

To compare the efficacy of fortification of expressed breast milk with medium chain triglycerides and coconut oil on the physical growth of very low birth weight babies

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Abstract

Background: The most important factor leading to growth failure in VLBW babies is inadequate nutrition. Though, higher amounts of protein, sodium, chloride, and magnesium are available in preterm human milk than those found in term milk, these levels still remain below recommendations. To compensate these requirements, human milk for preterm infants is routinely fortified to increase energy, protein and mineral intake. In the past, very few studies have been done to find out the efficacy of medium chain triglycerides and coconut oil for fortification of human milk. Since, a major chunk of LBW babies exists in our country, this study is undertaken. **Objectives:** To study and compare the physical growth (weight, length and head circumference) over a period of two months in each study group. **Design:** Prospective cohort study. **Setting:** The study was conducted from April, 2015 to August, 2016 at Department of Pediatrics, MY hospital and CNBC, Indore. **Participants:** 225 VLBW babies (<1.5 kg) admitted in SCNU and postnatal wards. **Intervention:** The babies were assigned to group 1, 2 and 3 in serial order. Sample size in each group was 75. Group 1- Given expressed breast milk with lactodex-HMF. Group 2- Given expressed breast milk with lactodex- HMF and MCT (Simyl MCT oil). Group 3- Given expressed breast milk with lactodex- HMF and coconut oil (Parachute-100% edible oil) Physical growth was monitored every week for 2 months. **Results:** Significant physical growth (weight, length and head circumference) was noticed in each of the study groups over 2 months (p value<0.05). There was no statistically significant difference in the physical growth between the groups (p>0.05). **Conclusion:** There is no advantage of MCT or coconut oil in addition to Lactodex- HMF on the physical growth of VLBW babies.

Keywords: Growth, Nutrition, Birth weight, Preterm, Fortifier

Introduction

Birth weight is the single most important marker of adverse perinatal and neonatal outcome. Over 80% of all neonatal deaths, in both the developed and developing countries occur among LBW babies. Extra uterine growth restriction is a major clinical problem in very low birth weight infants[1].

Growth failure is a result of the complex interaction of many factors, including morbidities that affect nutrient requirements, central nervous system damage, difficulty in suck and swallow coordination, endocrine abnormalities but the most important factor leading to growth failure is inadequate nutrition[2]. Following

birth, term infants rapidly adapt from a relatively constant intrauterine supply of nutrients to intermittent milk feeding but preterm infants are at increased risk for potential nutritional compromise due to limited nutrient reserves, immature metabolic pathways and increased nutrient demands [3].

Early inadequate nutrition exerts an adverse influence on long term developmental outcome. Malnutrition at this vulnerable period of brain development results in a decreased number of brain cells and deficits in learning, behavior, memory and poor long term growth [4]. The exclusive feeding of unfortified human milk in premature infants is associated with poorer rates of growth and nutritional deficits during and beyond the period of hospitalization [5-7] and therefore human milk for preterm infants is routinely fortified to increase

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energy, protein and mineral intake. Feeding preterm infants with expressed breast milk fortified with human milk fortifier is associated with weight gain, linear and head growth. Fat in human milk supplies a major proportion of caloric content. The ability of very low birth weight infants to absorb fat is poor due to immaturity of liver and decreased bile salt synthesis [8]. Medium chain triglycerides passively diffuse from the gastrointestinal tract to the portal system without requirement for modification like long chain fatty acids. Medium chain triglycerides can thus improve fat absorption in very low birth weight infants [9-12]. Medium chain triglycerides have also shown to increase weight gain and to enhance calcium absorption and nitrogen retention but limited studies are available to prove it. As coconut oil is rich in medium chain triglycerides, it can serve as a good substitute for MCT in a resource limited developing country like India. So far, very few studies have been done to find out the efficacy of medium chain triglycerides and coconut oil on fortification of human milk. Studies done in past have small sample size and conflicting results. This unique study aims to find out the efficacy of medium chain triglycerides and coconut oil on fortification of human milk.

Methods

Place of Study- 225 newborn babies with birth weight less than 1.5 kg admitted in Special Care Newborn Unit and postnatal wards of MY Hospital and Chacha Nehru Bal Chikitsalaya, Indore were included in the study.

