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A PROSPECTIVE OBSERVATIONAL STUDY ON SERUM MAGNESIUM LEVELS IN CHILDRENS ADMITTED TO PAEDIATRIC INTENSIVE CARE UNIT (PICU) AT A TERTIARY CARE HOSPITAL

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ABSTRACT

Background: *Magnesium, often termed the "forgotten electrolyte," is essential for numerous physiological functions. Critically ill children are particularly vulnerable to electrolyte imbalances, yet data on magnesium abnormalities in Indian paediatric populations remain limited.*

Objective*: To ascertain the frequency of hypomagnesemia and hypermagnesemia in children admitted to the pediatric critical care unit and to establish a relationship between entrance serum magnesium levels and both mortality and length of stay in the intensive care unit.*

Materials and Methods*: This 18-month prospective observational research was carried out in a tertiary care facility. 74 children between the ages of one month and eighteen who were hospitalized to the pediatric intensive care unit were included in the study. The FRONZAMAN DYE technique was used to test serum magnesium levels upon admission. Patient outcomes, length of stay in the intensive care unit, clinical parameters, and Pediatric Risk of Mortality III scores were all documented and examined. Results: Infants (0–12 months) made up 58.1% of the cohort, with a median age of 9.5 months. 10.8% of children had hypermagnesemia, 4.1% had hypomagnesemia, and 85.1% had normal magnesium levels. The total death rate was 4.1%. The mean blood magnesium level was 2.40 ± 0.30 mg/dL in non-survivors and 2.11 ± 0.26 mg/dL in survivors; however, this difference was not statistically significant (p = 0.235). Serum magnesium levels and length of stay in the critical care unit did not significantly correlate (p = 0.930). There was a statistically significant correlation between higher Pediatric Risk of Mortality III scores and mortality (p = 0.020).*

Conclusion*: Magnesium abnormalities were present in a minority of critically ill children in this cohort and did not show significant independent associations with mortality or duration of intensive care unit stay. Disease severity, as measured by the Pediatric Risk of Mortality III score, remained the strongest predictor of adverse outcomes. Routine monitoring of serum magnesium is recommended as part of comprehensive electrolyte assessment in pediatric intensive care settings.*

Keywords*: Magnesium, Hypomagnesemia, Hypermagnesemia, Paediatric Intensive Care Unit & Paediatric Risk of Mortality III score*

INTRODUCTION

Magnesium, often termed the "forgotten electrolyte," plays an essential role in maintaining cellular and systemic physiological balance. It is the second most abundant intracellular cation after potassium and acts as a cofactor for more than 300 enzymatic

processes, including those involved in muscle contraction, nerve conduction, protein synthesis, energy metabolism, and regulation of blood glucose and blood pressure [1,2]. Magnesium concentration in healthy individuals ranges from 1.5 to 2.7 mEq/L, and homeostasis is maintained through the coordinated actions of the kidneys, gastrointestinal tract, and bone reservoirs [3]. Magnesium absorption takes place in the small intestine, while renal excretion balances serum magnesium levels. Disturbances in magnesium homeostasis can significantly affect cellular metabolism and organ functions, potentially leading to life-threatening conditions in critically ill patients [4].

Magnesium abnormalities are quite common in critically ill patients, with hypomagnesemia observed in up to 65% of patients admitted to intensive care units. Causes of hypomagnesemia include low dietary intake, gastrointestinal losses, renal dysfunction, sepsis, protein-energy malnutrition, and certain medications such as aminoglycosides and catecholamines [5]. Hypermagnesemia, seen in fewer cases (approximately 5% of inpatients), is generally associated with renal impairment in excretion, excessive magnesium replacement, diabetic ketoacidosis, or iatrogenic causes [6]. In developing countries, children in Paediatric Intensive Care Units are most vulnerable to magnesium imbalance, given the higher risks of malnutrition, infection, and limited healthcare resources [7]. Previous studies have demonstrated that hypomagnesemia is associated with increased morbidity and mortality because of its potentiating role in conditions like sepsis, cardiac arrhythmias, and impaired wound healing [8].

Recent studies suggest that serum magnesium may be useful as a prognostic indicator in critically ill patients; however, none of the standardized ICU scoring systems to date incorporate magnesium as a parameter, creating a clinical need for further evaluation of this marker [9]. Critical care for ill children in the PICU is characterized by intensive organ support and invasive interventions, making the prediction of clinical outcomes a crucial part of care. In resource-constrained settings such as India, judicious use of healthcare resources mandates that prognostic markers be reliable, cost-effective, and easily measurable [10]. Magnesium disturbances are treatable and potentially preventable; however, they often get overlooked despite their marked influence on patient outcomes [11]. The present study aimed to fill the knowledge gap regarding magnesium's role in paediatric critical care in India by investigating the prevalence and implications of serum magnesium abnormalities in children admitted to PICU and their possible contribution to clinical outcomes and optimization of resources.

