

**‘How Adversity Gets Under
the Skin’:
Breaking the Cycle of
Trauma and Chronic Disease
in Our Communities**

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Our model of Diabetes has been too small...

- We've thought it was only about:
 - Genes we inherit
 - Our lifestyle choices (diet & exercise)
- But it's now clear that these alone do *not* explain all of diabetes risk
- It's also becoming clear that the roots of diabetes overlap with the roots of other chronic problems: heart disease, depression, substance abuse, domestic violence, learning problems, etc.

Childhood Trauma Predicts Adult Health

- Children born in Helsinki, Finland between 1934-44
- 320 were evacuated abroad during WW II—separated from their parents
 - Average age at evacuation: 4.8 years old
 - Average duration of evacuation: 1.7 years
- 60 years later, compared with children not evacuated, evacuees were much more likely to have:
 - Heart disease (OR 2.0) and hypertension
 - Type 2 Diabetes (OR 1.4)
 - Depressive symptoms (OR 1.7)
- “This study is among the first to show that early life trauma predicts higher prevalence of cardiovascular disease and type 2 diabetes in late adulthood...”

Ann Med. 2009;41(1):66-72, *Am J Epidemiol.* 2007;166(10):1126-33, *Am J Hum Biol* 2008;20(3):345-51

For diabetes risk, it matters what's happened...

- To us as adults
 - Diet and exercise choices
 - Food of poor nutritional quality: another stimulus to overeat
 - Stress and trauma
- To us as children
 - Nutrition and Stress
- To us in the womb
 - Nutrition and stress
- To our parents
 - Nutrition and stress
- To our grandparents
 - Nutrition and stress

Eur J Human Genetics 2007;15:784-790 and 2002;10:682-688

- “It is through epigenetic marks that environmental factors like diet, stress and prenatal nutrition can make an imprint on genes that is passed from one generation to the next.” *Time* 1/18/10, p. 50



“...confronting the origins of disparities in physical and mental health early in life may produce greater effects than attempting to modify health-related behaviors or improve access to health care in adulthood.”

“Adverse pre- and postnatal experiences can have a profound effect on the course of health and development over a lifetime. ... biological events that occur during fetal and postnatal life predispose the child to an elevated risk of subsequent problems in physical and mental health.”

“A Science-Based Framework for Early Childhood Policy: Using Evidence to Improve Outcomes in Learning, Behavior, and Health for Vulnerable Children”, Center on the Developing Child at Harvard University, August 2007, p.6 <http://www.developingchild.harvard.edu>

Early Life Experience and the Brain

- Developing brain is remarkably shapeable and adaptable
- “The brain’s exquisite sensitivity to experience in early childhood allows traumatic experiences during infancy and childhood to impact all future emotional, behavioral, cognitive, social, and physiologic functioning.”

