Is the Newborn Weight Loss Tool Clinically Useful for Predicting Excess Weight Loss at Day 4 of Life?

Anna Smith, MS, RD, LD[1], Laurie Nommsen-Rivers, PhD, RD, IBCLC[1] , Laura Ward, MD, IBCLC[2], Kathryn Dewey, PhD[3], Jane Heinig, PhD[3]

[1]University of Cincinnati College of Allied Health Sciences, [2]Division of Neonatology, Cincinnati Children's Hospital Medical Center,
[3]University of California, Department of Nutrition, Davis, CA

BACKGROUND

- The WHO and UNICEF recommend exclusive breastfeeding for 6 months and continued breastfeeding in combination of complementary foods for at least 2 years and beyond.
- Breast milk provides powerful health benefits for infants. However, some newborns experience excess weight loss (EWL, loss ≥10% by DoL4) while breastfeeding is being established.
- Unrecognized poor infant breastfeeding behavior and delayed lactogenesis put exclusively breastfed infants at risk for EWL.
- If EWL is unrecognized during infancy, neonates become greatly at risk for associated morbidities (i.e., hyperbilirubinemia, hypernatremia, and failure to thrive).

OBJECTIVES

1) Evaluate the validity of the Newborn Weight Loss Tool (NEWT) in early identification of exclusively breastfed newborns who will eventually lose ≥10% of birthweight once discharged to home.
2) 2) Determine if NEWT trajectory is associated with breastfeeding outcomes in the home setting.

METHODS

- We conducted a secondary analysis of prospective data from mother-infant dyads (*N*=280) screened during the birth hospitalization for inclusion in the Davis, CA site of the WHO Growth Reference Study.
- For our analysis, records were excluded where: newborn received >60 mL formula prior to DoL4 home visit, relevant data were missing, or NEWT exclusion criteria were met (newborn admission to Level II or III care, birthweight <2000g or >5000g, or biologically implausible weight value recorded).
- From included records, we extracted variables on infant weights, breastfeeding behavior, maternal breastfeeding attitudes/concerns, and other variables that may influence the accuracy of NEWT.
- With the above variables, record number, and NEWT-required variables, we generated a "working database". For each record, NEWT-required variables were entered, and a plot percentile was graphed demonstrating change in newborn weight from birthweight (**Figure 1**). This "working database" was merged with the analytic dataset.
- We defined NEWT-test positive status as in-hospital newborn weight falling at or below the NEWT trajectory intersecting with eventual 10% weight loss.
  - ≥90th percentile for vaginal deliveries
  - ≥75th percentile for cesarean deliveries
- We defined cases as having actual weight loss ≥10% between birth and the DoL4 home visit.
- We examined Se, Sp, PPV, and NPV of in-hospital newborn NEWT status in predicting newborn weight loss ≥10% by DoL4.
- We used Student's *t*-test and Chi-Square analysis to compare mother-infant dyad variables stratified by NEWT test status.
- We constructed a 2x2 contingency tables that cross classified in-hospital NEWT results with actual weight loss status by DoL4.
- We determined a theoretical NEWT prediction for EWL via *post-hoc* analysis by including infants who received formula.

RESULTS

Inclusion and Exclusion

- 220 mother-infant dyads met inclusion criteria

  → excluded were 27 that did not meet NEWT criteria, 15 had missing home visit weight, and 18 received >60 mL of formula between birth and home visit
  - 192 (87%) vaginal births and 28 (13%) cesarean births
  - 18 records were excluded solely due to receiving >60 mL formula supplement. Reasons for formula included:
    - 15, maternal convenience or concern
    - 2, physician concern of insufficient intake
    - 1, mother not well enough to room-in or breastfeed exclusively
  - Average in-hospital infant weight recorded at 17±8h
  - Average DoL4 infant weight recorded at 84±8h

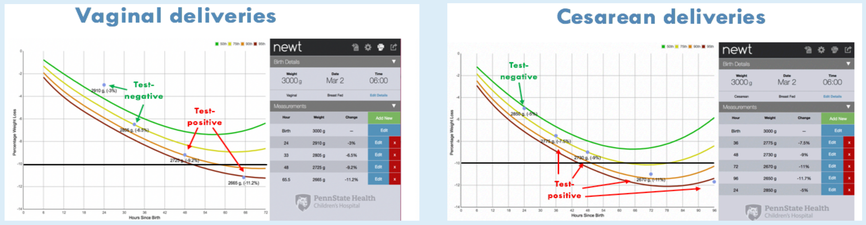

Figure 1. Example nomograms demonstrating weight loss trajectories of exclusively breastfed infants born via vaginal (left) and cesarean deliveries (right). Eventual EWL is predicted if the weight loss data point falls ≥90th percentile (vaginal) or ≥75th percentile (cesarean).

