

Nutritional status of low birth weight infants in Makkah region: Evaluation of anthropometric and biochemical parameters

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Abstract

Objective: To assess the nutritional status of low birth weight infants from Makkah area immediately after birth.

Methods: The prospective study was conducted between October and December 2012 at Al-Noor Speciality Hospital, Makkah, Saudi Arabia, and comprised low birth weight infants who were divided into three equal groups according to their birth weight: group A (low birthweight 1501-2500gm), group B (very low birthweight 1001-1500gm), and group C (extremely low birth weight <1000gm). Mothers who had delivered low birth weight infants were enrolled. Weight, length, head circumference, complete blood count, and blood tests were performed for all the infants under investigation.

Results: There were 300 infants in the study; 100(33.3%) in each of the 3 groups. Group C showed the lowest gestational age, length, and head circumferences ($p < 0.05$ each). No significant discrepancies were found in complete blood count results among the three groups ($p > 0.05$). Normal serum phosphorus, potassium and magnesium levels and mild hypocalcaemia were observed in all infants. However, hypernatraemia was significantly evident ($p < 0.05$) for group C. All infants had hyperglycaemia and hyperbilirubinaemia. Albumin content decreased significantly ($p < 0.05$) as birth weight decreased. Groups B and C infants showed higher serum urea than group A infants ($p < 0.05$).

Conclusion: Low newborn birth weight was related to the deteriorated nutritional status in terms of low anthropometric and abnormal biochemical measures. It was not possible to correlate the birth weight of the neonates to the parameters of the complete blood tests.

Keywords: Low birth weight infant, Nutritional assessment, Makkah region. (JPMA 66: 414; 2016)

Introduction

Low birth weight (LBW) infants are live born infants with birth weight less than 2500gm regardless of gestational age.¹ There are three subclasses: 1501-2500gm LBW, 1001-1500gm very low birth weight (VLBW), and less than or equal 1000 gm extremely low birth weight (ELBW).² LBW may be attributable to prematurity (<37 week gestation), shortened period of gestation, or a retarded intrauterine growth rate (IUGR).^{2,3} In developing countries, most of LBW infants are born at term and are mainly affected by foetal growth restriction. On the other hand, 50% of these infants in industrialised countries are born preterm.⁴ In Makkah region, the possible risk factors related to delivering LBW infants were low gestational age, multiple births, and smoking. The regional percentage of LBW ranges from 25% in South Asia, the highest worldwide, to 10% in Saharan Africa and 12% in Latin America.⁴ According to the last report from Centres for Disease Control and Prevention (CDC) at 2012, the LBW rate was stable at 8% from about four million births in the

United States.⁵

LBW children are more vulnerable with age to worsening nutritional status, subclinical atherosclerosis, failure of cognitive development, risk for brain maturation and lowered head circumference which implies both diminished intellectual development and brain volume.^{6,7} Later, this can impair learning process at school-age, and might affect the quality of jobs with age.⁶ Therefore, proper assessment of nutritional status of these infants during the first days of life is required to maintain optimal growth as well as prevent possible adverse outcomes with age.⁸

To the best of our knowledge, there are rare detailed studies in Saudi Arabia and other Arab countries about the nutritional status of LBW infants. Therefore, the current study was planned to assess the anthropometric and biochemical status of LBW infants in Makkah area and compare them with international references.

Subjects and Methods

The prospective study was conducted between October and December 2012 at Al-Noor Speciality Hospital in Makkah, the western province of Saudi Arabia. All infants appropriate-for-gestational age and delivered vaginally were included through consecutive sampling. The Infants

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were divided into the three subcategories of LBW, VLBW and ELBW. The participating mothers were 22-38 years old, non-smokers, and were generally healthy and free from any known chronic disease and/or pregnancy-induced illness such as diabetes, hypertension, placental failure or infections. Infants who died postnatally were excluded.

After approval from the Ethics Committee of the University of Umm Al-Qura, and after obtaining written informed consent from the mothers, anthropometric measurements as well as biochemical analysis were performed to evaluate the nutritional status of the LBW newborns. As babies were admitted to the neonatal unit, professional paediatric nurse at the hospital performed the anthropometric measurements; like weight, length, and head circumference. Infant's weight and length were measured on a pan-type paediatric electronic scale for weight with a stationary headboard and moveable footboard for length. The head circumference was measured using flexible and non-stretchable measuring tape.

