



# Association of Neonatal AKI with Gestational Age and Birth Weight in Tertiary Care Hospitals of Dhaka City, Bangladesh

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## Key words:

Neonatal AKI, perinatal asphyxia, neonatal sepsis, respiratory distress syndrome.

## Abstract

**Background:** Acute kidney injury (AKI) is common in neonatal intensive care unit (NICU) and also in general neonatal ward (GNW) of two tertiary care hospitals (Dhaka Medical College and Sir Salimullah Medical College Mitford Hospital). Association of neonatal AKI with different birth weights (low birth weight, very low birth weight, extreme low birth weight) and gestational age (both term and preterm) has greater impact on AKI. Early detection and immediate management is life saving.

**Methodology:** This prospective observational study carried out in NICU and GNW of DMCH & SSMC Mitoford Hospital over a period of one year to find out the AKI cases within the first 28 days of life. Blood sample collected by plane test tube and send to the laboratory and serum creatinine levels were estimated by auto analyzer (PICTUS-400). AKI was leveled when serum creatinine >1.5 times of medium values. Those AKI patients were evaluated in relation with gestational age & birth weight. After counselling and taking informed written consent from legal guardians, three hundred neonates were enrolled in this study by purposive sampling. The data were collected in a pre-structured questionnaire and analysis by SPSS 22 software.

**Results:** A total of 300 neonates were included in this study. Mean age of the neonates were  $5.71 \pm 6.70$  days (age range 1-28 days). Male were predominant (59.4%). Male and female ratio was 1.46:1. AKI developed in 23.7% neonates. Among them 53.5% was appropriate for gestational age (AGA), 36.6% had LBW and 9.9% had VLBW. Among preterm, term and post term 24.4%, 22.0% and 75.0% developed AKI respectively. Neonatal AKI also associated mostly with perinatal asphyxia (43.8%) and neonatal sepsis (35.21%).

**Conclusion:** AKI developed in 23.7% neonates. AKI prevalence is same in gestational age and birth weight.

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### Introduction:

Acute kidney injury can be defined as rapid deteriorations of renal function resulting in retention of nitrogenous wastes and inability of kidney to regulate fluid and electrolyte homeostasis<sup>1</sup>. There is wide variation in the incidence of AKI across studies. It affects approximately 1-24% of newborns in the NICU. The incidence of neonatal AKI, estimated at 8–24% of the general neonatal population<sup>2</sup>.

World health organization (WHO) estimates 25 million LBW babies are born annually worldwide and 95% occur in developing countries<sup>3</sup>. The prevalence of low birth weight in developing countries (16.5%) which is twice that in developed countries 7%<sup>4</sup>.

In infants with a birth weight under 1000 gm, AKI had a prevalence of 22% and in those over 1000 gm it was 5.4%<sup>5</sup>.

Acute kidney injury occurred in 39.8% of very low birth weight infants and was concentrated in the most premature and severely ill in infants<sup>6</sup>.

The shortterm outcome of AKI in newborn is highly dependent on the underlying etiology, the condition of other organs, and the facilities for renal replacement therapy. Mortality is more frequent and morbidity is much worse in neonates with multiorgan failure<sup>7</sup>.

Neonatal acute kidney injury (AKI) is highly related with low birth weight, very low birth weight, gestational age, birth asphyxia, neonatal sepsis, etc. This study was done to find out the magnitude of neonatal AKI with their relation with gestational age and birth weight. Early detection of AKI and minimize the preventable causes can improve the quality of life and prevent the long term morbidity and mortality.

### Materials and Methods:

This study was a prospective observational study. The Place of the study was Department of Neonatology, Dhaka Medical College Hospital (DMCH), Dhaka and Department of Neonatology, Sir Salimullah Medical College Mitford Hospital (SSMCMH), Dhaka. This study was conducted from July 2017 to June 2018 over a period of one year. Total study population includes neonates admitted in neonatal intensive care units and general neonatal wards of DMCH and SSMC and Mitford Hospital. Here, sample size was calculated purposively according to the inclusion and exclusion criteria which was 245. Purposive sampling was done on availability of patients during the study period with strictly considering the inclusion and exclusion criteria. Inclusion criteria included,

Patients admitted in neonatal intensive care unit (NICU) of DMCH and SSMC & Mitford Hospital. Patients admitted in general neonatal wards of these hospitals and patients parents/ attendants who gave consent to participate in this study. Exclusion Criteria included Patients parents/ attendants who refused to participate in this study and patients age more than 28 days.

