Environmental Exposures

Why Timing is Critical

Presented by:

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  Clinical Psychologist & Associate Professor, UC Berkeley School of Public Health

• Barbara Cohn, PhD
  Director of the Child Health and Development Studies, a project of the Public Health Institute.
Agenda

- Puberty and breast cancer
- Intersection of psychosocial factors, chemical exposure and obesity
- Social Justice impact
- DDT and Breast Cancer
Our Mission & Vision

To achieve health justice for all women at risk of and living with breast cancer

VISION: A world where lives and communities aren’t threatened by breast cancer.
Our Commitment to Social Justice

• Unequal burden of disease
• Root Causes
• Intersectionality
• Allyship
BCAction’s Strategic Priorities

1) Breast Cancer Screening, Diagnosis and Treatment

2) Root Causes of Breast Cancer

3) Pink Ribbon Marketing and Culture
Louise Greenspan, MD
Julianna Deardorff, PhD
Barbara Cohn, PhD
The New Puberty

Louise Greenspan, MD
Julianna Deardorff, PhD
The Misconceptions

When does puberty start?

Definitions:

– **Thelarche** = onset of breast development, breast budding

– **Pubarche** = onset of pubic hair development

– **Menarche** = first period
Puberty- The Old Days

• Girls:
  – Any pubertal development prior to age 8 is abnormal
  – Menses prior to age 10 is abnormal

• Boys:
  – Any pubertal development before age 9 is abnormal
Breast Cancer and the Environment Research Centers (BCERCs)
Rates of Breast Development

At Age 7

- 10% of White girls
- 25% of Black girls
- 15% of Hispanic girls
- 2% of Asian girls

Biro et al Peds 2010
Comparing the cumulative prevalence of Breast Stage 2+ for non-Hispanic WHITE participants between the BCERP Puberty Study and PROS.9.

Average Age of Breast Development

- African-American: 8.8 years
- Hispanic: 9.3 years
- Asian and White: 9.7 years
Rates of Pubic Hair Development
Girls

At Age 7

– 6% of White girls
– 20% of Black girls
– 6% of Hispanic girls
– 2% of Asian girls

Biro et al Peds 2010
Menarche (NHANES)

Estimates from national data

- 12.06y African Americans
- 12.25y Mexican Americans
- 12.55y non-Latina whites
Consequences – Adolescence

- Depression, anxiety
- Behavior probs, delinquency
- Overweight
- Substance use: tobacco, ETOH, MJ
- Early sexual initiation, early pregnancy
- Body image issues; eating disorder dx

Many outcomes more prevalent among African American and Latina youth
Long-term consequences – into adulthood

• Breast cancer
• Depression
• Substance use
• Other reproductive cancers (uterine, cervical)
• Overweight, obesity
• Poor cardiovascular health
The Culprits
Comparing the cumulative prevalence of Breast Stage 2+ for non-Hispanic WHITE participants between the BCERP Puberty Study and PROS.9.

Chemical Exposures (EDCs)

- Phthalates
- PBDEs
- Cotinine
- Triclosan
- Phenols/BpA
- PFOA
- Phytoestrogens
BCERP Findings

• Wolff et al:
  • Certain phthalates were associated with delayed PH, but not breast dev (2014)
  • 4 out of 10 phenols tested either accelerated or delayed puberty (2015)

• Windham et al:
  • Found flame retardants (PBDEs) and other POPs were associated with delayed breast development (2015)

• Hong et al:
  • Asthma/allergies associated w younger PH but not breast dev (2014)
Chemical Exposures

• Few long-term studies with good puberty measures
• BCERC started late, in utero exposure may be critical
• Know very little about:
  – synergistic effects of chemicals
  – whether stress potentiates chemical effects
Some Resources

- The New Puberty: Navigating Girls' Early Development in Today's World by Louise Greenspan, MD & Julianna Deardorff, PhD
- EWG's Skin Deep Cosmetics Database
- EWG's Dirty Dozen Guide: Worst Fruits & Vegetables of the Year
- EWG's Clean 15 Guide: Best Fruits & Vegetables for Purchase

