Lecture 16: Birth

- Energetics of Pregnancy
- Birth weight and health outcomes
- Labor Cross-culturally
- Process of Labor
- Birth and Human Evolution

Changes in Metabolism

- Metabolic processes speed up
- Store more water
- Store more protein
- Conversion of carbohydrates to glucose for baby - possible drop in blood sugar
- Produce more insulin - risk of gestational diabetes
Energetics of Pregnancy

How do women that are nutritionally stressed cope with pregnancy?

Nutritional Stress and Pregnancy in The Gambia

Prentice et al, 1983

Changes in Metabolic Rate

Undernourished Women

• Fat storage still occurs because:
  • Under-nourished women can decrease Basal Metabolic Rate (BMR) between ~8-10 weeks.

Effect of Low Energy Intake

Maternal Depletion

Effect of Low Energy Intake

• Food shortages reduce birth weight only by ~10%

• Supplements prevent very low birth weight rather than promote extra fetal growth.

How do Women meet the Energetic demands of Pregnancy?

• Increase amount eaten by 12% during pregnancy and 24% during lactation

• Utilization of fat stores in undernourished women

• Decrease in BMR in undernourished women
Does Birth Weight have an effect on Adult Health?

Barker Hypothesis
Low Birth weight babies are at greater risk for:

- Coronary heart disease
- Hypertension
- Non-insulin dependent diabetes
- Raised serum cholesterol
- Abnormal blood clotting

Birth Weight and Adult Risk of Coronary Heart Disease

Birth Weight and Adult Blood Pressure

Labor

“Traditional Labor”

- Lithotomy position:
  > Flat on back
  > Feet in stirrups
  > Hands sometimes tied down
Disadvantages of Lithotomy Position

- Goes against gravity
- Strains perineum, increased episiotomy
- Narrows pelvic outlet
- Compresses major blood vessels

“Traditional Labor”

- Shaving
- Episiotomy
- Pain killers
- No relatives

Episiotomy

Giving birth without tearing: 61% greater with perineal massage beginning in 34-35 weeks.
The Timing of Birth

- Maternal estrogen levels rise

- Estrogen also causes cells of uterine muscle to synthesize protein Connexin.
- Connexin molecules move to cell membrane and form electrical junctions

- Estrogen increases oxytocin receptor density in uterine muscles. Oxytocin ‘tells’ the cells to contract during labor
What Triggers Estrogen to rise?

CRH = Corticotropin Releasing Hormone

Initiation of Parturition

- CRH causes fetal adrenal to make DHEA-S (Dihydro-epi-andro-sterone sulfate)

Initiation of Parturition

- Placenta turns DHEA-S into Estrogen

Initiation of Parturition

- High estrogen causes placenta to produce prostaglandins

Initiation of Parturition

- Prostaglandins stimulate uterus to contract.
- When critical thresholds of CRH, estrogen, prostaglandins etc. are reached — labor begins.
Birth and CRH

Pre-Labor

- Early Contractions (Braxton-Hicks)
- Shorten (efface) & Widen (dilate) cervix
- Softens cervix
- Stretches bottom of uterus

Meanwhile … in the fetus

- Cortisol being made by fetal adrenal
- Ensure infants lungs undergo final preparation for breathing air by removing water from lungs and enabling to inflate

Lightening

- Baby drops down into pelvis due to thinning and stretching of bottom of uterus

Cervix

- “Show” = Mucous plug comes out due to dilation of uterus

- Prostaglandins digest collagen fibers in cervix so it will dilate
Digestion of Collagen in Cervix by Prostaglandins

Membranes Rupture
- Amniotic sac provides a cushion for baby’s head as presses against cervix

Contractions
- Decreased progesterone and increased estrogen, thus smooth muscle contraction in uterus is no longer inhibited

Contractions
- Calcium stored in uterine muscle cells is freed and a cell or group of cells becomes hyperirritable.

