The Basics on Breast Cancer and the Environment

A Workshop for Breast Cancer Advocates presented by:

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Objectives of Workshop Series

- After this six session workshop series, participants will be able to:
  - Identify environmental risk factors for breast cancer.
  - Identify and avoid chemicals of concern that are linked to breast cancer risk.
  - Choose safer products and practices to reduce exposure to chemicals of concern that are linked to breast cancer risk.
  - Design and conduct a workshop on breast cancer and the environment tailored to the cultural styles, language, education and health literacy or the community.
  - Communicate information to policymakers on environmental policies that linked to breast cancer risk.

Objectives of Workshop 1

- After Workshop 1, the Basics of Breast Cancer and the Environment, participants will be able to:
  - Identify and correct common myths about breast cancer
  - Identify known breast cancer risk factors
  - Identify suspected environmental breast cancer risk factors
  - Identify breast cancer Windows of Susceptibility
  - Understand how evidence of risk is determined and weighed
  - Define the precautionary principle

Myths about Breast Cancer

- Only women over 50 get breast cancer
- Breast cancer can't be cured
- Breast cancer is a fatal disease
- Only women get breast cancer
- If someone hits me in the breast it will turn into cancer
- If you get breast cancer the doctor will remove your breast
- Surgery will cause the cancer to spread
- Mammograms are dangerous
- No breast cancer in my family means I won't get it
- Breast cancer is only a genetic disease

Myths about environmental risk factors for disease

- Since consumer products are sold in stores they must be safe
- The FDA reviews all ingredients in cosmetics for safety before they can be sold
- Manufacturers of cosmetics and cleaning products must list all ingredients on the label
- Pesticides registered by the EPA don't have any harmful health effects
- It's okay to heat food in plastics that say "microwave safe"
- One person can't change our toxic environment

+ Facts About Breast Cancer

+ 5-10% of cases are inherited

+ Most common cancer in women

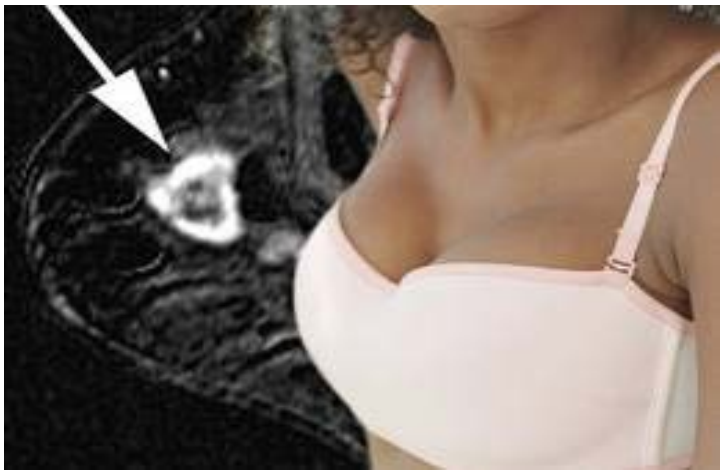
+ Second leading cause of cancer death in women

+ Some risk factors are known

+ Not all causes are known

Breast cancer and African - American women

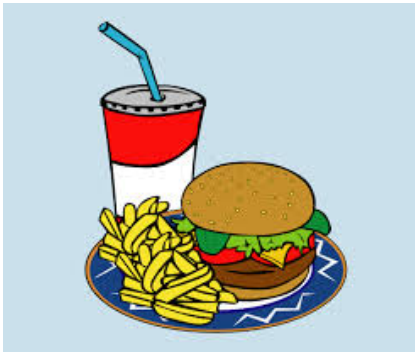
- #1 cause of cancer death
- African-American women are twice as likely to die from breast cancer than Caucasian women
- Despite having lower incidence rates than Caucasians, African-Americans have higher mortality rates
- Studies have shown more aggressive tumors in African-American women
- Environmental and lifestyle factors and access to care may account for differences in breast cancer rates among racial/ethnic groups



+ Risk Factors

Environmental Toxins

Breast Cancer



Defining Risk Factors

- "Recognized or accepted risk factors are defined as factors for which there are confirmatory human data showing consistent associations between an exposure and cancer risk. Biologic plausibility and underlying mechanisms are often demonstrated by animal studies "

-Interagency Breast Cancer and Environmental Research Coordinating Committee (IBCERCC) *Breast Cancer and the Environment, Prioritizing Prevention*

Breast Cancer Risk Factors: Can we do anything about them?

