

# **PATTERN OF IRON DEFICIENCY ANEMIA IN PEDIATRIC EMERGENCY ROOM AND ITS RELATION TO PROGNOSIS**

*Thesis*

Submitted for Partial Fulfillment of Master Degree  
In Pediatrics

*Presented By*

**Mohammed Karem Abd El-Azeem**

*(M.B., B.CH.2008)*

*Under Supervision of*

**Prof. Dr. Mohsen Saleh El-Alfy**

Professor of Pediatrics  
Faculty of Medicine – Ain Shams University

**Dr. Ahmed Al-Saïd Hamed**

Assistant Professor of Pediatrics  
Faculty of Medicine – Ain Shams University

**Dr. Nihal Saad El-Kinawy**

Consultant of Clinical Pathology  
Faculty of Medicine – Ain Shams University

*Faculty of Medicine  
Ain Shams University  
2015*

---

## Acknowledgment

*First of all, I would like to thank "**ALLAH**" who granted me the strength to accomplish this work.*

*Words fail to express my deepest gratitude and appreciation to **Prof. Dr. Mohsen Saleh El-Alfy**, Professor of Pediatrics, Ain Shams University for giving me the opportunity to work under his meticulous supervision and for his excellent guidance and powerful support.*

*My deepest thanks and appreciation go to **Dr. Ahmed El-Saeed Hamed**, Assistant Professor of pediatrics, Ain Shams University, who honored me by her great supervision, valuable guidance and precious time.*

*I would like to express my true thanks to **Dr. Nihal Saad El-kinawy**, Consultant of clinical pathology, Ain Shams University, for his great guidance and advices throughout this work.*

*My true love and warmest gratitude go to all my family, who were, and still always be, by my side and without whom I would have never been able to accomplish this work.*

*Last but not least, I would like to express my gratitude to my patients and their families and to every person who helped me while performing this work.*

 **Mohammed Kareem Abd El-Azeem**

## **List of Contents**

---

<i>Subject</i>	<i>Page No.</i>
<b>List of Abbreviations .....</b>	<b>i</b>
<b>List of Tables.....</b>	<b>iii</b>
<b>List of Figures .....</b>	<b>vi</b>
<b>Abstract .....</b>	<b>viii</b>
<b>Introduction .....</b>	<b>1</b>
<b>Aim of the Work .....</b>	<b>15</b>
<b>Review of Literature .....</b>	<b>4</b>
Anemia in Children.....	17
Iron and Iron Deficiency Anemia.....	51
Iron Deficiency Anemia in Children .....	72
<b>Patients and Methods .....</b>	<b>97</b>
<b>Results.....</b>	<b>108</b>
<b>Discussion .....</b>	<b>134</b>
<b>Summary .....</b>	<b>149</b>
<b>Conclusion .....</b>	<b>153</b>
<b>Recommendations .....</b>	<b>155</b>
<b>References.....</b>	<b>157</b>

---

## **List of Abbreviations**

<b>BF</b>	: Breast feeding
<b>CBC</b>	: Complete Blood Count
<b>CT</b>	: Computed tomography
<b>DFO</b>	: Desferrioxamine
<b>DNA</b>	: Dioxynucleic Acid
<b>EPO</b>	: Erythropoietin
<b>FEP</b>	: Free erythrocyte protoporphrin
<b>FL</b>	: Femtiiter
<b>Ft</b>	: Serum ferritin
<b>G6PD</b>	: Glucose 6 phosphate dehydrogenase deficiency
<b>GH</b>	: Growth Hormone
<b>HAMP</b>	: Hepcidin antimicrobial peptide
<b>HCT</b>	: Hematocrit
<b>HFA</b>	: Height for age
<b>HGB</b>	: hemoglobin
<b>HIV</b>	: Human immunodeficiency virus
<b>HO-1</b>	: Hemeoxygenase 1
<b>HR</b>	: Heart rate
<b>HUS</b>	: Hemolytic uremic syndrome
<b>ID</b>	: Iron deficiency
<b>IDA</b>	: Iron deficiency anemia
<b>IL-6</b>	: Interleukin-6
<b>Lab</b>	: Laboratory
<b>LDH</b>	: Lactate dehydrogenase
<b>MCH</b>	: Mean Corpuscular Hemoglobin
<b>MCHC</b>	: Mean Corpuscular Hemoglobin Concentration
<b>MCV</b>	: Mean Corpuscular Volume

