Exclusive Human Milk Diet Supports Fatty Acid Intake in Very Low Birthweight Infants

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BayCare KiDS

Jenelle Ferry MD, Brittany Bundy MD, Brandon Tucker DO

Abstract

Background: Long chain polyunsaturated fatty acid (FA) intake in preterm infants is crucial for neurodevelopmental outcomes, decreased morbidities, and linear growth. Preterm infants are born deficient in docosahexaenoic acid (DHA) and arachidonic acid (AA), levels decrease significantly, and deficits are largest in lower birthweights. The relation of FA levels to each other affects outcomes. Studies regarding supplementation have included a bovine fortified diet. We aim to evaluate how an exclusive human milk diet (EHMD), utilizing human-derived fortifiers, can support FA intake.
Methods: 27 infants received and EHMD; average birthweight 773 grams, gestational age 26 weeks and 3 days, and 2.9% small for gestational age. They received enteral feeds by 12-24 hours, fortification at 40mL/kg/day, and reached full feeds by average day 14. Serum levels of 5 essential FAs were measured at 4 timeframes. Actual intake volumes of milk and fortifiers were measured daily; levels of average daily enteral FA were reported.
Results: Serum DHA and AA levels minimally declined, then increased above birth by 30 days. Eicosopentoic acid had an initial increase, declined, then began to recover by 30 days. The ratio of AA:DHA declined over time (always greater than 2.7:1); LA:DHA declined over time.
Conclusions: An EHMD has been associated with decreased morbidities, and FA intakes have been tied to outcomes for extremely premature infants. Levels of DHA and AA experienced less of a decline than previously reported. AA:DHA remained above levels shown to improve outcomes. LA:DHA decreased over time, shown to be important in reduction of lung disease and sepsis. Early fortification with an exclusive human milk diet may provide improved FA intake to prevent significant deficits in highest risk patients.

Introduction

- Long chain polyunsaturated fatty acids are important for neurodevelopmental outcomes, linear growth, and decreased morbidity.
- Preterm infants are born prior to peak fetal accretion periods for DHA and AA. Levels decrease significantly in the first weeks of life.
- Deficits are more pronounced in very low birth weight infants for many reasons, including decreased intake, absorption, and variable FA synthesis.
- Decreased DHA and AA associated with increased BPD, NEC, ROP, Late Onset Sepsis. Increased ratio of LA to DHA associated with increased BPD and late onset sepsis.
- AA must be provided in sufficient quantities to benefit from increased DHA supplementation, and plays a role in growth and decelopment, ROP, and lung development.
- Studies on fatty acid supplementation have been done with a bovine supplemented diet.
- One recent study utilizing an exclusive human milk diet did not include universal provision of human derived cream.
- An exclusive human milk diet, utilizing mom's own milk or donor human milk with human-derived fortifiers including routine cream supplementation, can support essential fatty acid intake and mitigate deficits early in life.

Methods

- Twenty-seven infants receiving an exclusive human milk diet
- Average birthweight 773 grams, average gestational age 26 weeks and 3 days; 26.9% were SGA.
- TPN was started at birth, SMOF lipids on DOL 1, and enteral feeds by 24 HOL. Full feeds were reached at an average of 14 days.
- Feedings advanced per standard guidelines, increased by 20-30mL/kg/day. Human derived fortifier 24 cal/oz started at 40mL/kg/day, increased to 26 cal/oz at 60-80mL/kg/day. Human derived cream 4mL per 100mL of milk started at 80mL/kg/day.
- Serum levels of DHA, AA, LA, ALA, and EPA were measured at DOL 0-3, DOL 7, day of full feeds, and DOL 30 using a commercially available panel .
- Enteral intake volumes of human milk (mom's own or donor), fortifier, and cream were measured daily.