Objectives of the study:

To determine the occurrence and incidence of hypo- and hypermagnesemia in children admitted to Paediatric intensive care unit (PICU) at a tertiary care Hospital

Correlate serum magnesium levels at admission with mortality and with the length of Intensive care unit (ICU) stay at a tertiary care Hospital.

MATERIAL AND METHODS:

A Prospective observational study was carried out in the Paediatric intensive care unit at tertiary care hospital over the period of 18 months. The study participants included in the study were 74 Children admitted to PICU during the period of study with the Inclusion Criteria of children admitted to PICU aged between 1 month to 18 years of age. who had consented to be a part in the study. Exclusion Criteria was children who received magnesium products within last 24 hours of admission and Child who is a known congenital renal magnesium wasting eg: Bartter's syndrome and Gitelman's syndrome.

Sample size Calculation:

Sample size was estimated by using the proportion of abnormal serum magnesium in children who are critically ill was 70% from the study by Sunit C. Singhi, et al. using the formula

$Z_{1-\alpha/2}{}^2 P (1-P) / d^2$

Where $Z_{1-\alpha/2} =$ is standard normal variate (at 5% type 1 error ($P<0.05$) it is 1.96 and at 1% type1 error($P<0.01$) it is 2.58). As in majority of studies P values are considered significant below 0.05 hence 1.96 is used in formula.

P= Expected proportion in population based on previous studies or pilot studies

d= Absolute error or precision

P = 70% or 0.70

q = 30% or 0.30

d = 11% or 0.11

Using the above values at 95% Confidence level a sample size of 67 subjects will be included in the study. Considering 10% Nonresponse a sample size of 67 + 6.7 ≈ 74 minimum subjects will be included in the study.

METHODOLOGY

Data Collection was done by trained postgraduate by using structured Proforma. Institutional ethical committee approval was obtained before starting the study. The whole study details were explained in their mother tongue to the patient and written informed consent was obtained. The structured Proforma contain Clinical history in detail including Age in months, Gender, Haemodynamic Stability (Stable / Unstable), Respiratory Support (Required / Not Required), Inotropes Support (Required / Not Required), Fluid Resuscitation (Required / Not Required), The Paediatric Risk of Mortality (PRISM)-III score, Development and Immunisation History, Hemodynamic and Anthropometric Parameters, Pulse Rate (beats/min), Respiratory Rate (breaths/min), Oxygen Saturation (%), Systolic Blood Pressure (mmHg), Diastolic Blood Pressure (mmHg), Recorded Temperature (°F), Height (cm), Weight (kg), Capillary Refill Time < 3 seconds N (%), Peripheral Pulses present, Hematological and Biochemical Parameters, C-reactive Protein n (%), Number of days Children admitted in PICU, Hypo and hyper magnesium distribution and Outcome of the Children (Death / Discharge)

This study was started after obtaining consent from the parents. All children fulfilling the inclusion criteria will be included in the study. Data focused on the patient's age, sex, admission diagnosis, whether mechanical ventilation support was needed, time of mechanical ventilation and length of stay in the PICU and hospital was recorded. Vital signs, anthropometric measurements, a systematic examination, and a measurement of the Glasgow coma scale was recorded. The Paediatric Risk of Mortality (PRISM)-III score was calculated for each patient at the time of admission. Laboratory investigations - estimation of the levels of magnesium was done immediately after admission by drawing venous blood and processed by FRONZAMAN DYE method. The serum mg value was recorded.

Statistical analysis:

Data was entered into Microsoft excel data sheet and analysed using SPSS 22 version software. Categorical data was represented in the form of Frequencies and proportions. Chi-square test was used as test of significance for qualitative data. Shapiro wilks test was used to find the normal distribution of the data. Continuous data was represented as mean and standard deviation. Independent t test was used to compare between serum magnesium level with outcome of the Children admitted in PICU. one way ANOVA was used Comparison of Serum Magnesium Levels with Duration of PICU Admission. Pearson Correlation was used to Serum Magnesium Levels with Duration of PICU Admission. Comparison between PRISM III Score and Outcome of the children admitted in PICU was calculated based on Mann-Whitney U test. Graphical representation of data: MS Excel and MS word was used to obtain various types of graphs such as bar diagram, Pie diagram. P value (Probability that the result is true) of <0.05 was considered as statistically significant after assuming all the rules of statistical tests. MS Excel, SPSS version 22 (IBM SPSS Statistics) was used to enter and analyse the data.

