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Research Article

UMBILICAL CORD BLOOD NUTRIENTS AMONG LOW BIRTH WEIGHT AND NORMAL BIRTH WEIGHT BABIES IN PRIMARY HEALTH CARE SETUP IN LUCKNOW, INDIA

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DOI: 10.7897/2321-6328.01403

Article Received on: 15/09/13

Accepted on: 17/11/13

Abstract

Maternal factors have an effect on the birth weight. As a result of which, there is a high prevalence of low birth weight (LBW) babies. LBW babies have less nutrient reserve. Protein and iron are the key elements for neonatal growth and development. Deficiency of trace elements during intrauterine period is closely related to morbidity and mortality of the newborn. To assess the umbilical cord blood nutrients in low birth weight and normal birth weight babies. The present cross section study was conducted from 2011 to 2012 at Sarojni Nagar PHC, Lucknow, Uttar Pradesh, India. Study subjects included pregnant women who were registered in the third trimester of pregnancy at PHC Sarojni Nagar and followed up till delivery. Maternal biosocial characteristics like age, parity, height, weight and haemoglobin were recorded. Cord blood was collected from 42 LBW and 67 NBW babies delivered at the PHC Sarojni Nagar. In cord blood, serum iron, TIBC, serum protein and serum albumin were investigated. As evident from results s. protein, s. albumin and s. iron were significantly low in LBW babies than normal birth weight babies. In low birth weight group, serum protein, albumin and iron were insignificantly low in preterm than term LBW. TIBC showed inverse relationship, level of TIBC was high in LBW than NBW. In low birth weight group TIBC was also significantly high in preterm. LBW babies are born with significant lower nutrition reserve at birth. Finally this study can be integrated with existing health programme for better development of low birth weight babies and accordingly to provide supplementary nutrition to the pregnant women and low birth weight babies.

Keywords: Low Birth Weight, Cord Blood, Serum Protein, Serum Albumin, Serum Iron.

INTRODUCTION

Low birth weight (LBW) is the key determinant of neonatal mortality, morbidity, subsequent growth and developmental retardation and also early onset of adulthood diseases[1]. The rates of preterm delivery and low birth weight neonates have increases in the resent years in spite of increase antenatal visits[2]. Metabolic demands increase in pregnancy, both for the mother and for the developing fetus[3]. Nutritional reserve especially micronutrient stores are considered low in low birth weight babies at birth. The extent of nutritional deficiency in preterm and term low birth babies is likely to be different. Preliminary data in this regard in developing countries like India is scanty and still to be explored in larger sense. In developing countries 98 % of preterm delivery occurs due to nutritional deficiency[4]. Furthermore, other nutritional deficiencies such as deficiency of protein, vitamins etc. may also be responsible for preterm delivery especially in developing countries[2]. Albumin acts as a transport protein for trace elements. In addition to this, protein deficiency, especially deficiency of albumin and globulin may also be responsible for decreased maternal plasma Cu concentration, as they act as Cu-binding vehicle[5,6]. Deficiency of trace elements during intrauterine existence is closely related to mortality and morbidity of the newborn[7]. Anaemia is often the consequence of iron deficiency, when dietary intake of iron is low, preterm and low-birth-weight infants are at risk of iron deficiency as a result of reduced foetal iron stores[8]. The status of these elements will have impact on normal growth and development of the foetus inside the womb[9]. Current recommendations for nutritional and micronutrient supplementation and complementary feeding for LBW babies need to be modified based on the differences between low birth weight and normal birth weight babies. Therefore we undertook this study with the objective to look at key biochemical and clinical parameters of a group of low birth weight at birth including preterm and term babies and to stabilise the role of cord blood nutrient and determining the birth weight of babies in different group.