Two blood samples were obtained from each baby immediately postpartum; one for complete blood count (CBC) and the other for blood chemistry analysis. The CBC parameters were; white blood cells (WBC; leucocyte total), haemoglobin, haematocrit, red blood cell (RBC), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), mean corpuscular haemoglobin concentration (MCHC), and platelets. On the other hand, blood chemistry measures were calcium (Ca), phosphorus (P), sodium (Na), potassium (K), magnesium (Mg), glucose as random blood sugar (RBS), total and direct bilirubin (calculated by subtracting the mean direct bilirubin from the mean total bilirubin), albumin, urea, and creatinine. Cell-Dyn Ruby System (Abbott Diagnostics, Lane Cove, Australia) and Dimension (Siemens Dimension RXL, German) instruments available with the hospital were used to measure CBC parameters and blood chemistry, respectively, using the specific kit for each test. Reference ranges for the investigated parameters were obtained from Nelson Textbook of Paediatrics.⁹

Statistical analysis was performed using Statistic Analysis System (SAS) version 9.1. Analysis of variances (ANOVA) was done to differentiate between groups. $P < 0.05$ was considered significantly different according to the least significant differences (LSD) test.

Results

There were 300 LBW infants, with 100(33.3%) in each of the three groups. Overall, there were 144 (48%) boys and 156(52%) girls, and anthropometric measurements of the entire sample were noted (Table-1). Mean values of

Table-1: Characteristics and anthropometric measurements of low birth weight infants.

Group Parameter	LBW (n=100)	VLBW (n=100)	ELBW (n=100)
Male% : Female%	48.3% : 51.7%	36.8% : 63.2%	59.2% : 40.8%
Gestational age (Weeks)	36.06 ^a ± 2.81	32.76 ^{ab} ± 3.94	29.50 ^b ± 3.01
Weight (Kg)	2.1 ^a ± 0.25	1.29 ^b ± 0.16	0.93 ^c ± 0.03
Length (cm)	47.53 ^a ± 2.88	42.53 ^b ± 5.05	35.25 ^c ± 1.70
Head circumference (cm)	31.4 ^a ± 1.71	29.57 ^{ab} ± 4.50	26.25 ^b ± 2.06

Results are shown as Mean ± SD or as percent.

Means with different superscripts are significantly ($p < 0.05$) different according to least significant differences (LSD).

LBW: Low birthweight

VLBW: Very low birthweight

ELBW: Extremely low birthweight.

Table-2: CBC results of low birth weight infants.

Group Test	LBW (n=100)	VLBW (n=100)	ELBW (n=100)
WBC x 10 ⁹ (5 – 30 /L)	13.9 ± 9.98	11.40 ± 5.67	16.83 ± 10.13
Haemoglobin (12.5- 22.5 g/dL)	15.85 ± 3.51	17.01 ± 4.46	16.36 ± 3.13
Haematocrit (36 – 70 %)	46.9 ± 9.05	50.03 ± 13.38	47.26 ± 9.99
RBC x 10 ¹² (4.5 - 6.5 x 10 ¹² /L)	4.43 ± 0.70	4.37 ± 1.01	4.24 ± 0.93
MCV (95 – 121 fL)	101.35 ± 22.35	107.86 ± 8.43	117.43 ± 2.27
MCH (31 – 37 pg)	36.92 ± 4.03	37.45 ± 3.16	39.96 ± 1.82
MCHC (30- 37 g/dL RBC)	34.77 ± 0.92	34.11 ± 1.06	34 ± 1.17
Platelets x 10 ⁹ (84 – 478 /L)	213.8 ± 100.2	257.75 ± 81.3	115.6 ± 62.5

Results are shown as Mean ± SD.

Numbers between braces in the left column are reference ranges for each test at birth.

CBC: Complete blood count

LBW: Low birthweight

VLBW: Very low birthweight

ELBW: Extremely low birthweight

WBC: White blood cells

RBC: Red blood cell

MCV: Mean corpuscular volume

MCH: Mean corpuscular haemoglobin

MCHC: Mean corpuscular haemoglobin concentration.

mother's age for LBW, VLBW, and ELBW groups were 29.1±7.1, 32.4±6.7, and 30.8±8.4 years respectively ($p = 0.05$). ELBW infants showed the lowest gestational age, with significantly ($p < 0.05$) decreased weight, length and head circumference.

Table-3: Serum levels of selected minerals in low birth weight infants.

Group Test	LBW (n=100)	VLBW (n=100)	ELBW (n=100)
Ca (8.6 – 10.2 mg/dL)	8.04 ±1.66	7.5 ±1.48	8.2 ±0.65
P (4.8 – 8.2 mg/dL)	5.49 ±1.47	6.7 ±2.02	5.45 ±1.45
Na (135– 145 mmol/L)	137.8 ^b ±4.52	139.75 ^b ±5.62	157.33 ^a ±33.08
K (3.5– 7.0 mmol/L)	5.53 ±1.02	5.26 ±1.10	4.4 ±0.45
Mg (1.2 – 2.55 mg/dL)	2.23 ^a ±0.63	1.8 ^{ab} ±0.07	1.73 ^b ±0.34

Results are shown as Mean ± SD.

Means with different superscripts are significantly ($p < 0.05$) different according to least significant difference (LSD).

Numbers between braces in the left column are reference ranges for each test at birth.

LBW: Low birthweight

VLBW: Very low birthweight

ELBW: Extremely low birthweight

Ca: Calcium

P: Phosphorus

Na: Sodium

K: Potassium

Mg: Magnesium.