Ethical consideration:

Ethical principles such as respect to the patient, beneficence and justice were strictly adhered. Ethical committee approval was obtained before starting the study. The approval to conduct the present study was obtained from the Institutional Ethics Committee (IEC). Confidentiality of the study participants was maintained throughout the study.

RESULTS

Table 1: Basic characteristics of the study participants

	Frequency	**Percentage**
Median Age (IQR) in months	9.50 (5.0 – 39.0)	
Gender		
Male Child	39	52.7 %
Female child	35	47.3 %
Haemodynamic Stability		
Stable	5	6.8 %
Unstable	69	93.2 %
Respiratory Support		
Required	62	83.8 %
Not Required	12	16.2 %
Inotropes Support		
Required	5	6.8 %
Not Required	69	93.2 %
Fluid Resuscitation		
Required	53	71.6 %
Not Required	21	28 .4 %
PRISM score category		

< 7	25	33.8 %
7 to 10	11	14.9 %
> 10	38	51.4 %
Median (IQR)	12 (4 – 16)	
Development history		
Normal	72	97.3 %
Abnormal	2	2.7 %
Immunisation History		
Fully immunised	73	98.6 %
Partially immunised	1	1.4 %
Magnesium level		
Hypermagnesemia	8	10.8 %
Hypomagnesemia	3	4.1 %
Normal	63	85.1 %
Number of days Children admitted in PICU		
One day	2	2.7 %
> 1 to 7 days	68	91.9 %
> 7 days	4	5.4 %
Mean ± SD	3.64 ± 0.23	
Outcome of the Children		

Death	3	4.1 %
Discharge	71	95.9 %
Total	**74**	**100.0 %**

The median age among the study participants was 9.50 (IQR = 5.0 – 39.0) months. Majority of them were in age category between 0 to 12 months of which is 43 (58.1%). The minimum age observed was 1 month and the maximum was 204 months. Out of 74 study participants, 39 (52.7 %) were male and 35 (47.3%) were female, giving a male-to-female ratio of approximately 1.1:1. This reflects a slight male predominance in the study population. The majority of the children admitted in PICU were hemodynamically unstable which is 69 (93.2%) cases, 62 (83.8%) required respiratory support, 5 (6.8%) required inotropes support and 53 (71.6%) required fluid resuscitation. The median PRISM III score among children admitted in PICU was 12 (IQR = 4 – 16). The minimum score observed was 0 and the maximum score observed was 26. Among 74 children's, 25 (33.8%) had score less than seven, 11 (14.9%) had score of 7 to 10 and 38 (51.4%) had score more than 26. The majority of children, 72 (97.3%) , had a normal developmental history, while only 2 (2.7%) children were recorded as having abnormal development (including one child with Global Developmental Delay). Regarding immunization status, nearly all children 73 (98.6%) had received fully immunizations as per IAP/National immunisation schedule, and only 1 (1.4%) child had partially immunization. Among 74 children admitted in PICU, 8 (10.8%) had hypermagnesemia, 3 (4.1%) had Hypomagnesemia and 63 (85.1%) had normal magnesium level. The mean number of days admitted in PICU3.64 ± 0.23, the minimum days of admission was one day and the maximum number of days admission was 12. Majority 68 (91.9%) admitted between more than 1 to 7 days. Regarding outcome of the children, 71 (95.9%) children were successfully discharged from the PICU, while 3 (4.1%) children died during their PICU stay.

Table 2: Vitals and Anthropometric Parameters among Children admitted to PICU (n = 74)

Parameters	**Median**	**Interquartile Range**
Pulse Rate (beats/min)	129.00	111.50 - 138.00
Respiratory Rate (breaths/min)	56.00	41.50 - 62.50
Oxygen Saturation (%)	96.00	94.00 - 96.00
Systolic Blood Pressure (mmHg)	75.00	70.00 - 90.00
Diastolic Blood Pressure (mmHg)	52.00	48.00 - 60.00
Recorded Temperature (°F)	98.600	98.400 - 99.175
Height (cm)	71.500	62.000 - 99.000
Weight (kg)	7.8500	5.4500 - 14.0000

Capillary Refill Time < 3 seconds N (%)	74 (100.0%)
Peripheral Pulses present	74 (100.0%)

