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Kidney Function Test Of Term Low Birth Weight Versus Term Normal Birth Weight Babies At One Year

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Abstract

Introduction: *Kidney size is a crucial metric for both assessing children with functional disorders and determining appropriate organ growth. It is well recognized that early life factors, such as the mother's age and nutritional state during pregnancy, have an impact on later-life growth patterns, body composition, and the risk of chronic non-communicable diseases. The aim of this study was to compare kidney function test of low birth weight versus normal birth weight babies at one year.*

Methods: *This case-control study was conducted at the Department of Pediatric Infectious Diseases and Community Pediatrics at Bangladesh Shishu Hospital and Institute, Dhaka, from June 2009 to May 2010. Patients were selected according to inclusion and exclusion criteria. 100 children were recruited in this study at one year of age from that hospital. Among them 50 were born at term with NBW and the rest 50 were born at term with LBW. Data were collected by developing a structured questionnaire and a statistical analysis was carried out by using the Statistical Package for Social 'IBM SPSS Statistics for Windows, version XXII (IBM Corp., Armonk, N.Y., USA)'.*

Result: *It was observed that almost two-thirds (62.0%) of subjects belonged to age 12 months in term NBW and 28(56.0%) in term LBW. The mean age was 11.9±0.6 months in the term NBW and 12.2±0.7 months in the term LBW. More than half (58.0%) of subjects were male in term NBW and 22(44.0%) in term LBW. The majority (88.0%) of subjects came from urban areas in term NBW and 37(74.0%) in term LBW. The mean SBP was 86.6±8.0 mmHg in term NBW and 92.4±7.9 mmHg in term LBW. The mean DBP was 49.2±4.3 mmHg in term NBW and 52.2±4.7 mmHg in term LBW. The mean creatinine was 0.5±0.13 mg/dl in term NBW and 0.53±0.12 mg/dl in term LBW. The mean spot urine protein creatinine ratio was 0.3±0.06 in the term NBW and 0.4±0.07 in the term LBW. The mean GFR was 72.8±19.1 mL/min/1.73m^2 in term NBW and 66.4±16.7 mL/min/1.73m^2 in term LBW.*

Conclusion: *This study demonstrates that blood pressure and spot urine protein creatinine ratio were significantly elevated in term LBW babies. The mean GFR was lesser in the term LBW babies compared to term NBW babies. Term LBW can lead to adverse effects on kidney size in children and act accordingly.*

Keywords: *Term Low Birth Weight, Normal Birth Weight, Renal Volume*

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I. Introduction

Kidney size is an important parameter for both diagnosing infants with renal diseases and figuring out the right organ growth, according to Lee et al. (2014).[1] Early-life factors have been shown to impact growth patterns, body composition, and the chance of acquiring chronic noncommunicable diseases later in life. Examples of these factors include the mother's age and nutritional status during pregnancy.[2] The number of nephrons, the structural and functional units that make up the kidneys, can be inferred from the size of the kidneys. Since the number of nephrons is primarily regulated in prenatal life, smaller nephrons are the result of inadequate kidney growth and development in fetal life.[3] Preterm children, according to some studies, have smaller kidneys with fewer nephrons, retarded growth, and short for gestational age (SGA).[2,4] Although cellular proliferation

begins mostly before the third trimester of normal pregnancies in almost all organs, 60% of nephrons form in the third trimester and have formed by 36 weeks of gestation.[5,6] Studies have indicated that term LBW is an independent risk factor for the development of hypertension, renal problems, and adult-onset diabetes mellitus.[7,8] The kidney develops in the fetus from nine weeks to thirty-six weeks. It's crucial to keep in mind that no more nephrons develop after birth during term gestation. Risk factors for low nephron mass and/or kidney illness include low birth weight, preterm birth, low kidney mass and volume, and gene polymorphisms.[2] The secondary cause of low birth weight (LBW) at term could be intrauterine growth retardation (IUGR) or preterm. One important independent predictor of kidney size at delivery and in the first few months of life is weight for gestational age.[9] Furthermore, studies have demonstrated that, despite having 25% smaller kidney volumes during the first week of life, newborns with low birth weights (LBW) at term can nevertheless attain glomerular filtration rates (GFR) that are comparable to those of newborns with normal birth weights.10 Reduced placenta perfusion, late-pregnancy steroid use, and poor maternal nutrition (such as low protein intake and vitamin A deficiency) can all lead to fetal growth limitation and a persistent nephron deficit of up to 30%. According to earlier research, in these circumstances, the glomerular filtration rate (GFR) can drop by 50%.[3,6] Kidney size and function may be negatively impacted by low birth weight. It is crucial to comprehend the appropriate ranges for the kidney's volume and the body surface area's function in both term low birth weight (LBW) and term normal birth weight (NBW) babies.[6] Hughson et al. (2006) and Berglund et al. (2014) conducted research that found a relationship between term LBW, SGA, and preterm and an increased risk of kidney failure, albuminuria, hypertension, and chronic renal disease.[11,12] Kidney size has been used as a stand-in; in fact, birth weight has been connected to differences in kidney volume in children and young adults.[13,14] It is poorly understood how kidney function and kidney volume relate to each other in infants born before full term and up to late infancy, a crucial and dynamic time of renal functional maturity. Bagby et al. (2009) assert that for high-risk neonates based on critical parameters including birth weight and gestational age, ongoing GFR monitoring is necessary.[15] Nephron protection during birth is a significant issue that needs to be given top priority. Considering the facts and figures, the present study is aimed to compare kidney function test of low birth weight versus normal birth weight babies at one year.

