if possible)
- Avoid bringing contaminated clothing or other objects home. If work clothes must be brought home, transport them in a sealed plastic bag.
- NIOSH.

Addressing the Issue with Pregnant Women and Fathers

- Issues may seem heavy & overwhelming
 - Decreased control
- After receiving information, people may feel:
 - Angry
 - Guilty
 - Fearful



Environmental Justice/Racism

- Racial minorities, recent uncultured immigrants, stressed, poorly nourished, uneducated and low-income people exposed to higher levels of contaminants: factory work, low-paying unsuitable jobs
- Often “downwind” and “downstream” from contaminants
- Affects “high-risk” groups



Lessons

- Windows of Vulnerability - timing of exposure and dose equally are important (Minimata, thalidomide, rubella)
- Nature can convert inert substances to toxins
- Fetuses most vulnerable
- Threshold levels of chemicals may not exist for fetuses

Legal Principles

- Fetal protections policies?
- Does the woman have to choose between having a child and having a job?
- Ethically sound?
- Women’s rights
- Discrimination
- Fetal health and hypersusceptibility in working conditions.

Lessons

- Lessons like these have helped develop public health policies on certain medications, communicable disease, alcohol and smoking during pregnancy
(no “*acceptable amount*”)

Environment & Genetics

- Twin studies
 - (50/50 environment/genetics)
- Gene-Environment Interactions
 - heart disease, cancer, diabetes, PKU
- Specific examples
 - Organophosphate pesticides (OP's)

Children

“People who would not dream of abusing a child think nothing of giving their children and grandchildren an environment that has been abused.”

Richard J. Jackson, MD, MPH, Director
National Center for Environment and Health,
Centers for Disease Control and Prevention, USA

Lessons:

- Although genetic factors important, they should not be viewed in isolation.
- Environmental factors can alter genetic materials.

Exposures in Infants & Children

Children/Infants at greater risk than adults from environmental exposures because:

- Growth & development still taking place
- Eat, drink, breathe more (per kg body weight)
- Higher absorption levels in GI system & skin
- Play closer to ground and in contact with more contaminants, gases/vapours, dust

Taking A Precautionary Approach

- Health promotion and disease prevention approach
- Follow Precautionary Principle
 - “Better safe than sorry”
- 1964, US Surgeon General
 - Smoking causes lung cancer



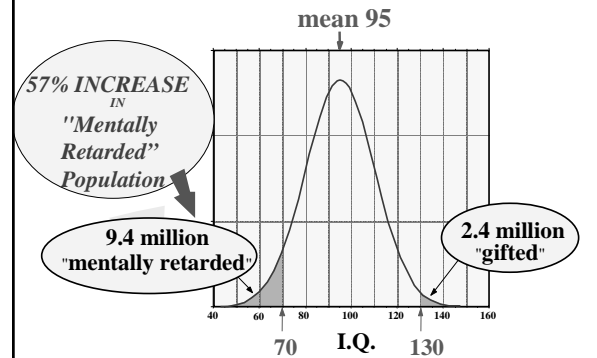
Bringing home the bacon, and something else...

- Bring home harmful substances on their clothing, shoes, tool box, car, hair, skin, breath can lead to poisoning in family members,
 - **ESPECIALLY YOUNG CHILDREN**
- Lead, mercury, dusts containing chemicals, pesticides, organochlorines, POPs

Major Health Effects of Environmental Contaminants

- Cognitive & Behavioural Effects
- Childhood Cancers
- Immune System Effects (allergies, sensitivities)
- Endocrine Disruption