The median Pulse Rate was 129 beats/min (IQR: 111.5–138.0) . The median Respiratory Rate was 56 breaths/min (IQR: 41.5–62.5), reflecting the high proportion of children with respiratory distress in the cohort. The median Oxygen Saturation (SpO2) was 96% (IQR: 94–96%), indicating that most children were adequately oxygenated at the time of admission. The median Systolic Blood Pressure was 75 mmHg (IQR: 70–90 mmHg), and median Diastolic Blood Pressure was 52 mmHg (IQR: 48–60 mmHg) . The median Temperature was 98.6°F (IQR: 98.4–99.2°F) . Regarding anthropometry, the median Height was 71.5 cm (IQR: 62.0–99.0 cm), and median Weight was 7.85 kg (IQR: 5.45–14.00 kg). All children had capillary refilling time less than 3 seconds and Peripheral Pulses present in all cases.

Table 3: Hematological and Biochemical Parameters in Children admitted to PICU (N = 74)

Parameters	**Median**	**IQR**
Hemoglobin (g/dL)	10.40	9.28 - 11.60
Red Blood Cell Count ($\times 10^6/\mu L$)	4.16	3.80 - 4.68
White Blood Cell Count ($\times 10^3/\mu L$)	12.41	7.11 - 16.40
Packed Cell Volume (%)	33.00	32.00 - 34.00
Platelet Count ($\times 10^3/\mu L$)	400.00	283.75 - 540.00
Serum Magnesium (mg/dL)	2.10	2.00 - 2.20
Serum Sodium (mEq/L)	136.50	133.00 - 139.25
Serum Potassium (mEq/L)	4.60	4.00 - 5.00
C-reactive Protein n (%)		
1:2 Positive	11 (14.9%)	
1:4 Positive	23 (31.1%)	
1:6 Positive	1 (1.4 %)	
1:8 Positive	17 (23.0%)	

Negative	22 (29.7%)

The median Hemoglobin (HB) was 10.40 g/dL (IQR: 9.28–11.60 g/dL). The median Red Blood Cell Count (RBC) was 4.16 × 10^6/µL (IQR: 3.80–4.68 × 10^6/µL). The median White Blood Cell Count (WBC) was 12.41 × 10^3/µL (IQR: 7.11–16.40 × 10^3/µL), reflecting the inflammatory response in critically ill children. The median Packed Cell Volume (PCV) was 33.0% (IQR: 32.0–34.0%). The median Platelet Count (PLT) was 400.0 × 10^3/µL (IQR: 283.75–540.0 × 10^3/µL), with a wide range reflecting both thrombocytopenia in conditions like dengue and thrombocytosis in reactive conditions. The median Serum Magnesium level was 2.10 mg/dL (IQR: 2.00–2.20 mg/dL). The median Serum Sodium was 136.5 mEq/L (IQR: 133.0–139.25 mEq/L). The median Serum Potassium was 4.60 mEq/L (IQR: 4.00–5.00 mEq/L). C-Reactive Protein (CRP) status, a marker of inflammation and infection, was positive in 52 (70.3%) children and negative in 22 (29.7%). Among those with positive CRP, the most common titers were 1:4 positive in 23 (31.1%), followed by 1:8 positive in 17 (23.0%), 1:2 positive in 11 (14.9%), and 1:6 positive in 1 (1.4%).

Table 4: Comparison between serum magnesium level and PRISM III score with outcome of the Children admitted in PICU

	Outcome		**p value**
	Death	**Discharged**	
Magnesium level			
Hypermagnesemia	1 (33.3%)	7 (9.9 %)	0.235
Hypomagnesemia	0	3 (4.2%)	
Normal	2 (66.7%)	61 (85.9 %)	
Mean ± SD	2.40 ± 0.30	2.11 ± 0.26	
PRISM III Score			
< 7	0	25 (35.2%)	0.020
7 to 10	0	11 (15,5%)	
> 10	3 (100.0%)	35 (49.3%)	
Mean ± SD	18.67 ± 6.43	9.45 ± 6.55	
Total	**3**	**71**	

Note p value based on independent sample t test

Among the children who died, one presented with hypermagnesemia (33.3%) and two presented with normal magnesium levels (66.7%), whereas among those discharged, seven had hypermagnesemia (9.9%), three had hypomagnesemia (4.2%), and 61 had normal magnesium levels (85.9%). Hypomagnesemia was observed exclusively in the discharged population (4.2%) and was absent in the mortality group. The mean serum magnesium level was higher among patients who died (2.40 ± 0.30) relative to those discharged (2.11 ± 0.26). Despite these observed differences in distribution and mean values, the statistical analysis yielded a p-value of 0.235, indicating that these associations do not reach statistical significance, likely influenced by the very low mortality rate of only three events in the study population. All three children who died (100.0%) presented with PRISM III scores exceeding 10, with a mean score of 18.67 ± 6.43 in this group, indicating high physiological instability. In contrast, among survivors, 35 (49.3%) children's had scores above 10, 11 (15.5%) children's had scores between 7 and 10, and 25 (35.2%) children's presented with scores below 7, yielding a significantly lower mean score of 9.45 ± 6.55. The statistical analysis demonstrates a p-value of 0.020, confirming a statistically significant association between higher PRISM III scores and mortality, despite the small death cohort.

