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IRON DEFICIENCY ANEMIA IN CHILDREN WITH WORM INFESTATION.

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ABSTRACT

BACKGROUND: Intestinal worm infestations are common in tropical and subtropical regions, particularly in areas marked by poverty and inadequate sanitation. Intestinal worms affecting around two billion people, consists of soil-transmitted helminth infections. The primary species responsible for these infections include *Ascaris lumbricoides, Trichuris trichiura,* and *Necator americanus/Ancylostoma duodenal*. **OBJECTIVE:** To determine the frequency of iron deficiency anemia in children with worm infestation. **METHODS:** This cross-sectional study was conducted in department of Pediatrics, Mardan Medical Complex, Medical Teaching Institution, Mardan. This study was conducted from 1st November 2021 to 1st April 2022. A total of 133 children of both gender with worm infestation were included in the study. Collected a blood sample and shipped to laboratory to look for iron deficiency anemia set per one of the criteria of iron deficiency anemia. **RESULTS:** Age range in this study was from 1 to 12 years with mean age of 3.985±1.77 years, mean weight was 13.090±3.16 Kg and mean duration of complain was 3.052±1.35 months. Male patients were 68.4% and females were 31.6%. Iron deficiency anemia was observed in 20.3% patients. **CONCLUSION:** To conclude, Iron deficiency anemia was observed in 20.3% children with worm infestation. This has to be addressed since parasite infections may harm children's lives in more ways than simply anemia and can set the stage for other illnesses as well. To halt the emergence and spread of such diseases, parents and educators should work together to encourage children to practice preventive and sanitary practices.

KEYWORDS: Children, Worm infestation, Iron deficiency anemia

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INTRODUCTION

Anemia, marked by low haemoglobin, is a widespread issue globally, notably affecting children, with high prevalence in sub-Saharan Africa (>60%) and 20–60% in developing nations[1]. Soil-transmitted helminth (STH) infections impact two billion people, yet hookworm infestation, once linked to anemia, is now rare [2]. Iron deficiency anemia (IDA) remains a pervasive global problem, affecting 25% of the world's population, with various contributing factors in low-income countries and high-risk groups in developed nations, making it the ninth modifiable risk factor for global mortality [3].

Hemoglobin carries the majority of body iron in heme form, and daily absorption (1–2 mg) from the diet is crucial, with heme iron (from meat) having higher bioavailability. In developed countries, iron is mainly absorbed as nonheme (5–10%), influenced by factors like phytates, contributing to iron deficiency anemia (IDA) linked to conditions such as chronic heart failure [3]. Anemia prevalence is a public health concern, particularly in developing nations, where poor iron bioavailability in diets contributes to IDA. Fortifying foods with iron is recommended, especially for infants and toddlers, but concerns include gut flora changes [4]. In developed nations, dietary errors and blood loss are primary causes of IDA, with preventive measures involving proper infant feeding, iron-rich diets, and, when necessary, iron supplements [5].

Anemia, characterized by hemoglobin levels, features microcytic and hypochromic aspects, including low MCV, MCH, and MCHC, along with biochemical markers such as low serum iron and elevated sTfR [6]. The debate over the cost-effectiveness of screening for iron deficiency anemia (IDA) persists, with varying recommendations for universal supplementation and targeted approaches, especially in low-income countries [7]. Oral iron medications, including newer options like sucrosomial iron, offer improved absorption but come with higher costs [2]. Studies indicate potential risks and benefits, such as a slight increase in parasitemia in children with malaria in developing countries. Worm infestation, impacting about one-fourth of the global population, is influenced by factors like poverty and poor hygiene [8]. Understanding parasitic worm life cycles is crucial for tailoring preventive and treatment strategies, as moderate to heavy infestations in children can lead to growth retardation and academic performance issues [9].

Ascariasis, caused by *A. lumbricoides*, may be asymptomatic but can result in the noticeable expulsion of adult worms in stools or vomit. Hookworms pose a risk of anemia through gastrointestinal bleeding, while whipworm infections resemble inflammatory bowel disease with symptoms like chronic abdominal pain and diarrhea. *Enterobius vermicularis*, highly transmissible and causing perianal pruritis, can lead to complications, including bacterial infections and lower urinary tract infections [10]. Stool microscopy, using fresh fecal specimens and concentration methods, aids in diagnosing parasitic organisms. Short-course anthelminthic therapies, such as mebendazole and albendazole, are effective, and initiatives like the Swachh Bharat Abhiyan contribute to reducing worm infestation rates. Helminths, prevalent parasites with well-developed organ systems, cause serious infections in poor tropical areas, evading host defenses [11].