Child Adolesc Psychiatr Clin N Am 1998;7(1):33-51

Brain Development

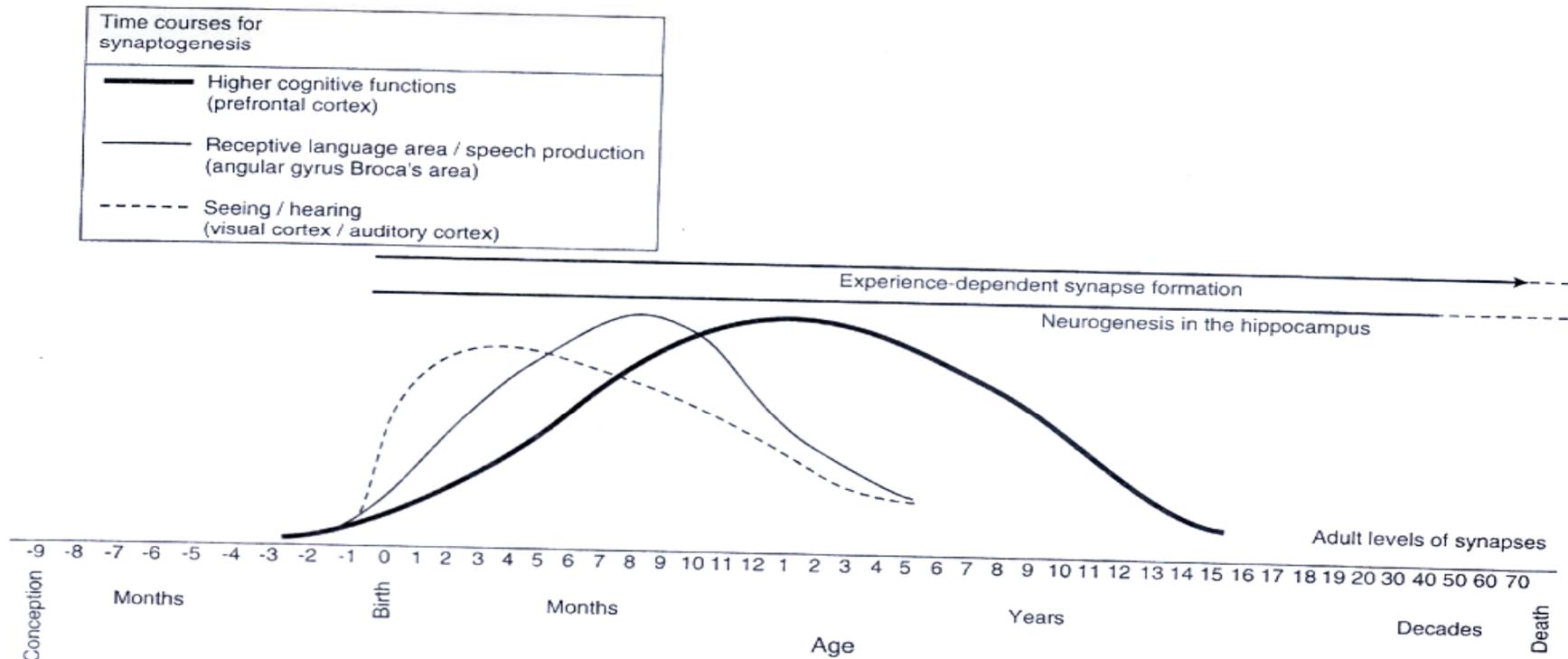


FIGURE 8-1 Human brain development. SOURCE: Charles A. Nelson, University of Minnesota. Reprinted with permission.

From Neurons to Neighborhoods: the Science of Early Child Development. National Academy of Sciences, 2000, p. 188

TABLE 8-1 Conditions and Substances that Affect the Developing Brain

Needed for Normal Brain Development	Detrimental or Toxic
Oxygen	Alcohol
Adequate protein and energy	Lead
Micronutrients, such as iron and zinc	Tobacco
Adequate gestation	Prenatal infections
Iodine	Polychlorinated biphenyls (PCBs)
Thyroid hormone	Ionizing radiation
Folic acid	Cocaine
Essential fatty acids	Metabolic abnormalities (excess phenylalanine, ammonia)
Sensory stimulation	Aluminum
Activity	Methylmercury
Social interaction	Chronic stress

Note: The listed factors are not intended to be exhaustive.

Early life risk factors combine and take their toll on the brain

- Family Structure
 - Parental employment
 - Father's absence
 - Teen parenthood
- Human Capital
 - Maternal education
 - Maternal verbal ability
- Mental Health
 - Maternal depression
 - Stressful life events
- “...associated with lower IQ scores as early as age 2-4 years and more behavior problems by age 3.”

Fuligni and Brooks-Gunn from *Promoting Health: Intervention Strategies from Social and Behavioral Research*, 2000

Early Life Risk Factors for Obesity at Age 7 years

1. Parental obesity
2. Birth weight
3. Weight gain in 1st year of life (“catch-up growth”, “adiposity rebound”)
4. >8 hrs/week TV watching at age 3 yrs
5. Short sleep duration at age 3 yrs
6. Not: calories eaten, junk food, breastfeeding

Reilly, *et al.* 2005. *BMJ*, doi:10.1136/bmj.38470.670903.E0

Other studies: youth obesity predicted by depression, behavior problems, low cognitive stimulation