Figure 1: Scatterplot diagram shows Correlation of Serum Magnesium Levels with Duration of PICU Admission

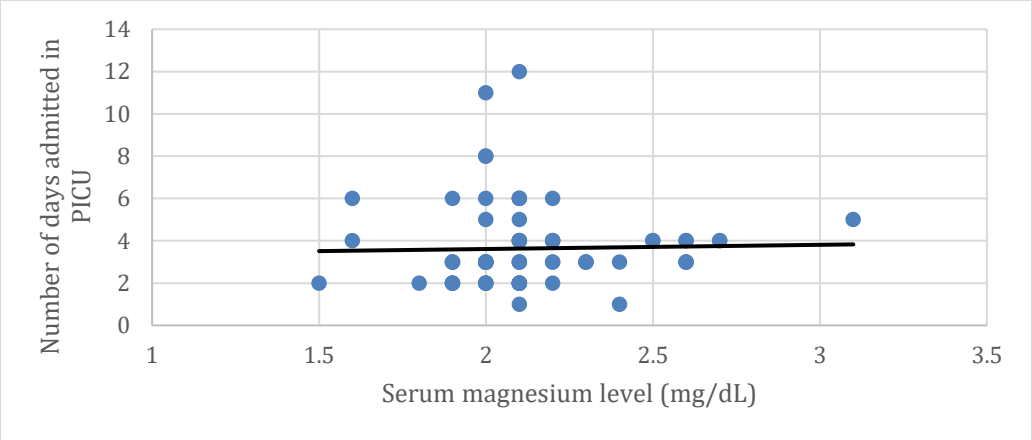
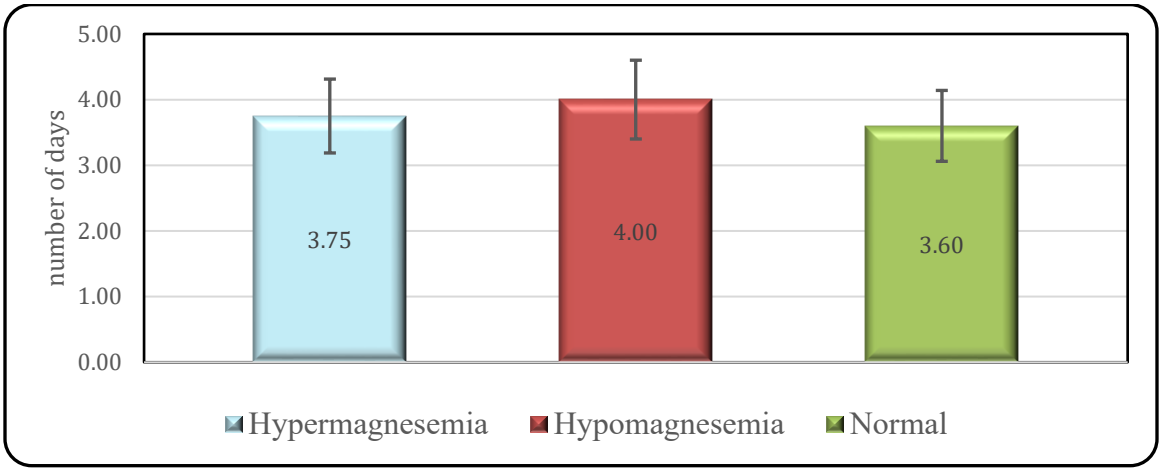


Figure 1represent scatter plot diagram shows slightly positive correlation which means when serum magnesium level increases the length of stay in PICU also increases and it is not statistically significant with the r value of 0.18 and the p value shows 0.118.

Figure 2: Error bar diagram shows mean duration of stay in PICU with serum magnesium level



The mean duration of stay in PICU among Hypermagnesemia children were 3.75 ± 0.71 days and in hypomagnesemia cases were 4.00 ± 2.00 days and in normal level serum magnesium cases were 3.60 ± 2.08 days. The mean duration stays were equally distributed in all the three groups with the p value shows 0.930.

