

# Correlation Between Iron Deficiency Anemia and Intestinal Parasitic Infection in School-Age Children in Peshawar

Aysha Sarwar Khan<sup>1</sup>, Shaista Alam<sup>2</sup>, Iftikhar Hussain<sup>4</sup>, Hafsa Sarwar Khan<sup>4</sup> and Ambreen Ali<sup>3</sup>

## ABSTRACT

**Objective:** The aim of this study was to investigate whether iron deficiency anemia and intestinal parasitic infections in school aged children are correlated or not.

**Study Design:** Cross-Sectional Study

**Place and Duration of Study:** This study was conducted at Peshawar Institute of Medical Sciences, from March 2019 to March 2020.

**Materials and Methods:** The total of 130 samples were included in this study by using consecutive sampling technique. The samples were collected from the middle school children aged from 8 to 12. The children who were willing were included in this study after taking permission from their parents. Another criteria for the sampling of this study was that the children should not have taken any antiparasitic medication for at least past six months. The blood and stool samples were taken to analyze peripheral blood smear, serum ferritin and intestinal parasites. The data was analyzed using univariate and bivariate analysis method (ANOVA test). The occurrence of anemia due to different species of intestinal parasite was also figured out. The Chi-Square test was performed to find out the correlation between iron deficiency anemia and some variables like mean corpuscular hemoglobin (MCH), mean corpuscular volume (MCV) and serum ferritin.

**Results:** The results showed that the occurrence of iron deficiency anemia was almost 28 percent. The percentage of intestinal parasitic infections was 26.7. Seven types of parasites were identified in infected participants. Entamoeba histolytica was the most prevalent parasite while Hymenolepis nana was the least prevalent. The blood results of almost 37 percent of the participants with intestinal infections showed either lowered red blood cell count or lowered hemoglobin concentration. The participants infected with Escherichia coli had the highest percentage of anemia; almost 48.7 percent. Participants with Hymenolepis nana showed the least number of anemic patients, 21 percent. The Chi-Square test showed significant correlation of MCV, MCH and serum ferritin with anemia.

**Conclusion:** According to the results of this study, there is positive correlation between iron deficiency anemia and intestinal parasitic infections. 37 percent of the participants which were infected by intestinal parasite had anemia. This proves that intestinal parasitic infections do cause anemia. Escherichia coli caused the highest percentage of anemia in participants. Also, the occurrence of intestinal parasitic infections was high in children generally. Entamoeba histolytica is one of the most common intestinal parasite. This needs to be taken care of as parasitic infections can affect the life of children in a number of ways other than just causing anemia and can pave the way for other diseases too. Preventive and hygienic measures should be promoted among children by the collective effort of parents and teachers to stop the development and spread of such infections.

**Key Words:** Iron Deficiency Anemia, Intestinal Parasitic Infections, Children, Serum Ferritin, MCV, MCH.

**Citation of article:** Khan AS, Alam S, Hussain I, Khan HS, Ali A. Correlation Between Iron Deficiency Anemia and Intestinal Parasitic Infection in School-Age Children in Peshawar. Med Forum 2021;32(7):88-92.

## INTRODUCTION

<sup>1</sup>. Department of Haematology / Microbiology<sup>2</sup> / Chemical Pathology<sup>3</sup>, Pak International Medical College, Peshawar.

<sup>4</sup>. Department of Medicine, HMC, Peshawar.

Correspondence: Dr. Aysha Sarwar Khan, Senior Lecturer, Haematology Pak International Medical College, Peshawar.

Contact No: 03339859590

Email: ayshaziaa@gmail.com

Received: March, 2021

Accepted: April, 2021

Printed: July, 2021

The percentage of school aged children having anemia is almost 34.3 percent in developing countries<sup>1</sup>. Anemia is a blood disorder having reduced hemoglobin, packed cell volume and red blood cell count<sup>2</sup>. There are many types of anemia depending on etiology but the most common type of anemia is iron deficiency anemia<sup>2</sup>. The causes of iron deficiency anemia can be less iron in diet, loss of blood, irregular food intake and parasitic infections.