International Diabetes Federation

Conference on Type 2 Diabetes Etiologies

2002

1. Genetics
2. Fetal Origins
3. Lifestyle
4. Stress

1. Genetics

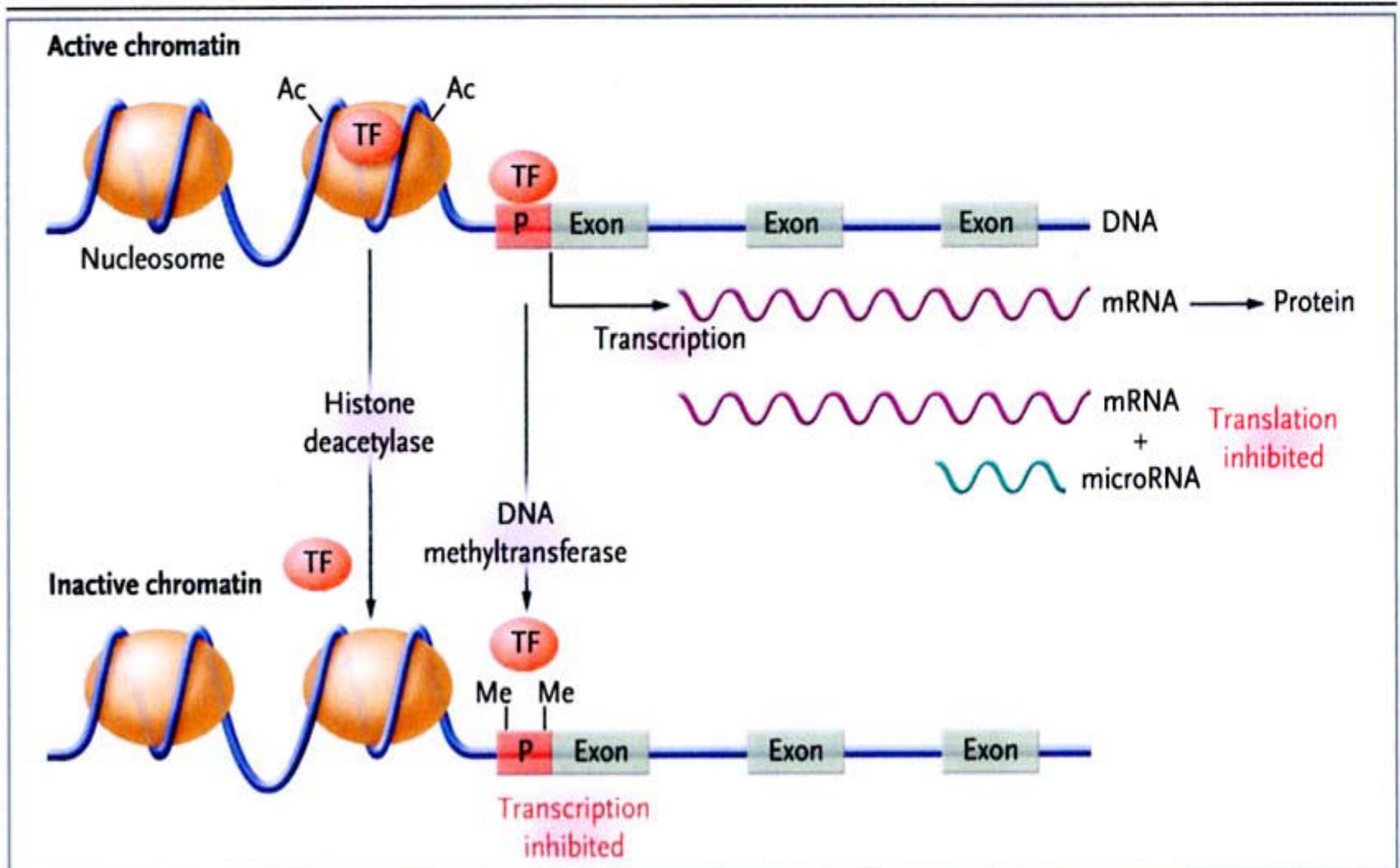
■ Genes *Inherited*

- It does matter what genes we inherit
- *But* only 15% of genes in cells “turned on” at any given time

