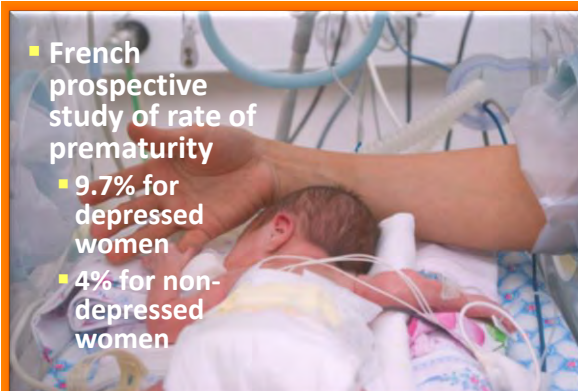




- Proinflammatory cytokines rise in last trimester
- Women's highest risk of depression in the last trimester
- Cytokines remain elevated postpartum



- Depression and anxiety increase the risk for preterm birth



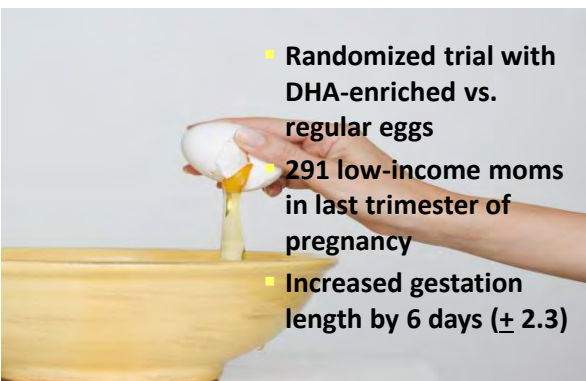
- French prospective study of rate of prematurity
- 9.7% for depressed women
- 4% for non-depressed women

Dayan et al., *Psychosom Med* 2006, 68: 938-946

- Increased IL-6, TNF- $\alpha$  in stressed and depressed moms
- IL-6, IL-8, TNF- $\alpha$  ripens cervix
- Levels increase in pre-eclampsia and infection
- CRH triggers parturition



Coussons-Read et al. *Psychosom Med* 2005, 67: 625-631



- Randomized trial with DHA-enriched vs. regular eggs
- 291 low-income moms in last trimester of pregnancy
- Increased gestation length by 6 days ( $\pm$  2.3)

Smuts et al., *Obstet Gyn* 2003, 101: 469-479

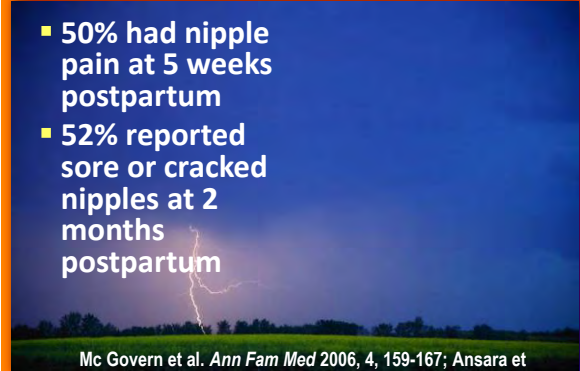


- 2,586 women in U.S. in neonatal period
- Women with severe breastfeeding pain Day 1, Week 1, and Week 2 significantly more likely to be depressed at 2 months postpartum
- Breastfeeding help was protective of mental health for women with moderate or severe pain



Watkins et al. *Ob Gyn* 2011. 118(2): 214-221

- 50% had nipple pain at 5 weeks postpartum
- 52% reported sore or cracked nipples at 2 months postpartum



Mc Govern et al. *Ann Fam Med* 2006, 4, 159-167; Ansara et al. *J Psychosom Ob Gyn* 2005, 26: 115-125

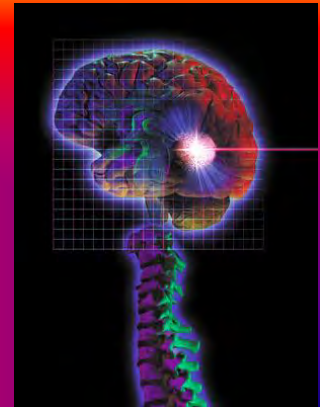


- Severity of post-birth pain, but not mode of delivery, predicted postpartum depression
  - Prospective, longitudinal study of 1,288 women
- Acute pain increased the risk of depression by three times
  - And the risk of persistent pain by 2.5 times

