Excess Weight Loss in Newborns Relates to Intrapartum Fluid Balance

...and other findings from the Early Lactation Success Study

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Disclosures

I have no relevant financial conflicts of interest or relationships with commercial interests to disclose
Primum non nocere
Clinical Case

E.B. is a 36 hr old term (37 and 6/7 weeks) appropriate for gestational age infant born to a 31 year old G2P1 mother by vaginal delivery. Pregnancy complicated by class A1 gestational diabetes.

Feeding has been improving, in the last 24 hr she has breastfed 7 times, LATCH score is 7 (1 each for latch, audible swallow and comfort). She has lost 7.6% of her birthweight, had 2 wet diapers and 1 stool, and her bilirubin is in the high-intermediate risk zone.

Mom is being discharged today, and the residents want to know whether they should start formula since weight loss is well beyond the described 3%/day and they were told that moms with diabetes get late ‘let-down’ of milk.
Early Lactation Success (ELS) Study
Overview

Early Lactation Success Study

- Background
- Methods
- Outcomes:
  - Excess Weight Loss
  - BF Outcomes with In-Hospital Formula Supplementation
  - Breastfeeding Problems
  - Delayed Lactogenesis
Excess Neonatal Weight Loss (EWL)

- Relatively common
  - 10% - 16% first-born infants
- Little data on risk factors
- Previous study:
  - Delayed onset of lactogenesis
  - Sub-optimal infant breastfeeding behavior
- Complications:
  - Hyperbilirubinemia, hypernatremic dehydration, hospitalization, death

Manganaro J Ped 2001; Matias SL Matern Child Nutr 2010; Dewey Pediatrics 2003; Michel Arch Pediatr 2007;
Background

In-hospital formula supplementation

- Associated with shorter duration BF any/exclusive
  - Adjusted Odds ratio 0.47 BF cessation < 6 wks with breastmilk only in-hospital (CDC)
- Causality unclear
- No studies adjusted for strength of breastfeeding intentions measured prenatally

ELS Study: OBJECTIVES

- Measure early lactation success at UCDMC
  - Large, diverse, multi-ethnic population of primips
  - Standardized, timely assessment of onset lactogenesis, infant weight, BF problems, concerns and outcomes

- Prospectively evaluate for potentially modifiable barriers to ELS
  - Identify risk factors – excess weight loss, delayed lactogenesis, in-hospital formula supplements

- Adjust for prenatal breastfeeding intentions
Prospective cohort study - UC Davis Med Center

- Recruited prenatally
  - Expecting 1st liveborn infant;
  - Spanish or English,
  - 8-mile radius;
- Excluded
  - Referred for high-risk condition
  - Known contraindication to BF;
- Enrolled Jan 06 – Dec 07
  - Prenatal interview
  - Postnatal visits day 0, 3, and 7
  - Telephone interviews days 14, 30, 60;
ELS Study: METHODS

- Record review and maternal interview:
  - Prenatal breastfeeding intentions;
  - Demographics;
  - Labor, delivery and birth interventions/outcomes;
  - Nipple type/pain;
  - Breastfeeding behavior; formula and pacifier use;
  - Urine and stool output;
  - Onset of lactogenesis

- Observed feed (IBFAT) and weighed infants
**Definitions**

- **EWL ≥ 10% of birthweight, measured 70-98 h**
- **Suboptimal infant breastfeeding behavior**
  - **IBFAT ≤ 10**
- **Delayed onset of lactogenesis**
  - Not feeling ‘noticeably fuller’ by 72 h postpartum
- **Intrapartum fluid balance**
  - \([\text{Total in (oral/IV)} - \text{total out}]\)/ # hrs active labor
Statistics

- Chi-square (proportions) and Wilcoxon signed-rank test (means) to compare variables of interest with outcomes (EWL, DOL and supplementation)
- Logistic regression - independent associations
- For EWL:
  - Traditional, empirical model
  - Theoretical model - BF frequency/behavior, delayed lactogenesis, intrapartum fluid balance, gestational age and formula use
993 screened

772 eligible

532 (69%) enrolled & interviewed prenatally

448 healthy, term deliveries followed postpartum

240 (31%) declined

40 (8%) lost to follow-up
44 (8%) became ineligible:
  • preterm birth (11)
  • separated >24 h (21)
  • chose not to BF (12)

407 plan to EBF;
431 with timing of Lactogenesis;
419 with data to 60 days;
315 infant weights (70-98h); 70.3%
## Participant Characteristics

