Nutritional Status of Low Birth Weight Infants: A Longitudinal Study in Mysore City, Karnataka

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Abstract

The birth weight of an infant is a reliable index of intrauterine growth and a sensitive predictor of newborn's chances of survival, growth and development throughout infancy and childhood and long term physical and psychosocial development. Low birth weight (LBW) is defined by the World Health Organization as weight at birth less than 2500 g. Overall, it is estimated that 15 to 20% of all births worldwide are LBW, representing more than 20 million births a year. The incidence of LBW especially in developing countries is much higher comparable to developed countries. In India, the prevalence of LBW infants is about 33%, as compared to 4.5% in industrially developed countries and 17.4% of LBW babies was found in Karnataka state. Growth of LBW infants during first year of life is crucial not just for the time being but it has a lifelong implication. Compared to normal birth weight (NBW) infants, LBW infants may experience a different pattern of growth and nutritional status. The relationship of LBW to subsequent physical growth including nutrition status and developments has been a subject of a great deal of study in recent years. In present study an attempt has been made to assess the nutritional status of LBW infants at birth, 6th, 12th, 18th and 24th month of age. A prospective longitudinal study was carried out on LBW infants born during 1st to 30th September 2010 at 6 selected hospitals of Mysore city. A total of 106 LBW infants were selected as sample group. The findings of the present study were clearly indicated that first six months period was crucial for LBW infants from nutritional point view. A higher percentage of male infants were severely underweight than female infants during the first six months. Beyond 6 months a higher percentage of male infants were moderately underweight than female infants. This clearly confirms that male LBW infants were more vulnerable for underweight than female LBW infants. A highly significant association was observed between genders with regard to underweight among LBW infants. There were ups and downs with incidence of moderately and severely stunting among LBW infants. Though the severity of stunting was decreased beyond 12th month but it was not up to acceptable level. A higher percentage of male infants were under stunting than female infants at all ages. This clearly confirms that male LBW infants were more vulnerable for stunting than female LBW infants. A highly significant association was observed between genders with regard to stunting among LBW infants. According to BMI-for-age, 91.5 percentages of LBW infants were below undernutrition at

the beginning and by the ending it was reduced to 8.4 percentages. But no significant association was observed between genders with regard to undernutrition among LBW infants. This clearly shows that the situation of malnutrition among LBW infants has improved by the end of second year of life. But a serious and dedicated efforts need to be put forth to quickly improve the health status of LBW infants.

Key Words: *Low birth weight infants, stunting, underweight, undernutrition*

Introduction

The birth weight of an infant is a reliable index of intrauterine growth and a sensitive predictor of newborn's chances of survival, growth and development throughout infancy and childhood (Kosińska, et.al. 2004) and long term physical and psychosocial development (Metgud, et.al , 2012). Birth weight measured during the first hour after birth also reflects the nutritional status of both the newborn infant and the mother. Low birth weight (LBW) is a risk factor linked with both infant mortality and morbidity and is used to investigate the conditions for survival and the quality of life of individuals (Motta, et.al, 2005). From past two decades, the survival rate of newborns with LBW has been significantly increased due to advancement of Neonatal Intensive Care Unit (NICU) services. LBW is defined by the World Health Organization as weight at birth less than 2500 g. Overall, it is estimated that 15% to 20% of all births worldwide are LBW, representing more than 20 million births a year (WHO, 2014). The incidence of LBW especially in developing countries is much higher comparable to developed countries. In India, the prevalence of LBW infants is about 33%, as compared to 4.5% in industrially developed countries (Gosavi and Koparkar, 2014). According to UNICEF and WHO, almost 8 million babies are born in India each year wherein almost one third neonates are LBW, this indicates an incidence of 30 percent which is highest in the world i.e. nearly 40 percent of global burden – the highest of any country (Ram, et.al. 2011). According to Indian Statistical Institute Analysis based on data of NFHS–3, the highest percentage of LBW babies was found in the North zone (26.60%) while the least percentage of LBW babies was seen in the north-east zone (13.67%) of India. 17.4% of LBW babies was found in Karnataka state (Bharati, et.al., 2011). The community based study conducted in rural Karnataka in 2008-09 observed a prevalence of LBW babies was 22.9% (Metgud, et.al , 2012). Prevalence of LBW was 20.1 % in villages under a primary health centre catering population of 26,977 Mysore district (Narayanamurthy, et.al. 2013).