The images also include icons and logos related to these resources, such as the EWG logo and the Think Dirty app.
Exposures and Puberty: The Contribution of Stress

Julianna Deardorff, PhD
UC Berkeley School of Public Health
Overview

• Multiple levels of exposures affect puberty and health
• Maternal and psychosocial factors that influence puberty
• Intersection between chemicals and stress
• CHAMACOS (thanks to PI: Eskenazi for slides!)
Health (and puberty) determined by many factors

- **Immediate environment**
  - Health
  - Home Environment
  - Nutrition
  - Pesticides
  - Housing quality
  - Family Relationships
  - Neurobiology
  - Enrichment

- **Host factors**
  - Genes

- **Larger environment**
  - Violence
  - Discrimination
  - Poverty
  - Acculturation
Maternal factors & puberty

• High maternal pre-pregnancy weight and excessive gestational weight gain predicted early menarche (NLSY; Deardorff et al, 2012)

• Gestational diabetes predicted earlier breast development in daughters (BCERP; Kubo et al, in press)

• Breastfeeding protective against early puberty (breast development) in daughters (BCERP; Kale et al. 2014)
Psychosocial environment & puberty

- Familial stress and conflict
- Father absence
- Low socioeconomic status
- Sexual abuse
- Neighborhood disadvantage
Cancers? Long-term issues

• Adolescent substance use: tobacco and alcohol
  • early initiation and heavier use at early ages
  • breast, lung cancer risk

• Adolescent overweight
  • risk factor and consequence of early puberty
  • risk for cancers

• Adolescent mental health
  • depression and anxiety
  • implications for survivor outcomes
  • higher inflammation, reduced immune functioning
Salinas Valley
The “Salad Bowl” of the Nation
In 1999-2000, we enrolled 601 pregnant women from clinics serving farm workers

- 92% Spanish-speaking
- 85% born in Mexico
- 54% < 5 years in U.S.
- 96% living within 200% of poverty
- 44% 6th grade education or less
- 44% worked in agriculture during pregnancy
- 84% other agricultural workers in home
CHAMACOS is a longitudinal birth cohort study N=600-900)
The CHAMACOS children grew up with many adversities...

<table>
<thead>
<tr>
<th>Issue</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal depression (12 m) (CES-D)</td>
<td>50%</td>
</tr>
<tr>
<td>Housing Density &gt;1.5 per room</td>
<td>49%</td>
</tr>
<tr>
<td>Rodents</td>
<td>32%</td>
</tr>
<tr>
<td>Food Insecurity</td>
<td>50%</td>
</tr>
<tr>
<td>No blocks or stacking toys (12m)</td>
<td>51%</td>
</tr>
</tbody>
</table>

Photo by Seth Holmes

Bradman et al., 2005 EHP
Obesity is high and increasing with age

![Graph showing prevalence of obesity with age and gender, categorized by NHANES and Mexican-American populations.](graph_image)
Endocrine Disruptors
Social justice

- Pubertal timing is a barometer for the environment
- Many factors likely intersect or “add up” to create risk for poor health, including cancers
- Major social justice issues when the most vulnerable communities are being overly subjected to the most harmful chemical and environmental exposures
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Breast Cancer and Environmental Chemicals

Barbara A. Cohn, Ph.D.

Director
Child Health and Development Studies
Public Health Institute
"DDT is good for me-e-e!"

The great expectations held for DDT have been realized. During 1946, exhaustive scientific tests have shown that, when properly used, DDT kills a host of destructive insect pests, and is a benefactor of all humanity.

Pennsalt produces DDT and its products in all standard forms and is now one of the country’s largest producers of this amazing insecticide. Today, everyone can enjoy added comfort, health and safety through the insect-killing powers of Pennsalt DDT products... and DDT is only one of Pennsalt’s many chemical products which benefit industry, farm and home.

GOOD FOR FRUITS — Bigger apples, juicier fruits that are free from unsightly worms... all benefits resulting from DDT dusts and sprays.