<table>
<thead>
<tr>
<th>Education</th>
<th>Mean (SD)</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>26.3 (6.0)</td>
<td></td>
</tr>
<tr>
<td>N (%)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Education</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≤ High school</td>
<td>177 (39)</td>
<td></td>
</tr>
<tr>
<td>Some college</td>
<td>110 (25)</td>
<td></td>
</tr>
<tr>
<td>College grad</td>
<td>161 (36)</td>
<td></td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asian</td>
<td>57 (13)</td>
<td></td>
</tr>
<tr>
<td>Black</td>
<td>62 (14)</td>
<td></td>
</tr>
<tr>
<td>Hispanic</td>
<td>119 (27)</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>183 (41)</td>
<td></td>
</tr>
<tr>
<td>Mixed</td>
<td>27 (6)</td>
<td></td>
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<tr>
<td>53% overweight or obese</td>
<td></td>
<td></td>
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<tr>
<td><strong>Health insurance</strong></td>
<td></td>
<td></td>
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<tr>
<td>Private</td>
<td>229 (52)</td>
<td></td>
</tr>
<tr>
<td>Public</td>
<td>215 (48)</td>
<td></td>
</tr>
<tr>
<td><strong>Planned BF Duration</strong></td>
<td></td>
<td></td>
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<tr>
<td>&lt; 1 mo</td>
<td>2 (0)</td>
<td></td>
</tr>
<tr>
<td>1-3 mo</td>
<td>9 (2)</td>
<td></td>
</tr>
<tr>
<td>4-6 mo</td>
<td>33 (7)</td>
<td></td>
</tr>
<tr>
<td>7-12 mo</td>
<td>126 (28)</td>
<td></td>
</tr>
<tr>
<td>&gt; 12 mo</td>
<td>275 (62)</td>
<td></td>
</tr>
<tr>
<td><strong>Planned EBF Duration</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&lt;1 mo</td>
<td>35 (8)</td>
<td></td>
</tr>
<tr>
<td>1-3 mo</td>
<td>39 (9)</td>
<td></td>
</tr>
<tr>
<td>3-6 mo</td>
<td>65 (15)</td>
<td></td>
</tr>
<tr>
<td>&gt;6 mo</td>
<td>309 (69)</td>
<td></td>
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</tbody>
</table>
Infants:
- 69% vaginal; 31% Cesarean
- Gestational age 39.6 (1.0) wks;
- 3.4 (0.4) kg

70.3% of postnatal subjects with weights (n=315)

With vs. without weight:
- no difference – subsequent illness/hospitalization
- More likely: vaginal, longer stage II, higher pain, earlier BF
- Less likely: low income, formula supplements, pacifier, still in hospital day 3
ELS Study Results: Excess Weight Loss

- Exclusively breastfed 42.4%
  n=133

- Minimal Formula (≤ 60 mL cumulative) 30.1%
  n=95

- ‘More’ Formula 27.5%
  n=87
## ELS Study Results: Excess Weight Loss

<table>
<thead>
<tr>
<th>Weight Loss</th>
<th>EBF N=133</th>
<th>Minimal formula N=95</th>
<th>More formula N=87</th>
<th>EBF / Minimal formula (0-&lt;60 mL) N=228</th>
<th>All Infants N=315</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Excess</strong></td>
<td>19 %</td>
<td>16 %</td>
<td>3 %</td>
<td>18 %</td>
<td>14 %</td>
</tr>
<tr>
<td>Mean day 3 (sd)</td>
<td>6.4% (3.8)</td>
<td>6.1% (3.6)</td>
<td>4.5% (3.7)</td>
<td>6.3% (3.7)</td>
<td>5.8% (3.7)</td>
</tr>
</tbody>
</table>
ELS Study Results: Excess Weight Loss

Bivariate Associations – Empirical Model

- Maternal age, education, income
- Postpartum Edema
- Delayed Onset of Lactogenesis
- Hourly intrapartum fluid balance
- Birthweight
- Fewer infant stools previous 24 hr
- Blood loss (EBF group only)
Multivariate associations:

- Net hourly maternal intrapartum fluid balance, \( p=0.034 \)
  - Adjusted RR (95%CI) vs. <100 mL/hr
  - 2.8 (1.2, 11.7) 100-200 mL/hr
  - 3.2 (1.4, 13.3) >200 mL/hr

- Delayed lactogenesis, \( p<0.0001 \)
  - Adjusted RR (95%CI)
  - 3.4 (1.7, 8.1) - onset >72 hrs vs. ≤ 72 hrs
Adjusted RR for EWL

Net fluids vs. <100 mL/hr

100-200

>200

Delayed Onset Lactogenesis
ELS Study Results: Excess Weight Loss

Initial infant voids by maternal fluid category:

- **<100 mL/hr**: 0.15 ± 0.35
- **100-200 mL/hr**: 0.23 ± 0.047
- **>200 mL/hr**: 0.36 ± 0.59

p<0.009
Limitations

• Likely *underestimates* prevalence EWL
  • Infants may have had EWL before/after recorded weight
  • Some infants may have had EWL if not supplemented
    48% of supplemented infants b/o wt loss or supply concerns

• Day 3 weight on 70% only
  • ‘Missing’ weights not different on associated variables, except
    more with low income (56% missing vs. 45%, p=0.04)

• IBFAT has ‘moderate’ inter-rater reliability

• Could not assess association with labor pain rx
  • only 9% with unmedicated labor
Conclusions

- EWL more common than other term studies (Firstborns: 9.6% Italy, 10% Peru, 14% France, 16% Davis)

- Intrapartum fluid balance *independently* associated with EWL

- Adjusted RR similar in magnitude to that of DOL

- EWL related to fluids likely represents loss of excess fluid - alternate mechanism possible
Conclusions
Excess Weight Loss

- Clinical significance EWL in setting of high net fluid balance needs to be determined in order to optimize management.