- Age
- Gender
- Family history
- Race and Ethnicity
- Personal history
- Low parity (number of pregnancies)
- Breast density
- Radiation
- Diet
- Limited exercise
- High BMI (measures overweight and obesity)
- Early onset of puberty
- Late onset of menopause
- Alcohol
- Smoking
- Environmental chemicals

What are some environmental risk factors for breast cancer?

Poor Diet

Limited Physical Activity

Alcohol

Smoking

Ionizing Radiation

Chemicals

Known and suspected breast cancer environmental risk factors

KNOWN RISKS

- Hormone Replacement therapy
- Diethylstilbestrol (DES)
- Ionizing radiation
- Tobacco smoke
- Alcohol
- **Occupational exposures:**
  - Solvents, benzene, PAHs, pesticides

SUSPECTED RISKS

- Some pesticides
- Air pollution (i.e. polycyclic aromatic hydrocarbons)
- Metals
- Dioxins
- Endocrine disrupting chemicals
  - BPA
  - Phthalates
  - Triclosan
  - Flame retardants
  - Parabens
  - Perflourooctanoic Acid (PFOA)
  - Polychlorinated biphenyls(PCBs)

What are potential environmental risk factors for breast cancer?

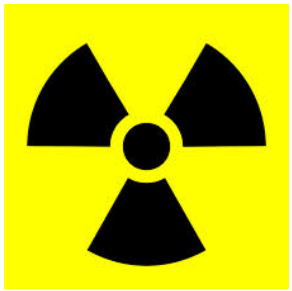
- 216 chemicals identified as inducing mammary tumors in at least one animal study (IARC, NTP)
  - 35 air pollutants
  - 73 in consumer products or food

Risk Factors of Concern in the African-American Community

- Indoor pesticide exposure
- Air pollution
- Personal care products
- Early puberty
- Diet and nutrition
- Obesity

- CDC detects higher exposures to:
  - PCBs
  - Mercury
  - Lead
  - PAHs
  - Dioxins
  - Phthalates
  - Parabens
  - 2,4-and 2,5-dichlorophenol (DCP)

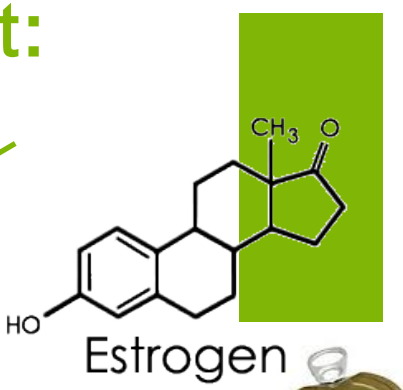
Breast cancer and the environment: Mechanisms



Radiation

DNA damage

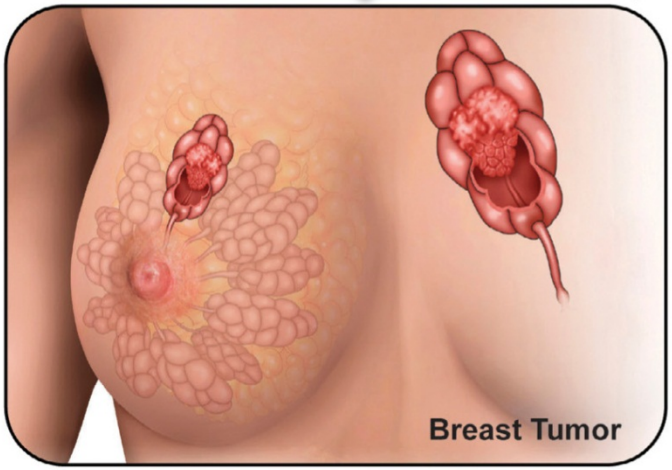
Cell Division



Estrogen

BPA

Phthalates



Parabens

What we know about two types of environmental chemicals linked to breast cancer risk