Results

- 80% of infants received mother's own milk as base diet
- More than 50% of total daily FA intake was from fortifiers
- DHA and AA levels by DOL 30 were minimally changed.
- DHA levels did not decline until after the first week of life and by 30 days were slightly above birth levels.
- AA levels followed a trend similar to DHA
- LA increased at each time frame, LA:DHA ratio declined.
- EPA had an initial increase, declined in the second week, and had begun to recover by DOL 30.
- AA:DHA remained greater than 2.7:1.

Results

Average Daily Total Fatty Acid Intake
mg/infant/day

Fatty Acid	DOL 0-3	DOL 4-7	DOL 8-Full Feeds	Full Feeds-DOL 30
DHA all enteral sources	**1.359**	**11.734**	**22.254**	**45.789**
DHA fortifiers only	*0.069*	*6.122*	*13.095*	*28.548*
AA all enteral sources	**3.881**	**32.52**	**61.182**	**125.204**
AA fortifiers only	*0.196*	*16.487*	*35.013*	*75.943*
LA all enteral sources	**164.044**	**1348.177**	**2519.444**	**5147.947**
LA fortifiers only	*8.3448*	*670.755*	*1413.821*	*3066.688*
ALA all enteral sources	**15.511**	**113.365**	**211.764**	**432.823**
ALA fortifiers only	*0.794*	*56.445*	*118.865*	*257.948*
EPA all enteral sources	**0.615**	**4.849**	**9.13**	**18.739**
EPA fortifiers only	*0.030*	*2.444*	*5.205*	*11.349*

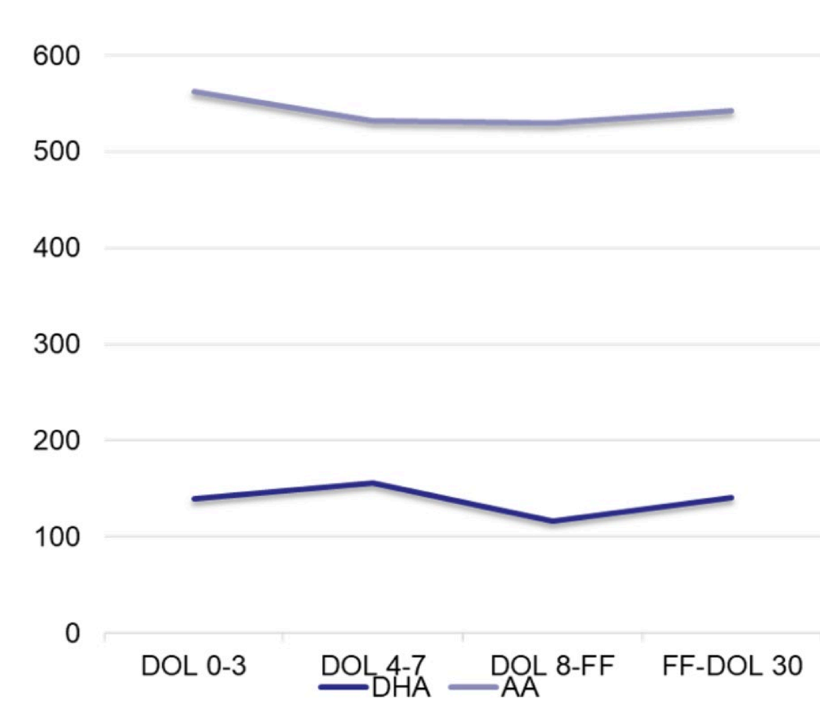
DHA= docosahexaenoic acid, AA=arachidonic acid, LA=linoleic acid, ALA=α-linoleic acid, EPA=eicosapentanoic acid.
*Total intake for specified time period averaged per day