Due to iron deficiency, the body cannot produce enough hemoglobin. Hemoglobin performs very important function of carrying oxygen in our body. Deficiency of hemoglobin can cause anemia, fatigue, dizziness, dyspnea, pale mucosa and skin, weakness and many other complications.<sup>2</sup>

The most common infections are intestinal parasitic infections. These infections affect nearly 3.6 billion individuals. Such infections also cause almost 455 million health issues yearly.<sup>3</sup> According to WHO, these infections are one of the 17 tropical neglected diseases and also have high ability to spread from person to person.<sup>4</sup> The most common intestinal parasites are *Giardia Intestinalis*, Hookworm, *Cryptosporidium* and *Strongyloides Stercoralis* among others<sup>5,6</sup>.

The helminthes are a variety of parasitic worms that usually cause intestinal infections. Hookworm is one of the examples of helminthes. These parasites cause infections in almost 2.1 billion people globally. It is one of the top disease-causing parasites in the world, especially affecting children.<sup>7</sup> These parasites suck blood directly from the intestine and cause anemia in their host. They also reduce iron absorption from the intestine, leading to iron deficiency anemia. By reducing iron absorption from the intestine, this parasite interferes with the iron metabolism in the body.<sup>5</sup>

Intestinal parasites can also damage the intestinal mucosa lining; this damaged lining is then unable to absorb nutrients, leading to nutritional deficiencies. In case of iron, it can cause iron deficiency anemia. Nutritional deficiencies can also weaken the immune system that can pave the way for other diseases to develop. This condition is particularly dangerous for children of development age.<sup>5</sup>

Intestinal parasites like *Ancylostoma duodenale* can also cause intestinal wall bleeding. This can also lead to iron deficiency and anemia.<sup>8</sup>

Intestinal parasitic infections are more common in developing countries as compared to other developed countries. The reason for it can be poor sanitary conditions in such countries, which makes the development and spread of such disease very easy. The socioeconomic conditions of these countries are also poor, which can contribute to a higher prevalence of disease. In this study, we investigated the correlation between the two conditions described above; iron deficiency anemia and intestinal parasitic infections.

## MATERIALS AND METHODS

This study was conducted in Peshawar, from March 2019 to March 2020. The total of 130 samples were included in this cross-sectional study by using consecutive sampling technique. The samples were collected from the middle school children aged from 8 to 12. The children who were willing were included in this study after taking permission from their parents. Another criteria for the sampling of this study was that the children should not have taken any antiparasitic medication for at least past six months. These children should also not have conditions like atopic eczema, asthma, immunological disorders, rheumatic disorders and cancer<sup>5</sup>.

The blood and stool samples were taken to analyze peripheral blood smear, serum ferritin and intestinal parasites. Damaged samples were excluded from the study. The aim of the study was explained to the parents of participants and proper consent was taken from them. After that, history of disease and medication consumption of participants was taken.

Stool containers were provided to the participants for the collection of stool samples. After collection of samples, they were preserved in 10 percent formalin for transportation to the laboratory for examination. Kato technique was used to examine the stool sample. Parasite present in the stool at any stage of its life cycle i.e. cysts or trophozoites, or eggs of helminthes confirmed the diagnosis of intestinal infection.<sup>5</sup>

After the collection of stool sample, blood samples were collected for peripheral blood smear test and ferritin test. Peripheral smear test tells us about the morphology of red blood cells and establish the diagnosis for anemia. Blood samples were collected by phlebotomy and kept in heparin-containing tube. Heparin acts as an anticoagulant for blood samples. All the samples were stored in a cold box and then transported to the laboratory where they were analyzed in less than 15 hours of collection. SYSMEX T-2000i analyzer was used to study the mean corpuscular hemoglobin (MCH), mean corpuscular volume (MCV) and hemoglobin level of the samples. COBAS 6000 c501 was used to measure the ferritin, total iron binding capacity, and serum iron.