Eisenach et al. *Pain* 2008; 140: 87-94

- Pain increases inflammation
- Inflammation increases pain
- Inflammation also increases prostaglandin synthesis

Simopoulos *J Am Coll Nutr* 2002, 21: 495-505

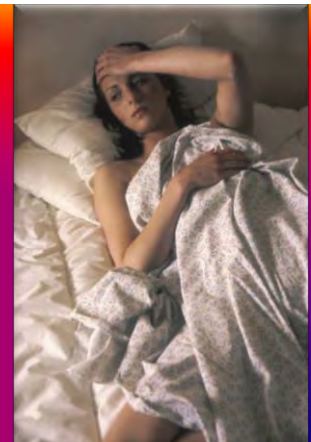


## Sleep Disturbances



- Both depression and trauma compromise sleep quality

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







- Sleep abnormalities in depressed new mothers
- Decreased sleep time and reduced REM latency

Ross et al., *J Psychiatry Neurosci* 2005, 30: 247-256



- Chronically disturbed sleep increases inflammation (IL-6, TNF- $\alpha$ ) and increases risk of cardiovascular disease and metabolic syndrome

Berk et al. 2013 *BMC Med* 11: 200; Suarez & Goforth, 2010, In *Psychoneuroimmunology of Chronic Disease*. American Psychological Assn.



**Trauma**

**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%
- CSA--rape 2%
- All types contact CSA 25%
- Parent depressed 36%
- Parent hit, bitten or kicked 16%
- Parental substance abuse 32%



- 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

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



- Rates of birth-related PTSD up to 9% in U.S. surveys
  - 18% had PTSD symptoms
  - 46% described their births as "traumatic"

Alcorn et al. *Psychological Med* 2010; 40: 1849-1859;  
Beck et al., *Birth* 2011; 38(3): 216-227

- Prior depression or trauma primes the stress response
- More rapid inflammatory response to current stressors

Kiecolt-Glaser et al., *Psychosom Med* 2007, 69: 217-224

- Reduce maternal stress
- Reduce inflammation

## Goals of Prevention & Treatment

## Reduce Maternal Stress

- Breastfeeding protects maternal mood by downregulating the inflammatory response system
- Breastfeeding difficulties can cause depression

### Oxytocin Response

- Well-being
- Affiliation
- Bonding

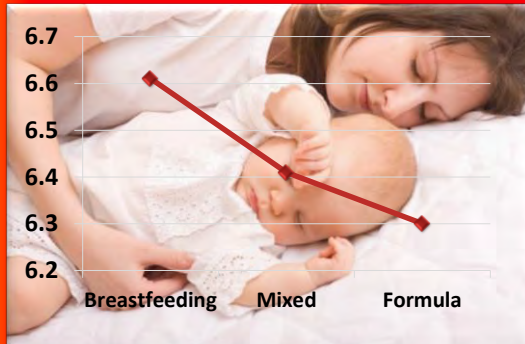
### Stress Response

- Depression & anxiety
- Alienation
- Hostility & interpersonal strife

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

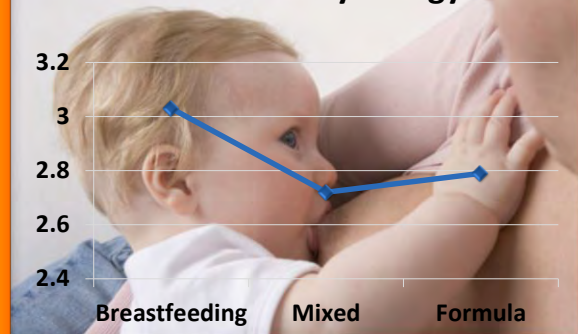
Heinrichs et al., *J Clin Endo Metabol* 2001, 86: 4798-4804