DISCUSSION

The present study revealed that infants aged 0–12 months constituted the majority of PICU admissions (58.1%), with a median age of 9.5 months. This age distribution pattern is consistent with previous research in paediatric critical care. Singhi and colleagues documented that over half of PICU admissions in their Indian cohort were infants, while Pozzi et al. observed that the majority of critically ill paediatric patients requiring intensive care were under one year of age [1,2]. The vulnerability of infants to serious infections, respiratory illnesses, and sepsis, combined with their relatively immature immune systems and lower physiological reserves, explains this higher admission rate [3]. The slight male predominance observed in this study (52.7% males, male-to-female ratio 1.1:1) aligns with multiple PICU-based studies, including those by Kirpal et al. and Halal et al., who reported higher PICU admission rates among male children [12,13]. Previous literature suggests that gender does not significantly influence serum magnesium levels in critically ill children [14].

Regarding the prevalence of magnesium abnormalities, the present study found hypomagnesemia in 4.1% of patients and hypermagnesemia in 10.8%, with the majority (85.1%) having normal serum magnesium levels. This prevalence is notably lower than that reported in many earlier studies. Singhi et al. reported hypomagnesemia in approximately 28% of critically ill children in an Indian PICU, while Dandinavar et al. found hypomagnesemia in 38% of children admitted to PICU [1,4]. Rubeiz et al. reported hypomagnesemia in approximately 20–65% of critically ill adults, and Chernow et al. documented magnesium deficiency in nearly 50% of intensive care patients [6,7]. The relatively lower prevalence of hypomagnesemia in the present study may be attributed to the short mean duration of PICU stay (3.64 days), early fluid resuscitation protocols, and routine electrolyte monitoring at the study institution [14]. Interestingly, hypermagnesemia was observed more frequently than hypomagnesemia, which may reflect specific practice patterns regarding magnesium supplementation or a higher prevalence of renal impairment among study participants [15].

The present study evaluated the association between serum magnesium levels and mortality. Among the three children who died, one had hypermagnesemia (33.3%) while two had normal magnesium levels (66.7%). Although the mean serum magnesium level was higher among non-survivors (2.40 ± 0.30 mg/dL) compared to survivors (2.11 ± 0.26 mg/dL), this difference was not statistically significant (p = 0.235). Previous studies have reported varying associations. Rubeiz et al. found that hypomagnesemia was associated with increased mortality in critically ill medical patients, while Chernow et al. reported that hypomagnesemia in postoperative intensive care patients was associated with worse outcomes [6,7]. Shankar et al. specifically evaluated hypomagnesemia as a predictor of mortality in PICU patients using PRISM scores and found that children with hypomagnesemia had significantly higher mortality rates [16]. However, Mohamed recently demonstrated that while hypermagnesemia was more common in non-survivors, serum magnesium levels alone could not function as an independent predictor of death, with disease severity scores remaining the best predictor [8]. The lack of statistical significance in the present study may be due to the very low mortality rate (4.1%) and small number of death events (n=3), which limited statistical power [17].

The relationship between magnesium levels and duration of PICU admission was also evaluated in this study. The mean duration of stay was slightly higher among children with hypomagnesemia (4.00 ± 2.00 days) and hypermagnesemia (3.75 ± 0.71 days) compared to those with normal levels (3.60 ± 2.08 days), but these differences were not statistically significant (p = 0.930). Correlation analysis showed a weak positive relationship (r = 0.18, p = 0.118). Chandrashekhar et al. conducted a prospective observational study and found that magnesium imbalance was associated with increased severity of illness and lengthened hospital stay, while Farrukh et al. reported that children with hypomagnesemia had increased complication rates and prolonged PICU stay compared to those with normal magnesium levels [9,10]. Gonuguntla et al. reported that while hypomagnesemia was associated with prolonged ICU stay in some patient subgroups, the association was not consistent across all analyses [18]. The lack of a significant correlation in the present study may again be attributable to the small sample size and the relatively short mean length of stay (3.64 days) [17].

Importantly, the study demonstrated a statistically significant association between PRISM III scores and mortality (p = 0.020). All three children who died (100%) had PRISM III scores exceeding 10, with a mean score of 18.67 ± 6.43 among non-survivors compared to 9.45 ± 6.55 among survivors. This finding is consistent with extensive literature demonstrating a clear

correlation between higher PRISM scores and increased mortality in PICU settings. Pollack et al., who originally developed the PRISM scoring system, demonstrated that higher scores are associated with more severe physiological derangement and increased mortality risk [11]. Gemke and Bonsel confirmed the validity of PRISM scores for mortality prediction in a national multicentre study of paediatric intensive care [19]. Taori et al. similarly reported that PRISM III scores are reliable predictors of mortality in critically ill paediatric patients in Indian tertiary care settings [20]. The significant relationship between higher PRISM III scores and mortality observed in this study supports the continued utility of this scoring system in assessing disease severity in PICU populations.