Predictive Analytics Software (PASW) was used to analyze all of the collected data. Then for the bivariate analysis, Chi-Square test was performed. This was done to find whether the correlation between iron deficiency anemia and intestinal parasitic infections existed or not. Then, ANOVA test was used to analyze the data variables like ferritin, mean corpuscular hemoglobin (MCH), mean corpuscular volume (MCV), serum iron and total iron binding capacity (TIBC).

## RESULTS

Total 130 samples were collected from children aged 10 to 12 years from --- (name of place). 55 percent samples were collected from boys while 45 percent were collected from girls.

Table 1 shows descriptive analysis i.e. univariate data analysis which shows the percentage of intestinal parasitic infections was 26.7. 28 percent of the participants had anemia. The blood results of almost 37 percent of the participants with intestinal infections showed either lowered red blood cell count or lowered hemoglobin concentration, which meant anemia. This shows the influence of parasitic infections on anemia. Seven types of parasites were identified in infected participants. *Entamoeba histolytica* was the most prevalent parasite while *Hymenolepis nana* was the least prevalent.

**Table No.1: General characteristics of samples**

Characteristics	Percentage
Gender	
Girls	45 %
Boys	55 %
Intestinal parasitic infection	
Yes	26.7 %
No	73.3 %
Anemia	
Yes	28 %
No	72 %
Anemia in infected participants	
Yes	37 %
No	63 %
Type of parasite	
Trichuris trichura	5.4 %
Giardia lamblia	23.6 %
Ascaris lumbricoides	3.9 %
Entamoeba histolytica	29.1 %
Hymenolepis nana	2.5 %
Ancylostoma duodenale	8.5 %
Escherichia coli	27 %
Serum ferritin (Low < 12 µg/mL)	
Normal	75 %
Low	25 %
Serum iron (low < 50 µg/mL)	
Normal	74 %
Low	26 %
MCV (78-98 fL)	
Normocytic	55 %
Macrocytic	0 %
Microcytic	45 %
MCH (25-33 pg)	
Normochromic	71 %
Hypochromic	29 %
TIBC (High TIBC > 346 µg/dL)	
Normal	61 %
High	39 %

25 percent of the population showed low serum ferritin value and 26 percent showed low serum iron. 45 percent of the population had microcytic red blood cells and 29 percent had hypochromic. Lastly, TIBC value was higher than normal in almost 39 percent of the participants. All of these values deviating from the normal indicates iron deficiency anemia in the participants.

**Table No.2: ANOVA p-value**

Variable	Anemia	Parasitic infection
Serum ferritin	.000	.345
Serum iron	.275	.654
MCV	.000	.356
MCH	.000	.246
TIBC	.368	.010

In the Table 2, we can see the bivariate analysis of anemia with serum ferritin, serum iron, MCV, MCH and TIBC; and bivariate analysis of parasitic infected participants with serum ferritin, serum iron, MCV, MCH and TIBC. The results show that the serum ferritin, MCV and MCH had a positive correlation with anemia. Other variables i.e. TIBC and serum iron did not show such correlation. The results also show that the serum ferritin, MCV, MCH, serum iron and TIBC had no correlation with parasitic infections. This show a positive correlation between MCV, MCH and serum ferritin with iron deficiency anemia.

**Table No.3: Occurrence of anemia according to species of intestinal parasite**

Parasitic specie	Percentage of anemia
Trichuris trichura	38 %
Giardia lamblia	31.4 %
Ascaris lumbricoides	34 %
Entamoeba histolytica	40 %
Hymenolepis nana	21 %
Ancylostoma duodenale	45.3 %
Escherichia coli	48.7 %

The Table 3 show the occurrence of anemia due to different species of intestinal parasite. According to the results, Hymenolepis nana infected participants show the least percentage of anemia while Escherichia coli infected participants show highest percentage of anemia. This show positive correlation between iron deficiency anemia and intestinal parasitic infestation, especially E coli.

## DISCUSSION

Anemia affect the people globally. People of every age, gender and socioeconomic condition get affected by anemia. According to WHO, almost 800 million women and kids suffer from anemia worldwide<sup>9</sup>. Our study show anemia in nearly 28 percent of the participants.