Objective 1—Validity of NEWT

- NEWT categorized 40 (18%) newborns as being on a trajectory for EWL, and 28 (12%) exhibited actual EWL by DoL4.
- Overall, NEWT correctly identified 6 of 28 cases (21% Se) and 158 of 192 non-cases (82% Sp).
  - PPV = 15% and NPV = 88%
- Among vaginally-delivered infants, NEWT correctly identified 3 of 21 cases (14% Se).
- Among cesarean-delivered infants, NEWT correctly identified 3 of 7 cases (43% Se).

Table 1. Contingency table and predictive summary results for predicting EWL among vaginally-delivered and cesarean-delivered cesarean newborns combined, *n*=220, X^2, *p*=0.63

Combined vaginally-delivered and cesarean-delivered newborns				
		Cases Newborns with actual EWL of ≥10% of birthweight at DoL4 home visit	**Non-cases** Newborns with actual weight loss <10% of birthweight at DoL4 home visit	**Total**
Test outcome	**NEWT test-positive for eventual EWL**	6	34	40
	NEWT test-negative for EWL	22	158	180
	Total	28	192	220
Prediction [95% Confidence Interval]	**Sensitivity (Se)**	21% [8-34%]		
	Specificity (Sp)	82% [75-89%]		
	Positive Predictive Value (PPV)	15%		
	Negative Predictive Value (NPV)	88%		

RESULTS

Objective 2—Breastfeeding Outcomes

- Variables significantly associated with NEWT test-positive status:
  - Birthweight, ≤3600g vs. >3600g, *p*=0.033
  - Average time of infant in-hospital weight recorded, 14.8h vs. 17.1h, *p*=0.049
  - Percent change between birthweight and home visit, -5.1% vs. -6.9%, *p*=0.01
  - Change between inpatient weight and DoL4 weight in grams, -189g vs. -245g, *p*=0.028
- NEWT-test positive was predictive of
  - Maternal perception of less breastfeeding support, *p*=0.03
  - Infant less often showing interest in breastfeeding in the past 24h, *p*=0.03

Table 2. *Post hoc* analysis: Contingency table and predictive summary results for predicting EWL among combined modes of delivery *assuming all 18 of those excluded for formula use were correctly categorized (16 test-negative as negative, 2 test-positive as positive.)* Doesn't include the 2 with sick mothers, *n*=238

Combined vaginally-delivered and cesarean-delivered newborns				
		Cases Newborns with actual EWL of ≥10% of birthweight at DoL4 home visit	**Non-cases** Newborns with actual weight loss <10% of birthweight at DoL4 home visit	**Total**
Test outcome	**NEWT test-positive for eventual EWL**	9	34	43
	NEWT test-negative for EWL	22	173	195
	Total	31	207	238
Prediction [95% Confidence Interval]	**Sensitivity (Se)**	29% [16-42%]		
	Specificity (Sp)	84% [77-91%]		
	Positive Predictive Value (PPV)	21%		
	Negative Predictive Value (NPV)	89%		

DISCUSSION

- NEWT test-positive status was significantly associated with greater weight loss at DoL4 home visit.
- However, the binary "NEWT status" cross classified with actual excess weight loss status was insignificant.
- NEWT results may be biased based on context of weight measurement.
- There may be an underlying link between NEWT test-positive status in-hospital with the breastfeeding outcomes at home.
- Although significant, breastfeeding outcomes at DoL4 aren't strong enough to be clinically useful in detecting mother-infant dyads who are at high-risk of breastfeeding difficulties, *p*=0.03.

CONCLUSION

- The Newborn Weight Loss Tool, when applied to a single in-hospital newborn weight at about DoL1, demonstrated poor Se in identifying exclusively breastfeeding newborns who develop EWL; however, NEWT test-positive status was associated with less favorable breastfeeding outcomes at DoL4. Further research is warranted to determine the clinical usefulness of ENWT when used later in the birth hospitalization.