Type of Study- Prospective cohort study

Sample collection- 225 preterm very low birth weight babies (<1.5 Kg) were included in this study. These babies were consecutively assigned to group 1, 2 and 3 in serial order. 1st baby to group 1, 2nd to group 2, 3rd to group 3, 4th again to group 1 and this was followed for whole sample of 225. Sample size was 75 in each group.

Inclusion criteria- Preterm newborn babies with birth weight less than 1.5 kg admitted in SCNU and postnatal wards of MY Hospital and CNBC, Indore.

Exclusion criteria- Babies with surgical problems, congenital anomalies and those receiving formula feeds were excluded from the study.

Results

This prospective cohort study was done on 225 very low birth weight babies to find out the efficacy of fortification of expressed breast milk with medium chain triglycerides and coconut oil. Human milk fortifier was common to all three groups as it has proven role in the physical growth of very low birth weight babies. The results of our study suggest that the gain in growth parameters (weight, length and head circumference) was similar in all three intervention groups during

Methodology- All details of babies including detailed antenatal history, events during labor, baby's details at birth, APGAR score (if available), details of resuscitation, gestational age (as per New Ballard score), birth weight, general condition of the baby at the time of admission and indication of admission were recorded on proforma designed for the study.

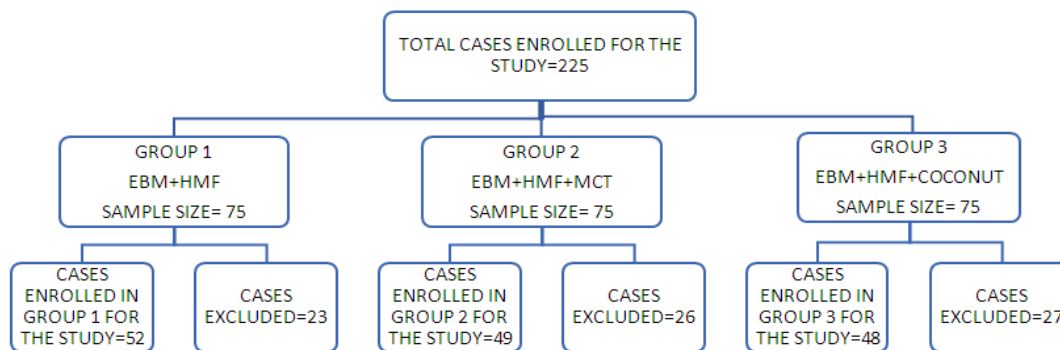
As soon as babies reached full feeds (140ml/kg/day), babies in group 1 were given expressed breast milk fortified with lactodex- human milk fortifier. 2 g sachet of lactodex-HMF was added to 50 ml of milk. Similarly in second group, in addition to lactodex- HMF, medium chain triglycerides were added (Simyl MCT oil). Dose given was 1 ml/kg/day in divided doses and this dose was kept constant throughout the study period of two months (Energy content of MCT oil- 8.3 kcal/g, 7.7kcal/ml). In the third group, Parachute coconut oil (100% pure edible oil) was given in the same dose(1 ml/kg/day) in addition to lactodex-HMF(Energy content of coconut oil=8.6kcal/g)

Weight, length and head circumference were recorded at the beginning of intervention. Weight was taken on digital electronic scale after removing clothes and diaper. The weighing scale was corrected for zero error before measurement. Serial measurement of weight was done on the same weighing scale. Length was taken on an infantometer. The neonate was placed supine with head held firmly in position and keeping legs straight with toes pointing upward. Head circumference was measured by an inch tape. The maximum circumference of the head from the occipital protuberance to the supraorbital ridges on the forehead was recorded. These babies were serially followed for a period of 8 weeks and weight, length and head circumference was noted every week. Cases which left against medical advice, did not come for follow up and those certified during the study period were not included for final data analysis. Final data was analyzed by different statistical tests.

The gain in physical growth (weight, length and head circumference) in each study group was noted over the study period of two months by applying repeated measures and one way ANOVA was applied for comparison between groups.

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the study period of 2 months. There was no statistically significant difference in weight, length and head circumference between the groups during the study period of 2 months. Very few studies have been done in India previously on human milk fortification and they have contradictory results. Our study suggests that there is no additional advantage of medium chain triglycerides and coconut oil on the physical growth of very low birth weight babies. In our study, medium chain triglycerides and coconut oil were given at a constant minimum dose of 1 ml/kg/day to avoid adverse effects of higher doses. No studies have been done with increasing doses of medium chain triglycerides and coconut oil. More studies are needed in this regard so that a meta-analysis can be done to find out the role of fat for fortification of human milk.

