

*Research Article***Malnutrition and vitamin D, what is the relation with sepsis?****Sawsen El-Banna\*, Duaa Mahrous\*, Hend Moonesi\*\* and Noura A. Mahmoud\***

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**Abstract**

**Background:** Malnutrition affects 50% of hospitalized children and 25-70% of the critically ill children. It increases the incidence of complications and mortality. Malnutrition is associated with an altered metabolism of certain substrates, increased metabolism and catabolism depending on the severity of the lesion, and reduced nutrient delivery. also,. Vitamin D is essential for bone health, as well as for cardiovascular and immune function. In critically ill adults vitamin D deficiency (VDD) is common, and is associated with sepsis and higher critical illness severity. **Objectives: Aim of the study:** to determine the effect of malnutrition on mortality in Pediatric Intensive Care Unit (PICU) and neonatal intensive care unit in minia university hospital. **Methods:** This was a prospective study done over 6 month. There were total 220 patients (1 month to 18 years), who were divided into cases with weight for age <3 (rd) centile and controls with ≥3(rd) centile of WHO charts. Cases were subdivided into mild/moderate (61-80% of expected weight for age) and severe malnutrition (<60%).. Blood was collected on admission to PICU and analyzed for 25-OH-D levels. **The three groups:** were subjected to complete history taking, through clinical examination and laboratory investigations including determining serum vitamin D level. **Results:** Out of total, 48% patients were underweight, and malnutrition was more in early childhood ( $P = 0.01$ ) and were more deficient in serum vitamin D level ( $p = 0.0001$ ) Cases needed prolonged mechanical ventilation ( $P = 0.0001$ ) and hospital stay ( $P = 0.0001$ ) compared to controls. mortality was significantly higher in severely malnourished ( $P$  value 0.0001). The prevalence of VDD was associated with prolonged stay in intensive care unit ( $P = 0.0001$ ), mechanical ventilation ( $p = 0.005$ ). **Conclusion:** Severe malnutrition and vitamin D deficiency at PICU admission was prevalent in critically ill children and was associated with adverse clinical outcomes.

**Keywords:** Vitamin D, Anthropometric data, malnutrition, outcome in malnourished children, pediatric risk of mortality.

**Introduction**

Severe acute malnutrition is defined by a very low weight for height (below -3 z scores of the median WHO growth standards), by visible severe wasting or by the presence of nutritional edema<sup>(1)</sup>. In 2017 globally, 51 million children under five years were wasted of which 16 million were severely wasted. This translates into a prevalence of 7.5 percent and 2.4 percent, respectively<sup>(2)</sup>. Chronic and acute malnutrition, may result from a combination of inadequate nutrient intake, increased losses (diarrhoeal episodes, vomiting) and increased energy expenditure (usually due to infections)<sup>(3)</sup>. The formation of nephrons is complete by 35-36 weeks of gestation, but glomerular and tubular growth continues in the first eighteen months of

post natal life<sup>(4)</sup>. Studies on visceral organ growth and role of malnutrition are scarce. We found few studies which reported that most severely malnourished children had smaller kidneys than normal ones. One of the most important factors identified in the growth of the kidneys is the nutrition of the child<sup>(5)</sup>. Malnutrition in addition to its effect on renal growth, is also known to affect the functioning of the kidney and may result in the reduction of glomerular filtration rate and renal plasma flow<sup>(6)</sup> Basic vitamin D physiology, specifically how the endocrine axis regulates calcium balance, is well described. Circulating 25-hydroxyvitamin D [25(OH)D], the inert precursor to the active hormone, is the accepted marker of body vitamin D status<sup>[7, 9]</sup>. Although thresholds and terminology vary, VDD is

generally accepted as a 25(OH)D concentration below 50 nmol/L, with severe deficiency developing at 25-30 nmol/L<sup>[10-14]</sup>.

### Patients and methods

This is a prospective case-control study that included 210 patients who were admitted to the Pediatric Intensive Care Unit, Minia University Children Hospital. They were selected during the period of June 2019 to November 2019. The investigations were done in the Clinical Pathology Department, Minia University Hospital. A total of 200 patients were included in the study.

#### Inclusion criteria:

- 1- All children who admitted in our PICU.
- 2- Age ranged from one month to 18 years.

#### Exclusion criteria:

- 1- children who died within 24 hours of admission.
- 2- children who discharged against medical advice.

#### Then included children were subjected to the following:

##### a- Careful history taking including:

Name, age, sex, residence, socioeconomic standard, birth weight, nutritional history and complications of malnutrition, history of repeated infection.

##### b. Full clinical examination: including

###### 1- Vital data:

Respiratory rate, heart rate, blood pressure, temperature, full chest, cardiac and abdominal examinations.

2- Anthropometric measurement including measurement of body weight, length, head circumference

### 3- Laboratory investigations:

- A. Routine investigations: as
  - Complete blood count (CBC).
  - Renal function (urea & creatinine).
  - ALT & AST.
  - Prothrombin time and concentration (PT, PC).
  - Bone marrow aspiration was done for all cases.
- B. Special investigations: Serum vitamin D (25-OH vitamin D) level for all cases at the beginning of the study. It was measured also after 6 weeks of VD supplementation for groups I.A and II.A.

### Classification of patients:

A total of 200 patients were included in the study, 13 of them were excluded because of their death during the 1<sup>st</sup> 24 hours of admission.

