Why Breastfeeding Prevents Maternal Metabolic Syndrome and CVD

The Psychoneuroimmunology of Human Lactation

Kathleen Kendall-Tackett, Ph.D., IBCLC
Department of Pediatrics
Texas Tech University School of Medicine

- Study of 139,681 postmenopausal women (Mean age=63)
- Lifetime history of lactation of more than 12 months related to lower
  - Hypertension
  - Diabetes
  - Hyperlipidemia
  - Cardiovascular disease

- Cohort analysis of 2,516 parous, midlife women (SWAN study)
- Increased breastfeeding duration lowered prevalence of metabolic syndrome in a dose-response way

- 20-year longitudinal study of 704 women enrolled during their first pregnancy (CARDIA study)
- Women without gestational diabetes who had breastfed for at least one month had a 56% reduced risk for metabolic syndrome
- 86% reduction in risk for women with GDM

- Duration of lactation inversely correlated with:
  - Current BMI
  - Waist circumference
  - Blood pressure
  - Fasting glucose
  - Insulin
  - Triglycerides
  - Total and LDL cholesterol

- 85,585 and 73,418 parous women (Nurses’ Health Study I & II; Mean age=50)
- Longer duration of lactation reduced risk of Type-2 diabetes
- Each additional year decreased risk by 15%
  - Independent of BMI, diet, exercise or smoking
- Did not decrease risk for women with gestational diabetes

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- Did not decrease risk for women with gestational diabetes
• Exclusive breastfeeding associated with greatest reduction in risk
• Longer duration per pregnancy resulted in greater benefit

Stuebe et al., JAMA 2005; 294:2601-2610

• Sustained lactation-associated metabolic changes have may profound effects on diabetes risk
  – May induce long-term changes in the HPA axis

Stuebe et al., JAMA 2005; 294:2601-2610

• Metabolic syndrome is the precursor syndrome to Type-2 diabetes
• Cluster of symptoms
  – Insulin resistance
  – High LDL and VLDL cholesterol
  – High triglycerides
  – Visceral obesity
• These symptoms also increase the risk of cardiovascular disease

Haffner & Taegtmeyer, Circulation 2003; 108: 1541-1545

Retnakaran & Shah, CMAJ 2009; 181: 371-376

• 12-year cohort study of women who gave birth 1994-1998, Ontario, Canada
• Women with either gestational diabetes or an abnormal glucose tolerance test had increased cardiovascular risk

• Why would breastfeeding lower risk?
  – Some proposed mechanisms

Lactation creates “metabolic drain” that alters energy homeostasis
  – Increases HDL levels
  – Decreases triglycerides
  – Improves insulin sensitivity

Ram et al., Am J Obstet Gynecol 2008; 198:268e1-268e6
• Reset hypothesis
• During gestation
  – Visceral fat accumulates
  – Insulin resistance increases
  – Lipid and triglyceride levels increase
• Breastfeeding helps reverse, or reset, these changes
• For maternal metabolism, pregnancy ends with weaning, not birth

“Lactation may prime the metabolic system by making it a more energy-efficient machine”

Ram et al., Am J Obstet Gynecol 2008; 198:268e1-268e6
**Stress**

**Catecholamines**
- Norepinephrine
- Epinephrine
- Dopamine

**HPA Axis**
- Hypothalamus
- CRH (CRF)
- Pituitary
- ACTH
- Adrenal cortex
  - Cortisol

**Proinflammatory Cytokines**
- IL-1β
- IL-6
- TNF-α
- IFN-γ

**Inflammation**
**Cardiovascular disease**
**Metabolic syndrome and insulin resistance**

Haffner & Taegtmeyer, Circulation 2003; 108: 1541-1545

**Inflammation**
**Metabolic syndrome and insulin resistance**
Chronic stress, depression and hostility increases the risk of:
- Coronary heart disease
- Myocardial infarction
- Metabolic syndrome and diabetes
- Neurodegenerative diseases


Negative mental states upregulate stress
- Depression
- Hostility
- Perceived low social status

Pulkki-Raback et al., Health Psychol 2009; 28: 108-116

- Depression increases the risk of both metabolic syndrome and cardiovascular disease

Hostility also increases risk of metabolic syndrome and heart disease
• Hostile people are more prone to ischemia and constriction of coronary arteries when under stress
• Trait hostility predicted new coronary events
• And sped up the progression of CHD in patients who already have it


• Prospective study of 135 patients with no symptoms of diabetes (75 men, 60 women)
• Women with higher levels of depression and hostility had higher fasting insulin, glucose & insulin resistance
  – Independent of BMI, age, fasting triglycerides, exercise, or ethnicity
Suarez, Health Psych 2006; 25: 484-492.