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Knox FOR THE HOME—helps to make healthier, more comfortable homes... protects your family from dangerous insect pests. Use Knox-Out DDT Powders and Sprays as directed.

Knox FOR DAIRIES—Up to 20% more milk... more butter... more cheese... tests prove greater milk production when dairy cows are protected from the annoyance of many insects with DDT insecticides like Knox-Out Stock.
Forms of DDT

**Insecticide**

\((p,p'-\text{DDT})\)

**Contaminant**

\((o,p'-\text{DDT})\)

**Metabolite**

\((p,p'-\text{DDE})\)
WHEN Blood is Collected Determines DDT Seen

Cohn et.al. EHP 115:10 October 2007
During 1959-1967 over 15,000 pregnant women in the Kaiser Permanente Health Plan joined the CHDS.
Blood collected after 1976 showed only the metabolite (DDE) and not the insecticide or contaminant.

For example, in a National health survey conducted between 1976 and 1980: 99% of samples showed the Metabolite, 40% showed Insecticide, and 1% contained the contaminant.

If the insecticide and contaminant forms of DDT are not measured near the time of exposure, they can not be measured as risk factors.

This is significant because the Insecticide and contaminant are both risk factors for breast cancer in our study.

*P. A. Stehr-Green, *Journal of Toxicology and Environmental Health* 27, 405 (1989).*
Blood samples from our cohort were taken during the height of DDT use and allow us to measure exposure for the mother, fetus and future grandchildren.
Vulnerability Differs by Generation

- One exposure impacts three or more generations of women differently

Adapted from Perera F, Herbstman J, Reproductive Toxicology PMID: 21256208
CHDS 1st Generation Breast Cancer Risk Increases with Increased DDT Exposure

- Women exposed to DDT before age 14 had a 5-fold increased risk of breast cancer when in the highest third (or tertile) of DDT exposure.
- Exposures after puberty (age 14) did not have increased risk, indicating a specific risk period as the breast develops.

Exposure to Contaminant (o,p’-DDT) in Utero increased Breast Cancer Risk in CHDS 2nd generation

- Daughters whose mothers had exposure in the highest 25% had nearly a four-fold increased risk of breast cancer
- Among the women with breast cancer, tumors of an aggressive form, expressing the HER-2 protein, were more common among daughters more highly exposed to o,p’-DDT.

Odds Ratio for Breast Cancer

- Quartile 1
- Quartile 2
- Quartile 3
- Quartile 4

Cohn et al J Clin Endocrinol Metab, August 2015, 100(8):2865–2872
Impact

• Findings suggest we can help prevent breast cancer beginning before birth
How can this help families now

• We can choose to limit exposure to chemicals for pregnant women and children

• Especially:
  – chemicals that are stored in the body for a long time
  – chemicals that disrupt or mimic a hormone like estrogen
  – chemicals that are not essential

• We can support changes in society that reduce the use of suspect chemicals
Where do we go from here

• Understanding early life exposures can help us to understand, treat, and prevent breast cancer.
Why Understand the Past

• New technologies like metabolomics can be applied to biospecimens in four CHDS generations to find diagnostic and treatment targets.

• For example: What is the “cholesterol” for breast cancer?
There is NO evidence that breast cancer is an **inevitable** consequence of early life environment
The CHDS needs your help to continue

- CHDS has existed for 56 years by receiving federal grant funding for research.
- However, government research $$ are not a steady source for cohort maintenance (sample storage, cohort outreach, extension of study to new participants)
- We are looking for partners to endow the study for future generations.
- Go to www.Chdstudies.org for more information
CHDS Participant Advisory Council
Thank you to the late Dr. Barbara Jane van den Berg who protected the CHDS during all the rainy days.
Dr. Jacob Yerushalmy

Founder of The Child Health and Development Studies
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• Recent collaborators at multiple academic institutions who use our data and/or advise us
• Public Health Institute that provided a sound and flexible contemporary home for the CHDS
• California Breast Cancer Research Program
• NIH (NICHD, NIEHS, NCI and the Breast Cancer Research and Environment Program)
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