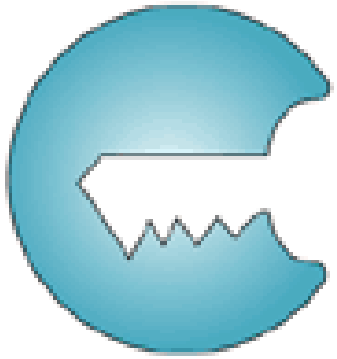
Carcinogens

- Cancer causing
- May directly damage DNA (mutagen)
- May make cells multiply at a rapid rate
- May alter cells so that they are hard to kill
- Examples: Radiation, formaldehyde, arsenic, flame retardants

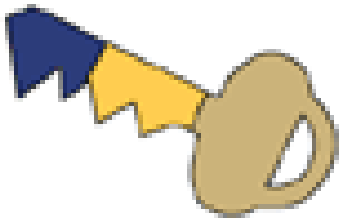
Endocrine Disrupting chemicals

- Affect many body systems
- Active at low doses
- Don't directly damage DNA
- Do interfere with hormones in the body
- May contribute to breast cancer by mimicking estrogen – ESTROGEN STIMULATES TUMOR GROWTH
- Examples: BPA, phthalates, triclosan

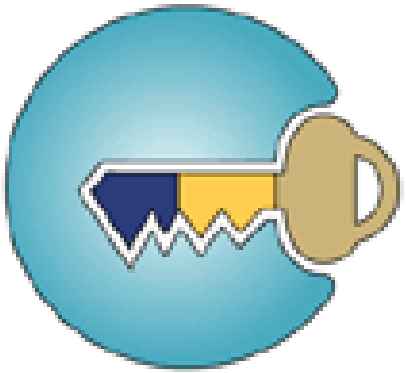
Estrogen and Breast Cancer



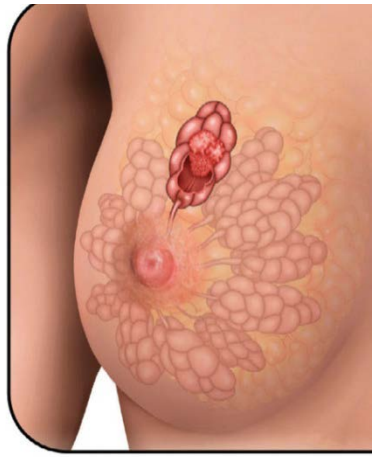
Inactivated Estrogen Receptor



Estrogen



Activated Estrogen Receptor



Growth of breast or tumor cells

Windows of Susceptibility
Not just *what*, but *when*

Prenatal Neonatal Puberty Pregnancy Menopause → Breast Cancer

Defining Risk

$$\text{RELATIVE RISK} = \frac{\text{Chances of getting breast cancer if you WERE exposed}}{\text{Chances of getting breast cancer if you WERE NOT exposed}}$$

Understanding Risk in a Population

"One extra unit of alcohol a day increases a woman's risk of breast cancer by **12%**"

So what does that mean?

http://news.bbc.co.uk/2/hi/uk_news/magazine/7937382.stm

Understanding Risk in a Population

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About 10 in every 100 women have breast cancer in a lifetime

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Understanding Risk in a Population

"One extra unit of alcohol a day increases a woman's risk of breast cancer by **12%**"

About 10 in every 100 women have breast cancer in a lifetime

If all 100 drink an extra unit of alcohol every day...