5 Point Decrease in Mean IQ



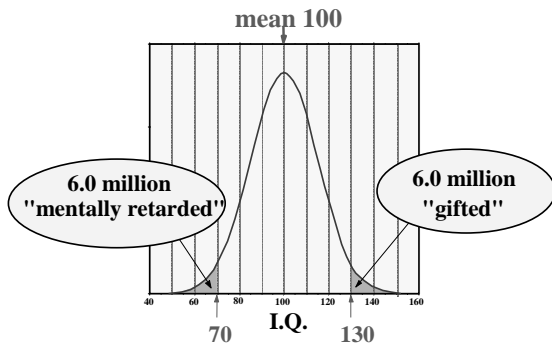
Neurodevelopmental Disorders

- Brain of fetus does not develop normally leading to developmental delays or learning disabilities later in life (ADHD, Conduct disorders, mental retardation, etc). Norm pop = 10% of children

Emerging Themes

- With increasing scientific understanding, as neurodevelopmental effects emerge, estimates of toxic thresholds tend to fall.
- Animal testing for neurodevelopmental toxicity has under predicted human vulnerability by a factor of 100- 10,000 (Hg, lead, PCB's).
- Subtle Effects in individual may carry profound impacts when expressed over a population.
- Adverse effects of some developmental neurotoxicants are synergistic or additive.

The Significance of Small Effects: EFFECTS OF A SMALL SHIFT IN IQ DISTRIBUTION IN A POPULATION OF 260 MILLION



Lead



- One of the most widely studied reproductive and developmental toxins
- Has been mined for thousands of years for human use
- Has no 'normal' function in humans but has many toxic effects
- Now found in the bodies of all living organisms and in all environments

Lead

■ Exposures

- Most common sources of day-to-day exposure are: lead paint, lead from the water supply, lead contaminated soil; tobacco smoke, lead glazed pottery, lead crystal; some hobbies, some candle wicks; inexpensive jewellery
- Common sources of occupational exposure include: painting; construction; battery manufacturing and recycling; automobile repair and electronics

Lead: Reproductive & Developmental Health Effects

- As blood lead level increases, more pre-term deliveries, low birth weight and increases incidence of delayed fetal growth.
- Long-term effects on behaviour and intelligence of infants born to mothers with blood lead levels between 10-25 ug/dl.
- Prenatal and postnatal exposures to lead associated with antisocial behaviour in children and adolescents.

Lead

■ Health Effects

- Exposure can damage brain and kidneys
- Even low levels can affect brain and nervous system development in fetus, infants and children.
- Results in learning disabilities and developmental delays

Lead: Recommendations

- Do not power sand or scrape when removing lead paint
- Contact CMHC about lead paint in the home
- Clean house often
- Do not wear shoes in the home
- Run taps when water has not been used for several hours
- Only use cold tap water for drinking, cooking and making baby formula [heat if necessary]
- Never burn painted wood or coloured paper
- Do not store food or drink in lead crystal containers
- Do not plant fruit and vegetables in soil near a major roadway

Lead: Reproductive & Developmental Health Effects

- High lead blood levels cause infertility in men and women
- Conflicting evidence as to whether or not lead interferes with the endocrine system.
- High exposures can cause spontaneous abortions and still-births, infertility – pottery workers 100 years ago. [60% increase in risk of spontaneous abortion among women who had suffered from lead poisoning as a child]

Childhood Cancers

■ **Leukemia**

SOLVENTS

- Benzene, alcohols, chlorinated solvents in paternal occupation before, during and after

NITROGEN DIOXIDE

- paternal before preg.

HYDROCARBONS

- maternal during preg

Childhood Cancers

■ Acute Lymphocytic Leukemia (ALL)

- **SOLVENTS**
Tri/perchloroethylene, CCl4: maternal occup before during and after birth
- **PAH, GASOLINE, EXHAUST:** maternal before and during

Childhood Cancers

■ Neuroblastoma

- **SOLVENTS** (benzene, alcohols, lacquer thinner, turpentine, diesel fuel): paternal occupational
- **AROMATIC AND ALIPHATIC HYDROCARBONS:** parental occupation

Childhood Cancers

■ Acute Non-Lymphoblastic Leukemia (ANLL)

- **PESTICIDES:** paternal occupational
- **SOLVENTS:** benzene, petroleum products, gasoline: paternal and maternal occupational