■ Genes *Expressed*

- **“Epigenetics”**: the “on/off switches” for genes
 - reaction to the environment
 - not always reversible if at key developmental stage of life
 - we know the body’s “on/off switches”: DNA methylation, histone acetylation, microRNA

JAMA 294(17):2221-4, 2005 and *NEJM* 359:61-73, 2008



Epigenetics

- No longer “nature vs. nurture”—nurture *affects* nature
- Rat pups raised by nurturing mothers
 - Gene which affects stress hormone receptors “turned on”
 - Grow up to be stress resilient
- Rat pups raised by neglectful mothers
 - Gene which affects stress hormone receptors “turned off”
 - Grow up to be very stress reactive
- Same process has now been shown in humans

Nature Neuroscience 2009;12:342-348
- “...there is no change in gene sequence; the changes are only in...gene expression. Hence, these kinds of effects are called *epigenetic*. Epigenetic mechanisms can provide a potential pathway by which early experience can have lasting effects on behavior.”

JAMA 2005;294(17):2221-4



2. Fetal Origins



- Alcohol/Drugs
- Nutrition
- Smoking
- Maternal Diabetes
- Toxic/Infectious Exposures
- Maternal Low Birth Weight
- Maternal Stress/Mental Health
 - Mother's own Childhood
 - Current/Prenatal

Definitions

- “Preterm” baby
 - Baby born before 37 weeks of pregnancy (“gestation”)
- Low Birth Weight (“SGA”) baby
 - “Small for Gestational Age”
 - Baby born small for *whatever* gestational age baby born at
- Babies can be either/both “SGA” and “Preterm”
 - they both are strongly associated with that baby’s later risk for chronic disease

Diabetes 2009;58:523-526

Prenatal Depression Effects on the Fetus and Newborn

- Mothers with depressive symptoms
 - ↑stress hormone (cortisol), ↓serotonin/dopamine levels
 - More likely to deliver prematurely and have low birth weight babies
- Newborns of mothers with depressive symptoms:
 - ↑ cortisol and ↓serotonin/dopamine levels (like mom)
 - ↓ “neurobehavioral profiles”

Infant Behavior & Development 2004;27:216-229

- Preterm delivery risk increases with depression severity
 - 44% of 791 pregnant patients had depressive symptoms, half of them severe