## **List of Abbreviations (Cont.)**

<b>NH</b>	: Neutrophil hypersegmentation
<b>NRBCs</b>	: Nucleated RBCs
<b>PCV</b>	: Packed cell volume
<b>PedNSS</b>	: Pediatric Nutrition Surveillance System
<b>PNH</b>	: Paroxysmal nocturnal hemoglobinuria
<b>PRBCs</b>	: Packed Red Blood Cells
<b>RBCs</b>	: Red Blood Cells
<b>RDW</b>	: Red blood cells Distribution Width
<b>Rh</b>	: Rhesus factor
<b>RR</b>	: Respiratory rate
<b>SD</b>	: Standard Deviation
<b>SI</b>	: Serum iron
<b>SNAP</b>	: Supplemental Nutrition Assistance Program
<b>SPSS</b>	: Statistical program for social science
<b>TEMP</b>	: Temperature
<b>Tf</b>	: Transferrin
<b>TfR</b>	: Transferrin receptor
<b>TIBC</b>	: Total iron binding capacity
<b>TIBC</b>	: Total iron binding capacity
<b>Tr mRNA</b>	: Transferring messenger ribonucleic acid
<b>TTP</b>	: Thrombotic thrombocytopenic purpura
<b>UIBC</b>	: Unsaturated Iron-binding capacity
<b>USA</b>	: United State of America
<b>WBCs</b>	: White blood cells
<b>WFA</b>	: Weight for age
<b>WFH</b>	: Weight for length
<b>WHO</b>	: World health organization
<b>A</b>	: Alpha

$\beta$  : Beta

## List of Tables

<i>Table No.</i>	<i>Title</i>	<i>Page No.</i>
<b>Table (1):</b>	Common causes of intravascular and extravascular hemolysis in the adult .....	22
<b>Table (2):</b>	Differential diagnosis of anemia .....	25
<b>Table (3):</b>	Factors that influence iron absorption.....	62
<b>Table (4):</b>	Iron requirements according to the age.....	66
<b>Table (5):</b>	Volumes are pipetted in to cuvetts to detect serum Iron. ....	104
<b>Table (6):</b>	Volumes are pipetted in to cuvetts to detect iron binding capacity. ....	105
<b>Table (7):</b>	Descriptive data of the study group. ....	110
<b>Table (8):</b>	Order of birth in the study group.....	111
<b>Table (9):</b>	Pattern of milk feeding during the first 6 months of life among studied children.....	112
<b>Table (10):</b>	Age at start of weaning among the studied children.....	112
<b>Table (11):</b>	Socio-economic status of the studied children.....	113
<b>Table (12):</b>	Values of z-score of anthropometric measurements of the studied children. ....	113
<b>Table (13):</b>	History suggestive of Anemia. ....	114
<b>Table (14):</b>	Clinical examination data of the study group.....	114

**Table (15):** Laboratory data of the studied children. .... 115

## **List of Tables** *(Cont.)*

<i>Table No.</i>	<i>Title</i>	<i>Page No.</i>
<b>Table (16):</b>	Distribution of anemia among the studied children.....	115
<b>Table (17):</b>	Comparison between non anemic children and children with IDA regarding age.....	117
<b>Table (18):</b>	Comparison between non anemic children and children with IDA regarding gender. ....	117
<b>Table (19):</b>	Comparison between non anemic children and children with IDA regarding the order in birth. ....	118
<b>Table (20):</b>	Comparison between non anemic children and children with IDA regarding milk intake in first 6 months.....	118
<b>Table (21):</b>	Comparison between non anemic children and children with IDA regarding the anthropometric measurements.....	119
<b>Table (22):</b>	Correlations between hemoglobin percent and risk factors for anemia. ....	119
<b>Table (23):</b>	Descriptive data of the Bronchopneumonia group.....	120
<b>Table (24):</b>	Comparison between patients with IDA and Non Anemic patients with bronchopneumonia. ....	121
<b>Table (25):</b>	Correlation between clinical improvement (duration of hospital stay and improvement of	

fever and hematological parameters in  
bronchopneumonia group..... 122

### **List of Tables** *(Cont.)*

<i>Table No.</i>	<i>Title</i>	<i>Page No.</i>
<b>Table (26):</b>	Descriptive data of patients with bronchilolitis.....	126
<b>Table (27):</b>	Comparison between patients with IDA and non anemic patients with bronchoiolitis.....	127
<b>Table (28):</b>	Correlation between duration of hospital stay and improvement of Respiratory Distress in bronchoiolitis group.	127
<b>Table (29):</b>	Descriptive data of patients with convulsion. ....	129
<b>Table (30):</b>	Comparison between patients with IDA and non anemic patients with convulsions....	130
<b>Table (31):</b>	Correlation between duration of hospital stay and improvement of seizures in convulsion group. ....	131