• 3-year study of 134 white and African American teens
• Hostility at T1 predicted at least 2 risk factors for metabolic syndrome at 75th percentile for age, gender and race
  – BMI, insulin resistance, ratio of triglycerides to HDL cholesterol, and arterial blood pressure

• Marital hostility increased systemic inflammation
• Hostility also impaired wound healing
  – High-hostile couples had 60% slower wound healing
Kiecolt-Glaser et al., Arch Gen Psychiatry 2005, 62: 1377-1384

• Women in unsatisfying marriages had an increase in cardiovascular risk over 13-year study
  – Related to low HDL, high triglycerides, BMI, blood pressure, depression and anger
Gallo et al., Health Psych 2003, 22: 453-463
• Low social status related to vascular inflammation
  – ET-1, sICAM
• Effects independent of hypertension status or ethnicity


• Low social status related to elevated CRP
  – 3-year longitudinal study of 188 middle-aged and older adults
• African Americans, women and those with low education had highest CRP


• Low parental education predicted metabolic and CVD risk factors in high school students
  – Higher insulin levels
  – Higher glucose
  – Greater insulin resistance
  – Higher-LDL, lower HDL
  – Higher waist circumference
  – Higher BMI


“Social connection has profound consequences for health. Being well integrated socially reduces all-cause age-adjusted mortality by a factor of two-fold, about as much as having low vs. high serum cholesterol levels or being a nonsmoker”

Spiegel, JAMA 1999, 281: 1328

Sleep

• Sleep problems increase the risk of metabolic syndrome and heart disease
Sleep disorders, such as primary insomnia and obstructive sleep apnea, increase inflammatory markers, such as CRP, IL-6 and TNF-α.

Suarez & Goforth. 2010 In Psychoneuroimmunology of Chronic Disease: American Psychological Association.

Subclinical sleep disorders also increase risk for CVD, hypertension, Type-2 diabetes, metabolic syndrome and all-cause mortality.

Suarez & Goforth. 2010 In Psychoneuroimmunology of Chronic Disease: American Psychological Association.

Even short periods of sleep deprivation can elevate cortisol and glucose levels, and increase insulin resistance.

McEwen, Biological Psychiatry 2003; 54: 200-207.

Disturbed sleep also increases the risk of depression and obesity.

Meta-analysis of sleep duration and obesity (36 studies, N=634,511)

Children and adults

Short sleep duration (< 5 hours) related to obesity worldwide.

Cappuccio et al. Sleep 2008: 31; 619-626.
• Poor sleep quality and depression are mutually maintaining

*Kendall-Tackett, Trauma Violence & Abuse, 8, 117-126*

• Insomnia significantly increases the risk for new-onset depression and anxiety disorders


• Sleep disturbances are among the most common symptoms of psychiatric disorders

• Insomnia significantly increases the risk for new-onset depression and anxiety disorders


• General population study in Japan (N=24,686)
• Sleep duration <6 hours or >8 had highest rates of depression
• Sleep duration 6-8 hours had lowest rates

*Kanefu et al. J Clin Psychiatry 2006; 67: 196-203*

• Sleep of <4 hours between midnight and 6 a.m. and daytime naps <60 min associated with depression at 3 months
• Problems falling asleep and excessive daytime sleepiness strongest predictors

*Goyal et al., Arch Womens Ment Health 2009; 12: 229-237*

*Trauma*

*Neuroscience, Molecular Biology, and the Childhood Roots of Health Disparities: Building a New Framework for Health Promotion and Disease Prevention*
Jack P. Shonkoff, W. Thomas Boyce; Bruce S. McEwen JAMA. 2009;301(21):2252-2259
“Adult disease prevention begins with reducing early toxic stress.”