II. Methods

This case-control study was conducted at the Department of Pediatric Infectious Diseases and Community Pediatrics in Bangladesh Shishu Hospital and Institute, Dhaka, from June 2009 to May 2010. Patients were selected according to inclusion and exclusion criteria. 100 children were recruited in this study at one year of age from that hospital. Among them 50 were born at term with NBW and the rest 50 were born at term with LBW. Term LBW babies of one year of age (weight: <2.5 kg), and Term NBW babies of 1 year of age (weight: >2.5 kg) were included among the inclusion criteria. History of severe perinatal asphyxia, severe sepsis, intrauterine infections, and any congenital anomalies were excluded from the study. Data were collected by developing a structured questionnaire and a statistical analysis was carried out by using the Statistical Package for Social 'IBM SPSS Statistics for Windows, version XXII (IBM Corp., Armonk, N.Y., USA)'.

III. Results

Table I: Distributions of the study subject by participants characteristics (N=100)

Participants characteristics	Term NBW (n=50)		Term LBW (n=50)		p-value
	n	%	n	%	
Distribution according to age (in months)					
11	11	22.0	7	14.0	$^{a}0.087^{ns}$
12	31	62.0	28	56.0	
13	8	16.0	15	30.0	
Mean±SD	11.9±0.6		12.2±0.7		
Range (min-max)	11-13		11-13		
Distribution according to Gender					
Male	29	58.0	22	44.0	$^{b}0.161^{ns}$
Female	21	42.0	28	56.0	
Distribution according to Residence					
Urban	44	88.0	37	74.0	$^{b}0.074^{ns}$
Rural	6	12.0	13	26.0	

ns = not significant, ^{a}p value reached from the Unpaired t-test, ^{b}p value reached from the Chi-square test

Table I shows the distributions of the study subjects by participants' characteristics. It was observed that almost two-thirds (62.0%) of subjects belonged to age 12 months in term NBW and 28(56.0%) in term LBW. The mean age was 11.9±0.6 months in the term NBW and 12.2±0.7 months in the term LBW. More than half

(58.0%) of subjects were male in term NBW and 22(44.0%) in term LBW. The majority (88.0%) of subjects came from urban areas in term NBW and 37(74.0%) in term LBW. The difference was statistically not significant (p>0.05) between the two groups.

Table II: Distributions of the study subject by anthropometry parameter (N=100)

Anthropometry parameter	Term NBW (n=50) Mean±SD	Term LBW (n=50) Mean±SD	*p*-value
Length (cm)	75.8±0.9	73.5±0.8	0.001[s]
Range (min-max)	74.1-76.9	72.0-75	
Weight (kg)	9.2±0.7	8.0±0.8	0.001[s]
Range (min-max)	8.0-10.5	6.5-9.4	
BMI (kg/ht m2)	15.9±1.3	14.9±1.6	0.001[s]
Range (min-max)	13.8-18.7	12.2-18.1	

s=significant, p-value reached from the Unpaired-t-test

The mean length was 75.8±0.9 cm in the term NBW and 73.5±0.8 cm in the term LBW. The mean weight was 9.2±0.7 kg in term NBW and 8.0±0.8 kg in term LBW. The mean BMI was 15.9±1.3 kg/m^2 in the term NBW and 14.9±1.6 kg/m^2 in the term LBW. The difference was statistically significant (p<0.05) between the two groups.

Table III: Distributions of the study subject by blood pressure (N=100)

Blood pressure (mmHg)	Term NBW (n=50) Mean±SD	Term LBW (n=50) Mean±SD	*p* value
SBP (mmHg)	86.6±8.0	92.4±7.9	0.001s
Range(min-max)	70-95	75-100	
DBP (mmHg)	49.2±4.3	52.2±4.7	0.001s
Range(min-max)	40-55	45-60	

s = significant, p-value reached from Unpaired t-test

The mean SBP was 86.6±8.0 mmHg in term NBW and 92.4±7.9 mmHg in term LBW. The mean DBP was 49.2±4.3 mmHg in term NBW and 52.2±4.7 mmHg in term LBW. The difference was statistically significant (p<0.05) between the two groups.