Serum Levels of Fatty Acids
µmol/L

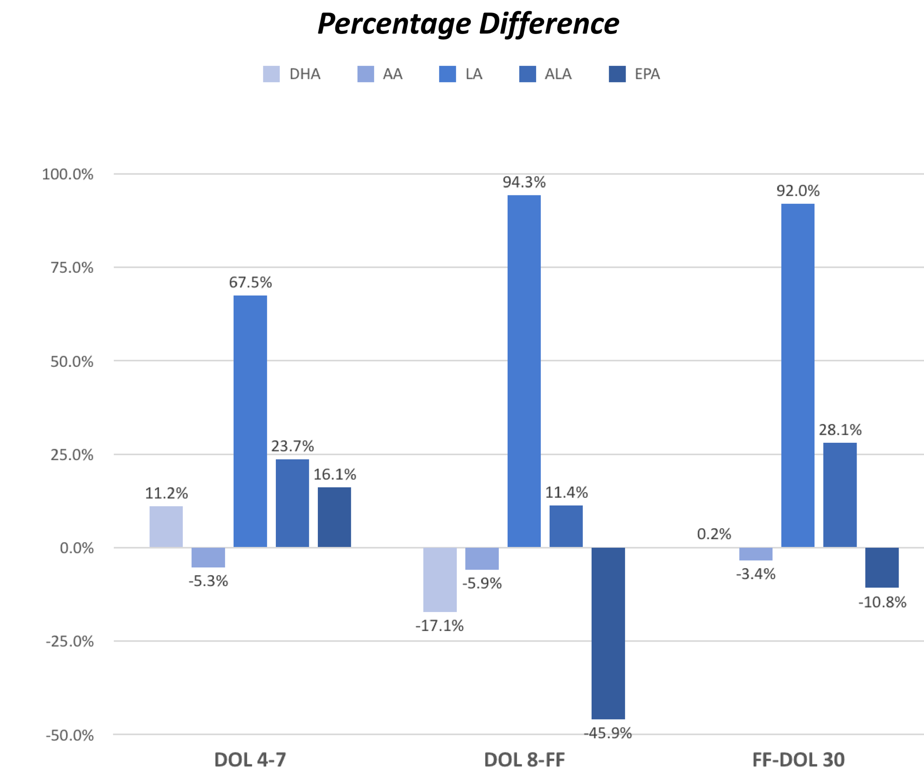
Fatty Acid	DOL 0-3	DOL 4-7	DOL 8-FF	FF-DOL 30
DHA	139.8 ± 51.8* median=135.1 n=18	155.4 ± 54.9 median=145.4 n=14	115.9 ± 33.2 median=114.9 n=12	140.1 ± 50.6 median=134.9 n=8
AA	562.1 ± 182.4 median=527.0 n=18	532.1 ± 193.5 median=489.5 n=14	529.2 ± 160.0 median=494.6 n=12	542.9 ± 224.5 median=517.2 n=8
LA	1004.3 ± 463.1 median=962.7 n=18	1682.2 ± 677.9 median=1600.2 n=14	1951.6 ± 762.6 median=1924.1 n=12	1927.9 ± 718.4 median=1838.7 n=8
ALA	41.3 ± 24.9* median=38.3 n=16	51.1 ± 24.4 median=47.1 n=14	46.0 ± 20.1 median=40.6 n=12	52.9 ± 27.7 median=49.1 n=8
EPA	62.8 ± 42.3 median=52.1 n=17	72.9 ± 44.6 median=62.4 n=14	34.0 ± 7.7 median=31.6 n=12	56.0 ± 46.3 median=42.3 n=8