MATERIAL AND METHODS

This descriptive study was conducted from Oct 2011 to May 2012 at primary health centre (PHC) Sarojni Nagar in district Lucknow, Uttar Pradesh, India. Study subjects included pregnant women who were registered in the third trimester of pregnancy at PHC Sarojni Nagar and followed up till delivery. The sample size was calculated to be 323, taking prevalence of low birth weight as 28 %[10], with relative precision of 20 % and design effect of 1.25. Out of these 323

pregnant women, 291 could be followed up and amongst these 287 pregnant women delivered a live baby. The birth weight was measured in these 287 live births. In 287 births, 82 were LBW and 205 were normal birth weight (NBW). Due to feasibility constraints, cord blood could be collected only from babies of those women, who delivered at the PHC in the daytime. Cord blood could be collected from 42 LBW and 67 NBW babies with the help of doctor/staff conducting delivery at the PHC Sarojni Nagar. Data collection was done on two occasions. The pregnant women attending the PHC during the third trimester were interviewed with the help of a pre-designed and pre-tested structured questionnaire to study their socio-demographic profile. Socioeconomic status of the family was assessed using modified Pareek's socioeconomic scale. Anthropometric measurement followed by laboratory testing of haemoglobin of pregnant women by Sahli's method was done. Pregnant women were examined per abdominally with the help of lady medical officer to correlate the date of last menstrual period (LMP) as told by the pregnant women. For the assessment of gestational age clinical and ultrasonogram criteria was used. Follow-up of the pregnant women was done during delivery and the birth weight of newborn was recorded with the help of a baby weighing machine immediately following delivery. Weight was measured up to minimum of 100 g. Written consent was taken from the subjects for umbilical cord blood collection. Umbilical cord blood (5 ml) was collected from the placenta of all the subjects within five minutes of delivery into plain tubes and centrifuged for 8 minutes. After centrifugation of blood, serum was separated in eppendroff tube. In umbilical cord blood, serum iron, TIBC, serum protein and serum albumin were investigated in the department of pathology, KG Medical University, Lucknow, India. The source of chemicals, substrates and diagnostic kits for analysis were first identified as per standardized procedures. Specific colorimetric assays were done for total protein (Biuret), Serum Albumin (Bromocresol Dye), iron and TIBC (Ferrozine method). Collected data were tabulated and analysed with the help of SPSS 17. Chi square test and t-test were used. Pearson's correlation coefficient was used to assess the relationship between birth weight and cord blood nutrients. Significance level was set at p value < 0.05.

RESULT

Out of 287 babies born during a one year of study, about 82 were LBW and 205 were NBW. In these subjects cord blood were collected from 42 LBW babies and 87 NBW babies. In maternal characteristics anthropometric, social and nutritional parameters were taken. In anthropometric measurements weight of pregnant women was significantly different in low birth weight babies and normal birth weight babies. Mean weight of pregnant women of LBW group was 48.7 ± 6.2 kg and NBW group was 50.7 ± 7.2 kg. In social characteristics socioeconomic status and age were significantly differed between LBW and NBW. Mean age of pregnant women in LBW and NBW group were 23.0 ± 3.0 years and 25.7 ± 3.5 years respectively. In nutritional parameter haemoglobin status and iron intake were significantly different in both group [Table 1].

Table 1: Maternal characteristics of subjects whom cord blood were collected

Parameters	Low birth Weight (n = 42)	Normal birth Weight (n = 67)	P-value
Age (mean)	23.0 ± 3.0	25.7 ± 3.5	< 0.001
Height (mean)	148.3 ± 5.6	149.0 ± 5.8	0.383
Weight in third trimester (mean)	48.7 ± 6.2	50.7 ± 7.2	0.028
Haemoglobin	9.2 ± 1.5	10.3 ± 1.3	< 0.001
Parity			
≤ 2	38 (90.5 %)	54 (80.6 %)	0.169
> 2	4 (9.5 %)	13 (19.4 %)	
Education			
Illiterate	12 (28.6 %)	18 (26.9 %)	0.846
Literate	30 (71.4 %)	49 (73.1 %)	
Socioeconomic status			
Class III	4 (9.4 %)	18 (26.9 %)	0.04
Class IV	24 (57.1 %)	37 (55.2 %)	
Class V	14 (33.3 %)	12 (17.9 %)	
Protein (g/day) intake	55.6 ± 10.6	59.0 ± 12.8	0.154
Iron (g/day) intake	27.7 ± 5.2	31.1 ± 6.0	< 0.001