Growth of LBW infants during first year of life is crucial not just for the time being but it has a lifelong implication. LBW infant gets an opportunity to recover its growth deficit of intra-uterine life in postnatal

period and to catch up with its normal birth weight (NBW) siblings (Borah and Baruah, 2014). Adaptation to extra-uterine life is an energy-consumptive process due to increased losses from respiration, metabolism, thermoregulation, tissue synthesis, and activity (Ernst et.al., 2003). During this adaptive period, NBW infants may lose up to 10% of their birth weight, while preterm and LBW infants may lose up to 15 to 20% of their birth weight. Furthermore, it is a time to return to birth weight (Ernst et.al., 2003). LBW infants may experience a different pattern of physical growth to those born with NBW and LBW infants are more likely to remain underweight subsequently (Kosińska, et.al. 2004). Child Malnutrition has been defined as a pathological state resulting from inadequate nutrition, including under-nutrition and over-nutrition. Child malnutrition or failure to thrive in the early years of life has been reported as major causes of death among children worldwide especially in developing countries. The LBW survivors are at a high risk of developing malnutrition (Gosavi and Koparkar, 2014). Compared to NBW infants, LBW infants may experience a different pattern of growth and nutritional status. The studies revealed that a higher percentage of LBW children with deficits in weight/age (W/A) and stature/age (S/A) indices at the end of their first year of life and LBW babies had a nine times greater chance of presenting a stature/age deficit by the end of their second year of life (Motta, et.al., 2005). The relationship of LBW to subsequent physical growth including nutrition status and developments has been a subject of a great deal of study in recent years. In present study an attempt has been made to assess the nutritional status of LBW infants in terms underweight (weight/age deficits), stunting (length/age deficits) and malnutrition (body mass index/age deficit) at birth, 6^{th}, 12^{th}, 18^{th} and 24^{th} month of age.

Materials and Methods

A prospective longitudinal study was carried out to assess the nutritional status of LBW infants from birth to 24 months of age. LBW infants born during 1^{st} to 30^{th} September 2010 at 6 selected hospitals of Mysore city were the sample for the study. The twin infants and LBW infants born with congenital anomalies or deformities were excluded from the study. All LBW infants whose parents had dwelling in Mysore city, gave informed consent to be the part of study and accessible for follow up study up to 24 months were included for the study. Ethical clearance was obtained from the Human Ethical Committee of University of Mysore, Mysore before starting of data collection. A total of 106 LBW infants were selected as sample group. Anthropometric measurements such as birth weight and birth length of newborn infants were taken from the hospitals' registers. Later on, the investigator had visited the households of samples to carry out the follow up recording of anthropometric measurements of infants up to 24 months. The length and weight parameters were further used to calculate Body Mass Index (BMI). Infants' weights, lengths and BMI were converted into weight-for age z-scores (WAZ), length-for-age z-scores

(LAZ) and BMI-for-age z-scores using median values from the World Health Organization Growth standard 2006 as the reference to assess the nutritional status of infants. The data were entered in MS Excel 2007 and statistical analysis was done in IBM - SPSS 19.0 version. Gender wise frequency and percentage were calculated. Chi-square test was applied to check the significant association between the genders and nutritional status.