## List of Figures

<i>Figure No.</i>	<i>Title</i>	<i>Page No.</i>
<b>Figure (1):</b>	Hypochromic microcytic anemia with a variant hemoglobin. ....	28
<b>Figure (2):</b>	Evaluation of anemia according to mean corpuscular volume .....	50
<b>Figure (3):</b>	Iron cycle in the body .....	54
<b>Figure (4):</b>	Hepcidin-mediated regulation of iron homeostasis. ....	58
<b>Figure (5):</b>	Response of the bone marrow in relation to the level of serum iron. ....	94
<b>Figure (6):</b>	Order of birth in the study group .....	111
<b>Figure (7):</b>	Distribution of anemia among the studied children.....	116
<b>Figure (8):</b>	Days of fever improvement in broncho-pneumonia group .....	122
<b>Figure (9):</b>	Correlation between days of hospital stay and TIBC.....	123
<b>Figure (10):</b>	Correlation between Days of improvement and Hb%. ....	123
<b>Figure (11):</b>	Correlation between Days of improvement and MCV. ....	124
<b>Figure (12):</b>	Correlation between Days of improvement and S.iron.....	124
<b>Figure (13):</b>	Correlation between Days of improvement and TIBC. ....	125

## **List of Figures** *(Cont.)*

<i>Figure No.</i>	<i>Title</i>	<i>Page No.</i>
<b>Figure (14):</b>	Correlation between days of hospital stay and S iron .....	128
<b>Figure (15):</b>	Correlation between days of hospital stay and TIBC.....	128
<b>Figure (16):</b>	Correlation between Days of improvement and TIBC .....	129
<b>Figure (17):</b>	Duration of hospital stay in convulsion group. ....	130
<b>Figure (18):</b>	Days of seizure improvement in convulsion group.....	131
<b>Figure (19):</b>	Correlation between days of hospital stay and TIBC.....	132
<b>Figure (20):</b>	Correlation between Days of improvement and HB%.....	132
<b>Figure (21):</b>	Correlation between Days of improvement and MCV .....	133

## Abstract

**Introduction:** Iron deficiency (ID) and iron-deficiency anemia (IDA) continue to be of worldwide concern. Among children in the developing world, iron is the most common single-nutrient deficiency. IDA remains a common cause of anemia in young children. In early childhood, bad feeding habits, especially during the weaning period, exacerbate the problem.

**Aim of the work:** to assess prevalence of iron deficiency anemia among children attending emergency room in pediatric hospital of Ain Shams University and its impact on management and prognosis of the underlying disease.

**Methodology:** 200 children (114 males and 86 females) with mean of age  $1.781 \pm 1.245$  years, recruited among those attending emergency room. All infants were subjected to full history taking, thorough examination and laboratory investigations including; Hb%, CBC, serum iron and TIBC, then patients were divided into 2 groups; Group(1): non anemic children and Group (2): anemic children.

**Results:** 128 (64%) were anemic of whom 44 (34.37%) had IDA. There was statistically significant higher incidence of low social class ( $p=0.02$ ), higher order of birth ( $p=0.001$ ), higher duration of hospital stay ( $p=0.000$ ) and days for improvement ( $p=0.02$ ) in anemic patients compared to non-anemic group. There was statistically significant higher day for fever to improve in anemic patients with pneumonia compared to non-anemic group ( $p=0.025$ ). There was statistically significant higher duration of hospital stay ( $p=0.03$ ) and days of improvement ( $p=0.003$ ) in anemic patients with convulsions compared to non-anemic patients. There was no statistically significant difference between anemic and non-anemic patients regarding duration of hospital stay and days of RD improvement in patients with bronchiolitis.

**Conclusion:** IDA is the most common cause of anemia among Egyptian children of low socioeconomic standard.

It may be an associated causal factor, especially as the length of hospitalization was generally short, and the patient was probably anemic at the time of admission.

---

***Key words:*** IDA, TIBC, anemic children, pneumonia, bronchiolitis, convulsions

---



---

# *Introduction*

---



## Introduction

**A**nemia is a global public health problem affects more than 30 percent of the world's population. It is generally assumed that 50% of the cases of anemia are due to iron deficiency anemia (*Glader, 2007*). A national nutrition survey showed the high prevalence of iron deficiency anemia in Egypt (*Kahn et al., 2002*).

The most common causes of microcytic hypochromic anemia are iron deficiency and Beta thalassemia. Thalassemia trait is frequently misdiagnosed as iron deficiency anemia because the two are similar hematologically and iron deficiency is much more prevalent (*Wonke et al., 2007*). Other rare causes include sideroblastic anemia, anemia of chronic diseases and lead poisoning (*Yip and Ramakrishnan, 2002*).

Factors that cause iron deficiency anemia include inadequate iron intake especially those with a history of prolonged breast feeding with delayed weaning, prolonged consumption of large amount of cow's milk and of food not supplemented with iron, periods of rapid growth, those who were low birth weight or born prematurely and loss of iron from bleeding especially from gastro intestinal tract (*Wright et al., 2004*).

Beta-thalassemia, the most common genetic disorder in Egypt is a major health problem with an estimated carrier rate of 9-10% (*Hussein et al., 2007*). As consanguineous marriage is common in most Arabic countries, the incidence of genetic disease is high (*Weatherall and Clegg, 2001*).



---

# *Aim of the Work*

---