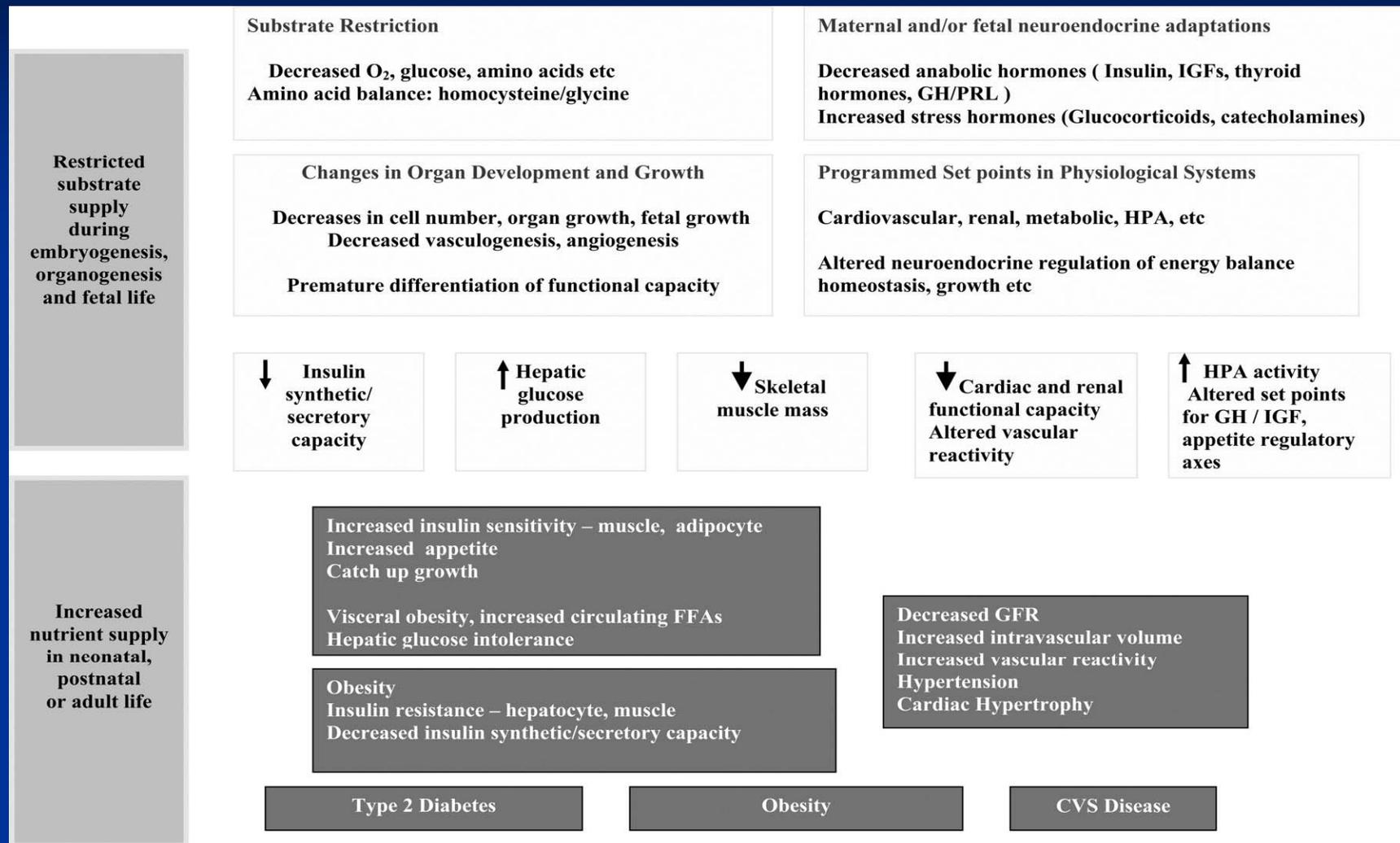
Human Reproduction 2009;24(1):146-153

Prenatal Effects on Stress Hormones Persist

- Girls born to mothers who had significant anxiety during pregnancy, themselves had increased stress hormones—as *adolescents*
- And this was associated with depressive symptoms in these adolescents

Neuropsychopharmacology 33:536-545, 2008

FIG. 7. The physiological mechanisms underlying the programming of the separate and combined elements of the metabolic syndrome



McMillen IC, et al. *Physiol. Rev.* 85: 571-633 2005;
doi:10.1152/physrev.00053.2003

Risk of Type 2 Diabetes

- Fetuses of obese mothers develop insulin resistance *in utero*
 - “...maternal obesity creates a significant risk for the next generations with metabolic compromise already apparent at birth.”
Diabetes Care 2009;32:1076-1080
- Inverse relationship between birth weight and risk of diabetes
JAMA 300:2886-2897, 2008
- Rapid weight gain in the first 3 months of life is associated with several determinants of CVD and type 2 diabetes by early adulthood
JAMA 2009;301(21)2234-2242

“Fetal Programming of Type 2 Diabetes”

“...intrauterine environment may modify gene expression permanently. ...They might also be inherited transgenerationally, affecting the health of future generations. ...During intrauterine life, there are waves of epigenomic modification, intimately associated with growth and development, and opportunities galore for environmental factors to influence these processes. A fetus thus programmed travels a path of limited options.”

Diabetes Care 30(10): 2754-5, 2007

Stress of Racism

- “The lifelong accumulated experiences of racial discrimination by African American women constitute an independent risk factor for preterm delivery.”
 - Odds ratio of 2.6
 - Independent of maternal sociodemographic, biomedical, and behavioral characteristics.

Am J Public Health. 94:2132–2138, 2004



3. Lifestyle

Overeating as an *Adaptive Response*

- Prevalence of overweight in women increases as food insecurity increases

Journal of Nutrition. 131:1738-1745, 2001

- Food Insecurity associated with depression and anxiety in mothers and behavior problems in children

Pediatrics 118(3):e859-e868, 2006

- Carbohydrates affect brain serotonin levels

Obes Res 1995 *Suppl* 4:477S-480S

- “Comfort Foods” reduce HPA axis stress response with its attendant anxiety

Proc Natl Acad Sci 100(20):11696-11701, 2003

Endocrinology 145:3754-3762, 2004

Overeating and Psychological Distress

“Youths who overeat may have or be at risk for serious psychological distress, including deficits to self-esteem, compromised mood, and suicide risk. Overeating may be a tangible behavior that signals the need for intervention.”

