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To study significant weight loss and it's association with hypernatremia in exclusively breastfed full term normal birth weight neonates born in Tertiary Care Hospital

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Abstract
Background: Full term neonates lose less than 10% of birth weight during initial 7-10 day of life. As the practice of exclusive breastfeeding is increasing, the incidence of hypernatremia is also increasingly reported. It has been observed that in case of hypernatremia, a neonate commonly loses more than 10% birth weight.
Aim: To study the correlation of significant weight loss and hypernatremia in exclusively breastfed full term normal birth weight neonates born in tertiary care hospital.
Methods: This study was conducted in maternity and opd patient of tertiary care hospital, Karad between November 2012 and May 2014. 200 eligible neonate enrolled in study. Assessment of neonates was done taking detailed maternal and perinatal history. Body weight, percent weight loss was recorded on 3rd and 5th day of life. Blood samples were collected on 3rd and 5th day of life for biochemical estimation including serum sodium levels.
Results: On 3rd day of life incidence of significant weight loss (>10 %) found in 18 neonates (9 %) and out of these 9 neonate (50%) were hypernatremic. And on 5th DOL, incidence of significant weight loss (>10 %) was found in 24 neonates (12 %) and out of these 6 neonate (25%) with birth weight more than 3 kgs were hypernatremic.
Conclusion: There is a significant correlation between significant weight loss and hypernatremia in exclusively breastfed full term male neonates on 3rd and 5th day of life with birth weight more than 3 kg.

Keywords: weight loss, hypernatremia, exclusively breastfed, neonates

1. Introduction
Current knowledge indicates that breastfeeding is best for the newborn for initial six months of life, and thus it is being promoted by healthcare providers all over world [1]. The practice of exclusive breastfeeding is increasingly accepted by mothers. With the increase in practice of exclusive breastfeeding it is also increasingly reported that, due to inadequacy of volume of breast milk or improper feeding technique - jaundice, hypernatremia, dehydration- are increasingly encountered [2,3,4]. These may be missed by healthcare providers due to certain reasons like-it may be avoidance of follow-up visit on the part of mother or lack of follow-up examination due to early discharge on day 2 or day 3 in normally delivered mothers, or difficulty in follow-up visit due to long distance from health care facility, etc. Most babies lose weight during first few days after birth, normally fullterm neonates lose less than 10% of birth weight during initial 7-10 day of life (DOL) and reachieve birth weight on 10th DOL, whereas preterm neonates lose 10-15 % of birth weight during initial 8-10th DOL and reachieve birth weight around 15th DOL [5]. Fullterm neonates lose maximum weight on 3rd and 4th DOL [6] and it has been observed that in case of hypernatremia, a neonate commonly loses more than 10% of birth weight. Jaundice may be a sign of insufficient lactation. Babies with hypernatremia can present with dehydration [2]. They also present with fever, lethargy, irritability, seizures, sleepiness, apnea, poor feeding [2].
Hypernatremia is a rare complication that can occur in exclusively breastfed babies due to inadequate lactation. It is commonly associated with loss of extracellular water. Primiparous mothers, Cesarean deliveries, use of phototherapy, improper and inadequate latch, poor breastfeeding technique, inadequate milk secretion, maternal illness, previous negative breastfeeding experience, lack of family and social support are some risk factors associated with hypernatremia in exclusively breastfed babies [7]. Infants with hypernatremia can present with complications such as cerebral edema, intracranial hemorrhage, gangrene, hydrocephalus, facial palsy, seizures, hypertension and disseminated intravascular coagulation [8].
Hypernatremia in neonate is defined as serum sodium level more than 145meq/l, although it is sometimes defined as >150 meq/L [9]. And in a newborn it is a potentially fatal condition. Earlier studies showed that Hypernatremia in newborn was a consequence of concentrated artificial feeds of too high sodium concentration, improper dilution, use of heaped scoops of formula milk powder [10].

