The Environment and Breast Cancer

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General Risks Factors Associated with Cancer

• **Genes** (primary, polygenic, epigenetic)

• **Lifestyle** (diet, exercise, BMI/obesity, alcohol intake, smoking history & exposure)

• **Reproductive history** (age at menarche, age at menopause, # full-term births, whether or not breastfed, etc.)
  
  ➤ *Lifetime exposure to estrogens, especially estradiol*

  ➤ *Also other endocrine factors (hormones)*
Other Risks Factors Associated with Breast Cancer

- Environmental toxicants
  - Radiation, including medical radiation
  - Known and recognized carcinogens
  - Endocrine Disrupting Compounds (EDCs)

- Risk factors for disease do not act in isolation
Caveats Important in Talking About Breast Cancer (or most cancers)

Breast cancer(s)

• Not a singular disease
  • Age
  • Menopausal status
  • Histopathology profile
  • Receptor (ER, PR) and oncogene (HER2) profile

• Risk factors intersect
  • Personal, social, community, ethnic history
Environmental chemicals in our bodies: Biomonitoring Studies

- 100s of chemical contaminants in our bodies
- 216 linked to mammary tumors
- 1000s more untested

Crowd-sourced study by Silent Spring Institute – test your own body burden for $299  
https://silentspring.org/detoxmeactionkit/
Environmental chemicals in our bodies: Biomonitoring Studies

- Chemicals found in adults & children
- Also
  - Amniotic fluid
  - Cord blood
  - Newborns
  - Breast milk

SO WHAT????
Environmental chemicals in our bodies: Links with breast cancer

SOME

• Personal care products
• Plastics and plastic additives
• Pesticides and herbicides
• Industrial chemicals
• Metals
• Detergents and other cleaning products
• Hormone supplements
• Radiation (including medical radiation)
An endocrine disrupting compound (EDC) “is an exogenous chemical, or mixture of chemicals, that interferes with any aspect of hormone action.” *Endocrine Society, 2012*

Endocrine (hormonal) systems are absolutely critical across the lifespan, as *organizers* during early development and *activators* later on in life.
### EDC Framework: Key themes

#### Timing of exposures
- Neonatal
- Early childhood
- Puberty, adolescence and early adulthood
- Pregnancy
- Lactation (mother and child)
- Post-menopausal

#### Low doses
- Real life exposure mixtures interact
  - Additively \((1+1=2)\)
  - Synergistically \((1+1=5)\)
  - Cancel one another out \((1+[−1]=0)\)

#### Mixtures
- Gene x environmental chemicals
- Reproductive history x environmental chemicals
- Lifestyle x environmental chemicals
- Timing of exposure X dose
An example: **Diethylstilbestrol (DES)**

Women prescribed DES during pregnancy:

- **1950s-1972**, to stave off spontaneous miscarriages & other problems of pregnancy
- Millions of women
- “Natural experiment”: Proof of concept
- **Mothers only exposed to DES during pregnancy**
- **Daughters only exposed to DES during gestation**
**An example: Diethylstilbestrol (DES)**

**Women** who took DES during pregnancy:
- Breast cancer (after age 40)

**Daughters** of women who took DES during pregnancy:
- Clear cell adenocarcinoma
- Breast cancer
- Fertility problems

**Granddaughters** of women who took DES during pregnancy:
- (Breast cancer)
Diethylstilbestrol (DES)

Classic EDC:

• Acts via estrogen (estradiol) pathways

• Changes DNA expression
  • Mainly through epigenetic changes

• Increases mammary cell proliferation (cell growth and division)
Exposures through leaching from food containers & wraps, chewing on plastics, contamination of air, water, dust

**Alkylphenols:** antioxidant stabilizers, surfactants

**Phthalates:** Plastic softeners, cosmetics additives

**Polyvinylchloride (PVC):** food packaging, credit cards, toys, building materials, etc

**Bisphenol A (BPA)**
An example: **Bisphenol A (BPA)**

1938: BPA shown to mimic estrogen

![Chemical structures of Estradiol and BPA](image)

2008: BPA found in 93% of U.S. adult human urine samples

Also: Amniotic fluid, fetal blood, newborns, milk
Unlike DES, most BPA research in animal (rodent) and cell culture studies

- **Early exposures and non-linear dose effects**
  - Morphological changes
  - Functional changes

- Alters cell culture proliferation, even with extracts from canned foods
BPA and negative health outcomes: Laboratory studies

Low doses of BPA $\rightarrow$ pregnant rats in their diet

- Increased mothers’ risk for developing mammary tumors.
- Increased daughters’ risk for developing mammary tumors as adults.

Effect on daughters found when mothers were fed BPA

- Just during pregnancy.
- Just during lactation.
BPA and negative health outcomes: Laboratory studies

- Adult human mammary tissue
- Adult rat mammary tissue with no treatment during gestation
- Adult rat mammary tissue with low dose BPA treatment during gestation
BPA and DES: many similar effects

Acts through similar, overlapping mechanisms as does DES

For example:

• **Kass et al (2012):** Neonatal exposures → similar effects on
  • Altered mammary gland development (delayed differentiation)
  • During lactation, changes in milk
    • Yield
    • Composition
BPA and negative health outcomes: Laboratory studies

- Decreases efficacy of common chemo agents (vinblastin, doxycyclin, cisplatin)
Another example: DDT

DDT: Organochlorine pesticide

- First synthesized 1874
- WWII – anti malaria and typhus
- 1950 – DDT hormone disruptor in roosters
- 1950’s – local, ubiquitous insecticide
- 1962 – Rachel Carson’s *Silent Spring*
- 1968 – DDT estrogenic in mammals
- 1972 – DDT agricultural restriction by EPA
DDT: Age of exposure and breast cancer risk

(Cohn, 2011)
Another example: **Soy Derivatives**

**Soy and soy derivatives**

- Protective
- Epidemiological and animal studies
- Timing of exposures and doses
- Dietary form matters; ethnic framing
Prevention

• Primary vs. secondary prevention

• Goal: cure for cancer or prevention of cancer?
Tips for Health and Beauty

Simple is best:
• Fewer products
• Avoid fragrances

Be careful about ‘organic’ or ‘natural’ claims
• Read labels

Avoid products with chemicals including:
• Parabens, phthalates, nonylphenol, triclosan
• Hormones including placental hormones
• Toluene, formaldehyde, petroleum distillate
• PEG, DEA, TEA, DMDM etc. !!
Tips for Home

Eat organic/pesticide free and kick the can

Minimize use of plastics, especially in the kitchen
• Use stainless steel or pyrex
• Don’t microwave in plastic

Chose safer cleaning products
• Check for full disclosure on ingredients
• Make simple cleaners (vinegar, baking soda …)

Stay away from non-stick pans: use oil and elbow grease with stainless steel, cast iron or ceramic!
Whether you are a shift worker or not, minimize your exposure to light while you sleep.
tips for out and about

check ingredients on sunscreens:
• best choices may be zinc oxide or non-nanoized titanium oxide
• avoid 4-MBC, OMC, HMS and oxybenzone

minimize use of chemicals on your lawn and in your garden

wash hands regularly, with simple soap and water. Avoid products containing anti-bacterials
Tips for Future Health

Share this information with your children and grandchildren.

Simplest is often the best!
THANK YOU!!!

For more science, policy and practical tips, go to http.bcpp.org

To read our recent publication on the connection between breast cancer and the environment, go to https://www.bcpp.org/resource/state-evidence-2017/