Results and Discussion

According to figure – 1, of the total sample, higher percentages of females (57.54%) than males (42.45%) observed as LBW infants. **Table 1** shows the occurrence of underweight (weight-for-age) among LBW infants at birth, 6^{th}, 12^{th}, 18^{th} and 24^{th} month of age. At the time of birth, almost all LBW infants (96.3%) were moderately (49.1%) and severely (47.2%) underweight while only 3.8% were mildly underweight. Between the genders, higher percentage of males (57.8%) than females (41.0%) were severely underweight, while higher percentage of females (52.5%) than males (44.4%) were moderately underweight. At the age of 6^{th} month, each 50 percentage of LBW infants observed under moderate and severe level of underweight. Between the genders, higher percentage of males (82.2%) than females (26.2%) observed under sever level of underweight and vice versa result was observed with regard to moderate level of underweight. At the age of 12^{th} month**,** half of LBW infants (50.9%) observed under mild level of underweight followed by 8.5 percentages of them under moderate level of underweight and 0.9 percentages were under severe level of underweight. Between the genders, higher proportions of males (71.1%) than females (36.1%) were under mild level of underweight. Only male infants (20%) observed under moderate level of underweight while only female infants (1.6%) observed under severe level of underweight. At the age of 18^{th} month, majority (67.0%) of LBW infants observed under mild level of underweight, followed by 12.3 percentages were under moderate level of underweight and 0.9 percentage of them were severely underweight. Between the genders, higher percentages of males (71.1%) than females (63.9%) were under mild level of underweight. Only male infants (28.9%) were moderately underweight while only female infants (1.6%) were severely underweight. At the age of 24^{th} month, majority (67.9%) of them were mildly underweight followed by 11.3 percentage of them were moderately underweight and 0.9 percent were severely underweight. Between the genders, higher percentages of males (75.6% and 24.4%) than females (62.3% and 1.6%) observed under mild and moderate level of underweight respectively, whereas only female infants (1.6%) observed under severe level of underweight. A highly significant association was observed between genders and level of underweight among LBW infants at birth, 6^{th}, 12^{th}, 18^{th} and 24^{th} month of age. This clearly confirms that level of underweight is dependent on gender. **Fig 2** shows that at birth, the incidence of severely

underweight infants was 47.2% and by six months of age, the incidence was increased to 50%. At 12 months, the incidence of severely underweight infants was significantly reduced to 0.9% and later it was stable till 24 months. This clearly indicates that first six months period was crucial for LBW infants from nutritional point view. A higher percentage of male infants were severely underweight than female infants during the first six months. Beyond 6 months a higher percentage of male infants were moderately underweight than female infants. This clearly confirms that male LBW infants were vulnerable for underweight than female LBW infants.

Table 2 shows the level of stunting based on length-for-age among LBW Infants at birth, 6^{th}, 12^{th}, 18^{th} and 24^{th} Month. At the time of birth, 26.5 percent of LBW infants were moderately (20.8%) and severely (5.7%) stunting while 44.4 percent of them were mildly stunting. Between the genders, higher proportions of males than females observed under mild (44.4% and 29.5%), moderate (28.9% and 6.7%) and severe (6.7% and 4.9%) level stunting respectively. At 6^{th} month, cent percent of LBW infants were moderately (34.9%) and severely (65.1%) stunting. Between the genders, cent percent of males and 39.3% of females were severely stunting. Only female infants (60.7%) were moderately stunting. At 12^{th} month**,** majority of LBW infants (49.1%) observed under mild level of stunting followed by 13.2 percent of them under moderate level of stunting. None of them were severely stunting. Between the genders, higher percentages of males (68.9%) than females (34.4%) were observed under mild level of stunting. Only male infants (31.1%) observed under moderate level stunting. None of the male infants were normal according to height for age. At 18^{th} month, majority (77.4%) of LBW infants observed under moderate level of stunting, followed by 19.8 percent under mild level of stunting and 2.8 percent of them under severe level of stunting. Between the genders, higher percentages of males (93.3%) than females (65.6%) were moderately stunting. Only male infants (2.8%) were severely stunting while only female infants (34.4%) were mildly stunting. At 24^{th} month, majority (54.7%) of them were observed under moderate level of stunting followed by 42.5 percent were at mild level of stunting and 2.8 percent were at severe level of stunting. Between the genders, higher percentages of males (60.0% and 4.4%) than females (50.8% and 1.6%) were observed under moderate and severe level of stunting while higher percentages of female infants (47.5%) than male infants (35.6%) were observed under mild level of stunting. A highly significant association was observed between genders of LBW infants with regard to level of stunting at birth, 6^{th}, 12^{th}, 18^{th} and 24^{th} month of age. This clearly confirms that level of stunting is dependent on gender. **Fig 3** shows the trend of stunting among LBW infants. At birth only 5.7 percentages of infants were at severe level of stunting and by 6^{th} months the incidence was increased to 65.1%. At 12 months of age, none of the LBW infants were at severe level of stunting. At 18 months and 24 months of age the