“An increasing amount of research in neuroscience, social epidemiology, and the behavioral sciences suggests that a reduction in the number and severity of early adverse experiences will lead to a decrease in the prevalence of a wide range of health problems.”

Adverse Childhood Experiences (ACE) include:
- Child Sexual Abuse
- Child Physical Abuse
- Child Emotional Abuse
- Witnessing Intimate Partner Violence
- Parental substance abuse
- Parental criminal activity
- Parental mental illness
- Parental divorce

Adverse Childhood Experiences (ACEs) are related to the leading causes of premature mortality and preventable death in adults.

Patients with 4 or more ACEs had higher rates of:
- Ischemic heart disease
- Cancer
- Stroke
- Chronic bronchitis
- Emphysema
- Diabetes
- Skeletal fractures
- Hepatitis

• Nine-fold increase in risk of cardiovascular disease in women maltreated as children in the National Comorbidity Study.
Danese et al., *Proc Nat Acad Sci U S A* 2007;104(4), 1319-1324

- Dunedin Multidisciplinary Health and Development Study (N=1,037)
- Independent effect of childhood maltreatment on C-reactive protein 20 years later
- White blood cell count and fibrinogen also elevated
- Dose-response effect of severity of abuse on inflammation

Surveys of Mothers’ Sleep and Fatigue
Kendall-Tackett & Hale

- Online survey of 6,410 mothers with infants aged 0-12 months (Mean infant age=6.96 months)

Danese et al. *Arch Ped Adolesc Med* 2009; 163: 1135-1143

- Dunedin Multidisciplinary Health and Development (N=1,037)
- At 32 years, those who experienced adverse childhood experiences (low SES, maltreatment or social isolation) had higher rates of:
  - Major depression
  - Systemic inflammation
  - Having at least 3 metabolic risk markers

Rohde et al., *Child Abuse Negl* 2008: 32; 878-887

- Study of 4,641 middle-aged women (Mean age=52 years)
- Childhood physical and sexual abuse doubled the odds of both depression and obesity

Survey of Mothers’ Sleep and Fatigue Full Sample (N=6,410)

- Hit or slapped hard enough to leave a mark
  - 34%
- Raped as teen or adult
  - 13%
- Contact child sexual abuse
  - 25%
- Parent depressed
  - 36%
- Parent hit, bitten or kicked
  - 16%
- Parental substance abuse
  - 32%

Comparison of three groups

- No rape as a child (CSA) or as teen or adult (N=5044)
- 1-type: CSA or teen/adult rape (N=857)
- 2-types: Child sexual abuse and rape (N=137)
Mental Health Effects

- Abuse history increases the risk of depression
- Abuse survivors are more likely to have:
  - Severe depression
  - A higher number of episodes

Depression on PHQ-2

F(2)=18.49, p<.0001

History of Depression

X2(2)=132.94, p<.0001

Severity of depression

F(2)=22.2, p<.0001

Episodes of Depression

F(2)=23.85, p<.0001

- Sexual assault also impacts sleep and fatigue in some specific ways
**Minutes to Get to Sleep**

F(2)=38.19, p<.0001

**Length of infant sleeps at longest stretch (hours)**

F(2)=2.91, p<.055

**Total Hours of Sleep per Night**

F(2)=9.19, p<.0001

**Overall Physical Health**

F(2)=18.8, p<.0001

**Energy Level on Most Days**

F(2)=3.15, p<.043

**Chronic fatigue syndrome/Fibromyalgia**

X2(2)=12.55, p<.002
Breastfeeding
- Downregulates stress
- Improves mood
- Decreases risk of depression
- Decreases hostility
- Improves mother-infant bond

Groër et al., JOGNN 2002, 31: 411-417

• Why does breastfeeding help?