Mean weight of newborn was 2.62 ± 0.45 kg. In low birth weight group, mean weight of term LBW and preterm LBW were 2.13 ± 0.16 kg and 2.11 ± 0.16 kg respectively

Table 2: Mean birth weight of study group

Study group	Birth weight (kg)			
	Mean	SD	Range	
			Minimum	Maximum
Low birth weight	2.10	0.16	1.50	2.40
Term low birth weight	2.13	0.16	1.50	2.40
Preterm low birth weight	2.11	0.16	1.80	2.40
Normal birth weight	2.87	0.36	2.50	4.00
Mean birth weight	2.62	0.45	1.50	4.00

In LBW serum level of protein, albumin and iron were below the expected normal range but TIBC was more than the expected normal range. The difference observed in the biochemical parameters between LBW and NBW was statistically significant

Table 3: Comparison of LBW and NBW on the basis of their cord blood biochemical parameters

Parameters	Low Birth Weight (n = 42)	Normal birth weight (n = 67)	P value
Total protein (g/dl) (4.6-7.6)	4.5 ± 0.9	6.9 ± 0.9	< 0.001
S. albumin (g/dl) (2.5-3.4)	2.4 ± 0.6	3.8 ± 0.6	< 0.001
TIBC (µg/dl) (60-175)	265.6 ± 23.1	231.8 ± 54.6	< 0.001
S. iron (µg/dl) (100-250)	68.1 ± 22.0	153.1 ± 24.6	< 0.001

There was no statistically significant relation between preterm and term babies for the s. protein, albumin and iron value. However the difference in serum TIBC between the preterm and term Low Birth Weight babies was found to be statistically significant

Table 4: Preterm and term LBW babies on the basis of their cord blood biochemical parameters

Parameters	Low Birth Weight (n=42)		p-value
	Preterm (n = 19) mean ± SD	Term (n = 23) mean ± SD	
Total protein (g/dl) (Preterm 4.3-7.6) (Term 4.6-7.4)	4.3 ± 0.8	4.7 ± 1.0	0.212
S. albumin (g/dl) (Preterm 1.8-3.0) (Term 2.5-3.4)	2.4 ± 0.5	2.5 ± 0.7	0.639
TIBC (µg/dl) (60-175)	276.4 ± 22.7	256.7 ± 19.8	0.005
S. iron (µg/dl) (100-250)	66.8 ± 27.5	69.1 ± 16.7	0.738

Birth weight was showed significant correlation with umbilical cord nutrients. Serum protein, serum albumin and serum iron were directly correlated but TIBC was inversely correlated with birth weight

Table 5: Pearson correlation coefficient between birth weight and cord blood nutrients

Parameter	Cord blood nutrient	Pearson coefficient (r^2)	P value
Birth weight	S. protein	0.590	< 0.01
	S. albumin	0.544	< 0.01
	S. iron	0.697	< 0.01
	S. TIBC	-0.201	0.036