- Important to ascertain if less aggressive fluid management, *when appropriate*, will lead to EWL.

- Subsequent similar study documented association between weight loss and maternal intrapartum fluids – suggest *consider weight loss after 24 hours*.

Women and infants who participated
Staff in prenatal clinic and maternity ward who facilitated study
Co-investigators:
  - Dr. Kay Dewey
  - Dr. Roberta Cohen
  - Dr. Laurie Nommsen-Rivers
  - Jan Peerson
Maternal and Child Health Bureau,R40MC04294,
Prevalence of Delayed OL: Sacramento Cohort

190 of 431 (44%) delayed OL

Median onset 68.9 hrs

Sacramento

Nommsen-Rivers, Chantry, Peerson et al. AJCN 2010; 92:574-84.
Prevalence of Delayed OL: Sacramento vs. Peru

(Nommsen-Rivers et al, AJCN 2010) (Matias et al, MCN 2009)
## Sacramento Cohort: Logistic regression Odds Ratios (OR) for delayed OL

<table>
<thead>
<tr>
<th>Effect</th>
<th>OR</th>
<th>AOR*</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Maternal Age</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>≥ 30 vs. &lt; 30 y</td>
<td>2.2</td>
<td>2.8</td>
<td>1.7 – 4.7</td>
</tr>
<tr>
<td><strong>Body Mass Index</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>25–29.9 vs. &lt; 25.0</td>
<td>1.7</td>
<td>1.8</td>
<td>1.1 – 3.2</td>
</tr>
<tr>
<td>≥ 30.0 vs. &lt; 25.0</td>
<td>2.6</td>
<td>2.2</td>
<td>1.2 – 3.9</td>
</tr>
<tr>
<td><strong>Birth weight</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt; 3.6 vs. ≤ 3.6 kg</td>
<td>2.5</td>
<td>2.3</td>
<td>1.4 – 3.7</td>
</tr>
<tr>
<td><strong>BF well, 0-24 h</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0,1 vs. 2 or more</td>
<td>2.6</td>
<td>2.2</td>
<td>1.1 – 3.9</td>
</tr>
<tr>
<td><strong>Peak nipple pain</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>none/mild vs. mod/sev</td>
<td>1.9</td>
<td>1.8</td>
<td>1.1 – 3.0</td>
</tr>
</tbody>
</table>

*adjusted for all variables shown and prenatal BF intentions

Nommsen-Rivers, Chantry, Peerson et al. AJCN 2010; 92:574-84
Increased risk of impaired glucose metabolism

Maternal obesity

Older maternal age

Greater birth weight

Delayed onset of lactogenesis

Observed associations with delayed onset of lactogenesis (dashed arrows) and proposed underlying interrelationships (solid arrows)
Timing of onset of stage II lactogenesis by Gestational Diabetes

Proportion at stage II lactogenesis

Hours postpartum

P < 0.01
189/407 (46%) of infants received formula in-hospital.

Varied by infant feeding intention: $p=0.008$
Reasons for In-Hospital Formula Supplementation

- Low Milk Supply: 18%
- Medical Concern/Sign of Inadequate Intake: 16%
- Poor Infant BF Behavior: 14%
- Separation: 10%
- Psychosocial Reason: 3%
- BF Pain: 4%
- Mother Incapacitated: 4%
- Medication Concern: 1%

Percent of all mothers supplementing for stated reason
## BF Cessation by 60 days

<table>
<thead>
<tr>
<th></th>
<th>No BF</th>
<th>RR (95% CI)</th>
<th>Adjusted RR* (95% CI)</th>
<th>Non-EBF</th>
<th>RR (95% CI)</th>
<th>Adjusted RR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H-Formula</td>
<td>33%</td>
<td>3.1 (2.0-4.9)</td>
<td>2.7 (1.7-4.5)</td>
<td>68%</td>
<td>1.9 (1.5-2.4)</td>
<td>1.8 (1.4-2.3)</td>
</tr>
<tr>
<td>No H-Formula</td>
<td>10%</td>
<td></td>
<td></td>
<td>37%</td>
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</tbody>
</table>

Adjusted RR – adjusted for Infant Feeding Intention
In-hospital formula supplementation significantly increases risk of early breastfeeding cessation, even after adjusting for feeding intentions.