Table-1: Description of Data.**TABLE-2: MEAN WEIGHT OVER 8 WEEKS IN ALL THREE INTERVENTION GROUPS.**

Treatment groups	Week	Mean	Std. Deviation
EBM+HMF	W0	1.28327	0.148241
	W1	1.32067	0.152264
	W2	1.37308	0.166292
	W3	1.43990	0.199351
	W4	1.53433	0.230819
	W5	1.62240	0.260223
	W6	1.72721	0.303863
	W7	1.83173	0.333052
	W8	1.94288	0.360736
EBM+HMF+MCT	W0	1.25133	0.140615
	W1	1.28388	0.131257
	W2	1.33684	0.140597
	W3	1.40480	0.169131
	W4	1.49827	0.204951
	W5	1.59224	0.250269
	W6	1.70673	0.294538
	W7	1.82163	0.329304
	W8	1.94551	0.355226
EBM+HMF+COCONUT	W0	1.24500	0.158130
	W1	1.28041	0.167652
	W2	1.33806	0.190438
	W3	1.40531	0.203325
	W4	1.48663	0.236047
	W5	1.57612	0.263208
	W6	1.68337	0.316385
	W7	1.79857	0.369472
	W8	1.93245	0.412556

p value<0.05

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There is a significant increase in weight over 8 weeks in all groups (Test applied: Repeated measures)

Table-3: Mean length over 8 weeks in all three intervention groups.

Treatment groups	Week	Mean	Std. Deviation
EBM+HMF	L0	38.69231	1.973237
	L1	38.93269	2.079378
	L2	39.49038	2.234951
	L3	40.09615	2.225165
	L4	40.71154	2.333360
	L5	40.96	2.840
	L6	41.83654	2.228868
	L7	42.36538	2.240701
	L8	42.83654	2.188923
EBM+HMF+MCT	L0	38.18367	1.453064
	L1	38.40816	1.570143
	L2	38.96939	1.668982
	L3	39.59184	1.556818
	L4	40.06122	1.553332
	L5	40.40	2.280
	L6	41.05102	2.112081
	L7	41.70408	1.997181
	L8	42.20408	1.970930
EBM+HMF+COCONUT	L0	38.20833	2.023357
	L1	38.50000	2.175786
	L2	39.01042	2.300531
	L3	39.69792	2.477000
	L4	40.16667	2.478274
	L5	40.49	3.081
	L6	41.36458	2.575952
	L7	41.65625	2.980711
	L8	42.38542	2.484504

p value<0.05

There is a significant increase in length over 8 weeks in all groups(Test applied: Repeated measures)

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Table-4: Mean head circumference over 8 weeks in all three intervention groups.

Treatment groups	Week	Mean	Std. Deviation
EBM+HMF	HC0	28.067	1.4315
	HC1	28.308	1.5021
	HC2	28.635	1.6243
	HC3	29.096	1.7293
	HC4	29.615	1.7196
	HC5	30.269	2.3146
	HC6	30.462	1.7901
	HC7	31.048	1.7967
EBM+HMF+MCT	HC0	27.646	1.1107
	HC1	27.896	1.1155
	HC2	28.292	1.2583
	HC3	28.792	1.3322
	HC4	29.271	1.2798
	HC5	29.896	2.1061
	HC6	30.125	1.3349
	HC7	30.583	1.3382
EBM+HMF+COCONUT	HC0	28.020	1.7046
	HC1	28.265	1.8711
	HC2	28.694	1.9943
	HC3	29.010	2.0297
	HC4	29.561	2.0632
	HC5	30.296	2.5616
	HC6	30.500	2.0842
	HC7	30.949	2.1268
HC8	31.276	2.2245	

Pvalue < 0.05

There is a significant increase in head circumference over 8 weeks in all groups (Test applied: Repeated measures)

Table-5: Comparison Of Weight Between Groups.

Between groups and within groups	F Value	P value
W0	0.971	0.381
W1	1.051	0.352
W2	0.775	0.462
W3	0.558	0.574
W4	0.642	0.528
W5	0.437	0.647
W6	0.285	0.753
W7	0.138	0.871
W8	0.024	0.976

p value > 0.05

The weight gain in all 3 groups is similar over 8 weeks. There is no significant difference in weight gain. (Test applied: One way ANOVA).

Table-6: Comparison of Length between groups.