Childhood Cancers

■ Wilm's Tumor

- **PESTICIDES**
Parental farm exposures
- **HYDROCARBONS**
Parental occupational exposures

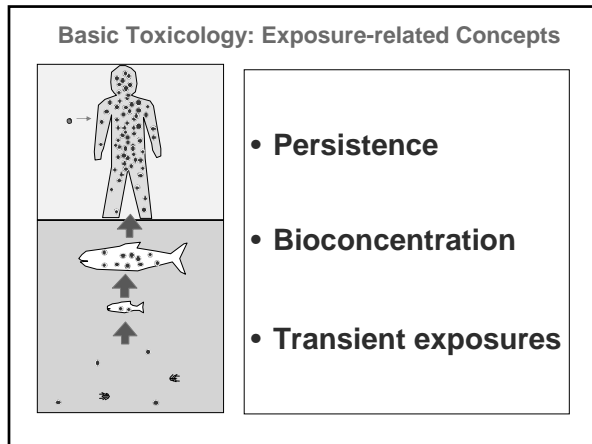
Childhood Cancers

■ CBT

- **PESTICIDES** (paternal farm or forestry)
- **SOLVENTS**

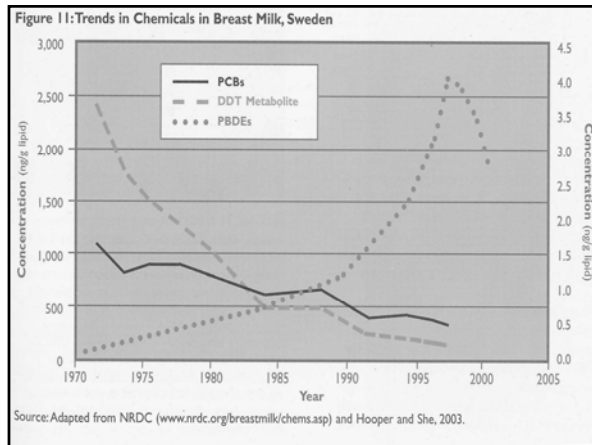
Endocrine Disrupters

- Chemicals that affect endocrine system.
 - Natural
 - Impact on human development/reproduction unknown
 - shared evolution with humans (adaptation)
 - Synthetic
 - No shared evolution
 - Body less able to break them down (accumulate)
 - Structures/Applications vary widely
 - Widespread contaminants
 - Many identified as ED's, but few tested





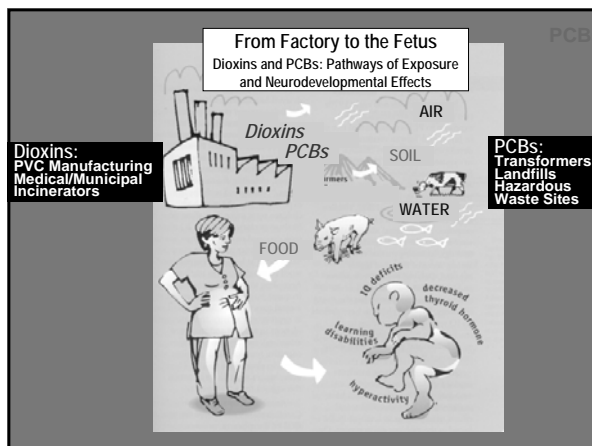
How do ED's Work?

- Upset very delicate balance of hormones.
 - Mimic hormones
 - Block hormones
 - Interfere with hormone breakdown
 - Change production & availability of hormones
 - Affect transport of hormones in body and across membranes



What are the Effects of ED's?