incidence of severely stunting was 2.8%. The incidence of moderately stunting was 20.8% at birth and at 6th month, the incidence was increased to 34.9%. At 12th month of age, incidence of moderately stunting was decreased to 13.2% and again it was increased to 77.4% at 18th month of age. At 24th month, the incidence of moderately stunting was reduced to 54.7%. There were ups and downs with incidence of moderately and severely stunting among LBW infants. Though the severity of stunting was decreased beyond 12th month but it was not up to acceptable level. A higher percentage of male infants were under stunting than female infants at all ages. This clearly confirms that male LBW infants were more vulnerable for stunting than female LBW infants.

Table 3 shows the level of malnutrition i.e. underweight and overweight based on BMI-for-age among LBW Infants at birth, 6th, 12th, 18th and 24th Month. At birth, 34.9 percentages of infants observed under severe level of underweight while 21.7 percentages of them were at moderate and 34.9 percentages of them were at mild level of underweight. Between the genders, higher percentages of females than males observed under moderate (23.0% and 20%) and severe (41.0% and 26.7%) level of underweight respectively. Vice-versa result was observed with regard to mild level of underweight i.e. higher percentages of males (42.2%) than females (29.5%) observed under mild level of underweight. At the age of 6th month, 48.1 percentages of infants observed under mild level of underweight followed by 10.4 percentages of them observed under moderate and 2.8 percentages of them observed under severe level underweight. Between the genders, higher percentages of males (51.1%) than females (45.9%) were mildly underweight. Vice versa result was observed with regard to moderate level of underweight i.e. higher percentages of females (14.8%) than males (4.4%) observed under moderate level of underweight. Only female infants (4.9%) observed under severe level of underweight. At 12th month**,** 18.9 percentages of infants were mildly underweight followed by 1.9 percent of them under moderate and 0.9 percent of them under severe level of underweight. Between the genders, higher percentages of males (24.4%) than females (14.8%) observed under mild level of underweight. Only female infants observed under moderate (3.3%) and sever (1.6%) level of underweight. At the age of 18th month, only 1.9 percentages of infants were at mild level of underweight followed by 0.9 percentages of them at severe level of underweight. Between the genders, higher percentages of males (2.2%) than females (1.6%) were at mild level of underweight. Only female infants (1.6%) observed under sever level of underweight. At 24th month of age, only 7.5 percentages of infants observed under mild and 0.9 percentages of them observed under severe level of underweight. Between the genders, higher percentages of females (8.2%) than males (6.7%) observed under mild level of underweight. Only female infants (1.6%) observed under severe level of underweight. No significant association of genders with regard to level of undernutrition was

observed within LBW infants at birth, 6th, 12th, 18th and 24th Month of age. **Fig 4** indicates that the incidence of severe level of underweight at birth was 34.9% and that was considerably reduced to 2.8% at 6th month of age and to 0.9% at 12th month of age, later it was remained stable till 24th month of age. The incidence of moderate level of underweight at birth was 21.7% and it was radically reduced to 10.4% at 6th month of age and further reduced to 1.9% at 12th month of age. None of the LBW infants were under moderate level of underweight at the age of 18th and 24th month. The incidence of mild level of underweight at birth was 34.9% and that was reduced to 7.5% by the age of 24th month. According to BMI-for-age, 91.5 percentages of LBW infants were below undernutrition at the beginning, it was reduced to 64.6 percentages by the age of 6th month. Further it was still reduced to 21.7% by the age of 18th month and by the age of 24th months, it was reduced to 8.5% percentages. This clearly shows that by the end of second year of life, the LBW infants had better nutritional status.

On the whole, low birth weight infants of the present are at nutritional risks. The study by Motta, et.al. (2005) revealed that a higher percentage of LBW children with deficits in weight/age (W/A) and stature/age (S/A) indices at the end of their first year of life and LBW babies had a nine times greater chance of presenting a stature/age deficit by the end of their second year of life.

