EUROPEAN ACADEMIC RESEARCH
Vol. XII, Issue 9/ December 2024

Impact Factor: 3.4546 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

Iron Deficiency Anemia among School Children at Kosti City (Sudan)

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Abstract

This work is a cross sectional study conducted to measure the prevalence of anemia among Kosti city school children. Samples were collected from hundred students (54 boys and 46 girls). Complete blood count was carried by (Sysmex EX 3000). The results were statistically analyzed using (SPSS) program. The parameters mean values were, hemoglobin (11.4g/dl), serum iron (100.88), packet cell volume (35.9 L/L), mean cell volume (80.5%), mean cell hemoglobin (26.5 Pg), mean cell hemoglobin concentration (32%), white blood cell (5.9 cell /cumm), platelet count (270 cell /cumm) and red blood cells (4.4 cell /cumm). The WBCs differential count was significantly increased in eosinophil (35%), Lymphocytosis (13%) and neutrophilia (1%). The analysis indicated that (40%) of the studied children were anemic, with Hb < 11.2 g/dl. Anemia prevalence was (23%) among girls and (17%) among boys. The low socioeconomic status and low education levels of the parents were found to be the major anemia risk factors.

Keywords: Risk factors, Red blood cells, Eosinophilia , Serum iron, SPSS.

INTRODUCTION:

Childhood anemia is still a major public health problem which associated with increased mortality and morbidity in low and middle income countries (Amarasinghe *et al*; 2017). Anemia was described as a common problem in primary education school boys of low income (EL Hioui M 2008). Globally, anemia among school-age children is a serious public health problem, impacting their growth, development, educational attainment and future learning potential (Li, S.; Cheng, X.; Zhao, L.; Ren, H. 2021). According to WHO reports (2004, 2019, 2021) and Ararso Hordofa Guye *et al*; (2024) anemia can be a public health issue when hemoglobin levels fall below the population-specific (Hb) threshold and it's prevalence ranges can be classified as, no for (≤ 4.9%), mild for (5.0–19.9%) , moderate for (20.0–39.9%) , and severe for (≥40%). Depending on the size of erythrocytes, Woolf N. (1998) classified anemia into, microcytic (MCV <80 fL), normocytic (MCV from 80 to 100fL) or macrocytic (MCV >100 fL). The general manifestations of anemia include vertigo, faintness, pale skin , headache, heart palpi pallor, low blood pressure, slight fever, edema, in addition to general signs and symptoms associated with specific types of anemia (Ullah, I.*et al;* 2014, Visalacshi 2016). Epidemiology of anemia varies substantially between the different ecological and

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socio-cultural settings (EL Hioui M). The cause of anemia in school children is multi factorial and has been associated with delayed psychomotor development, poor cognitive performance, impaired immunity and decrease of working capacity (EL Hioui M. 2008, Zegeye Getaneh *et al;* 2017, Peter Anlaakuu *et al* ; 2017, Bihanu M 2018). Anemia can be caused by chronic inflammation, parasitic infections, inherited disorders, the lack of iron, folate, vitamin A or vitamin B12 (Bihanum, *et al*; 2018, Robel Tezera, *et al;* 2018). Anemia during infancy and childhood period is associated with poor health and impaired cognitive development, leading to low academic activity and earnings potential in adulthood life (Haile Woldie *et al;* 2015). Maternal anemia, malaria infection and type of residency were identified as the major three anemia predictors in (6 month - 5years) children across 18 states of Sudan (Elmardi *et al;* 2020). The most significant anemia risk factors may be socioeconomic such as, maternal education, gender norms, low income or infectious diseases such as malaria, worm infestation, schistosomiasis, renal diseases, nutritional deficiency, gender, age, pregnancy, deficiencies of micronutrients such as folic acid and vitaminB12 (Firehiwot M. *et al*; 2015, Ashraf Mikhail, *et al;*2017 and Sana Syed *et al* ; 2017). The Hb level can be influenced by many other factors such as, smoking, altitude, race and genetic disorders (Sana Syed *et al*; 2016, Ashraf Mikhail *et al*; 2017). Uneducated mothers, intestinal parasite infections, and underweight children were found to be determinants of anemia among school-age children, leading to poor physiological development, reduced immunity in addition to low physical and mental activities (Ullah, I.*et al;* 2014, Ararso Hordofa Guye *et al* 2024). EL Hioui M. (2008) reported significant relationship between education of the mother and anemia in children (p= 0.01). Rehab Omer *et al;* (2017) reported that, infants who belong to mothers with anemic history during pregnancy time, mothers of low education level, low income family or low feeding practices, were generally facing higher risk of anemia. Children may be classified as anemic and non-anemic on the basis of hemoglobin cut off values for different age-groups (Saroj K. *et al*; 2015). A recent meta-analysis of 12,000 children aged from 28 days to 12 years indicates that, for each 1g/dL increase in Hb the risk of death falls by 24% (Sana Syed, O. *et al;* 2016). Rapid physical and physiological development was reported to make school age-children more vulnerable for iron deficiency anemia (Robel Tezera *et al;* 2018). The worldwide prevalence of anemia was reported as (25.4%) among school-age children followed by (47.4%) for preschool children and (30.2%) in women of childbearing age (WHO 2008). Globally, around 1.62 billion people were reported to be anemic, accounting for more than 24.8% of the world population, where iron deficiency anemia represented about (30 to 50%) of the total (Saroj K. *et al*; 2015). Baral KP and Onta SR (2009) reported that, 65.6% of adolescent were anemic in eastern Nepal with very high rate among school girls (60.5%). Sana Syed (2017) reported anemia prevalence among school age children as 11.6% in Mexico and 4.2% in Colombia. National Health and Nutrition Survey reported anemia among primary school children as 58% in Sri Lanka, 84% in Monaragala and 52.7% in Colombo (Amarasinghe *et al*; 2017). For children of southern China, mothers and fathers with education level below senior high school, eating meat less than 3 times per week were reported to be risk factors of anemia (Li, S.; Cheng, X.; Zhao, L.; Ren, H.2021). The range of anemia prevalence among school children was reported as 5% in North America, 22% in Europe and 30–63% in Asia (Zegeye Getaneh *et al;* 2017). Ararso Hordofa Guye *et al;* (2024) reported anemia prevalence among school aged children as 12% in Malawi and Kenya, 41% in Ghana, 54% in Mozambique, 57% in Tanzania, 58% in Mali and 30% in Vietnam and Indonesia. Uttara Partap *et al;* (2022) identified nutritional, dietary and hygiene