- Exposure during critical stages of development can result in permanent effects on:
 - Ability to reproduce
 - Health 
 - Intelligence 



Multigenerational Effects of ED's

- Women store ED's in body
- Passed on to developing child (placenta, breast-feeding)
- Impacts passed through generations (eg. DES children)
- Unknown interactions between ED's that each generation is exposed to and levels they're born with

Asbestos

■ Reproductive Health Effects:

- High levels may increase woman's risk of ovarian and uterine cancer.
- Little research done on reproductive effects of asbestos.
 - Possible effects cannot be ruled out
- Has been shown to cross animal placentas and has been found in higher levels in some stillborn infants.



EMFs

■ Recommendations:

- Wires in home properly grounded
- Furniture away from circuit boxes, points where power lines enter the house
- Arrange furniture so most activities away from major energy consuming appliances
- Reduce energy consumption – unplug non-essential appliances when not in use.
- Do not sit directly in front of televisions or computers: 50 cm from monitor, 1 m from back and sides.

EMFs

■ Health Effects:

- Mechanisms by which EMFs affect health not clear
- Can change how calcium ions interact with cells
- (may affect muscle contractions, egg fertilization and cell reproduction)
- No chronic disease for which a cause-effect relationship has been established.
- Possible relationships between:
 - childhood leukemia and postnatal exposure to EMFs.
 - adult leukemia and brain tumours and certain occupational exposures.
 - amyotrophic lateral sclerosis and occupational EMF exposures.

Cleaning Products

- Mixtures of chemicals used to clean homes
- Cut grease, make foam, break down fat, emulsify, add colour and fragrance.
- Difficult to find out ingredients – “trade secrets”
- Regulation complicated and often insufficient.



EMFs

■ Reproductive Health Effects:

- Early studies indicate maternal exposure during pregnancy resulted in more spontaneous abortions and low birth weight babies
- More recent studies have not found a relationship between EMF exposure and miscarriages, birth defects or low birth weight babies.
- Impossible to conclude that low frequency EMF exposure has no reproductive consequences, although much of the evidence points in that direction.



Cleaning Products

- We are exposed over a lifetime – at home, at work and in public buildings.
- Aerosolized => inhaled, swallowed and absorbed
- Some ingredients in cleaners also found in pesticides, personal care products and art supplies.
- Many chemicals or their break-down by-products make way into environment, providing another route of exposure.

Cleaning Products

■ Signs and Symptoms

■ *Immediate*

- Dizziness, weakness, nausea, vomiting, skin/eye irritation and headache.
- In some people, trigger asthma, allergic reactions and/or environmental sensitivities/intolerances.

■ *Long Term*

- Little known re: long-term exposure, cumulative and synergistic effects
- Specific chemicals linked with organ damage, respiratory and circulatory damage and cancer

Plastics

- Contain additives such as plasticizers, stabilizers, lubricants, release agents, flame retardants, antistatic agents and colourants
- Not always chemically stable



Cleaning Products

■ Reproductive & Developmental Health Effects

- Some known reproductive toxins have been removed from cleaning products
- Some chemicals left in cleaning products are known or possible endocrine disrupters (ED) – APE's
- Borax and boric acid are toxic to the testes and developmental toxins – reduced fetal weight, malformations of the eyes, central nervous system, cardiovascular system and axial skeleton

Plastics

TYPE OF PLASTIC	COMMON HOUSEHOLD USES
Polyvinyl Chloride (PVC)	Shower curtains, soft plastic toys, pipes, raincoats, vegetable oil bottles, some plastic wrap
High-density polyethylene (HDPE)	Milk and juice jugs, margarine containers, motor oil containers
Low-density polyethylene (LDPE)	Garbage bags, plastic bottles, ice cream tubs
Polyethylene terephthalate (PETE)	Detergent bottles, beverage bottles, peanut butter containers
Polypropylene (PP)	Screw on caps, food tubs, car battery cases
Polystyrene (PS)	Clear take-out containers and cutlery

Cleaning Products: Recommendations

- Check labels and avoid if flammable, corrosive, chemically reactive or poisonous.
- Make your own or use alternative, safer commercial products
- Use as few disinfectant cleaners as possible
- Use gloves and open windows
- Use Hazardous Waste depot for disposal