Conclusion

Low birth weight is a sensitive predictor of newborn's chances of survival, growth and development. The findings of the present study clearly indicated that first six months period was crucial for LBW infants from nutritional point view. A higher percentage of male infants were severely underweight than female infants during the first six months. Beyond 6 months a higher percentage of male infants were moderately underweight than female infants. This clearly confirms that male LBW infants were more vulnerable for underweight than female LBW infants. A highly significant association was observed between genders with regard to underweight among LBW infants. There were ups and downs with incidence of moderately and severely stunting among LBW infants. Though the severity of stunting was decreased beyond 12th month but it was not up to acceptable level. A higher percentage of male infants were under stunting than female infants at all ages. This clearly confirms that male LBW infants were more vulnerable for stunting than female LBW infants. A highly significant association was observed between genders with regard to stunting among LBW infants. According to BMI-for-age, 91.5 percentages of LBW infants were below undernutrition at the beginning, it was reduced to 64.6 percentages by the age of 6th month. Further it was still reduced to 21.7% by the age of 18th month and by the age of 24th months, it was reduced to 8.5%

percentages. But no significant association was observed between genders with regard to undernutrition among LBW infants. This clearly shows that the situation of malnutrition among LBW infants has improved by the end of second year of life. But a serious and dedicated efforts need to be put forth to quickly improve the health status of LBW infants.

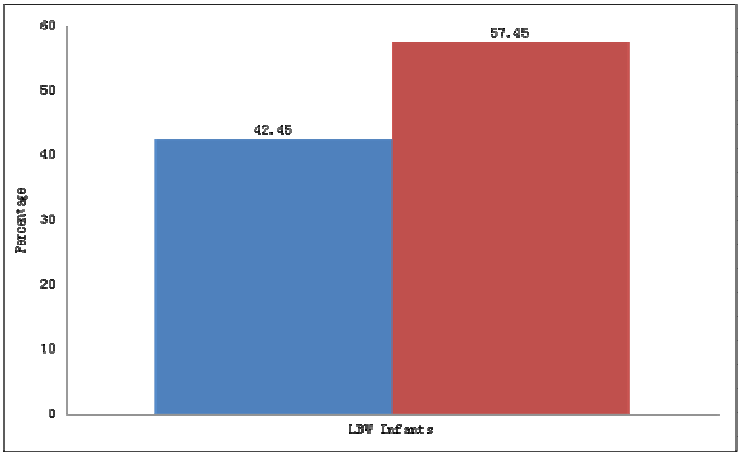

Fig 1: Gender wise Distribution of Low Birth Weight Infants

Table 1: Underweight (Weight-for-Age) among LBW Infants

Levels of Underweight		Normal		Mild		Moderate		Sever		χ^2 Value Sig
		No	%	No	%	No	%	No	%	
At Birth	F (n_1=61)	0	0.0	4	6.6	32	52.5	25	41.0	4.456 (d.f =2) P>0.108
	M (n_2=45)	0	0.0	0	0.0	20	44.4	25	57.8	
	T(n_3=106)	0	0.0	4	3.8	52	49.1	50	47.2	
6th month	F (n_1=61)	0	0.0	0	0.0	45	73.8	16	26.2	32.476 (d.f =1) P<0.001**
	M (n_2=45)	0	0.0	0	0.0	8	17.8	37	82.2	
	T(n_3=106)	0	0.0	0	0.0	53	50.0	53	50.0	
12th month	F (n_1=61)	38	62.3	22	36.1	0	0.0	1	1.6	37.822 (d.f =3) P<0.001**
	M (n_2=45)	4	8.9	32	71.1	9	20.0	0	0.0	
	T(n_3=106)	42	39.6	54	50.9	9	8.5	1	0.9	
18th month	F (n_1=61)	21	34.4	39	63.9	0	0.0	1	1.6	34.051 (d.f =3) P<0.001**
	M (n_2=45)	0	0.0	32	71.1	13	28.9	0	0.0	
	T(n_3=106)	21	19.8	71	67.0	13	12.3	1	0.9	
24th month	F (n_1=61)	21	34.4	38	62.3	1	1.6	1	1.6	28.797 (d.f =3) P<0.001**
	M (n_2=45)	0	0.0	34	75.6	11	24.4	0	0.0	
	T(n_3=106)	21	19.8	72	67.9	12	11.3	1	0.9	