### Hours Mothers Sleep



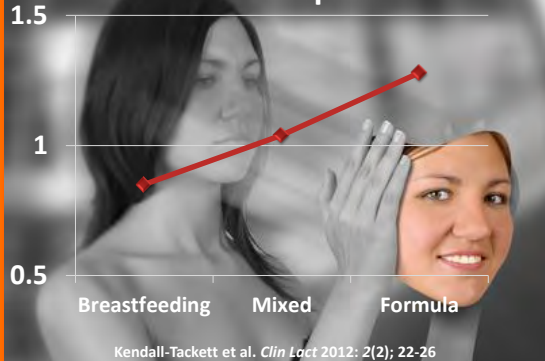
Kendall-Tackett et al. *Clin Lact* 2012; 2(2); 22-26

### Mothers' Daily Energy



Kendall-Tackett et al. *Clin Lact* 2012; 2(2); 22-26

### Mothers' Depression



Kendall-Tackett et al. *Clin Lact* 2012; 2(2); 22-26

- 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

Schwartz et al. *Obstet Gyn* 2009; 113: 974-982

- Breastfeeding improves mother-infant interaction and stops intergenerational transmission of abuse and trauma

- Babies of depressed-breastfeeding mothers had normal EEG patterns
- Depressed-BF moms touched, stroked and looked at babies more than depressed-non/BF moms

Jones et al., *Biol Psychology* 2009; 67: 103-124





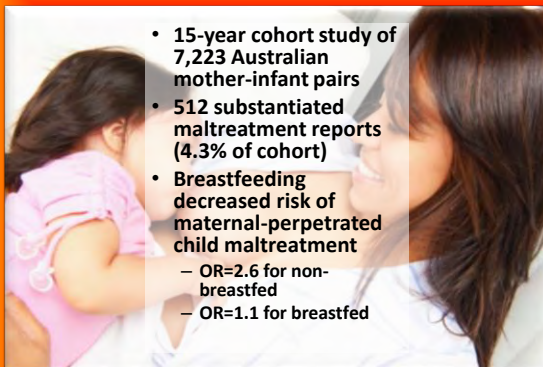
- 14-year longitudinal study in W. Australia of 2900 pregnant women
- Children assessed at 2, 6, 8, 10 and 14 years
- Longer duration of breastfeeding associated with better child mental health at every assessment
- Dose-response effect

Oddy et al. *J Pediatrics* 2009

#### Child Behavior Checklist Scores

##### – Total morbidity

	Never BF	BF 12+ Months
Age 2	16.1	9.6
Age 5	26.3	16.0
Age 8	19.4	13.5
Age 10	15.2	12.6
Age 14	16.7	10.9



- 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

Strathearn et al. *Pediatrics* 2009; 123: 483-493



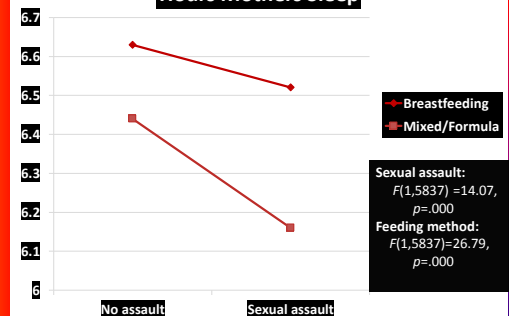
- Risk of neglect decreased with breastfeeding duration
  - OR=1.0 >4month
  - OR=2.3 for <4 months
  - OR=3.8 for non-breastfed

Strathearn et al. *Pediatrics* 2009; 123: 483-493

#### Percentage who are breastfeeding



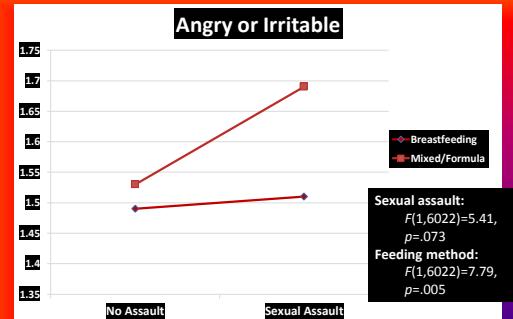
#### Hours Mothers Sleep



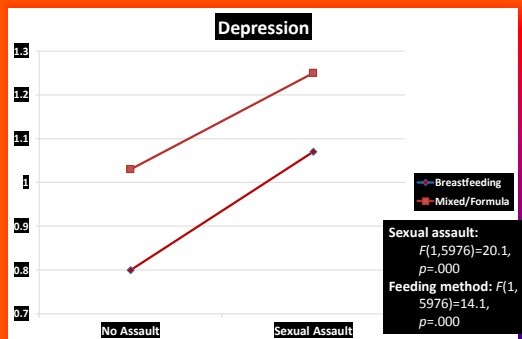
Kendall-Tackett et al. *Breastfeed Med* 2013; 8(1); 16-22