Plastics

■ Exposures

- inhaled as fumes and absorbed (if heated or very soft), particularly through medical devices
- Additives “leach out” of finished product
- Levels of exposure affected by temperature, mechanical agitation, heat, age, chemical makeup and concentration of additives used
- Most common exposure is via ingestion:
 - babies and children chewing on soft PVC toys
 - milk and formula in clear plastic baby bottles

Plastics

■ Reproductive Health Effects

- Lowered fertility in males and females
 - Long term DEHP exposure led to 25% reduction of human sperm motility in a 1993 study
 - Animal studies have indicated a lowered ovarian weight and fertility following DEHP exposure

- Birth Defects



Solvents

- Chemicals that evaporate easily and break down fats
- Many different classes, which vary in potential to affect human health
- Many are made of, or emit, volatile organic compounds (VOCs) that contribute to air pollution.
- Extensively used in industry
- Contained in wide variety of products found and used in the home
 - e.g. paint thinners, varnishes, adhesives, markers, cleaning products, cosmetics...

Plastics: Recommendations

- Minimize PVC furnishings, furniture and construction products
- Let any new soft plastic products, air out outdoors for at least 1 to 3 days
- Never burn plastics.
- Avoid foods packaged in plastic, plastic wrap
- Minimize exposure to soft plastic toys - particularly vinyl.
- Do not heat breast milk, formula or milk in plastic bottles.

Paints and Solvents

■ Exposures

- Happens more than most people realize
- Inhalation is main route of exposure
- Common household sources:
 - paints, stains, adhesives, dry-cleaned clothing, cleaning products, cosmetics
- Contaminated waste which makes it's way into our air and drinking water.
- Solvents are attracted to fatty tissue, especially the nervous system.

Paints

- Pigment particles suspended in a medium
- Oil and latex paints contain metal-based pigments (e.g. zinc, iron...) as well as a variety of additives
- Lead is now only occasionally found in small quantities in exterior paints. It is a bigger concern in specialty paints
- Oil paints contain organic solvents
- Latex paints contain limited quantities of organic solvents



Paints and Solvents

■ Health Effects

- Specific health effects depend on: solvent in question, dose and duration of exposure.
- Solvents deposit & accumulate in fatty tissue
- Solvents are associated with skin irritation, reduced brain/nervous system function, some cancers, heart dysfunction, some respiratory illnesses and may contribute to development of environmental sensitivities and intolerances



Paints and Solvents: Reproductive and Developmental Health Effects

- Paints manufactured before 1990 may contain mercury-based fungicides – some toxic to the developing fetus.
- Solvents may affect female reproductive health (higher risk of preeclampsia and menstrual disorders).
- Solvent exposure may affect male and female fertility.

With Respect to Painting:

- Use products that do not require painting, varnishing, etc...
- Avoid areas where paints, finishes are used until there is no smell
- Use highest quality latex paint. (Low VOC)
- Paint in summer and open windows and doors
- Do not eat or drink while painting
- Other people in the household who use paints or solvents should change clothes before coming home and wash clothes separately.

Paints and Solvents: Reproductive and Developmental Health Effects

- Solvents can cross the placenta and impact on the fetus. Exposure in first trimester can affect structural and anatomical development. Later exposure more likely to result in growth impairment and functional damage
- High levels of exposure linked to miscarriage, slowed fetal growth, birth defects, developmental disabilities and higher risk of cancer later in life.
- Fetal alcohol syndrome (FAS).

With Respect to Solvents:

- Avoid areas where adhesives and other solvent-containing products are used until there is no smell
- Avoid clothing that requires dry-cleaning. If you do dry-clean, find a cleaner who uses Green-clean.
- Air dry-cleaned items outside for several days before bringing them into the home
- Use products with lower levels of solvents
- Use less solvents and avoid spray products
- While pregnant avoid hobbies that use solvents
- Ventilate well, wear a face mask with organic vapour cartridge, gloves and protective clothing

Paints and Solvents: Recommendations

- Women planning a pregnancy, who are pregnant or nursing should lower their exposure to paints and the organic solvents found at work and home.