Between groups and within groups	F Value	p Value
L0	1.239	0.293
L1	1.037	0.357
L2	0.977	0.379
L3	0.798	0.452
L4	1.325	0.269
L5	0.613	0.543
L6	1.483	0.230
L7	1.345	0.264
L8	1.090	0.339

p value >0.05.

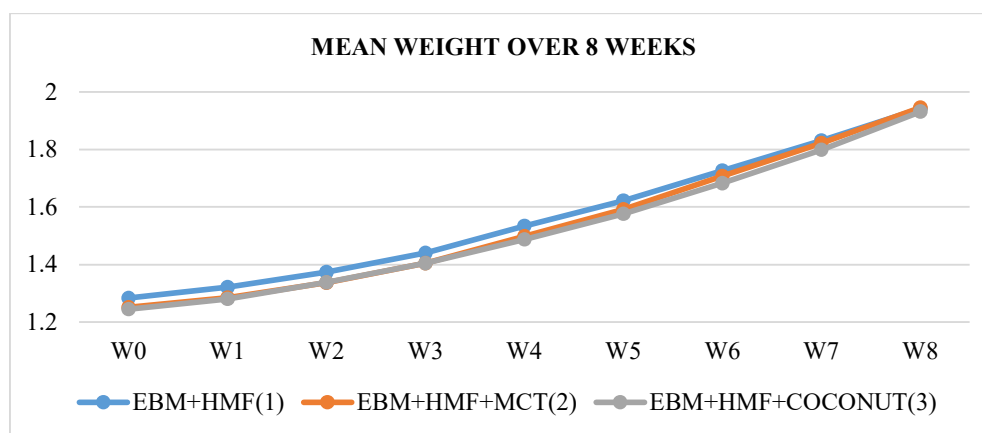
There is no significant difference in length over 8 weeks in all 3 groups (Test applied: One way ANOVA)

Table-7: Comparison of head circumference between groups.

Between groups and within groups	F Value	p Value
HC0	1.401	0.250
HC1	1.155	0.318
HC2	0.849	0.430
HC3	0.450	0.638
HC4	0.646	0.526
HC5	0.477	0.621
HC6	0.696	0.500
HC7	0.953	0.388
HC8	.802	.450

p value >0.05

There is no significant difference in head circumference over 8 weeks in all 3 groups. (Test applied: One way ANOVA)

**Figure-1**

Line diagram showing increasing mean weight over 8 weeks in all groups. Mean weight of group 2 is highest but difference between groups is insignificant.

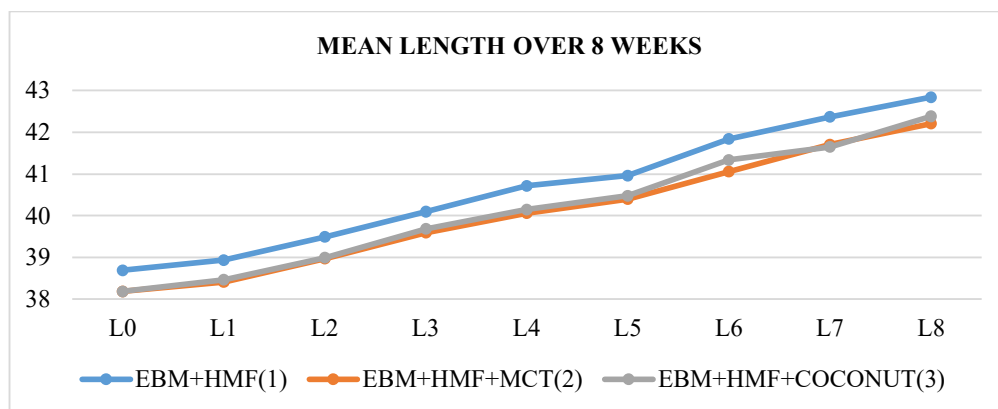


Figure-2

Group 1 mean length is highest but the difference between groups is insignificant