DISCUSSION

In India low birth weight is major problem, where the prevalence of low birth babies is high up to 28 percent[10]. Birth weight of a baby is a good indicator for mother's health and nutritional status, as well as outcome for survival, growth, long-term health and psychosocial development of the baby[11,12]. LBW babies weighing less than 2.5 kg; face a greater risk of dying and is the main contributor with respect to neonatal, infant and under five mortality. Out of those who survive have impaired immune function and have increased risk of early onset of adulthood diseases like diabetes and heart disease later in life, as per the 'Barker hypothesis'[13] and the 'foetal origin of adulthood disease (FOAD) hypothesis[1]. They are also likely to remain malnourished and may have lower IQ and cognitive disabilities leading to school failure and learning difficulties[11,12]. The lower nutrient levels at birth are liable to be further lowered by recurrent infection, inappropriate feeding habits, so they need nutritional surveillance, extra feeding and nutrient supplements. Growth alteration and developmental delays is the rule in those to continue to be malnourished[14]. It has been reported earlier that very low levels of micronutrient documented in children with malnutrition[15] and the positive outcome in growth has been documented extensively using comprehensive early interventions including nutritional and developmental inputs[15,16]. The result of iron deficiency in neonatal period is affecting the production of neurotransmitters dopamine, serotonin and GABA. So it is believe that iron deficiency causes irreversible, decreasing physical stigma, cognitive ability and learning ability[17-21]. In the current study, low birth weight babies serum level of protein, albumin and iron were below the expected normal range but TIBC was more than the expected normal range. The difference observed in the biochemical parameters between low birth weight and normal birth weight babies was statistically significant. There was no significant relation between preterm and term babies for the s. protein, albumin and iron value. However the difference in serum TIBC between the preterm and term Low Birth Weight babies was found to be statistically significant. One study was found to be consistent with only one recent report[17]. According to these study nutrients measured namely total protein, albumin, cholesterol, triglycerides, calcium, magnesium, zinc and iron were significantly lower in LBW babies compared to term control babies. These values were lowest in preterm LBW followed by term LBW. TIBC showed inverse association with iron. In other studies, Iron level was higher in cord blood of normal birth weight babies than in low birth weight babies. Decrease availability of iron in cord blood might cause a reduction in birth weight and also preterm delivery of baby[18,19]. In developing countries pregnant women consume diets with a lower quantity of protein, minerals and vitamins[22,23]. So this finding may be due to inadequate diet. Poor socioeconomic status and low haemoglobin level of the pregnant women may be another cause. Low serum protein and albumin among newborns is of concern as it will lead to reduced oncotic pressure and carrier protein. According to another study preterm infant have

special nutrition need in the period post discharge from the neonatal unit[22].

CONCLUSION

Low birth weight babies are born with significantly lower nutritional reserve at birth compared to normal birth weight babies. LBW serum level of protein, albumin and iron were below than expected normal range but TIBC was more than the expected normal range. The difference observed in the biochemical parameters between low birth weight and normal birth weight babies was statistically significant. Finally, this study can be integrated with existing health programme for better development of low birth weight babies and/or accordingly to suggest supplementary nutrition to the pregnant women and low birth weight babies.