Kendall-Tackett et al. *Breastfeed Med* 2013; 8(1); 16-22



Kendall-Tackett et al. *Breastfeed Med* 2013; 8(1); 16-22



Kendall-Tackett et al. *Breastfeed Med* 2013; 8(1); 16-22

## Reduce Inflammation



- All treatments for depression lower inflammation



- Breastfeeding was related to lower C-reactive protein
  - CRP is an inflammatory marker for cardiovascular and other chronic diseases
  - Study of 26-year-old women who participated in the Dunedin Multidisciplinary Health Study

Williams et al., *J Epidemiol Community Health* 2006; 60: 146-148



## Exercise



- Exercise is an effective treatment for even major depression
- High-fitness leads to lower inflammatory response to stress

Berk et al. 2013 *BMC Med* 11: 200; Blumenthal et al., *Psychosom Med* 2007, 69: 687-696; Hamer & Steptoe, *Psychosom Med* 2007, 69: 660-666

- 32-longitudinal study of 163 people
  - Followed since birth
  - Attachment measured (Strange Situation) at 12-18 months
- At age 32, those with insecure attachments at 12-18 months significantly more likely to have inflammation-based illness



Puig et al. *Health Psychology* 2013; 32(4): 409-417

## EPA & DHA



- Populations with high fish consumption have lower rates
  - Postpartum depression
  - Major depression
  - Bipolar disorder
  - Suicide risk

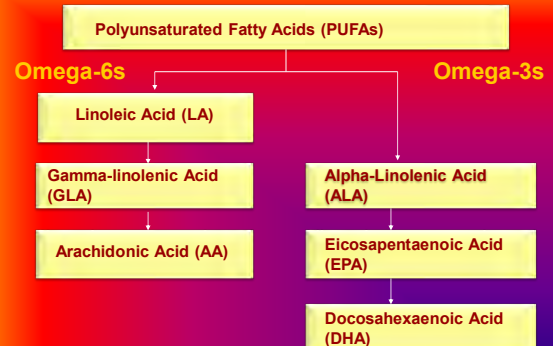


Hibbeln *J Affective Disorders* 2002, 69: 15-29; Noaghiul et al. *Am J Psychi* 2003: 160, 2222-2227; Sublette et al., *Am J Psychi* 2006:163, 1100-1102; Tanskanen et al. *Psychi Serv* 2006: 52, 529-531

- Many pregnant and postpartum women in the U.S., Canada, Europe, Australia, and New Zealand are deficient in EPA/DHA

- Pregnancy further depletes maternal stores of both

Rees et al., *Austral NZ J Psychiatry* 2005, 39: 279-284; Wang et al. 2004, Agency for Healthcare Research & Quality



Wang et al. Agency for Healthcare Research & Quality, 2004

- Population study found high Omega-3s related to low IL-1 $\alpha$ , IL-1 $\beta$ , IL-6, TNF- $\alpha$
- Opposite true of people low in Omega-3s

Ferrucci et al., *J Clin Endo Metabol* 2006, 91: 439-446



- Students with higher EPA/DHA had a lower inflammatory response to a lab-induced stressor

Maes et al., *Biol Psychi* 2000, 47: 910-920



- St. John's wort
  - Antidepressant constituent is hyperforin
  - Hyperforin is anti-inflammatory and reduces proinflammatory cytokines

Balch, *Prescription for herbal healing*, 2002



- SSRIs are specifically anti-inflammatory and decrease production of pro-inflammatory cytokines

Berk et al. 2013 *BMC Med* 11: 200; O'Brien et al., *Brit J Psychiatry* 2006, 188: 449-452



## Summary & Implications

Wellness ↑

~~Stress~~

- Inflammation is an important contributor to the onset and severity of depression





- **Breastfeeding attenuates stress and protects maternal mood**
- **But breastfeeding problems increase risk of depression**



- **All effective treatments for depression are anti-inflammatory**

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