Breastfeeding decreased ACTH & cortisol
Lower stress response to induced stressor
Suckling provided short-term lessening of stress response

Heinrichs et al., J Clin Endo Metabol 2001, 86: 4798-4804

Stress Response
- Depression & anxiety
- Alienation
- Hostility & interpersonal strife

Oxytocin Response
- Well-being
- Affiliation
- Bonding
• Review of 49 studies on breastfeeding and depression
• Bottle feeding increases the risk of depression
• Breastfeeding decreases risk of depression

Dennis & McQueen Pediatrics 2009; 123: e376-e751

• 15-year cohort study of 7,223 Australian mother-infant pairs
• 512 substantiated maltreatment reports (4.3% of cohort)
• Breastfeeding decreased risk of maternal-perpetrated child maltreatment
  – OR=2.6 for non-breastfed
  – OR=1.1 for breastfed


• Risk of neglect decreased with breastfeeding duration
  – OR=1.0
  – OR=2.3 for <4 months
  – OR=3.8 for non-breastfed


• Abuse-lowering effects of breastfeeding may be due to oxytocin release, which:
  – Reduces anxiety
  – Elevates mood
  – Increases maternal responsiveness
  – Lowers maternal stress
  – Increases attachment


• Breastfeeding also improves maternal sleep

Study of 2830 women at 7 weeks postpartum
• Poor sleep was an independent risk factor for depression
• Factors associated with poor sleep
  – Depression
  – Previous sleep problems
  – Primiparity
  – Not exclusively breastfeeding
  – Younger or male infant

Dorheim et al. Sleep 2009; 32: 847-855
• “For new mothers, a complaint of trouble falling asleep may be the most relevant screening question in relation to their risk for postpartum depression”


• Study of 133 new mothers & fathers (3 mos postpartum)
  – Questionnaire and actigraphy data
  – 67% EBF, 23% mixed, 10% formula
  – EBF mothers slept 40 minutes longer than mixed-feeding mothers


• Slow-Wave Sleep
  – 12 exclusively breastfeeding women
  – 12 age-matched control women
  – 7 women exclusively bottle feeding
• Minutes in SWS
  – Exclusive breastfeeding (M=182 minutes)
  – Control group (M=86 minutes)
  – Exclusively bottle-feeding (M=63 minutes)


• Does breastfeeding help trauma survivors decrease risk of metabolic syndrome and cardiovascular disease?

• Percentage who are breastfeeding

Impact of breastfeeding on maternal sleep

Percentage who are breastfeeding

- No
- CSA or rape
- CSA & Rape

- 0
- 20
- 40
- 60
- 80
- 100

- No
- CSA or rape
- CSA & Rape

- 0
- 20
- 40
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- 80
- 100
Impact of breastfeeding on maternal mental health

- Longest Stretch Baby Sleeps
  - Hours: 3, 4.5, 6, 7.5, 9
  - Sexual Trauma: No, CSA or rape, CSA & rape
  - F(8)=32.64, p<.0001

- Number of Hours Mothers Sleep
  - Hours: 5.75, 6, 6.25, 6.5, 6.75
  - Sexual Trauma: No, CSA or rape, CSA & rape
  - F(8)=6.93, p<.0001

- Minutes to Get to Sleep
  - Minutes: 15, 20, 25, 30, 35, 40, 45
  - Sexual Trauma: No, CSA or rape, CSA & rape
  - F(8)=16.002, p<.0001

- Mother's Daily Energy
  - Rating Scale: 2.3, 2.4, 2.5, 2.6, 2.7, 2.8, 2.9
  - Sexual Trauma: No, CSA or rape, CSA & rape
  - F(8)=11.01, p<.0001

- Mother's Overall Physical Health
  - Rating Scale: 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8
  - Sexual Trauma: No, CSA or rape, CSA & rape
  - F(8)=24.65, p<.0001
Edinburgh Postnatal Depression Scale Score

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$F(8)=17.39, p<.0001$

Depression on PHQ-2

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$F(8)=9.62, p<.0001$

Mother’s Self-Rated Emotional Health

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$F(8)=12.24, p<.0001$

Conclusions

- Breastfeeding lowers risk of metabolic syndrome and CVD by
  - Decreasing depression and hostility
  - Increasing mother-infant bond

- Breastfeeding also
  - Improves sleep quality
    - Total sleep hours
    - Minutes to fall asleep
  - Attenuates the effects of trauma
    - Decreasing trauma-related sleep problems
    - Improving maternal well-being
• Breastfeeding—particularly exclusive breastfeeding—protects women’s physical and mental well-being
• These effects persist long past the perinatal period

For more information on inflammation, depression and disease

806-352-2519

Infant Risk Center
Texas Tech University Health Sciences Center

UppityScienceChick.com
BreastfeedingMadeSimple.com
KathleenKendall-Tackett.com