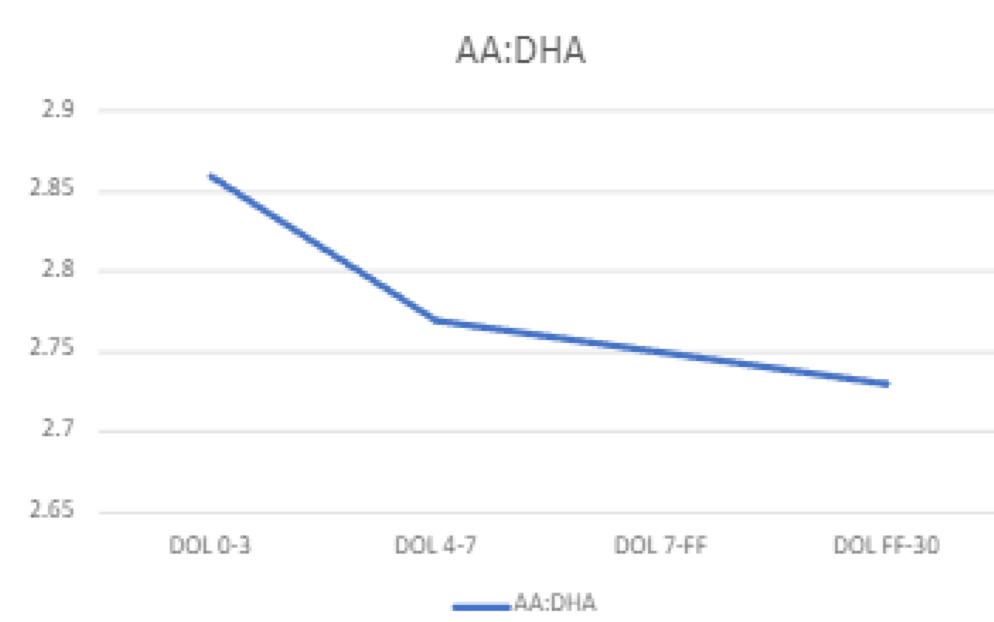
* Mean ±SD

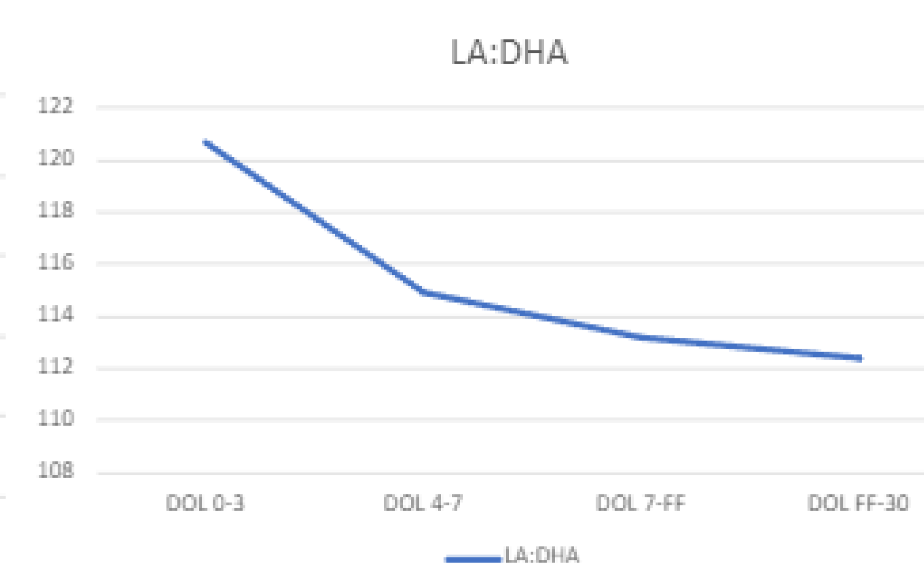
Serum DHA and AA Over Time



Levels Change From Baseline
Percentage Difference







Discussion

- Studies have described decreased morbidities with an exclusive human milk diet.
- Essential fatty acid intakes have been tied to outcomes of extremely premature infants.
- Levels of DHA and AA experienced less of a decline than previously reported. This decline was also less than reported in one other study looking at an exclusive human milk diet, which could possibly be related to the routine provision of human derived cream.
- Fatty acid ratios appear to be favorable for improved outcomes. AA:DHA remained well above 2:1, previously reported to correlate with improved growth and neurodevelopmental outcomes. LA:DHA decreased over time, suggested to be associated with a decreased BPD risk.
- Early fortification with an exclusive human milk diet may provide more optimal essential fatty acid intake and prevent significant deficits in these highest risk patients

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