REFERENCES

1. Eriksson JG. The foetal origins hypothesis - 10 years on. BMJ 2005; 330: 1096-7. http://dx.doi.org/10.1136/bmj.330.7500.1096 PMid:15891207 PMCid:PMC557875
2. Costello AM, Osrin D. Micronutrient status during pregnancy and outcomes for newborn infants in developing countries. J Nutr 2003; 133: 1757S-1764S. PMid:12730495
3. Walravens PA. Nutritional importance of copper and zinc in neonates and infants. Clin Chem 1980; 26(2): 185-189. PMid:6986210
4. Iams JD. Prediction and early detection of preterm labor. Obstet Gynecol 2003; 101: 402-412. http://dx.doi.org/10.1016/S0029-7844(02)02505-X
5. Perveen S, Altaf W, Vohra N, Bautista ML, Harper RG, Wapnir RA. Effect of gestational age on cord blood plasma copper, zinc, magnesium and albumin. Early Human Development 2002; 69: 15-23. http://dx.doi.org/10.1016/S0378-3782(02)00024-5
6. Bro S, Berendtsen H, Norgaard J, Host A, Jorgensen PJ. Serum zinc and copper concentrations in maternal and umbilical cord blood relation to course and outcome of pregnancy. Sca J Clin Lab Invest 1988; 48: 805-811. http://dx.doi.org/10.3109/00365518809088764
7. Casey CE, Walravens PA. Trace elements. In: Tsang RC, Nichols BL. Eds. Nutrition during infancy. Philadelphia, Hanley and Belfus; 1988. p. 190-215.
8. Allen LH. Anaemia and iron deficiency: effects on pregnancy outcome, The American Journal of Clinical Nutrition 2000; 71: 1280–1284.
9. Baranski B. Effect of cadmium on prenatal development and on tissue cadmium, copper and zinc concentration in rats. Environmental Research 1987; 42: 54-62. http://dx.doi.org/10.1016/S0013-9351(87)80006-3
10. WHO and UNICEF. Low birth weight: Country, regional and global estimates, Geneva: World Health Organization; 2011.
11. Goldenberg RL, Hoffman HJ, Cliver SP. Neuro-developmental outcome of small for gestational age infants. Eur J Clin Nutr 1998; 52: 54-58.
12. Hack M. Effects of intrauterine growth retardation on mental performance and behaviour: outcomes during adolescence and adulthood. Eur J Clin Nutr 1998; 52(1): 65-71.
13. Stein CE, Fall CH, Kumaran K, Osmond C, Cox V, Barker DJ. Foetal growth and coronary heart disease in south India. Lancet 1996; 348: 1269-73. http://dx.doi.org/10.1016/S0140-6736(96)04547-3
14. Sathy N, Elizabeth KE, Nair MKC, Sugunabai NS. Growth faltering and developmental delay in children with PEM. Indian Pediatr 1991; 28: 255-8. PMid:1718866
15. Elizabeth KE. Status of micronutrients in malnutrition before and after rehabilitation. Indian Pediatr 2000; 37: 912-3. PMid:10951651
16. Elizabeth KE, Sathy N. The role of developmental stimulation in nutritional rehabilitation. Indian Pediatr 1997; 34: 681-95. PMid:9492396
17. Elizabeth KE, Krishnan V, Vijayakumar T. Umbilical cord blood nutrients in low birth weight babies in relation to birth weight and gestational age. Indian J Med Res 2008; 128: 128-133. PMid:19001675
18. Ahokas RA, Dilts PVJ. Cadmium uptake by the rat embryo as a function of gestational age. American Journal of Obstetrics and Gynecology 1979; 135: 219-222. PMid:474675
19. Srivastava S, Mehrotra PK, Srivastava SP, Siddiqui MKJ. Some Essential Elements in Maternal and Cord Blood in Relation to Birth Weight and Gestational Age. In Biological trace element research 2001; 86: 97-105.
20. Walter T. Effect of iron deficiency anaemia on cognitive skills in infancy and childhood. In: Halbergh L, George N. Eds. Iron nutrition in health and disease. London, Nestle Foundation and John Libbey; 1996. p. 219-29.PMid:8580497
21. Evans D. Cerebral function in iron deficiency: a review. Child Care Health Dev 1985; 11: 105-12.
22. Reifen RM, Zlotkin S. Micro minerals. In: Tsang RC, Lucas A, Uauy R, Zlotkin S. Eds. Nutritional needs of the preterm infant. Baltimore, Williams and Wilkins; 1993. p. 195-208. http://dx.doi.org/10.1111/j.1365-2214.1985.tb00455.x PMid:4028339
23. Mahan LK, Escott Stump S. Nutrition during pregnancy and lactation. In: Krause's Food, Nutrition and diet therapy. Philadelphia: WB Saunders Company; 2004. p. 183-189.

Cite this article as:
Krishna Kumar Sahu, M.Z Idris, Monika Agarwal, S.K Singh, Wahid Ali, Pratap Shankar, R.K. Dixit. Umbilical cord blood nutrients among low birth weight and normal birth weight babies in primary health care setup in Lucknow, India. J Biol Sci Opin 2013; 1(4): 300-303 http://dx.doi.org/10.7897/2321–6328.01403

Source of support: Nil; Conflict of interest: None Declared