### Procedure of data analysis of interpretation:

Data were entered in SPSS 22 software after cross checking and were analyzed by using same software. Some of the baseline characteristics of the cases were expressed as means and  $\pm$ SD and others as percentages with range. Data will also be present with several tables. Data will be analyzed cautiously with SPSS 22.0 software.

### Results:

**Table I.** Demographic profile of study subjects (n=300)

	Frequency (n)	Percentage (%)
Age in (days)		
1 – 7	233	77.6
8 – 14	35	11.6
15 – 21	11	3.6
22-28	21	7.0
Mean $\pm$ SD (Range)	5.71 $\pm$ 6.70 (1-28)	
Gender		
Male	178	59.4
Female	122	40.6
Residence		
Rural	219	73.0
Urban	81	27.0
Mothers' Occupation		
Housewife	247	82.4
Business	14	4.7
Service	23	7.6
Day laborer	5	1.7
Student	2	0.6
Others	9	3.0
Monthly family income		
Below 10,000 Tk	96	32.0
10,000-25,000 Tk	171	57.0
Above 25,000 Tk	33	11.0
Mothers' education		
Primary	125	41.7
High school	39	13.0
College & university	20	6.7
No education	116	38.6
Birth weight		
2500-<4000 gm	149	49.66
<2500-1500 gm	106	35.33
<1500-1000 gm	42	14.00
<1000 gm	3	1.00

Table I shows demographic profile of the study subjects. Most of the patients (77.6%) were in age group 1 – 7 days followed by 11.6%, 3.6% and 7.0% in age group 8 – 14 days, 15-21 days and 22 – 28 days respectively. Mean age of the neonates were  $5.71 \pm 6.70$  days with a range of 1 – 28 days. Male were predominant (59.4%). Most of the study subjects were from rural area (73%). Majority of the mothers were housewife (82.4%). More than half of the cases monthly family income was 10,000-25,000 taka. Most of the mother either had primary education (41.7%) or had no education (38.6%). 49.66% neonates had 2500-<4000 gm birth weight and 35.33% neonates had <2500-1500 gm birth weight. Rest of the distribution displayed in the table.

Table II shows distribution of the study patients by birth weight. Among the 300 neonates AGA was highest (49.7%) followed by low birth weight, very low birth weight and extreme low birth weight were 35.30%, 14.0% and 1.0% respectively.

Table III shows a total of 300 neonates were included in this study suffering from different medical illness.

Perinatal asphyxia, neonatal sepsis, pre term with LBW, Pre term with VLBW, term with AGA with meconium stained liquor, respiratory distress syndrome (RDS) were found 33.3%, 24.0%, 12.0%, 4.7%, 4.7%, 3.0% cases respectively. Rest of the distribution listed in the table.

**Table II.** Distribution of the patients by birth weight (n=300)

Birth weight	Frequency) (n)	Percentage (%)
Low birth weight (<2500-1500 gm)	106	35.3
Very low birth weight (<1500-1000 gm)	42	14.0
Extreme low birth weight (<1000 gm)	3	1.0
Appropriate for gestational age (AGA)	149	49.7
Total	300	100

**Table III:** Distribution of the neonates by medical illness (n=300)

Medical illness	Frequency	Percentage
Perinatal asphyxia	100	33.3
Neonatal sepsis	72	24.0
Pre term with LBW	36	12.0
Pre term with VLBW	14	4.7
Term with AGA with Meconium stained liquor	14	4.7
Respiratory distress syndrome	9	3.0
Term with AGA with TTN	4	1.3
Term with AGA with trachea esophageal fistula	2	0.7
Pre term with LBW with CHD with LONS	6	2.0
Term with LBW with CHD with LONS	6	2.0
Term with AGA with IDM	2	0.7
Others	35	11.6

**Table IV:** Clinical presentations of the study patients (n=300)

Sign & symptoms	Frequency	Percentage
Fever	21	7.0%
Swelling of the body	4	1.3%
Asymptomatic	275	91.6%
Total	300	100.0

Table IV shows distribution of the study cases by presenting sign symptoms. Among the 300 patients, 91.6% were asymptomatic. 7.0% presented with fever. Rest of the distribution displayed in the table.