2. Materials and methods
This study was conducted in maternity and opd patient of

Krishna Institute of Medical Sciences Deemed University, Karad between November 2012 and May 2014. Inclusion criteria were fullterm neonate with age less than 10th DOL, birth weight above 2.5 kgs, both sexes and babies who were exclusively breastfed. Exclusion criteria were birth weight below 2.5 kgs, sick babies, gestation less than 37 weeks, age more than 10th DOL, those babies with family h/o cystic fibrosis, endocrinological abnormalities, twin/multiple pregnancies, neonate on iv fluids and diuretic therapy. 200 eligible neonate enrolled in study after obtaining the informed consent from the parents. Assessment of neonate was done taking detailed maternal and perinatal history & reviewing antenatal records. Baby weight and percent weight loss was recorded on 3rd and 5th DOL. Blood samples was collected on 3rd and 5th DOL and biochemical estimation including serum sodium level was done.

Statistical Analysis

All parameter were categorized as follows

- Birth weight a) 2.5-2.9 kg b) >3 kg
- Percent birth weight loss a) <5% b) 5-10% c) >10%
- Serum sodium(meq/l) a) 125-135 b) 136-145 c) 146-155 d) 156-165

Chi-square test was used to find the significance of study parameters on categorical scale between two or more groups.

3. Results

Out of total 200 neonates studied;

1. 102(51%) were male and rest 98(49%) were female neonates;
2. 76(38%) were neonates of primiparous mothers and rest 124(62%) were of multiparous mothers;
3. 78(39%) neonates were delivered by LSCS and 122(61%) delivered pervaginum;
4. 8(4%) neonates needed phototherapy and 192(96%) neonates did not need phototherapy;
5. On 3rd DOL 48(24%) neonates had weight loss of <5% of birth weight, 134(67%)neonate with weight loss of 5-10% of birth weight and 18(9%) neonates had >10% loss of birth weight;
6. On 5th DOL 53(26.5%) neonates had weight loss of <5% of birth weight, 123(61.5%) neonates with weight loss of 5-10% of birth weight and 24(12%) neonates had >10% loss of birth weight;
7. On 3rd DOL 22(11%) neonates had serum sodium level of 125-135 meq/l, 128(64%) neonates had 136-145 meq/l, 47(23.5%) neonates had 146-155 meq/l and 3(1.5%) neonates had 156-165 meq/l;
8. On 5th DOL 39(19.5%) neonates had serum sodium level of 125-135 meq/l, 141(70.5%) neonates had 136-145 meq/l, 18(9%)neonates had 146-155 meq/l and 2(1%) neonate had 156-165 meq/l.

Table 1: Distribution of gender, percent weight loss and serum sodium level on 3rd DOL

% Weight loss on 3rd DOL DOL	Serum sodium level in neonate on 3rd DOL															
	125-135 meq/l (22 neonate)				136-145 meq/l (128 neonate)				146-155 meq/l (47 neonate)				156-165 meq/l (3 neonate)			
	M	% neonate	F	% neonate	M	% neonate	F	% neonate	M	% neonate	F	% neonate	M	% neonate	F	% neonate
<5%,	6	27.27%	6	27.27%	15	11.72%	15	11.71%	3	6.38%	3	6.38%	0	00%	0	00%
5-10%,	6	27.27%	4	18.19%	43	33.59%	46	35.94%	19	40.43%	14	29.79%	0	00%	2	66.67%
>10%	0	00%	0	00%	5	3.91%	4	3.13%	4	8.51%	4	8.51%	1	33.33%	0	00%
Total	12	54.54%	10	45.46%	63	49.22%	65	50.78%	26	55.32%	21	44.68%	1	33.33%	2	66.67%

On 3rd DOL, significant association in male (p value-0.0083) neonates between percent weight loss and serum sodium level. There is no significant association in female (p value-0.0522) neonates between percent weight loss and serum sodium level when all birth weight groups considered together.