#### Patient were classified into groups:

- 1- **Group (1):** normal weight for age.
- 2- **Group (2):** moderate malnutrition.
- 3- **Group (3):** severe malnutrition.

### Result

Intubation, duration of PICU stay and PICU outcome was statistically significant value between moderate malnutrition, severe malnutrition and normal with (p value 0.0001), (p value 0.0001), (p value 0.0001) respectively (Table 1).

Also showed that there were significant fair negative correlation between serum vitamin D and duration of PICU stay (p value 0.0001).

	Moderate MN N=58	Severe MN N=43	Normal wt N=109	P value
<b>Intubation</b>				P 0.0001*
Negative	29 (50%)	9 (20.9%)	69 (63.3%)	P1 0.003*
Positive	29 (50%)	34 (79.1%)	40 (36.7%)	P2 0.0001*
				P3 0.09
<b>Duration of PICU stay (days)</b>				P 0.0001*
<7 days	3 (5.2%)	5 (11.6%)	109 (100%)	P1 0.0001*
7-10 days	55 (94.8%)	0 (0%)	0 (0%)	P2 0.0001*
>10 days	0 (0%)	38 (88.4%)	0 (0%)	P3 0.0001*
<b>Final outcome</b>				P 0.0001*
Improved	33 (56.9%)	9 (20.9%)	62 (56.9%)	P1 0.0001*
Died	25 (43.1%)	34 (79.1%)	47 (43.1%)	P2 0.0001*
				P3 0.9

**Table (2):** showed that there were significant weak negative correlation between serum vitamin D and history of intubation (p value 0.005) .

<b>Vitamin D</b>		
<b>Parameters</b>	<b>Spearman's rho</b>	<b>P value</b>
<b>Intubation</b>	-0.19	0.005*
<b>PICU stay duration</b>	-0.42	0.0001*
<b>Improvement</b>	0.12	0.06
<b>Malnutrition</b>	-0.51	0.0001*

showed that there were significant moderate negative correlation between serum vitamin D and malnutrition (p value 0.0001) .

### Discussion

Sever acute malnutrition (SAM) is a common contributing factor for childhood morbidity and mortality. Globally, approximately 19 million children under 5 years are suffering from Severe Acute Malnutrition (SAM). It is a major cause of morbidity and mortality in low-income countries<sup>(11)</sup>. vitamin D has important functions besides bone and calcium homeostasis<sup>(12)</sup>.

This study was conducted on 210 children aged one month to 18 years who were admitted to the Pediatric Intensive Care Unit, Minia University Children Hospital. They were selected during the period of Jan 2019 to November 2019.

Concerning assessment of period of ventilation and PICU length of stay our result showed statistically significant

between malnutrition and length of PICU stay (Table 3) where 88.4% of severe malnourished group >10 days in PICU, 94.8% belongs to moderate malnutrition group stay 7-10 days in PICU and 100% normal group stay < 7 days (p value 0.0001) .this is similar study by (Bagri et al., 2015), (Bechard et al., 2016) as well as (Zamberlan et al., 2012). This result against studies done by (Vermilyea et al., 2013). The Percentage of mortality in this study was found 79.1%in sever malnourished child, 43.1% in moderate malnourished childand 43.1% in normal child as shown in Table (3). This percentage was high in comparison to percentage of mortality in studies done by (Grippa et al., 2017), (Bechard et al., 2016) as well as (Bagri et al., 2015) (27.8% ,7%, 38.8%) respectively.

This study included ventilated patients 40.7% of them are vitamin D sufficient,

70.2% are deficient and 48% are insufficient. On the other hand, mechanically ventilated patients represent in McNally et al., 65% of vitamin D sufficient group and 75% of vitamin D deficient. in Rey et al., 40.9% of vitamin D sufficient group and 39.1% of vitamin D deficient group (Rey et al., 2013).

### Conclusions

Ur. Ca /Cr ratio was elevated in nocturnal enuretic patients and correlated with NE.

### Recommendations

From our study we recommend that: Adding the measurement of urine calcium level in patients with nocturnal enuresis in the process of looking for the etiologies, based on accompanying enuresis and hypercalciuria, its therapeutic approach may need to be changed and more studies should be done considering the controversy which exists about the role of hypercalciuria in the pathogenesis of nocturnal enuresis. Declarations Acknowledgments None Funding Personally funded by the authors. Availability of data and materials The datasets used and /or analyzed during the current study are available from the corresponding author on reasonable request.

### Authors' Contributions

MA, LA, AM and SH participated in the study design, data collection an interpretation and wrote the manuscript. AM and NA analyzed the immunological data and SH, LA and MA participated to discuss the results and to write the manuscript. MA supervised the research group. All authors listed in a manuscript have contributed substantially to the work and seen revise and approved the submitted version.

Authors' information Available Ethics approval and consent to participate Written consents were obtained from patients' caregivers for patients less than 16 years old.

The study was conducted According to the declarations of Helsinki and Approved from the faculty of medicine scientific committee in Minia University (No: 116-5-2016).

Consent for publication Not applicable  
Competing interests. The authors declare that they have no competing interests.

List of Abbreviations PE: Primary enuresis; SE: Secondary enuresis; ADHD: Attention deficit hyperactivity disorder; SDB: Sleep disordered breathing ADH: Anti-diuretic hormone; NE: Nocturnal enuresis DSM-5: Diagnostic and statistical manual of mental disorders fifth edition ICCS: International children continence society.

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