Contractions
- Freed calcium enables muscle cells to grab onto one another, shortening cells and contracting uterine muscle fibers

Uterine Contractions
- Active segment, muscle fibers shorten, remain shorter
Uterine Contractions
- Active segment, muscle fibers shorten, remain shorter
- Fundus becomes thicker and thicker

Dilation and Effacement
- Cervix shortens (effacement)
- Cervix dilates (widens)
- Cervix made of pleated muscle fibers

Expulsion of the Placenta
- After birth, uterus contractions 2-5x greater
- Placenta shears away from uterus

Expulsion of the Placenta
- Shearing causes blood loss
- Contractions clamp off uterus (living ligature)
The Placenta

Exercise & Length of Labor

Exercise & Labor Complications

Exercise & the Course of Labor

- 75% Decrease in maternal exhaustion
- 50% decrease in need to induce labor
- 50% decrease in need to intervene because of fetal heart rate
- 55% decrease in episiotomy

What happens to the mother after birth?

- Of 1-2 liter rise in blood during pregnancy
  - 1/3 lost during delivery
  - Rest back to normal in 3 weeks
- Extra iron from RBC’s passed to baby in milk
- 10% drop in breathing efficiency (more co2)
- Estrogen drops by 90% in 3 hrs.
- Uterus shrinks (involution) and lochia discharged.
The Evolution of Human Birth

- Gestation Length
- Pelvic Constraints
- Assisted Birth in Humans

Human Gestation

- Gestation length is generally correlated with brain weight.
- However, human gestation is not appreciably longer than other great apes although they have much smaller brains.
- For brain development humans “should” have a longer gestation ~ 18 months.
- Birth = when placenta no longer most efficient means of delivering nutrients.
- At 6-9 months human babies have the motor & brain development that most primates have at birth.

Constraints on Gestation

- Minimum size:
  - Survival without placental support
  - Ability to care for altricial infant

Constraints on Gestation

- Maximum Size:
  - Size and shape of the pelvis constrains neonatal brain and body size.
  - Bipedal locomotion requires a narrower pelvic outlet.

Constraints of the Human Pelvis

- Shortening of distance between sacroiliac joint and acetabulum (hip joint)

Constraints of the Human Pelvis

- Sacrum is opposite pubic symphysis (pubic bone)
Constraints of the Human Pelvis

- Pelvic inlet is widest in transverse dimension

Constraints of the Human Pelvis

- Pelvic outlet is widest sagitally (down the middle)

Human Birth

- Baby must rotate 45-90° to exit pelvis

QuickTime™ and a Cinepak decompressor are needed to see this picture.

Why is Labor Painful in Humans?

The size of fetal head going through pelvis?

Why is Labor Long in Humans?

- Dilation and Effacement of cervix
- Mean = 14 hours in first birth

Stage 1

- Expulsion of fetus
- Mean = 50 minutes in first births
- 20 minutes in later births

Stage 2
Why is Labor Long in Humans?

The need for the cervix to dilate to 10 cm to accommodate the large fetal head?

Why is Labor Painful in Humans?

Humans spend significantly more time in the later stages of dilation when pain is greatest.

Apes probably experience relatively little pain during labor because they have relatively little dilation.

How is Human Birth Different?

Although rotation through the pelvis contributes to the duration and degree of difficulty during labor …

Difficult labor in humans is primarily due to the degree of cervical dilation necessary to accommodate the size of the human fetal head (3x greater than in apes).

Labor Pain

Why does relaxation help?

• Autonomic nervous system
  - Parasympathetic (relaxation)
  - Sympathetic (fight or flight response)

Assisted Birth in Humans

• Birth is routinely performed with assistance in humans.
  • Emotional support to the mother
  • Mechanical assistance
Birth Support (doula effect)

Assisted Birth in Humans

- Birth is routinely performed with assistance in humans.
- Emotional support to the mother
- Mechanical assistance
  - May be particularly important for breech births (2 - 4% of births)

Next time ...

- Physiology of Lactation
- Lactation and Birth
  - Spacing