Table 2: Distribution of gender, percent weight loss and serum sodium level on 5th DOL

% Weight loss on 5th DOL	Serum sodium level in neonate on 5th DOL															
	125-135 meq/l (39 neonate)				136-145 meq/l (141 neonate)				146-155 meq/l (18 neonate)				156-165 meq/l (2 neonate)			
	M	% neonate	F	% neonate	M	% neonate	F	% neonate	M	% neonate	F	% neonate	M	% neonate	F	% neonate
<5%,	2	5.13%	5	12.82%	19	13.48%	20	14.18%	4	22.22%	3	16.66%	0	00%	0	00%
5-10%,	16	41.03%	11	28.21%	43	30.50%	46	32.62%	2	11.11%	3	16.67%	1	50%	1	50%
>10%	2	5.13%	3	7.68%	9	6.38%	4	2.84%	4	22.22%	2	11.11%	0	00%	0	00%
Total	20	51.29%	19	48.71%	71	50.36%	70	49.64%	10	55.55%	8	44.45%	1	50%	1	50%

On 5th DOL, no significant association in male (p value-0.0558) and female (p value-0.4410) neonates between percent weight loss and serum sodium level when all birth weight groups considered together.

Table 3: Distribution of gender, percent weight loss and parity of mother on 3rd DOL

% Weight loss on 3rd DOL	Parity of mother							
	Primiparous mother (76 mothers)				Multiparous mother (124 mothers)			
	M	% mothers	F	% mothers	M	% mothers	F	% mothers
<5%,	8	10.53%	11	47.37%	16	12.90%	13	10.48%
5-10%,	30	39.47%	20	6.58%	38	30.65%	46	37.10%
>10%	2	2.63%	5	26.32%	8	6.45%	3	2.42%
Total	40	52.63%	36	44.47%	62	50%	62	50%

On 3rd DOL, no significant association in male (p value-0.2749) and female (p value-0.1156) neonates between percent weight loss and parity of mothers was found.

Table 4: Distribution of gender, percent weight loss and parity of mother on 5th DOL

% Weight loss on 5th DOL	Parity of mother							
	Primiparous mother (76 mothers)				Multiparous mother (124 mothers)			
	M	% mothers	F	% mothers	M	% mothers	F	% mothers
<5%,	8	10.53%	11	14.47%	17	13.71%	17	13.71%
5-10%,	25	32.89%	21	27.64%	37	29.84%	40	32.26%
>10%	7	9.21%	4	5.26%	8	6.45%	5	4.03%
Total	40	52.63%	36	44.47%	62	50%	62	50%

On 5th DOL, no significant association in male (p value-0.6290) and female (p value-0.7991) neonates between percent weight loss and parity of mothers was found.

Table 5: Distribution of gender, percent weight loss and mode of delivery on 3rd DOL

% Weight loss on 3rd DOL	Mode of delivery							
	LSCS (78 deliveries)				Per vaginum delivery (122 deliveries)			
	M	% deliveries	F	% deliveries	M	% deliveries	F	% deliveries
<5%,	9	11.54%	11	14.10%	15	12.30%	13	10.65%
5-10%,	27	34.61%	25	32.05%	41	33.61%	41	33.61%
>10%	3	3.85%	3	3.85%	7	5.73%	5	4.10%
Total	39	50%	39	50%	63	51.64%	59	48.36%

On 3rd DOL, no significant association in male (p value-0.8374) and female (p value-0.7851) neonates between percent weight loss and mode of delivery.

Table 6: Distribution of gender, percent weight loss and mode of delivery on 5th DOL

% Weight loss on 5th DOL	Mode of delivery							
	LSCS (78 deliveries)				Per vaginum delivery (122 deliveries)			
	M	% deliveries	F	% deliveries	M	% deliveries	F	% deliveries
<5%,	13	16.66%	12	15.38%	12	9.84%	16	13.12%
5-10%,	22	28.21%	24	30.77%	40	32.79%	37	30.32%
>10%	4	5.13%	3	3.85%	11	9.02%	6	4.92%
Total	39	50%	39	50%	63	51.64%	59	48.36%

On 5th DOL, no significant association in male (p value-0.2171) and female (p value-0.8730) neonates between percent weight loss and mode of delivery.