The physiological importance of magnesium in critically ill patients is well-established in the literature. Magnesium acts as a cofactor for more than 300 enzymatic reactions and is essential for cardiovascular stability, neuromuscular function, and immune modulation [21]. Hansen and Bruserud highlighted that hypomagnesemia remains underdiagnosed despite its clinical significance, with multifactorial causes including low nutritional intake, gastrointestinal losses, renal impairment, and medications such as diuretics and aminoglycosides [14]. Aal-Hamad et al. noted that hypermagnesemia, while less common, carries significant clinical implications including neuromuscular depression, cardiovascular compromise, and altered mental status [15]. Wang et al. found that hypermagnesemia, rather than hypomagnesemia, was a predictor of inpatient mortality in critically ill children with sepsis, suggesting that both ends of the magnesium spectrum have clinical relevance [22]. Yue et al. demonstrated a U-shaped association between serum magnesium levels and mortality in a large cohort of PICU patients, indicating that both low and high levels are associated with increased mortality risk [23]. The present study's findings support routine monitoring of serum magnesium as part of comprehensive electrolyte assessment in PICU settings, while recognizing that disease severity measured by PRISM III score remains the strongest predictor of adverse outcomes [17].

Strengths and Limitations

This study has a number of advantages. First, it was created as prospective observational research that made it possible to gather clinical and biochemical data from children admitted to the PICU in a methodical and timely manner. Second, in order to provide a more comprehensive clinical view, the study assessed serum magnesium levels in connection to significant clinical indicators such PRISM III score, length of PICU stay, and patient outcomes. Third, all participants had standardized laboratory tests and clinical evaluation procedures, which contributed to the uniformity and dependability of data gathering. Additionally, the study covered a broad range of pediatric ages, from newborns to teenagers, giving an overview of the magnesium status of various pediatric age groups admitted to the PICU. The study was carried up at a single tertiary care institution with a very small sample size of 74 kids, which would restrict the findings' applicability to different demographics or medical environments. The distribution of magnesium levels and clinical outcomes may have been affected by the fact that newborns made up the bulk of subjects. The research population's low death rate is another key drawback that may have diminished the statistical power to find a meaningful correlation between blood magnesium levels and patient outcomesFurthermore, only baseline serum magnesium levels were assessed; serial monitoring throughout the PICU stay was not carried out, which might have improved knowledge of dynamic electrolyte changes during critical illness. Lastly, magnesium levels in connection to certain disease categories or drugs that might affect electrolyte balance were not examined in this investigation.

CONCLUSION

Serum magnesium levels in children hospitalized to a tertiary care hospital's Pediatric Intensive Care Unit (PICU) were assessed in this prospective observational research. A little percentage of severely sick children had hypermagnesemia and hypomagnesemia, while the majority had normal blood magnesium levels. The correlation between blood magnesium levels and death was not statistically significant, despite the fact that children who died had higher mean serum magnesium levels than those who were released. Similarly, there was no discernible correlation seen between the length of PICU hospitalization and serum magnesium levels. Higher PRISM III scores, however, demonstrated a strong correlation with death, suggesting that in critically sick children, illness severity is still a major predictor of prognosis. Overall, the results indicate that although PICU patients may have aberrant serum magnesium levels, serum magnesium levels by themselves may not be a good independent predictor of clinical outcomes. To further understand the prognostic importance of magnesium abnormalities in critically unwell pediatric patients, larger multicentric studies with larger sample numbers are advised.

REFERENCES (VANCOUVER STYLE)

1. Singhi SC, Singh J, Prasad R. Hypo- and hypermagnesemia in an Indian Pediatric Intensive Care Unit. J Trop Pediatr. 2003;49(2):99-103.

2. Pozzi N, Cogo P, Moretti C, Biban P, Fedeli T, Orfeo L, et al. The care of critically ill infants and toddlers in neonatal intensive care units across Italy and Europe: our proposal for healthcare organization. Eur J Pediatr. 2022;181(4):1385-93.

3. Frankel LR, Hsu BS, Yeh TS, Simone S, Agus MSD, Arca MJ, et al. Criteria for Critical Care Infants and Children: PICU Admission, Discharge, and Triage Practice Statement and Levels of Care Guidance. Pediatr Crit Care Med. 2019;20(9):847-87.