Helminths infect humans through ingestion, skin penetration, or vectors, with susceptibility influenced by hygiene, climate, and food practices. Human behavior, hygiene, and exposure to infective stages impact susceptibility, especially in children, and factors like genetics, age-related immune changes, and concurrent infections contribute to varying levels[12]. Often large, helminths can evade defenses through mobility and size, causing direct damage through organ blockages, pressure effects, and migrations triggering hypersensitivity reactions [2].

Infective stages navigate non-specific defenses during oral ingestion or skin penetration, with success determined by survival through the acidic stomach and avoidance of inflammatory responses. Specific immunity against helminths involves antibodies and cellular responses, with weak protective immunity in endemic areas. Helminths use mechanisms like surface disguise and immune suppression to evade host defenses, illustrating their adaptability [13]. The objective of this cross sectional study was to determine the frequency of iron deficiency anemia in children with worm infestation.

METHODS AND MATERIALS

This research was carried out from November 1st, 2021 to April 1st, 2022 at the pediatric department of the Mardan Medical Complex Teaching Hospital in Mardan. A total 133 sample of patients were analyzed with non-probability consecutive sampling technique. In this study both male and female patients between the ages of 1 year to 12 year with worm infestation were included. Patients with history of malnutrition, dysentery and diarrhea and parents refused the consent were excluded. All 133 patients outpatient's department of pediatrics Mardan Teaching Institute (MTI) Mardan Medical Complex were included after permission from ethical committee and research department. Informed consent was taken from parents or legal guardians after explaining the benefits of the study. I collected blood sample with minimum of 3ml in a fluoride tube and was send to laboratory to look for iron deficiency anemia set per one of the criteria of iron deficiency anemia.

A statistical analysis tool (SPSS, version 20) was used to examine the data. For qualitative characteristics including gender and iron deficiency anemia, frequency and percentage were calculated. For quantitative characteristics including age, weight, and length of complaint, mean ±SD was provided. Iron deficiency anemia was stratified according to age, gender, length of complaint, and weight. A chi square test was used after stratification, and a p-value of less than 0.05 was deemed statistically significant.

RESULTS

This research had a 1–12 years of age range, with a mean age of 3.9±1.7 years, a mean weight of 13.09±3.1kg, and a mean complaint length of 3.0±1.3 months (Table 1).

Table 1: Mean±SD of patients according to age, weight and duration of complaint

Demographics	Mean±SD
Age(years)	3.9±1.77
Weight (Kg)	13.1±3.16
Duration of complaint (months)	3.0±1.35

Male patients were 68.4% and females were 31.6% and percentage of Iron deficiency anemia was observed in 20.3% patients (Table 2).

Table 2: Distribution of patients according to Gender and Iron Deficiency Anemia

Parameters	Frequency	%age	
Gender	Male	91	68.4%
	Female	42	31.6%
Iron deficiency anemia	Yes	27	20.3
	No	106	79.7

Stratification of iron deficiency anemia with respect to age, gender, duration of complaint and weight. (Table 3). Iron deficiency anemia observed in 20.3% (n=27) children in which highest number of

Table 3: Comparison of Iron deficiency anemia with patient age, gender of patients, duration of disease complaint and weight of patient.

Parameters		Iron deficiency anemia		p-value
		Yes % (n)	No % (n)	
Age (years)	1-6	19.3 (23)	80.7 (96)	0.416
	7-12	28.6 (04)	71.4 (10)	
	Total	20.3 (27)	79.7 (106)	
Gender	Male	17.6 (16)	82.4 (75)	0.251
	Female	26.2 (11)	73.8 (31)	
Duration of complaint (months)	1-3	2.4 (02)	97.6 (82)	0.000
	>3	51 (25)	49 (24)	
Weight (Kg)	≤15	20.8 (21)	79.2 (80)	0.802
	>15	18.8 (06)	81.2 (26)	

DISCUSSION

Anemia is widespread in developing countries, particularly affecting school children, as highlighted in a sub-Saharan Africa survey [14]. The study involved children with a mean age of 3.985±1.77 years, placing them at the highest risk of anemia. Compared to other studies, Evbuomore exhibited a higher prevalence of anemia, likely influenced by the younger age of the studied children (mean age 2.75 years) undergoing rapid growth spurts [15].