Table 7: Distribution of gender, percent weight loss and use of phototherapy on 3rd DOL

% Weight loss on 3rd DOL	Use of phototherapy							
	Received phototherapy (8 neonate)				Did not Received phototherapy (192 neonate)			
	M	% neonate	F	% neonate	M	% neonate	F	% neonate
<5%,	1	12.5%	1	12.5%	23	23%	23	11.98%
5-10%,	2	25%	2	25%	66	66%	64	33.33%
>10%	1	12.5%	1	12.5%	9	9%	7	3.65%
Total	4	50%	4	50%	98	98%	94	48.96%

On 3rd DOL, no significant association in male (p value-0.5605) and female (p value-0.4416) neonates between percent weight loss and use of phototherapy.

Table 8: Distribution of gender, percent weight loss and use of phototherapy on 5th DOL

% Weight loss on 5th DOL	Use of phototherapy							
	Received phototherapy (8 neonate)				Did not Received phototherapy (192 neonate)			
	M	% neonate	F	% neonate	M	% neonate	F	% neonate
<5%,	1	12.5%	1	12.5%	24	12.5%	27	14.06%
5-10%,	3	37.5%	3	37.5%	59	30.73%	58	30.21%
>10%	0	00%	0	00%	15	7.81%	9	4.69%
Total	4	50%	4	50%	98	98%	94	48.96%

On 5th DOL, no significant association in male (p value-0.6869) and in female (p value-0.7747) neonates between percent weight loss and use of phototherapy was found.

Table 9: Distribution of gender, serum sodium level and percent weight loss in neonates and on 3rd DOL with birth weight between 2.5-2.9 kg

Birth Weight	% Weight Loss on 3rd DOL	Serum sodium level in neonate on 3rd DOL															
		125-135 meq/l (18 neonate)				136-145 meq/l (95 neonate)				146-155 meq/l (34 neonate)				156-165 meq/l (1 neonate)			
		M	% neonate	F	% neonate	M	% neonate	F	% neonate	M	% neonate	F	% neonate	M	% neonate	F	% neonate
2.5-2.9 KG	<5	4	22.22%	5	27.78%	9	9.47%	12	12.64%	2	5.88%	3	8.83%	0	00%	0	00%
	5-10	6	33.33%	3	16.67%	29	30.52%	37	38.94%	13	38.23%	11	32.36%	0	00%	1	100%
	>10	0	00%	0	00%	4	4.21%	4	4.22%	4	11.76%	4	2.94%	0	00%	0	00%
Total		10	55.55%	8	44.45%	42	44.20%	53	55.80%	13	55.87%	19	44.13%	0	00%	1	100%

On 3rd DOL, no significant association in male (p value-0.2266) and female (p value-0.3381) neonates between percent weight loss and serum sodium level whose birth weight is between 2.5-2.9 kg.

Table 10: Distribution of gender, serum sodium level and percent weight loss in neonates and on 3rd DOL with birth weight between >3 kg

Birth Weight	% Weight Loss on 3rd DOL	Serum sodium level in neonate on 3rd DOL															
		125-135 meq/l (4 neonate)				136-145 meq/l (33 neonate)				146-155 meq/l (13 neonate)				156-165 meq/l (2 neonate)			
		M	% neonate	F	% neonate	M	% neonate	F	% neonate	M	% neonate	F	% neonate	M	% neonate	F	% neonate
>3 KG	<5	2	50%	1	25%	6	18.18%	3	9.09%	1	7.69%	0	00%	0	00%	0	00%
	5-10	0	00%	1	25%	14	42.42%	8	24.25%	6	46.15%	3	23.08%	0	00%	0	00%
	>10	0	00%	0	00%	1	3.03%	1	3.03%	0	00%	3	23.08%	1	50%	1	50%
Total		2	50%	2	50%	21	63.63%	12	36.37%	7	53.84%	6	46.16%	1	50%	1	50%