Ackard et al, Pediatrics 2003;111:67-74

Reducing Prenatal and Early Life Risk Factors for Chronic Disease

Cultural/Group Support

- Pima Pride/Action
 - DPP pilot study
 - People randomized to “Action” group
 - Structured diet/exercise meetings
 - People randomized to “Pride” control group
 - Unstructured activities emphasizing Pima culture and history
- *“Pima Pride” group showed more positive outcomes on every biological parameter measured*

Narayan et al, Diabet Med 1998;15:66-72

Break the Depression Cycle

- 2-3x increased risk for anxiety and disruptive behavior disorders and major depression in children of depressed parents
- “These offspring problems often begin before puberty, continue into adolescence and adulthood and can be transmitted to the next generation.”
- Treating children is difficult and controversial
- *But treating the mothers' depression reduces symptoms in both mothers and children*

JAMA. 2006;295:1389-1398

Stimulation in Early Childhood: Has Effects Years Later

- Psychosocial stimulation (weekly play sessions with mother and child over 2 years) given to growth retarded children age 9-24 months resulted in less anxiety, depression, attention problems and higher self-esteem *16 years after the intervention.*
- Intervention aimed to improve the mother-child relationship: listening and talking to children, allowing them to experience success/praise, reducing punishment

BMJ 2006; doi:10.1136/bmj.38897.55208.2F

Parenting Groups Improve Antisocial Behavior in Children

- “Harsh, inconsistent parenting is strongly associated with antisocial behaviour in children...”
- Intervention was a series of group classes which focused on parenting skills and support
- Resulted in “a large reduction in antisocial behaviour” in the children

BMJ 2001;323:194

The economics of early life intervention

- “...for many skills and human capabilities, later intervention for disadvantage may be possible, but it is much more costly than early remediation to achieve a given level of adult performance.”
- “Simple economic models show the importance of ...examining the ...economic costs of late remediation for early environmental influence.”

Heckman, *PNAS* 2007;104(33):13250-13255



Nurse-Family
Partnership

Helping First-Time Parents Succeed



Nurse-Family Partnership Program Overview



FAMILIES SERVED

- **Low income pregnant women**
 - Usually teens
 - Usually unmarried
- **First-time parents**



THREE GOALS

1. **Improve pregnancy outcomes**
2. **Improve child health and development**
3. **Improve parents' economic self-sufficiency**

Elements of the Nurse-Family Partnership

- Mothers enroll voluntarily early in pregnancy
- Home visits by nurses over 2½ years
- Powerful relationships with families build on native strengths
- Construct program around each family's goals and values
- Nursing guidelines are rich with resources to nurture multiple, inter-related aspects of health

Nurses and Families Attend To:

