

- 1 **Epigenetics and Breastmilk:
The Potential Impact of Breastfeeding on Genetic Expression**
By Laurel Wilson, IBCLC, CLE, CCCE, CLD
Author of The Greatest Pregnancy Ever and The Attachment Pregnancy
- 2 **Why am I interested in epigenetics?**
- 3 **It's About History and Herstory**
- 4 **What is epigenetics?**
 - Literally means above the gene.
 - Study of how our environment, internal and external influences genetic expression.
 - Genome=DNA
 - Epigenome=Phenotype
- 5 **What is epigenetics?**
- 6 **How does epigenetics work?**
 - Genome – Traditional Biology
- 7 **How does epigenetics work?**
- 8 **How does epigenetics work?**
 - Genetic Activity
- 9 **How does Epigenetics Work?**
 - Imprinting
- 10 **How does Epigenetics Work?**
 - Imprinting
- 11 **How does Epigenetics Work?**
- 12 **How does Epigenetics Work?**
 - Imprinting
- 13 **How does epigenetics work?**
 - Epigenome
 - Translator
 - Methylation
- 14 **How does epigenetics work?**
- 15 **How does epigenetics work?**
 - Developmental Origins
 - Metabolism

- Hormone Production
- Tissue Sensitivity

- 16 **How does epigenetics work?**
 ➤Genetic Activity
- 17 **How does epigenetics work?**
 ➤Epigenome
 ➤Can be inherited
 ➤The memory of the environment experienced is passed down
 ➤Has been demonstrated in animal research up to 5 generations out
- 18 **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.
- 19 **Breastfeeding and Epigenetics**
 ➤During pregnancy and early postpartum life babies are programmed nutritionally to adapt to their environment.
 ➤Abundant resources, immune support, healthy food
 ➤Limited resources, immune challenge, poor nutrition
- 20 **How does epigenetics work?**
 ➤You are what you eat?
 ➤You are what your mother and grandmother ate.
 ➤Diet of grandparents linked to longevity in offspring
 ➤What is the impact of breastmilk?
 ➤The act of breastfeeding?
- 21 **How does epigenetics work?**
 ➤"Nutritional status can influence epigenetic profiles by inhibiting enzymes that catalyze DNA methylation or histone modifications or by influencing dietary availability of substrates necessary for these enzymatic processes."
 Zaneta, 2011
- 22 **Clear evidence that prenatal and early postpartum**

environment influences the child lifelong.

- 23  **Epigenetic Animal Studies**
- Mouse studies
 - Agouti mice (Jirtle, 2000)
 - PCOS/BPA and rats (Nilsson, 2012)
 - Prescott 2012 reduced ability to release oxytocin
- 24  **Study 1 – Mammary Growth Yields**
- Role of Compensatory Mammary Growth in Epigenetic Control of Gene Expression – Chung 2005
 - Rats on compensatory nutrition program
 - Energy restriction (all essential nutrients but caloric reduction) has significant biological impact on animals
 - Retardation of aging
 - Reduction of cancer
 - Reduction late life disease
 - Energy restriction shifts physiology to energy-conserving and away from energy wasteful metabolic pathways
 - Refeeding then causes accelerated anabolism, increased growth
- 25  **Study 1 – Mammary Growth Yields**
- Role of Compensatory Mammary Growth in Epigenetic Control of Gene Expression – Chung 2005
 - Majority of mammary growth occurs in developmental phase of neonate
 - Dairy industry has been practicing this for years, called stairstepping
 - Energy restriction followed by refeeding during pre-puberty, puberty and gestation. Increases yields by up to 10%
 - Two groups in trial - Rats
 - Group One-dietary restrictions for first 10 days gestation
 - Same minerals, protein and vitamin, just energy restriction at 60% of mean intake
 - Group Two
 - Regular diet

- 26 **Study 1 – Mammary Growth Yields**
 ➤ Mammary Development and Epigenetic Expression in Prenate
 ➤ Dietary restriction group showed improved mammogenesis and later lactation performance
- 27 **Study 1 – Mammary Growth Yields**
 ➤ Restricted energy led to
 ➤ Increased cell proliferation
 ➤ Concurrent elevations of the expression of genes involved in cell proliferation and differentiation
 ➤ When diet improved in last trimester during epithelial cell proliferation this had significant impact
 ➤ Effect impacts subsequent lactations
- 28 **Study 1 - Mammary Growth Yields**
- 29 **Duration of Breastfeeding and LEP**
 ➤ “Duration of breastfeeding and gender are associated with methylation of the LEPTIN gene in very young children.” Obermann-Borst et al.
 ➤ DNA methylation of LEP, a non-imprinted gene
 ➤ Responsible for appetite regulation and fat metabolism
- 30 **Duration of Breastfeeding and LEP**
 ➤ Study
 ➤ Maternal Education, Breastfeeding Duration, Constitutional Factors at 17 mo. old
 ➤ Measured DNA methylation of LEP in whole blood and also serum leptin
 ➤ 120 mother/child couplets (99 breastfeeding info)
 ➤ 75% breastfed
 ➤ 14% <1 mo.
 ➤ 22% >1-3 mo.
 ➤ 21% >3-6 mo.
 ➤ 18% >6 mo

- 31 **Duration of Breastfeeding and LEP**
 ↗ Findings
 ↗ No assoc. maternal education and duration of bf
 ↗ Children who breastfed at least 1-3 mo (instead of receiving artificial milk) had higher serum concentrations of leptin
 ↗ 2.8 vs. 2.6 mmol/l; P=0.025
- 32 **Milk Kinship and Epigenetics**
 ↗ Epigenetics and Milk Kinship
 ↗ Ozkan et al.: Milk kinship hypothesis in light of epigenetic knowledge. *Clinical Epigenetics* 2012, 4-14.
 ↗ Does wet nursing or milk sharing cause consanguinity?
- 33 **Milk Kinship and Epigenetics**
 ↗ Epigenetics and Milk Kinship
 ↗ Why is this a possibility?
 ↗ Exosomes in breastmilk
 ↗ Genetic material such as microRNA
 ↗ Stem Cells
 ↗ Organic substances affecting epigenetic regulation mechanisms
- 34 **Milk Kinship and Epigenetics**
- 35 **Milk Kinship and Epigenetics**
- 36 **miRNA in Breastmilk**
 ↗ MicroRNA in Breastmilk
 ↗ Kosaka et al.: microRNA as a new immune-regulatory agent in breast milk. *Silence*, 2010, 1:7.
 ↗ High levels of miRNA in breastmilk in first six months of lactation

➤ Suggest that humans can transfer genetic material other than sexual reproduction

37 **miRNA in Breastmilk**

➤ Biggest Risk of Influence

➤ Before age of 2

➤ Inadequacy of immune system to reject genetic material

➤ Increased plasticity

➤ Increased vulnerability of epigenome during developmental period

38 **Questions to ponder**

➤ Might prenatal and preconception nutrition make stronger environmental signals on epigenetic breastmilk programming than supplementing only during critical periods?

➤ Short term supplement may mimic short term environmental conditions. Humans are highly plastic and adaptive.

39 **Questions to Ponder**

➤ Very clear data that stress has epigenetic impact, and is multigenerational.

➤ Very clear evidence that social standing and hierarchy has very clear impact on health gradient.

➤ Very clear evidence that in western societies, low income, higher stressed mothers have shorter duration of breastfeeding?

➤ What epigenetic influence is this cumulative effect having on babies and their future offspring?

40 **Thank You**

➤ Questions:

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➤ www.thegreatestpregnancyever.com list of research, updated slide outline