measures as key risk factors of anemia among young adolescents (10−14 years) in sub-Saharan Africa, where the prevalence of anemia was10.8% in Ethiopia, 25.0% in Sudan and 58.3% in Tanzania with overall mean as 32.0%. Ullah, I.*et al;* (2014) showed anemia prevalence among school-age children of Pakistan as (38.9%) in girls, (31.0%) in boys, (40%) in age group of 10 - 12 years, (55.8%) in lower socioeconomic family children, (32.2%) in middle class and (17%) in upper class. In Morocco mean hemoglobin and mean ferritin levels were reported as 12.4 g/dl and 26.7 Wg/l among boys compared with 12.5 g/dl and 27.9 Wg/l among girls where, the overall prevalence of anemia was 12.2 % and iron deficiency was 20.4 % (EL Hioui M 2008). Ethiopia Federal Ministry of Health (2011) reported anemia prevalence as 24% among children below 15 years of age. According to Saroj K. *et al*; (2015), anemia affects 45.7% to 49.1% of school-age children worldwide and it ranges from 64.3% to 71% in Africa. In India the prevalence of anemia among school children was ranging from 52 to 96.5% (Visalacshi Jeyseelan *et al;* 2016). Anemia among school children may strongly associate with low maternal education, food insecurity and stunting (Getaneh. Z 2017). Sarar M. and M. Diab (2015) stated that, stunting, thinness and anemia were significantly common among school children of less than 10 years age in Dolgo area of the Northern State where, the prevalence of anemia was (29.7%) with (7.1%) stunted and (23.1%) thin.

IRON DEFICIENCY ANEMIA (IDA):

According to WHO (2018) malnutrition affects 43% of children worldwide as the most common form of (IDA). The remarkable influences of iron deficiency anemia include, stunt development, less developed immunity, lower IQ level, improper physical work capacity, more fatigue, maternal mortality rates, low birth weight, birth complications and high infant mortality rates (Ullah, I.*et al;* , 2014). Iron is an essential constituent in four protein categories, including mononuclear iron proteins, di iron-carboxylate proteins, iron-sulfur proteins and heme proteins (J.L. Miller, 2013). Iron deficiency is a severe condition that, associate with the presence of microcytic hypochromic red cells and can lead to decreased erythropoiesis (Ramadas and Sharada 2012). Iron deficiency is a state of iron-poor erythropoiesis which leads to insufficient mobilization of iron from stores in the presence of increased demands, as that observed after treatment with erythropoiesis-stimulating agents (Clara C. and M.D, 2015). Clinical signs of anemia may arise from the lack of other iron-containing proteins such as myoglobin, cytochrome, and metabolic enzymes (Dinaz Z. *et al;* 2012). Pica development is due to iron deficiency anemia (Mulugeta Melku *et al;* 2018). The impact of iron deficiency anemia rarely results in death (J.L. Miller, 2013). Robel Tezera, *et al;* (2018) reported that, rapid physical and physiological development makes school-age children more vulnerable to iron deficiency anemia. Mohammed S. E *et al;* (2016) reported high iron deficiency anemia among the majority of (Khalawi) students in Gezira State, followed by hemolytic, macrocytic and sickle cell anemia with mean Hb value as 11.75g/dl. M.D. Hussein and S. Mohamed (2014) reported significantly high anemia prevalence (80.4%) with, Hb level lower than (11 g/dL) in some villages of northern Sudan among 3–6 years children.