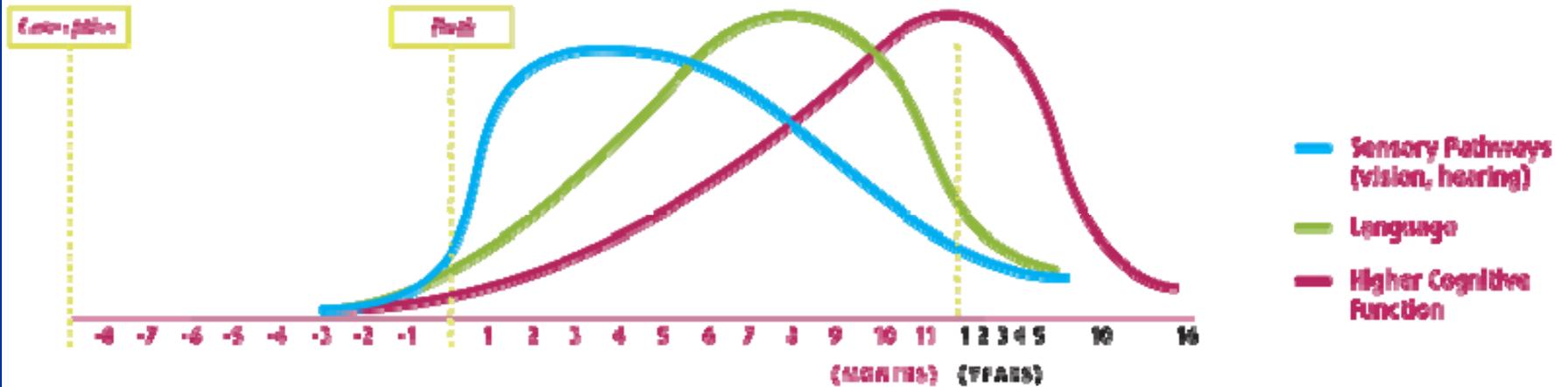
- Personal health
- Environmental health
- Life course development
- Maternal (Parental) role
- Building support systems through family, friends, community
- Connections to other health and human services as needed



Human Brain Development

Synapse formation dependent on early experiences

30-Month Period—Area of Focus



Source: Nelson, C.A., *From Infancy to Neighborhoods* (2000).
Shankoff, J., & Phillips, D. (Eds.)

TRIALS OF PROGRAM

Elmira, NY – '77



N = 400

- Low-income whites
- Semi-rural

Memphis, TN - '87



N = 1,138

- Low-income blacks
- Urban

Denver, CO – '96



N = 735

- Large portion of Hispanics
- Nurse versus paraprofessional visitors

Consistent Program Effects*

- Improved prenatal health
- Fewer childhood injuries
- Fewer subsequent pregnancies
- Increased intervals between births
- Increased maternal employment
- Improved school readiness

*Effects observed in at least two of the three trials (Elmira, Memphis, Denver)



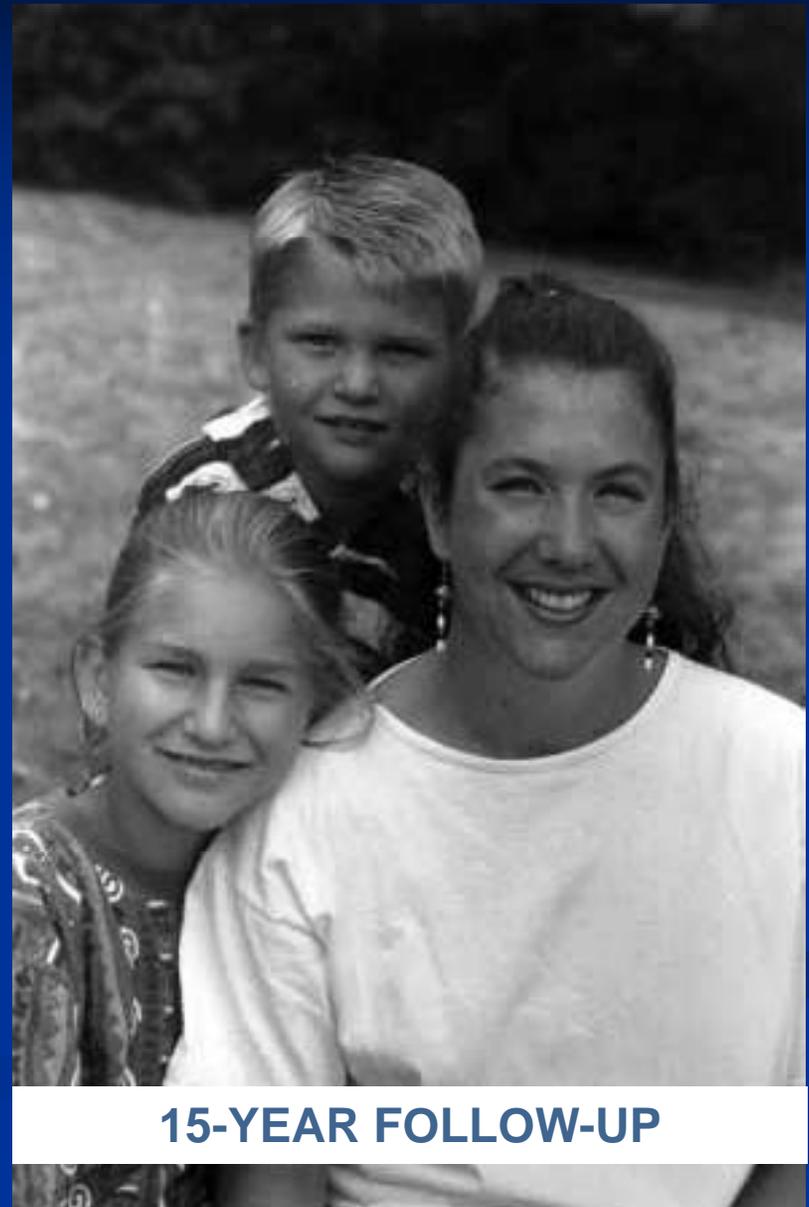
ELMIRA LONG-TERM RESULTS: Benefits to Mothers