* Significant association at 5% level; ** Significant association at 0.1% level;
NS- No significant association

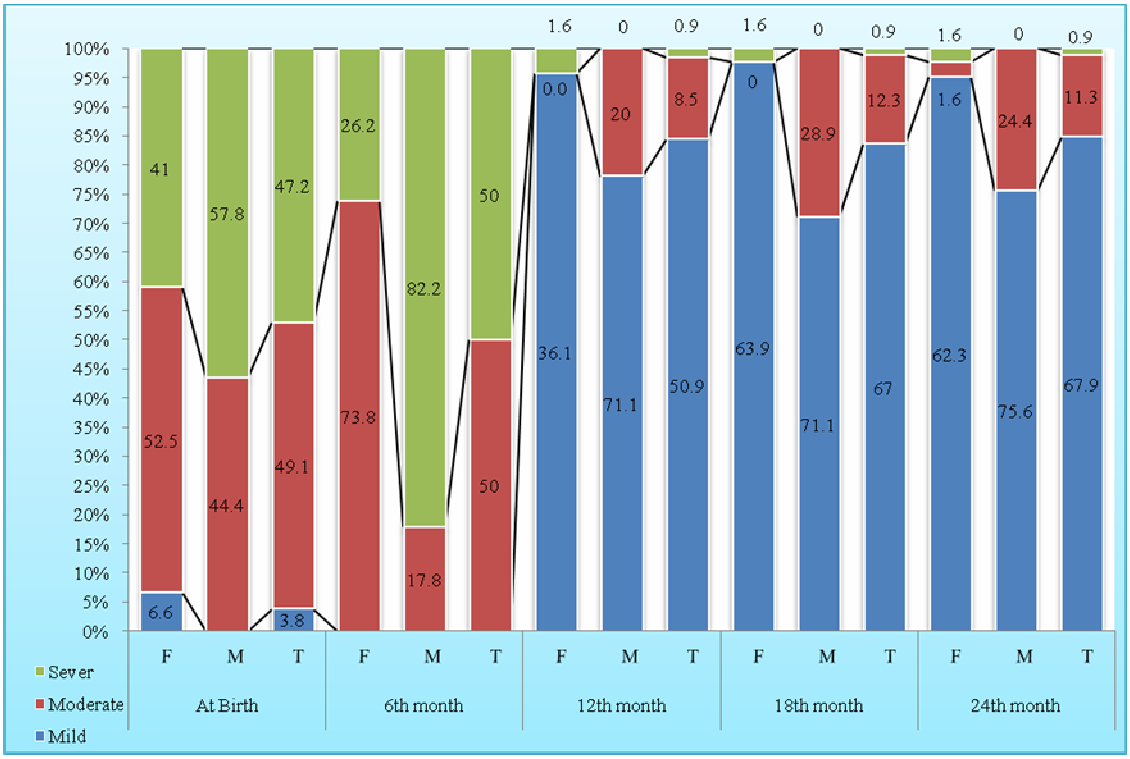

Fig - 2: Underweight among LBW infants at birth, 6th, 12th, 18th and 24th month of age

Table 2: Stunting (Length-for-Age) among LBW infants

Level of stunting (Length-for-Age)		Normal		Mild		Moderate		Sever		χ^2 Value Sig
		No	%	No	%	No	%	No	%	
At birth	F (n_1=61)	31	50.8	18	29.5	9	14.8	3	4.9	10.763 (d.f =3) P<0.013*
	M (n_2=45)	9	20.0	20	44.4	13	28.9	3	6.7	
	T(n_3=106)	40	37.7	38	35.8	22	20.8	6	5.7	
6th month	F (n_1=61)	0	0.0	0	0.0	37	60.7	24	39.3	41.932 (d.f =1) P<0.001**
	M (n_2=45)	0	0.0	0	0.0	0	0.0	45	100.0	
	T(n_3=106)	0	0.0	0	0.0	37	34.9	69	65.1	
12th month	F (n_1=61)	40	65.6	21	34.4	0	0.0	0	0.0	54.756 (d.f =2) P<0.001**
	M (n_2=45)	0	0.0	31	68.9	14	31.1	0	0.0	
	T(n_3=106)	40	37.7	52	49.1	14	13.2	0	0.0	
18th month	F (n_1=61)	0	0.0	21	34.4	40	65.6	0	0.0	22.138 (d.f =2) P<0.001**
	M (n_2=45)	0	0.0	0	0.0	42	93.3	3	6.7	
	T(n_3=106)	0	0.0	21	19.8	82	77.4	3	2.8	
24th month	F (n_1=61)	0	0.0	29	47.5	31	50.8	1	1.6	40.551 (d.f =3) P<0.001**
	M (n_2=45)	0	0.0	16	35.6	27	60.0	2	4.4	
	T(n_3=106)	0	0.0	45	42.5	58	54.7	3	2.8	