...that rises to about 11

http://news.bbc.co.uk/2/hi/uk_news/magazine/7937382.stm

Understanding Risk in a Population

"One extra unit of alcohol a day increases a woman's risk of breast cancer by **12%**"

is the same
as saying

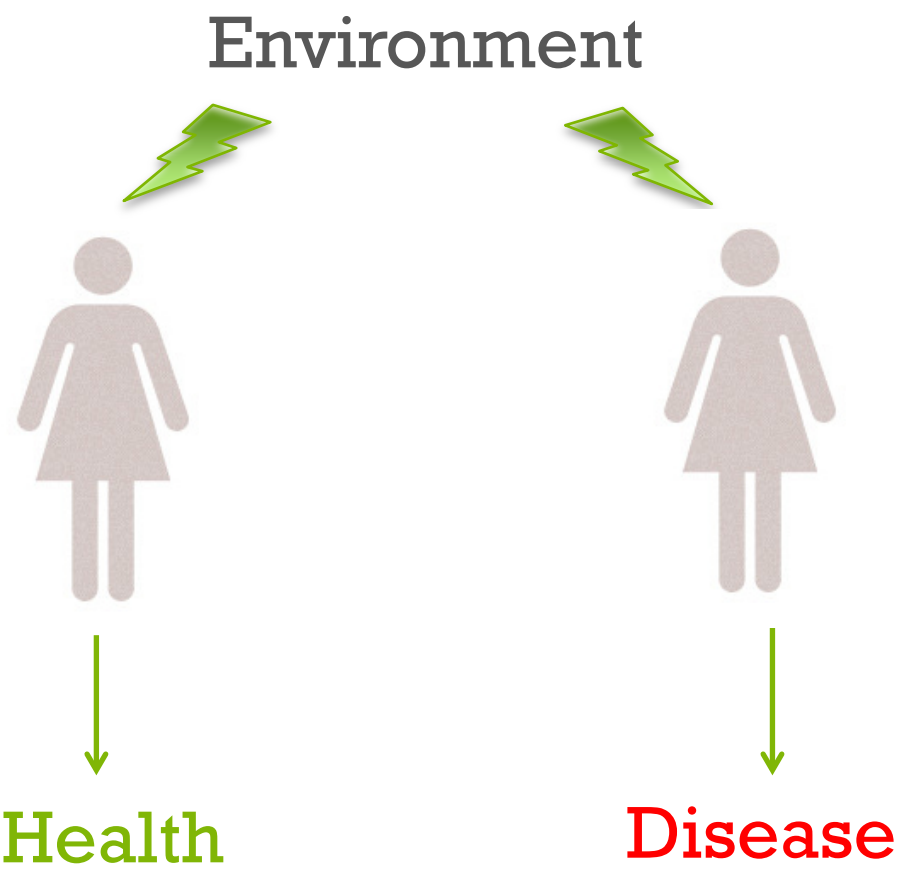
about one extra case in every 100 women

http://news.bbc.co.uk/2/hi/uk_news/magazine/7937382.stm

Individual Susceptibility

"Genetics loads the gun and environment pulls the trigger."
Francis Collins, NIH Director

- Studies that estimate risk are conducted at a population level
- Not every person who is exposed will develop disease
- Genes and environment interact



How do we study breast cancer risk?

- Cells
- Animals
- Human Populations
  - Observational
  - Intervention

Weighing the evidence: Human Cell-based studies (*in vitro*)

What can they tell us?

- If a chemical binds to or activates estrogen receptor
- If a chemical increases growth of cells
- If a chemical causes a genetic mutation
- Something about *how* a chemical may cause breast cancer

What are limitations?

- A breast has many different cell types
- Difficult to mimic the tumor environment
- Cells in a dish act differently than cells in a body
- Certain lifestyle factors cannot be studied

Weighing the evidence: Animal studies (*in vivo*)

What can they tell us?

- If a chemical alters mammary development
- If a chemical increases growth of mammary tumor
- About Windows of Susceptibility
- About new therapeutic targets

What are limitations?

- Animals process chemicals differently
- Difficult to mimic human exposure levels and routes
- Difficult to mimic human exposure to mixtures

Weighing the evidence: Human studies (epidemiology)

What can they tell us?

- If exposure to a chemical is **associated** with increased chance of getting breast cancer in a **population**

What are limitations?