Table-4: Biochemical tests of low birth weight infants.

Group Test	LBW (n=100)	VLBW (n=100)	ELBW (n=100)
Glucose (RBS) (40 – 60 mg/dL)	75.62 ±26.19	88.06 ±18.43	85.53 ±19.59
Total bilirubin (0–1 mg/dL)	4.37 ±1.88	4.41 ±2.81	4.68 ±1.17
Direct bilirubin (0–0.25 mg/dL)	0.43 ±0.20	0.20 ±0.16	0.16 ±0.11
Albumin (1.8– 3.4 g/dL)	3.24 ^a ±1.56	2.36 ^{ab} ±0.44	1.73 ^b ±0.27
Urea (3–25 mg/dL)	21.11 ±9.33	26.72 ±14.7	26.07 ±12.12
Creatinine (0.3 – 1.0 mg/dL)	0.78 ±0.65	0.98 ±0.20	0.85 ±0.07

Results are shown as Mean ± SD.

Means with different superscripts are significantly ($p < 0.05$) different according to least significant difference (LSD).

Numbers between braces in the left column are reference ranges for each test at birth.

LBW: Low birthweight

VLBW: Very low birthweight

ELBW: Extremely low birthweight

RBS: Random blood sugar.

No significant differences in the CBC results were detected in the groups ($p > 0.05$). All the results were within the normal ranges except RBC which was slightly lower (Table-2).

Serum P, K and Mg were within the normal ranges. Ca concentrations were low for all the groups, while Na levels for ELBW group were significantly higher than the others

($p < 0.05$) (Table-3).

Hyperglycaemia was detected with insignificant differences between the groups ($p > 0.05$). Total bilirubin was remarkably high for all the groups. Direct bilirubin level was the highest in the LBW group, but the mean value for the indirect bilirubin for LBW, VLBW and ELBW groups were 3.94 ± 1.65 , 4.21 ± 1.72 , and 4.52 ± 1.33 mg/dL, respectively. Albumin levels were within the normal range though marginally low for ELBW, there was a significant difference between the groups ($p < 0.05$) with a noticeable trend of decreasing levels as the infants' weight at birth decreased. Urea levels were found slightly higher than the reference range for the VLBW and the ELBW groups. Normal creatinine levels were found in the three groups (Table-4).

Discussion

The mean gestational age in weeks for LBW, VLBW and ELBW groups were 36.06, 32.76, and 29.5, respectively. These findings were partially comparable to earlier studies¹⁰ that reported gestational age for VLBW and ELBW infants as 28.5–30.9 and 24.8–27.6 weeks, respectively. Other studies considered the gestational age of LBW infants commonly as less than 37 weeks.^{3,4} The average birth weight, length, and head circumference of a full-term newborn are approximately 3.4 kg, 49.8 cm, and 34.5 cm, respectively.¹¹ The studied infants showed lower birth weight, length, and head circumference than full-term infants. The findings in this study were in agreement with an earlier study¹⁰ which pointed out that LBW infants failed to develop well due to their preterm birth and the anthropometric measurements were remarkably lower than full-term infants.

The tests of CBC were performed to investigate the possibilities for the infants to have any serious infections or blood disorders such as sepsis, haemoglobinopathies, sickling, thalassemia major, α - and β -thalassemia, and other types of anaemia.¹² The CBC tests can also reflect fluid volume problems, such as dehydration or loss of blood, as well as predicting problems with RBC production and destruction, help diagnose allergies and blood clotting disorders.^{13,14} The results of the CBC tests showed no major abnormality for any of the tested parameters. This could be attributed to the fact that the blood system develops at earlier stages of the pregnancy, where the circulation system starts functioning at the week 11 of pregnancy.¹⁵

In terms of essential minerals, phosphate, potassium and magnesium readings were within normal ranges, though slightly lower for ELBW group were found. These findings do not comply with literature. Hypophosphataemia,

hypokalaemia and hypomagnesaemia were previously reported in premature infants and were justified by the rapid anabolic metabolism of the skeletal system, the high cellular demand and the significant renal elimination for these minerals.¹⁶⁻¹⁸ A study reported that premature infants usually suffer from hypocalcaemia, low vitamin D level and concomitant rickets of prematurity.¹⁹ Serum calcium for all groups of infants in this study was lower than the reference range. ELBW group of infants in this study suffered significant ($p<0.05$) hypernatraemia, but all groups showed normal levels of sodium. Hypernatraemia is not uncommon in infants, especially when they are born prematurely, because their renal functions are not optimised at birth and higher water molecules secretion in comparison to the elimination of the sodium ions, can be noticed upon analysing the sodium levels in their plasma.²⁰

Conclusion

The birth weight of the neonates was apparently related directly to their nutritional status. This correlation was clear as the minimum birth weight was combined with the worst nutritional conditions as was obvious in terms of low anthropometric measures and the abnormal biochemical results. No correlation was found between low birth weight of the neonates and CBC parameters.

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