Our study identified iron deficiency anemia in 20.3% of patients, aligning with Oliveira D, et al.'s findings (21.6%) in children with worm infestation. Concordantly, studies in Sabah, Malaysia, and local rural settings reported varying prevalence of anemia and iron deficiency anemia [6]. In south-eastern Brazil, prevalence rates were relatively lower6, while Kenya's extremely high anemia rate (92.0%) was attributed to malaria 16. Despite regional variations, our study parallels recent findings in Nigerian children (38.6%) and northeast Thailand (31.0%) [17, 18].

For all age groups, school-age children were less likely than young children to have anemia, iron deficiency, or iron deficiency anemia (IDA). The benefit of government-sponsored iron supplementation for students in rural schools may account for this discrepancy [19]. The low frequency of IDA among kids who used iron supplements during the previous year was discovered by our investigation, although it wasn't statistically significant [20]. Significantly, studies back up the immediate advantages of giving iron-folate supplements to students in the classroom, offering a workable, secure, efficient, and reasonably priced way to improve their wellbeing [21].

On the other hand, earlier research conducted in Brazil, Malaysia, and Thailand shown that anemia decreased with age [22.] Poor daily iron intake, poverty, and infections are likely associated with the higher prevalence of anemia and IDA in the children in our research [23.] Other studies revealed low and insufficient daily iron consumption among rural children, ranging from 29.0% to 49.0% of the Recommended Daily consumption (RDI), despite fruitless attempts to measure dietary patterns [24.]

The current investigation found a strong correlation between IDA and anemia in *T. trichiura*-infected people, which is consistent with findings from research conducted on children from Kenya and Panama. Moreover, a severe T. trichiura infection was approximately twice as likely to cause IDA which is consistent with other studies that have demonstrated that high infection intensity is a significant risk factor for both anemia and IDA [25.] Similar relationships were discovered in studies from southeast Brazil and East Africa between the seriousness of hookworm and T. trichiura infections anemia and ID [26.]

Our findings indicate that children with A. lumbricoides infections in rural regions have a much higher risk of iron deficiency anemia. However research on students in Zanzibari found a negative link between A. lumbricoides infection and lower hemoglobin levels whereas a recent study on children in rural Nigeria found a high correlation between A. lumbricoides infection and anemia [27]. It is thought that A. lumbricoides inhibits iron absorption in this intestinal tract because it is present in the duodenum and jejunum which are areas where iron absorption takes place [28].

However regardless of hookworm infection severity we found no significant association between iron status and hookworm infection. Nevertheless those with infections of hookworm had higher rates of anemia and IDA 20. This is in line with studies conducted on kids from Vietnam and Uganda which revealed no connection between anemia and hookworm infection [21]. This result is in contrast to recent research conducted in East Africa [29] and rural Nigeria [30] It discovered that despite light egg counts iron stores were declining. Previous research pointing to hookworm infection as a major cause of anemia and IDA may have been influenced by the low prevalence and severity of hookworm infection among the children in our study [31]. It is plausible that the degree of infection was insufficient to significantly impact iron status and that there may not have been sufficient iron reserve loss for hookworm to be associated with anemia. [32].

One of its numerous flaws is the major data collection method utilized in this study cross sectional research. Because of this it might not be feasible to establish a direct causal link between those variables and the conditions that cause iron deficiency anemia [33]. To confirm causal links with significant risk factors more research on the impact of deworming treatments on iron status is required. This research should focus on observational studies conducted before and after the intervention. The idea that consistent antihelminthic therapy can significantly improve the iron status of sick persons is supported by the available data 34. Notable research assessing how school-based deworming programs affected iron status in Tanzania and Zanzibar showed significant increases in serum ferritin and hemoglobin (Hb) concentrations after anthelminthic medication therapy 35, 36.

CONCLUSION

In summary, 20.3% of children with worm infestation exhibited iron deficiency anemia. Targeted intervention programs should focus on both controlling worm infestation and providing iron supplementation. It is important to address this since parasite infections may have a variety of negative effects on children's lives in addition to producing anemia. They can also open the door for other illnesses. To halt the emergence and spread of such diseases, parents and educators should work together to encourage children to practice preventive and sanitary practices.

ETHICS APPROVAL: The ERC gave ethical review approval.

CONSENT TO PARTICIPATE: written and verbal consent was taken from subjects and next of kin.

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