METHODOLOGY:

Venous blood samples were collected from hundred school children with age range of 6 to15 years at kosti city. The study population consisted of 54 boys and 46 girls. The

questionnaire included the name, age, gender, address, sample number, parent's education level, parent's work, breakfast time, duty time and infection with other diseases. The measured parameters included Hb, PCV, MCV, MCH, MCHC, RBCS, PLTS, MPV, PDW, RCV, WBCs and serum iron. The obtained results were statistical analyzed by (SPSS) program.

RESULTS AND DISCUSSION:

Table (1): The means of Hb, PCV, MCV, MCH, MCHC and RBCs.

Parameter	Minimum	Maximum	Mean	Normal range
Hb(g/dl)	6.80	16.20	11.44	11.2-15.3
PCV (%)	21	84.60	35.94	31-44
MCV(FL)	51.40	91.10	80.46	68-95
MCH(PG)	16.60	82.60	26.46	24-34
MCHC(g/dl)	28	34.10	32.00	32-37
RBCs(m/mcl)	2.30	6.47	4.45	3.3-5.2

Table (1) indicates that, all the measured parameters showed mean values within the minimum accepted normal ranges as, hemoglobin (11.44 g/dl), packet cell volume (35.94%), mean cell volume (80.5%), mean cell hemoglobin (26.5 Pg), mean cell hemoglobin concentration (32%) and red blood cells (4.4 cell /cumm). When compared with the accepted normal ranges, seriously low minimum values can be observed for Hb (6.80 g/dl), PCV (21%), MCV (51.4FL), MCH (16.6pg), MCHC (28g/dl) and RBCs (2.3 m/mcl). In this study 40% of the school children were anemic where 17% of the boys and 23% of the girls have Hb level below 11.2 g/dl. Among these anemic school children 75% have microcytic hypo-chromic anemia. The present study showed that the parents of low socioeconomic status were (70%) and 95% of them were of low education level. These obtained results may strongly agree with the findings reported by, Mamoun M. *et al;* (2001), EL Hioui M. *et al;* (2008), M.D. Hussein and S. Mohamed (2014, 2015), Visalacshi J. *et al* (2016), Mohammed S. E *et al;* (2016), Singh Ritu (2017) and Robel Tezera (2018). EL Hioui M. *et al;* (2008) and Visalacshi J. *et al;* (2016), who considered the children under 15 years of age to be anemic when Hb level is <11 g/dl for girls and <12 g/dl. For 6- 15 years children, Robel Tezera (2018) reported anemia prevalence as (28%) in boys and (25%) in girls. Singh Ritu (2017) described the prevalence of anemia among children of 5-12 years to be 37% worldwide, compared with 39.1% in Ethiopia and 36.4% in Vietnam. Sana Syed (2017) reported relatively low anemia prevalence among school age children as 11.6% in Mexico and 4.2% in Colombia.

Table (2): Mean values of PLTS, MPV, PDW, RDW and WBCs.

Parameter	Minimum	Maximum	Mean	Normal range
PLTS	135	465	270	150-450
MPV (fl)	6.80	91.0	17.48	7-11.2
PDW (%)	14	17	15.52	10-17.9
RDW	12	24	14.1000	12-15
WBCs(cell /cumm)	700	17200	5085	5000 -13500
Serum iron (mcg/dl)	29	224	100.89	35-150

As shown by table (2) the mean values were, platelets (270 cell /cumm), MPV (17.48), PDW (15.52), RCV (14.1) white blood cells (5.9 cell /cumm) and serum iron (100.89). The minimum values of PLTS (135) and MPV (6.80) were less than the lower permissible limits although their means were within the normal range. The minimum and mean values of PDW and RDW were within the normal ranges. The minimum WBCs values

was severely low (700) and it's mean value was almost at the minimum limit of the normal range (5085). Although it's minimum value was clearly low (29) the mean of serum iron was within the normal range (100.89). In this study 40% of the school children showed low serum iron whereas 10% have high serum iron. The differential count of WBCs was significantly increased in eosinophil (35%), Lymphocytosis (13%) and neutrophilia (1%).

CONCLUSION:

- The present study indicated that 40% of Kosti school children were anemic with prevalence of (23%) between girls and (17%) between boys.
- Significant differences were observed in peripheral blood pictures, hemoglobin and serum iron.
- Low socioeconomic status and low education levels of the parents were found to be major risk factors of anemia in school age children.

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