4. Dandinavar SF, D S, Ratageri VH, Wari PK. Prevalence of hypomagnesemia in children admitted to pediatric intensive care unit and its correlation with patient outcome. International Journal of Contemporary Pediatrics. 2019;6(2):462-7.

5. Ahmed F, Mohammed A. Magnesium: The Forgotten Electrolyte—A Review on Hypomagnesemia. Med Sci (Basel). 2019;7(4):56.

6. Rubeiz GJ, Thill-Baharozian M, Hardie D, Carlson RW. Association of hypomagnesemia and mortality in acutely ill medical patients. Crit Care Med. 1993;21(2):203-9.

7. Chernow B, Bamberger S, Stoiko M, Vadnais M, Mills S, Hoellerich V, et al. Hypomagnesemia in patients in postoperative intensive care. Chest. 1989;95(2):391-7.

8. Mohamed AO. Hyper- and hypomagnesemia as an initial predictor of outcomes in septic pediatric patients in Egypt. Acute Crit Care. 2025;40(1):105-12.

9. Zafar MSH, Wani JI, Karim R, Mir MM, Koul PA. Significance of serum magnesium levels in critically ill-patients. Int J Appl Basic Med Res. 2014;4(1):34-7.

10. Woodruff AG, Choong K. Long-Term Outcomes and the Post-Intensive Care Syndrome in Critically Ill Children: A North American Perspective. Children (Basel). 2021;8(4):254.

11. Laddhad DS, Hingane V, Patil TR, Laddhad DD, Laddhad AD, Laddhad SD. An assessment of serum magnesium levels in critically ill patients: A prospective observational study. Int J Crit Illn Inj Sci. 2023;13(3):111-7.

12. Kirpal H, Behl A, Jain S, Pandit S. Clinical profile and outcome of patients admitted in pediatric intensive care unit of tertiary care teaching hospital of rural North India: an observational study. International Journal of Contemporary Pediatrics. 2024;11(7):921-8.

13. El Halal MG dos S, Barbieri E, Filho RM, Trotta E de A, Carvalho PRA. Admission source and mortality in a pediatric intensive care unit. Indian J Crit Care Med. 2012;16(2):81-6.

14. Hansen BA, Bruserud Ø. Hypomagnesemia in critically ill patients. J Intensive Care. 2018;6:21.

15. Aal-Hamad AH, Al-Alawi AM, Kashoub MS, Falhammar H. Hypermagnesemia in Clinical Practice. Medicina (Kaunas). 2023;59(7):1190.

16. Shankar P, Reddy NVM, Devaraj S. Hypomagnesemia as a predictor of mortality in critically ill pediatric patients in picu using prism score. International Journal of Contemporary Pediatrics. 2019;6(3):1294-7.

17. Deekshitha R, Shilpa P, Chaitra KM. Occurrence of hypomagnesemia in children admitted to paediatric intensive care unit. Int J Contemp Pediatr. 2023;10(9):1825-9.

18. Gonuguntla V, Talwar V, Krishna B, Srinivasan G. Correlation of Serum Magnesium Levels with Clinical Outcome: A Prospective Observational Study in Critically Ill Patients Admitted to a Tertiary Care ICU in India. Indian J Crit Care Med. 2023;27(5):342-7.

19. Gemke RJ, Bonsel GJ. Comparative assessment of pediatric intensive care: a national multicenter study. Pediatric Intensive Care Assessment of Outcome (PICASSO) Study Group. Crit Care Med. 1995;23(2):238-45.

20. Taori RN, Lahiri KR, Tullu MS. Performance of PRISM (Pediatric Risk of Mortality) score and PIM (Pediatric Index of Mortality) score in a tertiary care pediatric ICU. Indian J Pediatr. 2010;77(3):267-71.

21. de Baaij JHF, Hoenderop JGJ, Bindels RJM. Magnesium in Man: Implications for Health and Disease. Physiological Reviews. 2015;95(1):1-46.

22. Wang H, Huang J, Jin X, Chen C, Zhang A, Wu Y, et al. Hypermagnesaemia, but Not Hypomagnesaemia, Is a Predictor of Inpatient Mortality in Critically Ill Children with Sepsis. Dis Markers. 2022;2022:3893653.

23. Yue CY, Zhang CY, Huang ZL, Ying CM. A Novel U-Shaped Association Between Serum Magnesium on Admission and 28-Day In-hospital All-Cause Mortality in the Pediatric Intensive Care Unit. Front Nutr. 2022;9:747035.