* Significant association at 5% level; ** Significant association at 0.1% level

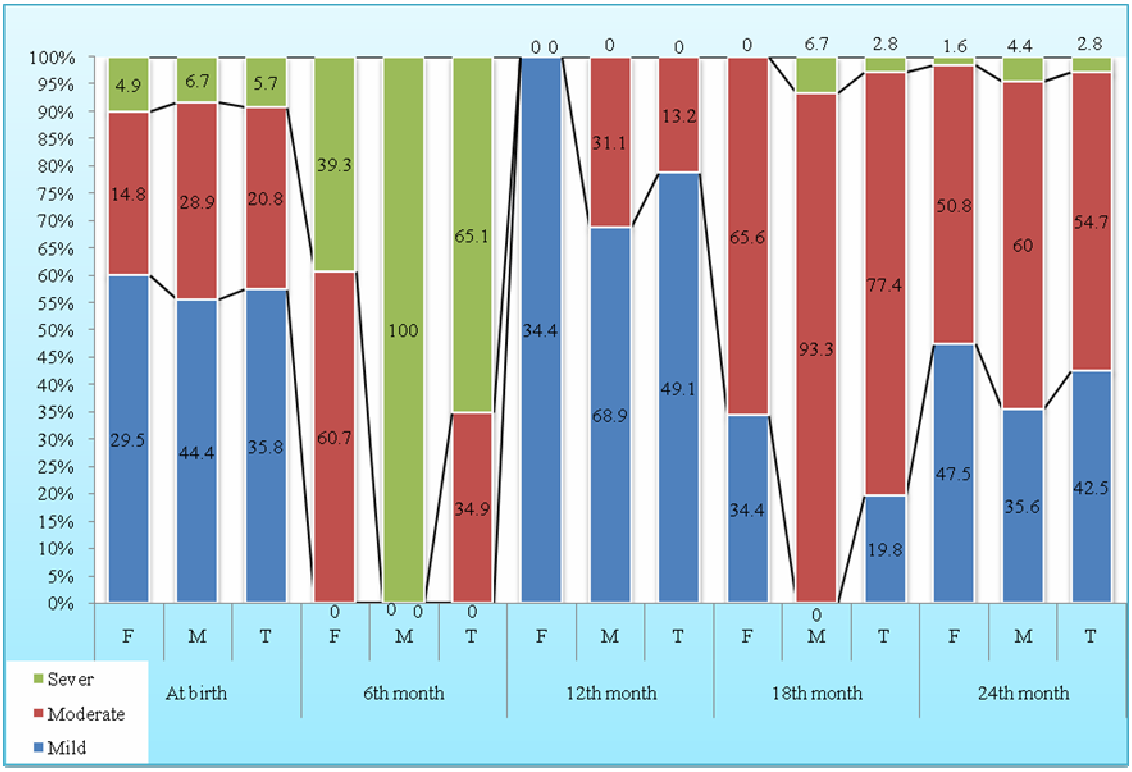

Fig – 3: Stunting among LBW infants at birth, 6th, 12th, 18th and 24th month of age