Table V shows 300 patient, AKI developed in 71 (23.7%) neonates.

Table VI shows association between birth weight with acute kidney injury. 25.5% AGA, 24.5% low birth weight and 16.7% very low birth weight neonates developed AKI.

**Table V.** Distribution of the study patients by acute kidney injury (n=300)

AKI	Frequency (n)	Percentage (%)
AKI	71	23.7
Non-AKI	229	76.3
Total	300	100.0

**Table VI:** Relationship of birth weight with AKI (n=300)

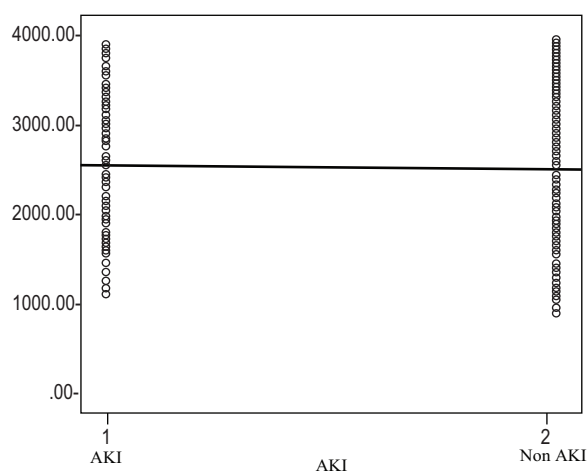
Birth weight	AKI	Non AKI	Total	p-value
AGA (2500 -<4000gm)	38 (25.5)	111 (74.5)	149	0.458
Low birth weight (1500 to <2500gm)	26 (24.5)	80 (75.5)	106	0.791
Very low birth weight (1000 to <1500gm)	7 (16.7)	35 (83.3)	42	0.250
Extreme low birth weight (<1000gm)	0 (0.0)	3 (100.0)	3	0.583
Total	71 (23.7)	229 (76.3)	300	

Chi-square test was done to measure the level of significance

**Table VII:** Relationship of gestational age with AKI (n=300)

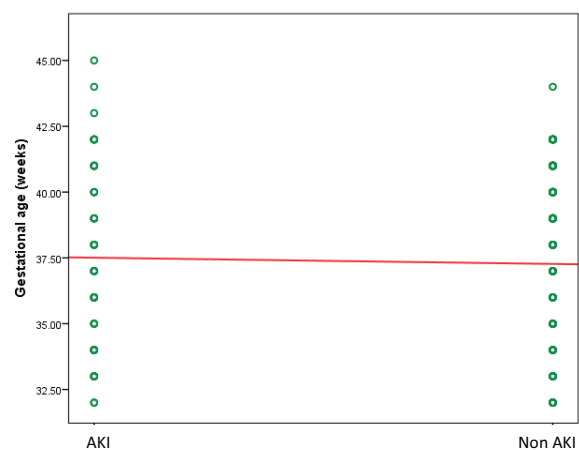
Gestational age	AKI	Non AKI	Total	p-value
Preterm	30 (24.4)	93 (75.6)	123	0.806
Term	38 (22.0)	135 (78.0)	173	0.420
Post term	3 (75.0)	1 (25.0)	4	0.042
Total	71 (23.7)	229 (76.3)	300	

Chi-square test was done to measure the level of significance



**Fig.-1:** Correlation of AKI with birth weight (Spearman correlation was performed)

There was no correlation of AKI with birth weight ( $r_s = -0.017$  and  $p = 0.770$ )



**Fig.-2:** Correlation of AKI with gestational age (Spearman correlation was performed)

There was no correlation of AKI with gestational age ( $r_s = -0.023$  and  $p = 0.697$ )

Table VII shows association between gestational age with acute kidney injury. 24.4% preterm, 22.0% term and 75.0% post term neonates developed AKI.