On 3rd DOL, significant association in male neonates (p value-0.0019) between percent weight loss and serum sodium level whose birth weight is >3 kg. There is no significant association in female (p value-0.1620) neonates on 3rd DOL between percent weight loss and serum sodium level whose birth weight is >3 kg.

Table 11: Distribution of gender, serum sodium level and percent weight loss in neonates and on 5th DOL with birth weight between 2.5-2.9 kg

Birth Weight	% weight loss on 5th DOL	Serum sodium level in neonate on 5th DOL															
		125-135 meq/l (31 neonate)				136-145 meq/l (107 neonate)				146-155 meq/l (9 neonate)				156-165 meq/l (1 neonate)			
		M	% neonate	F	% neonate	M	% neonate	F	% neonate	M	% neonate	F	% neonate	M	% neonate	F	% neonate
2.5-2.9 KG	<5	1	3.24%	4	12.90%	14	13.08%	16	14.96%	1	11.11%	2	22.22%	0	00%	0	00%
	5-10	12	38.70%	9	29.03%	31	28.98%	38	35.51%	2	22.22%	3	33.34%	1	100%	0	00%
	>10	2	6.46%	3	9.67%	7	6.54%	1	0.93%	0	00%	1	11.11%	0	00%	0	00%
Total		15	48.40%	16	51.60%	52	48.60%	55	51.40%	3	33.33%	6	66.67%	1	100%	0	00%

On 5th DOL, no significant association in male (p value-0.6791) and female (p value-0.1271) neonates between percent weight loss and serum sodium level whose birth weight is between 2.5-2.9 kg.

Table 12: Distribution of gender, serum sodium level and percent weight loss in neonates and on 5th DOL with birth weight between >3 kg

Birth Weight	% weight loss on 5th DOL	Serum sodium level in neonate on 5th DOL															
		125-135 meq/l (8 neonate)				136-145 meq/l (32 neonate)				146-155 meq/l (10 neonate)				156-165 meq/l (2 neonate)			
		M	% neonate	F	% neonate	M	% neonate	F	% neonate	M	% neonate	F	% neonate	M	% neonate	F	% neonate
>3 KG	<5	1	12.5%	1	12.5%		15.62%	4	12.5%	3	30%	1	10%	0	00%	0	00%
	5-10	4	50%	2	25%		37.5%	8	25%	0	00%	0	10%	0	00%	1	50%
	>10	0	00%	0	00%		6.25%	1	3.13%	4	40%	2	20%	0	00%	1	50%
Total		5	62.5%	3	37.5%		59.37%	13	40.63%	7	70%	3	30%	0	00%	2	100%

On 5th DOL, significant association (p value-0.0144) was evident between percent weight loss and serum sodium level in male neonate whose birth weight is >3 kg. There is no significant association (p value-0.1993) in female neonate whose birth weight is >3 kg on 5th DOL between percent weight loss and serum sodium level.

Discussion

Weight loss in neonates after birth is a well-known fact. It is important to know percent weight loss as excess weight loss more than 10 % associated with hypernatremia and also with breastfeeding failure in neonates, despite improving resource and support for woman choosing to breastfeed. Traditionally weight loss in neonates has been divided into in three groups i.e. < 5 % weight loss, 5-10 % weight loss and > 10 % weight loss.

1. Weight loss: In our study on 3rd DOL out of 200 neonates, 48(24%) neonates had a weight loss of <5% of birth weight, 134(67%)neonate with weight loss of 5-10% of birth weight and 18(9%) neonates had >10% weight loss of birth weight whereas on 5th DOL 53(26.5%) neonates had weight loss of <5% of birth weight, maximum 123(61.5%) neonates with weight loss of 5-10% of birth weight and 24(12%) neonates had >10% weight loss of birth weight.