Pesticides

- Synthetic or natural agents that kill living organisms
- Thousands currently registered for use in Canada
- “Active” and “inert” ingredients
- Growing resistance of pests to the pesticides, leading to higher levels of use and need to keep developing new products
- Over-used. “Non-essential” usage is of concern

Pesticides

- **Health Effects**
- Depends on the specific pesticide, dose, duration of exposure and individual susceptibility
- Effects of acute exposure:
 - Coughing, breathing difficulties, nausea, vomiting, eye and skin irritation, weakness, dizziness, muscle twitching and convulsions.
- Long-term effects:
 - Cancer, damage to the CNS, respiratory illness
- Very high exposures:
 - Organ damage, paralysis, brain haemorrhages, heart problems, coma, cancer

Sick Schools

- Impact on staff and children exposed to:
 - HM
 - ED
 - Asbestos
 - EMFs
 - Cleaning products
 - Plastics
 - Paints
 - Solvents
 - pesticides

Pesticides: Reproductive & Developmental Health Effects

- Pesticides and their breakdown products can cross the placenta or be passed on through breast milk
- Reproductive impacts:
 - Spontaneous abortion, stillbirth, low birth weight, slow or delayed fetal growth, and birth defects
- Topic of debate. There are studies that point to such an association.
- Number of pesticides = known endocrine disruptors.
Some now banned for use.



Review of Environmental Factors

- Well water supply (bacterial and chlorine)
- VOCs
- Renovations: particle board, varnish, paints
- Ventilation problems with HVACs, CO₂, CO, H₂S, RH
- Cleaning agents, pesticides, scented products
- Insulation integrity
- Floods, leaks, pool area, rinks => mold, gases
- Arts and crafts materials, school supplies

Pesticides: Recommendations

- Avoid chemical pesticide products, particularly if pregnant or nursing. Natural pest control.
- If you must use chemical products:
 - Ventilate well, wear equipment, avoid aerosol/spray products, follow directions carefully, never mix pesticides, shower and wash clothing immediately and stay out of the environment for at least 12 hours

Possible history of concerns: for staff and children

(due to exposure of all mentioned)

- Tendency to get colds more often (immune system low)
- Rashes
- Fatigue, malaise, spaciness
- headaches, dizziness, nosebleeds, nausea
- Sore throat
- Cough, congestion, coryza, SOB, wheezing
- More allergies and sensitivities
- Dermatographism (atopy)

Overall concerns regarding sick schools

- Inability to involve physicians easily
- Staff unwell, can't carry out job description
- Children symptomatic, unable to reach full potential
- Very volatile, angry parent community
- Intense negative local and even national media attention

Recommendations

- Adopt less toxic methods of pest control
- Notify parents and staff when pesticides are applied on school grounds
- Consider Integrated Pest Management approach.
- Teachers who could get or are pregnant are at risk as are male teachers thinking of having children

Schools

- US data: 1998-2002 pesticide poisoning in schools has increased significantly.
- Insecticides and disinfectants (less so repellants and herbicides)
- Off-site drift
- Low estimates – grossly under reported
- Toxic Exposure Surveillance System: 7.4 cases per million students, 27.3 cases per million employees

Recommendations for children

Promote practical small changes to decrease total dose of exposures to known allergens, irritants, toxins at home, work, school, and in the community

Schools

- PERSISTENT LOW LEVEL EXPOSURES
- ?what are the chronic long-term impacts?
- Children were victims in 76% of cases
- Organophosphates most frequently responsible of the pesticides =>
 - Developmental delays
 - Behavioural disorders
 - Motor dysfunction

There is a Fluctuating background level of multi-system, multi-factorial symptoms in every school setting. (LM)

The Precautionary Principle

*Where there is suggestive evidence,
action should be taken.*