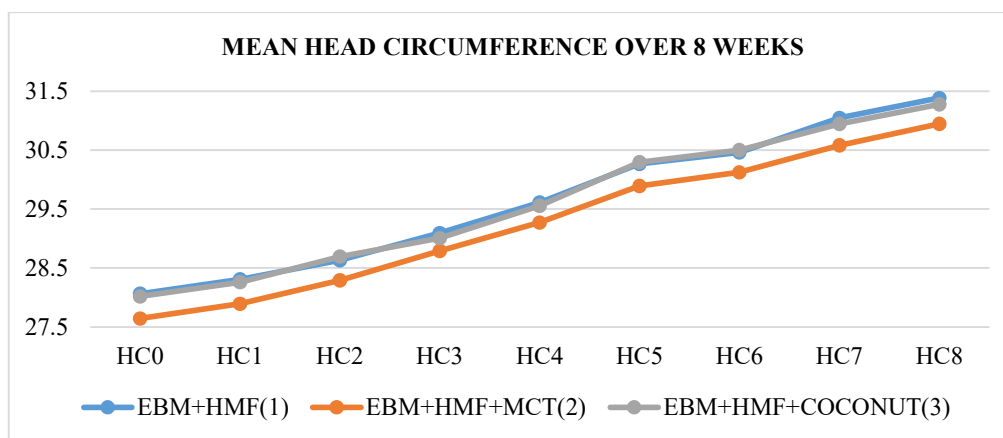


Figure-3

Group 1 mean HC showed the highest growth over the 8 weeks.

Discussion

Fat provides the major source of energy for the growing premature infants. Fat is a major determinant of growth, visual and neural development and long term health [13-15]. Medium chain triglycerides are absorbed faster and more completely by pancreatic lipase than Long chain triglycerides. Medium chain triglycerides are prepared by the hydrolysis and fractionation of coconut oil. Coconut oil can serve as a good substitute for medium chain triglycerides in a resource limited developing country like India. So, this study was undertaken.

Previous studies have reported gain in weight, length and head circumference with currently available powdered fortifiers [16], so in our study Lactodex-HMF was given to all the study groups. In our study, there was no significant difference in mean weight, mean length and mean head circumference between the study groups at the beginning of intervention.

The weight gain in each group was statistically significant for the study period of two months and per week increase in weight was also statistically significant for all the groups. Similarly, the change in length and head circumference was also significant in each group during the study period of two months.

Group 2 received medium chain triglycerides and Group 3 received coconut oil with lactodex- HMF but their results were similar to group 1 which consisted of HMF alone. There was no statistically significant difference in the study parameters between the groups. The pattern of gain in weight, length and head circumference was similar in all three study groups. Deborah L. O' Connor et.al. 2008 in their study found that low birth weight infants who received human milk fortifier were heavier, longer and had large head circumference as compared to controls that did not receive human milk fortifier[17].

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Vaidya et.al. in 1992 in their study took 75 very low birth weight babies and divided them into 3 groups. In first group safflower oil and in second group coconut oil was used for fortification and third group consisted of controls with no fortification. The mean weight gain was highest and significantly higher than the controls in the coconut oil group[18]. The weight gain was definitely superior in the coconut oil group as compared to the safflower oil group but in this study control group did not receive any fortification.

Cochrane neonatal reviews on 182 infants from eight randomized trials on high versus low medium chain triglyceride content of formula for promoting short term growth of preterm infants reported no difference in growth parameters when high or low MCT were used [19]. This metaanalysis was done on formula fed infants. Formula fed infants were excluded in our study. An earlier study showed no effect on short term growth of preterm infants fed fat supplemented human milk[20]. Our study also shows similar growth in all study groups over the study period of 2 months.

Conclusion

There was a significant physical growth (weight, length and head circumference) in all the 3 groups over the study period of two months ($p < 0.05$, test applied-repeated measures). One way ANOVA method was used to compare the weight, length and head circumference between the groups. There was no statistically significant difference in the study parameters between the groups ($p > 0.05$)

There is no advantage of medium chain triglycerides or coconut oil in addition to lactodex human milk fortifier on the physical growth of very low birth weight babies.

Recommendation

1. Medium chain triglycerides and coconut oil do not have an additional advantage on the physical growth of very low birth weight babies (1-1.5kg). Hence; human milk fortification can be recommended with HMF only.
2. This study has been done with fixed doses of medium chain triglycerides and coconut oil throughout the study period to avoid adverse effects associated with higher doses. More studies can be done with increasing doses to find out the role of fat for fortification of human milk.
3. Our study has been done on a small sample size; more studies are needed so that a meta-analysis can be done to find out the role of fat for fortification of human milk.