### Discussion:

A total of 300 neonates were included in this study, they were from 1-28 days of age. Most of the patients (77.6%) were in age group 1–7 days followed by 11.6%, 3.6% and 7.0% in age group 8–14 days, 15-21 days and 22–28 days respectively. Mean age of the neonates were  $5.71 \pm 6.70$  days with a range of 1–28 days (Table-I).

Among the 300 patients in this study it was observed that majority 178(59.4%) patients were male (Table-I).

In a study found that 64.2% were male and 35.7% female which is similar result with our study.<sup>8</sup> Another study done in Dhaka Medical College Hospital (DMCH), which included 44 neonates where 21(47.72%) were male and 23(52.27%) were female (Afroz et al., 2016)<sup>9</sup>. Male predominance was also seen in other study<sup>10</sup>.

In this study, male and female ratio was 1.46:1. In another study done by Airedo et al. (1997) where they found 3.3:1.<sup>11</sup>

In the present study, total 73% patients who admitted in the hospitals were from rural area (Table-I) and 41.7% had primary education (Table-I). Among the 300 patients, 57% parents had monthly family income 10,000-25,000 taka (Table-I).

In current study, among the 300 patients appropriate for gestational age (AGA) or normal birth weight was highest (49.7%) followed by low birth weight, very low birth weight and extremely low birth weight were 35.30%, 14.0% and 1.0% respectively (Table-II).

A study found normal birth weight 57% cases and 35% with low birth weight and 7.14% were very low birth weight.<sup>8</sup> In another study showed that the overall prevalence of low birth weight was 17.4%<sup>12</sup>.

In this study, perinatal asphyxia, neonatal sepsis were found 33.3%, 24.0% (Table-III). In the study of Halder et al. (2017), 35.3% neonates had sepsis and 34.6% neonates had perinatal asphyxia<sup>8</sup>. In another study where they found perinatal asphyxia 53.4%, sepsis 32.6% respectively.<sup>11</sup>

In the present study, 91.6% patient did not have any problem. Seven percent patient presented with fever due to neonatal sepsis and 1.3% AKI patient developed swelling of the body (Table-IV). Other study did not find association of fever with AKI.

Among 300 neonates AKI developed in 71 (23.7%) neonates. In the study shows frequency of neonatal AKI was 24.9% which was similar to this study result<sup>13</sup>. But 4.66% AKI in their study conducted in neonatology unit of Dhaka Shishu Hospital<sup>8</sup>. The incidence of AKI 3-8% in sick neonates.<sup>11, 14, 15</sup>

In this study, among neonates with AGA, 25.5% had AKI, 24.5% low birth weight and 16.7% very low birth weight developed AKI. In a study by another study found 52.7% with normal birth weight because of higher prevalence of normal birth weight, 40.5% and 1.3% LBW and VLBW respectively<sup>10</sup>. One study found 57.0% normal birth weight and 43.0% LBW neonates among AKI<sup>8</sup>. The incidence of AKI in VLBW infants estimated to be  $18\% \pm 40\%$ <sup>16</sup>. The incidence of AKI was 26% (39 of 150) in all preterm infants, 39% (37 of 96) in VLBW infants.<sup>17</sup>

In this study, AKI developed in 24.4% of preterm, 22.0% of term and 75.0% of post term (Table-VII). Previously it was found that 71.4% term and 28.5% preterm neonates among AKI.<sup>8</sup> One study found 71.6% full term and 28.4% pre term neonates<sup>10</sup>. In this study prevalence of AKI did not differ between different gestational age and birth weight.

In the present study, out of 300 patients, 71(23.7%) developed AKI which was associated with some etiological factors mostly perinatal asphyxia, neonatal sepsis 43.8%, 35.2% respectively. Sepsis was the most common cause of AKI (30.9%) followed by birth asphyxia (11.5%)<sup>18</sup>.

### Conclusion:

This study concluded that, AKI developed in 23.7% neonates. Prevalence of AKI is same in all gestational age and birth weight. Common etiology of neonatal AKI was perinatal asphyxia, neonatal sepsis.

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