Table IV: Distributions of the study subject by renal function test (N=100)

Renal function test	Term NBW (n=50) Mean±SD	Term LBW (n=50) Mean±SD	p-value
Creatinine (mg/dl)	0.5±0.13	0.53±0.12	0.282[ns]
Range (min-max)	0.3-0.7	0.33-0.72	
Spot urine protein creatinine ratio	0.3±0.06	0.4±0.07	0.001[s]
Range (min-max)	0.2-0.39	0.25-0.48	
GFR(mL/min/1.73m^2)	72.8±19.1	66.4±16.7	0.079[ns]
Range (min-max)	49.5-112.7	46.1-102.3	

s = significant, ns = not significant, p-value reached from Unpaired t-test

The mean creatinine was 0.5±0.13 mg/dl in term NBW and 0.53±0.12 mg/dl in term LBW. The difference in Creatinine was not statistically significant (p>0.05) between the two groups.

The mean spot urine protein creatinine ratio was 0.3±0.06 in the term NBW and 0.4±0.07 in the term LBW. The difference in spot urine protein creatinine ratio was statistically significant (p<0.05) between the two groups. The mean GFR was 72.8±19.1 mL/min/1.73m^2 in term NBW and 66.4±16.7 mL/min/1.73m^2 in term LBW. The difference in GFR was not statistically significant (p>0.05) between the two groups.

IV. Discussion

In the present study, the mean age was 11.9±0.6 months in term NBW and 12.2±0.7 months in term LBW. The mean age difference was almost similar between the term NBW and the term LBW. Similarly, higher age and age ranges were also observed by Gilarska et al. (2019), Park et al. (2019), and Kaze et al. (2020).[16,17,18] In the current study it was observed that 42.0% of subjects were female in term NBW and 56.0% in term LBW, which indicates that term LBW was more common in the female than in the male children. A study by Ferdous et al. (2018) found that 57.2% and 42.8% were female and male respectively in LBW.[6] Considering residence in the current study it was observed that 88.0% of subjects came from urban areas in the term NBW and 74.0% in

the term LBW. Bener et al.'s (2012) study found that 83.9% of subjects were urban areas in term LBW and 85.4% in NBW.[19] It was also observed from this study that the mean length was 75.8±0.9 cm in term NBW and 73.5±0.8 cm in term LBW, the mean weight was 9.2±0.7 kg in term NBW and 8.0±0.8 kg in term LBW and the mean BMI was 15.9±1.3 kg/m^2 in term NBW and 14.9±1.6 kg/m^2 in term LBW. The mean values for length, weight, and BSA were significantly (p<0.05) lower in the term LBW children than in the NBW children. Ferdous et al. (2018) study observed similar results.[6] While considering blood pressure in the current study it was observed that the mean SBP was 86.6±8.0 mmHg in term NBW and 92.4±7.9 mmHg in term LBW. The mean DBP was 49.2±4.3 mmHg in term NBW and 52.2±4.7 mmHg in term LBW. The mean difference in blood pressure was significantly (p<0.05) higher in the term LBW group.[6] Lillas et al. (2021) also obtained in their study that the group with term LBW had higher blood pressure as compared with those in the NBW group, which is similar to the present study.[20] Moreover, in the present study it was found that the mean creatinine was 0.5±0.13 mg/dl in term NBW and 0.53±0.12 mg/dl in term LBW, no statistically significant (p>0.05) difference was observed between term NBW and term LBW. The mean GFR was 72.8±19.1 mL/min/1.73m^2 in term NBW and 66.4±16.7 mL/min/1.73m^2 in term LBW. The mean GFR was higher in NBW but the difference was not statistically significant (p>0.05) between term NBW and term LBW. The mean spot urine protein creatinine ratio was 0.3±0.06 in the term NBW and 0.4±0.07 in the term LBW. The mean spot urine protein creatinine ratio was significantly (p<0.05) higher in term LBW. Ferdous et al. (2018) study found the mean eGFR was lower in the term LBW children than in the NBW children 61.8±12.8 mL/min/1.73m^2 and 67.4±16.0 mL/min/1.73m^2 respectively, which is comparable with the present study.[6] Similarly, Gilarska et al. (2019) study also found the mean GFR was lesser in the term LBW babies compared to NBW babies.[16]

Limitations of the Study

The study was conducted for a very short period in a single hospital with a small sample size. So, the results may not represent the whole community. Kidney function was not measured by inulin clearance and the unavailability of data about maternal and child dietary habits is also a limitation.

V. Conclusion

This study demonstrates that blood pressure and spot urine protein creatinine ratio were significantly elevated in term low birth weight babies. The mean GFR was lesser in the term LBW babies compared to term NBW babies. Term LBW can lead to adverse effects on kidney size in children and act accordingly.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee and Ethical clearance was obtained from the ethical board of Bangladesh Shishu Hospital and Institute, Dhaka.

VI. Recommendation

More studies including kidney histology, are much needed. Enough precaution is recommended to prevent LBW and reduce the difficulties related to this.

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