Table 3: Malnutrition (BMI-for-Age) among LBW Infants

Malnutrition (Body Mass Index-for-age)		Normal		Mild		Moderate		Sever		χ^2 Value Sig
		No	%	No	%	No	%	No	%	
At birth	F (n_1=61)	4	6.6	18	29.5	14	23.0	25	41.0	3.456 NS (d.f = 3) P>0.326
	M (n_2=45)	5	11.1	19	42.2	9	20.0	12	26.7	
	T(n_3=106)	9	8.5	37	34.9	23	21.7	37	34.9	
6th month	F (n_1=61)	21	34.4	28	45.9	9	14.8	3	4.9	5.684 NS (d.f = 3) P>0.128
	M (n_2=45)	20	44.4	23	51.1	2	4.4	0	0.0	
	T(n_3=106)	41	38.7	51	48.1	11	10.4	3	2.8	
12th month	F (n_1=61)	49	80.3	9	14.8	2	3.3	1	1.6	3.577 NS (d.f = 3) P>0.311
	M (n_2=45)	34	75.6	11	24.4	0	0.0	0	0.0	
	T(n_3=106)	83	78.3	20	18.9	2	1.9	1	0.9	
18th month	F (n_1=61)	59	96.7	1	1.6	0	0.0	1	1.6	0.846 NS (d.f = 2) P>0.655
	M (n_2=45)	44	97.8	1	2.2	0	0.0	0	0.0	
	T(n_3=106)	103	97.2	2	1.9	0	0.0	1	0.9	
24th month	F (n_1=61)	55	90.2	5	8.2	0	0.0	1	1.6	1.461 NS (d.f = 2) P>0.482
	M (n_2=45)	42	93.3	3	6.7	0	0.0	0	0.0	
	T(n_3=106)	97	91.5	8	7.5	0	0.0	1	0.9	

NS- No significant association

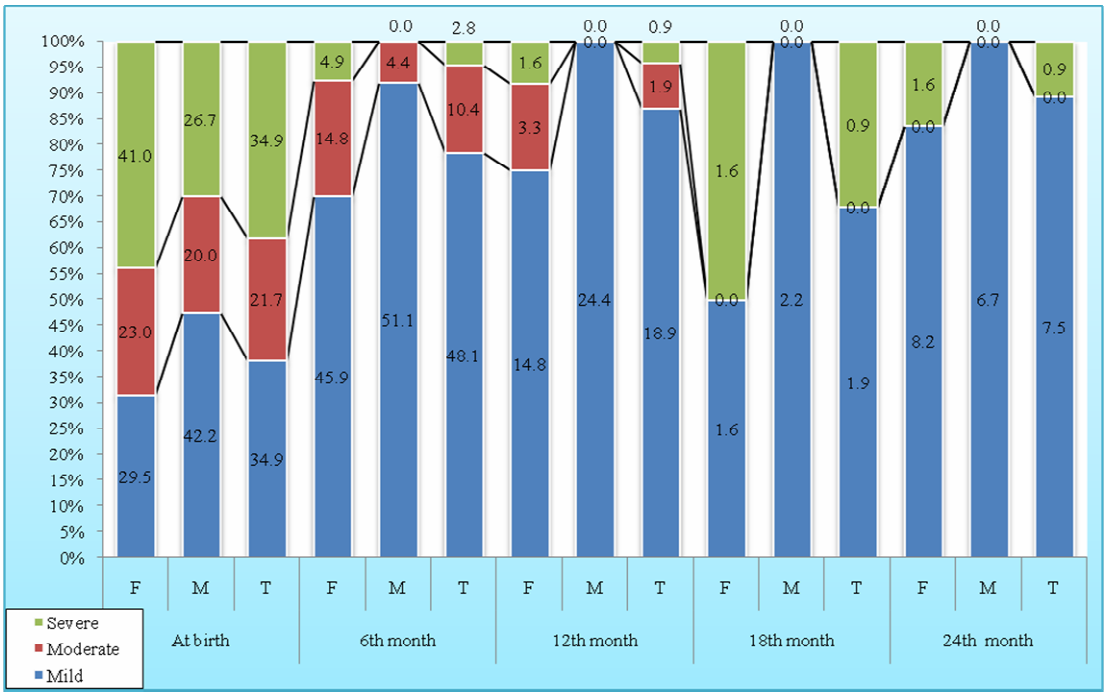

Fig – 4: Malnutrition (BMI-for-Age) among LBW infants at birth, 6th, 12th, 18th and 24th Month of age

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