Incidence of significant weight loss (>10 %) found to be in 18 neonates (9 %) and out of these 9 neonate (50%) were

hypernatremic on 3rd DOL. And on 5th DOL, incidence of significant weight loss (>10 %) was found to be in 24 neonates (12 %) and out of these 6 neonate (25%) were hypernatremic.

In a study by Moritz M L, *et al* (2005) [11], medical records of neonates who had suspected breast feeding associated hypernatremia were searched, it was found that 73 % of such infants had > 10 % of weight loss on admission but only 5 % of these neonates were referred to hospital by their doctors because of excessive weight loss, indicating that the referring doctors were not aware of importance of relationship between hypernatremia and excessive weight loss. Authors quote that 'weight loss and inadequate stooling are sensitive indicators of dehydration among breastfed infants'. Breast feeding associated hypernatremia can be difficult to recognize clinically. Because infants with hypernatremic dehydration have better preserved extracellular volume and therefore have less pronounced clinical signs of dehydration.

In a study by Dewey KG (2003) [12], while studing risk factors for suboptimal infant breastfeeding behavior, It was found that 16% of exclusively breastfed infants born to primiparous women had >10 % of weight loss by 3rd DOL inspite of education and support provided by lactation consultant and delayed onset of lactation was an important contributory factor for excessive weight loss.

2. Weight loss and hypernatremia: In our study on 3rd DOL, out of 200 neonates, 22(11%) neonates had a serum sodium level of 125-135 meq/l, 128(64%) neonates had 136-145 meq/l, 47(23.5%) neonates had 146-155 meq/l and 3(1.5%) neonates had 156-165 meq/l whereas on 5th DOL 39(19.5%)neonates had a serum sodium level of 125-135 meq/l, 141(70.5%) neonates had 136-145 meq/l, 18(9%)neonates had 146-155 meq/l and 2(1%) neonate had 156-165 meq/l. Incidence of hypernatremic neonate was found to be 20 neonates (10%).

Bhat SR, *et al.* [13], Conducted a study on 496 neonates and results of the study show 157 (31.6%) neonates had significant weight loss (>10%), out of these 157 neonates(31.8 %) had hypernatremia.

Oddie S, Richmond S (2001) [3] studied reported that 10 % of breastfeed infants developed hypernatremia and nearly 33% of breastfeed infants with weight loss exceeding 10 % had hypernatremia.

3. Risk factors for weight loss and hypernatremia: In our study we have assessed risk factors associated with significant weight loss and hypernatremia in neonates.

Moritz M L *et al* (2005)[11] conducted a retrospective study on 3718 neonates and they found that hypernatremic infants were significantly more likely to be born to primiparous mothers than were infants in control group. In our study there was no significant association between significant weight loss, hypernatremia in neonates and parity of mother. This may be partly due to the cultural practice of taking mother during first delivery to her own parents home and in supportive environment.

In the same study Moritz M L *et al* found that breastfeeding associated hypernatremia was found in 70 breastfed neonates within 29 days of age over a period of 5 years, hyperperbilirubinemia (>15 mg /dl) was most common metabolic complication, occurring in 50 i.e. 71 % of neonates. While in our study only 8 neonates required phototherapy and there was no significant association found between significant weight loss and use of phototherapy on 3rd as well as on 5th DOL. This could be because of small sample size in our study.

In our study there was no significant association found between significant weight loss on 3rd as well as on 5th DOL and mode of delivery.

Conclusion

This study concludes, there is a significant correlation between significant weight loss and hypernatremia in exclusively breastfed full term male neonates on 3rd and 5th DOL with birth weight more than 3 kgs. Healthcare providers should be aware of this potentially serious complication of insufficient breastfeeding and its association with excessive weight loss.

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