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References

1. Clark RH, Thomas P, Peabody J. Extrauterine growth restriction remains a serious problem in prematurely born neonates. *Pediatrics*. 2003 May; 111 (5 Pt 1): 986-90.
2. Embleton NE, Pang N, Cooke RJ. Postnatal malnutrition and growth retardation: an inevitable consequence of current recommendations in preterm infants? *Pediatrics*. 2001 Feb;107(2):270-3.
3. McGuire W, Henderson G, Fowlie PW. Feeding the preterm infant. *BMJ*. 2004 Nov 20; 329 (7476): 1227-30.
4. Grantham-McGregor S. A review of studies of the effect of severe malnutrition on mental development. *J Nutr*. 1995 Aug;125(8 Suppl):2233S-2238S. doi: 10.1093/jn/125.suppl_8.2233S. doi:10.1093/jn/125.suppl_8.2233S
5. Cooper PA, Rothberg AD, Pettifor JM, et al. Growth and biochemical response of premature infants fed pooled preterm milk or special formula. *J Pediatr Gastroenterol Nutr*. 1984 Nov;3(5):749-54.
6. Davies DP. Adequacy of expressed breast milk for early growth of preterm infants. *Arch Dis Child*. 1977 Apr;52(4):296-301.
7. Kashyap S, Schulze KF, Forsyth M, et al. Growth, nutrient retention, and metabolic response of low - birth-weight infants fed supplemented and un supplemented preterm human milk. *Am J Clin Nutr*. 1990 Aug; 52(2):254-62. doi:10.1093/ajcn/52.2.254
8. Andrews BF, Lorch V: Improved fat and Ca absorption in L.B.W. infants fed a medium chain triglyceride containing formula. *Pediatric Research*. 1974; 8(4):378
9. Tantibhedhyangkul P, Hashim SA: Clinical and physiologic aspects of medium-chain triglycerides: Alleviation of steatorrhea in premature infants. *Bull NY Acad. Med*. 1971 Jan;47(1):17-33
10. Tantibhedhyangkul P, Hashim SA: Medium-chain triglyceride feeding in Premature infants: Effects on fat and nitrogen absorption. *Pediatrics*. 1975 Mar; 55 (3) : 35.

Case Report

11. Andrews BF, Lorch V: Improved fat and Ca absorption in L.B.W infants fed a medium chain triglyceride containing formula. *Pediatric Research*. 1974; 8 (4):378
12. Roy CC, Ste-Marie M, Chartr and L, et al. Correction of the malabsorption of the preterm infant with a medium-chain triglyceride formula. *J Pediatr*. 1975 Mar;86(3):446-50.
13. O' Connor DL, Hall R, Adamkin D, et al. Growth and development in preterm infants fed long chain polyunsaturated fatty acids: a prospective randomized control trial. *Pediatrics*.2001 Aug;108(2):359-71
14. Fewtrell MS, Abbott RA, Kennedy K, et al. Randomized double blind trial of long chain polyunsaturated fatty acid supplementation with fish oil and borage oil in preterm infants. *J Pediatr*. 2004 Apr; 144(4):471-9
15. Collins CT, Makrides M, Gibson RA et al. Pre and post term growth in preterm infants supplemented with higher dose DHA: a randomised control trial. *Br J Nutr*. 2011 Jun; 105(11):1635-43.doi:10.1017/S000711451000509X.
16. O'Connor DL, Khan S et al. Growth and nutrient intakes of human milk fed preterm infants provided with extra energy and nutrients after hospital discharge. *Pediatrics*.2008 Apr;121(4):766-76.doi:10.1542/peds.2007-0054
17. Deborah L.O' Connor, Sobia Khan, Karen Weishuhn, Jennifer Vaughan et.al. Growth and Nutrient Intakes of Human Milk- Fed Preterm Infants provided with extra energy and nutrients after discharge. *Pediatrics*. 2008 Apr;121(4);766-76.doi:10.1542/peds.2007-0054
18. Vaidya UV, Hegde VM, Bhave SA, Pandit AN. Vegetable oil fortified feeds in the nutrition of very low birthweight babies. *Indian Pediatr*. 1992 Dec;29(12): 1519-27.
19. Klenoff Brumberg HL, Genen LH et al. High versus low medium chain triglyceride content of formula for promoting short term growth of preterm infants. *Cochrane Database Syst Rev*.2003;(1):CD002777
20. Amissah EA, Brown J et al. Fat supplementation of human milk for promoting growth in preterm infants. *Cochrane Database Syst Rev*.2018 Jun 19;6:CD000341. doi:10.1002/14651858.CD000341.pub2.

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