

- 1 **Bridging the Nutrition Gap:
The Potential Long- term Impact of Breastfeeding on
Future Health**
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The Greatest Pregnancy Ever and The Attachment Pregnancy
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- 2 **Up to 5 Generations**
- 3
- 4 **Traditional Thinking**
- 5 **How does epigenetics work?**
- 6 **How Does Epigenetics Work**
- 7 **What is epigenetics?**
- 8 **What is epigenetics?**
- 9 **The Epigenetic Switch**
- 10 **How does epigenetics work?**
 - DNA Methylation
 - Histone Modification
 - mRNA
 - Phosphorylation
 - Ubiquitylation
 - Sumolyation
- 11 **Methylation**
 - @30 million genes that can be methylated
- 12 **Histones**
 - 50 trillion cells in body
 - 6 linear feet of DNA in each one

13 **Histone Modification/Chromatin**14 **Histone Modification**

- Deacetylated, condensed genes, difficult to access
- Acetylated, decompressed, easy access to genes

15 **messenger RNA**

- Messenger between DNA and Proteins that express genes through down regulation or translation

16 **Let's Get Visual**17 **Epigenome as Translator**

- Translator – How do cells differentiate the DNA?
- The Epigenome!

18 **Nutrigenomics**

- Nutrients can directly or via hormonal activity influence the expression of genes
- An entire new field now called nutrigenomics
- What is the most important first food?

19 **Epigenetics at Work**

- Food that goes in changes the enzymes in the gut
- Fermentation of proteins of polysaccharides
- Methyls and Acetyl Groups

20 **Breastmilk and the microbiome**

- Artificial milk fed infants have completely different pH. Changes pH (from an acidic base of 5.1-5.4 to more alkaline of 5.9-7.3 which allows putrefactive bacteria) (Walker, Marsha)

- Change the fermentation process and methyl groups available to body

21 **Breastfeeding and the Phenotype**

22 **Animal Research**

- Mouse studies
- Agouti mice (Dolinoy, 2006; Jirtle, 2000)

23 **Breastmilk's Epigenetic Influence**

24 **Why does it work?**

- We are constantly adapting for optimal survival.
- The fetus is preparing for optimal survival outside the womb.
- The newborn is managing its new environment and adjusting to cues.

25 **Unique Microbiome/ Nutritionally Impacted**

26 **Epigenetics and the Microbiome**

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31 **HMOs -Oligosaccharides
Marvels Newest Heros**

- HMO – Human Milk Oligosaccharides
- Can't be used by baby
- There to feed our bacteria
- Genetically driven
- Influenced by geography

- 32 **Super Hero's of Milk**
- Bouncers – bacteria latch on and get a ride out of gut
 - Immune Tuners – Dial down immune in gut so bacteria can establish hold
 - Feeders –Providing unique nourishment

33 **Why Is It Important?**

34

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37 **Breastmilk and Inflammation**

38 **Baby Building Can Have long term consequences**

39 **Mothers Are Architects**

40 **Studies in Review**

41

42 **Mammary Growth Yields**

43 **Mammary Growth Yields**

44 **Mammary Growth Yields**

- Restricted energy led to:

45 **The Epigenome Helps Breast Tissue “Remember”**

46 **Duration of Breastfeeding and LEP**

- DNA methylation of LEP
- Responsible for appetite regulation and fat metabolism
- Formula feeding dims down the Leptin producing gene

- 47 **Duration of Breastfeeding and LEP**
- Maternal Education, Breastfeeding Duration, Constitutional Factors at 17 mo. old
 - Measured DNA methylation of LEP in whole blood and also serum leptin
- 48 **Milk Kinship and Epigenetics**
- Does wet nursing or milk sharing cause consanguinity?
- 49
- Why is this a possibility?
 - Exosomes in breastmilk
 - Tiny endosome-derived membrane vesicles that are released into the extracellular environment
 - Genetic material such as microRNA
- 50 **miRNA in Breastmilk**
- High levels of miRNA in breastmilk in first six months of lactation
 - Approximately 1.3×10^7 copies/liter/day of miR-181a
- 51 **immune cell regulation and metabolism**
- Rich with mRNAs that promote
 - Cellular differentiation and proliferation
 - Tissue identity
 - Metabolism
 - Developmental programming
- 52
- 53 **Day to Night**

- 54 **MiRNA From Womb to Milk**
- 55 **miRNA in Breastmilk**
- 56 **miRNA in Breastmilk**
 - Influence is strongest before age of 2
 - Inadequacy of immune system to reject genetic material
 - Increased plasticity
 - Increased vulnerability of epigenome during developmental period
- 57
 - What Does Epigenetics Have to Do With Attachment?
- 58 **Molecules of Emotion**
- 59 **Entrainment/Synchronicity**
- 60 **Molecules of Emotion**
- 61 **Babies have an emotional Life**
- 62 **Prenatal Brain and Stress**
 - Prenatal stress reduces proteins needed for synaptogenesis
 - Altered expression in hippocampus (depression and anxiety)
 - Increased fear response
- 63 **Moms brains Change, too**
- 64 **It Looks Like Falling In Love**
- 65 **Amygdala Response**
- 66 **The Mother's Nose**
- 67 **The Eyes Have It**
 - Oxytocin and Dilation
- 68 **Let's Get Back to the Prenatal Environment**
- 69 **Epigenetics and Stress**

- Scientific Data
 - Baboon studies
 - (Sapolsky)

70 **Stress**71 **Sustained Stress in Fetus**72 **Stress and Pregnancy**

- What we know about stress
 - Increases ego “me centered” behavior
 - Inability to feel gratitude, joy
 - Body holds on to fat cells, even in baby
 - Indian babies study

73 **What Does Stress Have to DO With Breastfeeding and Epigenome?**74 **Epigenomic Inheritance**

- Human research - influence beyond three generations –
HongerWinter winter 1944-spring 1945
 - 30% nutrition
 - Early pregnancy or late pregnancy
 - Specific epigenetic tags for diabetes

75 **Honger Winter and Mood Disorders**76 **Potential Brain Changes in Babies Due to Prenatal Stress**77 **Brain Changes in Babies Due to Prenatal Stress**78 **The Behavior of Breastfeeding**79 **Ultimately Human Milk Is Important**

- Share Milk Systems
- Improving donations to Donor Milk sites

- Improving access to human milk for those in need.
- Wet nursing???

80 **Future Generations are Counting on us**
Thank you, WIC!