Fewer convictions ↓ 72%

Fewer days in jail* ↓ 98%

Fewer arrests ↓ 61%

* Impact on days in jail is highly significant, but the number of cases that involved jail-time is small, so the magnitude of program effect is difficult to estimate with precision



15-YEAR FOLLOW-UP

ELMIRA LONG-TERM RESULTS: Benefits to Children

Abuse & Neglect

↓ 48%

Arrests

↓ 59%

Adjudications as PINS*
(person in need of supervision) for incorrigible behavior

↓ 90%

* Based upon family-court records of 116 children who remained in study-community for 13-year period following end of program.



15-YEAR FOLLOW-UP

Effects on Child Development Memphis 6-Year

- Higher IQ's
- Better language development
- Fewer mental health problems



Nurse-Family Partnership

- “The most rigorously evaluated example of a program that promotes safe, stable, and nurturing relationships and environments...”
JAMA 2009;301(21):2262-4
- “in a series of rigorous experimental evaluations, the Nurse Family Partnership has produced multiple, positive impacts on families and children, including fewer subsequent pregnancies, increased maternal employment, higher cognitive performance, and better social behavior by children in the preschool years, as well as (in the study with the longest-term follow-up) fewer arrests in adolescence”
(p. 13).

“A Science-Based Framework for Early Childhood Policy: Using Evidence to Improve Outcomes in Learning, Behavior, and Health for Vulnerable Children”,
Center on the Developing Child at Harvard University, August 2007, p.6
<http://www.developingchild.harvard.edu>

“...we are placing bets on the value of early intervention, beginning prenatally with a mother’s first pregnancy, and extending throughout the first years of life and beyond, as one of the surest ways to begin to address past centuries of neglect and improve the prospects of American Indian and Alaska Native children in this century.”

Sarche and Spicer, *Ann NY Acad Sci* 2008;1136:126-136

“It is important to understand that the story is not about birth weight but about fetal programming, and that intergenerational prevention of type 2 diabetes (primordial prevention) will need to target maternal nutrition and metabolism.”

“Fetal Programming of Diabetes: Still So Much to Learn!

Diabetes Care 2010;33:1146-1148

<Preconception Conception--- Birth Early Childhood Adolescence >

Nutrition Fruit/Veg Supplementation WIC+ WIC+ School Food Programs
Breastfeed "Backpack Foods"

Depression Screen: high schools, family planning/prenatal/well child/WIC clinics
&Substance Treatment: CBT, EMDR, DBT, groups, dual diagnosis
Abuse Coping Skills classes: emotions (e.g. LifeSkills), racism, finances, relaxation
Find ways to help pregnant women abstain from drugs/alcohol/smoking

"Parenting" Nurse-Family Partnership-----
Case manage all pregnancies Family Planning
Parenting classes—pay parents to attend-----
Play groups/psychosocial stimulation
Parent-Child Interaction Therapy Mentoring
DSS/Court referrals Pregnant teens group
Harlem Children's Zone: Strong Day Care—Head Start—Schools
Coping skills for kids, bullying interventions
Renew tribal traditional pregnancy/child-rearing practices

“Dance with Desire to Make the World Well”