- Unethical to expose subjects to potentially harmful chemicals
- Rarely establish **cause and effect**
- Sometimes rely on patient's memory to assess exposure
- Difficult to assess windows of susceptibility
  - Breast cancer takes many years to develop
  - Exposure may have happened decades before
- Difficult and expensive to conduct **longitudinal studies**
- Difficult to **generalize** findings to all populations

Two Types of Human Studies of Breast Cancer Risk

- **Observational**
  - Watch and see what has happened or will happen
  - Researcher does not do anything to alter the outcome
- **Intervention**
  - Researcher attempts to alter the outcome
  - Limited to interventions that will have a positive effect (do no harm)
  - Randomized Controlled Clinical Trial

Cohort studies of breast cancer

- Prospective Cohort
  - Enrolls subjects before they have a disease
  - Measures exposures of interest as they occur
  - Observes whether disease develops or not
- Retrospective Cohort
  - Subjects may or may not have disease at enrollment
  - Assesses exposures that occurred in the past through patient recall or medical records
  - Subject to recall bias

The Nurse's Health Study

A prospective cohort study

- Followed 238,000 nurses beginning in 1976 to the present
- High retention rate
- Allows for measurement of potential risk factors in real-time
- Identified many breast cancer risk factors:
  - Current oral contraceptive use
  - Postmenopausal hormone replacement
  - Obesity
  - Physical Activity
  - Alcohol
  - Diet
  - Family history
  - Breast Density
  - Shift work

Growing Up Healthy – a prospective cohort study

- The aim of the the BCERP Puberty Study(2003-Present) is to understand how early life exposures may be related to breast cancer risk
- 1100 girls between ages 6 and 8 enrolled at NYC/Mount Sinai: San Francisco, California/Kaiser Health System; Cincinnati, Ohio/Cincinnati Children's Hospital & Univ. of Cincinnati.
- Collected data annually on weight, height, BMI, diet, physical activity levels, the built environment, product use and exposure to endocrine disrupting chemicals to understand how these exposures effect age of puberty. Early puberty is a known risk factor for breast cancer.
- Found that black girls who are overweight or obese are entering puberty and menarche earlier than white or Hispanic girls.

Case-Control studies

Example: Dietary Patterns and Breast Cancer

- Subjects enrolled after they have breast cancer and compared with subjects who don't have breast cancer
- Subjects are asked to complete surveys about the types of food they eat and how often
- Studies show healthy diet associated with reducing risk of breast cancer
- Subjects may not accurately recall what they ate years before and cancer patients may have **recall bias**: more likely to recall poor dietary habits if they got sick

Intervention Studies
Dietary Intervention Example

- The Women's Intervention Nutrition Study
  - *Does a low-fat diet reduce cancer recurrence and improve survival?*
  - 2000 postmenopausal women randomized to receive standard treatment plus a low-fat dietary intervention or standard treatment alone
  - Followed up for five years.
  - **Outcome:** women on low fat diet had reduced breast cancer recurrence rate

Precautionary Principle

- Avoid exposure when:
  - Risk of harm is suspected
  - Existing scientific evidence cannot prove cause and effect

"Better Safe Than Sorry"

Precautionary Principle

- Science was right and you avoid exposure
  - **SAFE**
- Science was wrong and you avoid exposure
  - **SAFE**
- Science was right and you don't avoid exposure
  - **NOT SAFE**

Upcoming Workshops in the Series

- Environmental Exposures in Every Day Life Part 1: Personal Care Products
- Environmental Exposures in Every Day Life Part 2: Consumer Products
- How to Communicate about Breast Cancer and the Environment to Diverse Lay Audiences
- Local, State and National Policies on Environmental Exposures
- Review of What We Have Learned, Evaluation and Next Steps

Resources

- http://www.breastcancerfund.org/
- http://www.preventionisthecure.org/
- http://zerobreastcancer.org/research/brbio_engl.pdf
  - An educational tool for community members to facilitate understanding of breast biology, windows of susceptibility, and environmental risk factors for breast cancer.
- http:/sciencereview.silentspring.org
  - Lists chemicals found to be associated with mammary tumors in animals and humans with links to peer reviewed articles
- http://news.bbc.co.uk/2/hi/uk_news/magazine/7937382.stm
  - Graphic display of how to understand risk
- http://www.iarc.fr/en/publications/pdfs-online/epi/cancerepi/CancerEpi-5.pdf
  - Defines different types of epidemiological studies