The most common infections are intestinal parasitic infections. These infections effect nearly 3.6 billion individuals<sup>3</sup>. These infections are classified as neglected tropical disease according to WHO. In this study, 26.7 percent of the children were infected by some kind of intestinal parasite. The most common route of these infections is contaminated food, water and poor hygienic conditions. Entamoeba histolytica was the most common infectious parasite according to the results of this study, which is similar to the Al-Niaeemi, Khazal & Dawood's study. In a different study, the most common parasite was A. lumbricoides<sup>10</sup>.

There are many types of anemia depending on etiology but the most common type of anemia is iron deficiency anemia<sup>2</sup>. The causes of iron deficiency anemia can be less iron in diet, loss of blood, irregular food intake and parasitic infections. Anemia is more prevalent in

developing countries, especially in school aged children<sup>11</sup>.

Parasites can also be the cause of anemia. Like anemia, intestinal parasitic infections are also more common in developing countries due to a number of reasons i.e. poor hygienic conditions, poor socioeconomic conditions. These infections can also cause anemia. Maybe this is the reason of higher anemia rate in developing countries.<sup>11</sup>

The rupturing of blood vessels of the intestine is one of the many ways an intestinal parasite cause anemia in their host. Hookworms work through this mechanism. To further increase the blood loss, these worms secrete anti-coagulant substances to hinder the mechanism of clot formation to stop the bleeding. *Trichuris trichura* causes bleeding in the large intestine and causes anemia. Along with blood loss, these parasites absorb the nutrients from the gut wall of the host and cause malnutrition. This can lead to other disorders like anorexia.<sup>5</sup>

*Ascaris lumbricoides* also absorbs nutrient like iron from the small intestine and cause iron deficiency anemia. Some parasites can cause atrophy, inflammation and hypertrophy in the intestines. These processes hinder the nutrient absorption from the intestines and cause decreased amount of essential nutrients i.e. iron, folic acid and vitamins, in the body.<sup>5</sup> Such conditions are very harmful for children at development age.

According to this study, participants with intestinal parasitic infections had the higher percentage of iron deficiency anemia and it positively correlated in numerical analysis. Some other studies also showed similar results. One of these study was Gopalakrishnan, Eashwar, Muthulakshmi & Geetha's study conducted in India<sup>11</sup>. Mahmoud, Abdul Fattah, Zaher, Abdel-Rahmanm & Mosaad's study in Egypt also showed significant correlation between iron deficiency anemia and intestinal parasitic infections<sup>12</sup>.

The MCV, MCH and serum ferritin showed positive correlation with anemia in our study. These variables did not show any significant correlation with intestinal parasitic infections in ANOVA test done for this study. These results were similar to the results of Darlan, Ananda, Sari, Arrasyid & Sari's study conducted in Medan.

This study shows significant link between intestinal parasitic infections and anemia. This also indicates lack of awareness about the association of such infections with hygiene and unclean food and water consumption. Also people need to be educated about the importance of iron supplements to overcome such huge number of anemia patients.

## CONCLUSION

According to the results of this study, there is positive correlation between iron deficiency anemia and

intestinal parasitic infections. 37 percent of the participants which were infected by intestinal parasite had anemia. This proves that intestinal parasitic infections do cause anemia. *Escherichia coli* caused the highest percentage of anemia in participants. Also, the occurrence of intestinal parasitic infections was high in children generally. *Entamoeba histolytica* is one of the most common intestinal parasite. This needs to be taken care of as parasitic infections can affect the life of children in a number of ways other than just causing anemia and can pave the way for other diseases too. Preventive and hygienic measures should be promoted among children by the collective effort of parents and teachers to stop the development and spread of such infections.

### Author's Contribution:

Concept & Design of Study: Aysha Sarwar Khan  
Drafting: Shaista Alam, Iftikhar Hussain

Data Analysis: Ambreen Ali, Hafsa Sarwar Khan

Revisiting Critically: Aysha Sarwar Khan, Shaista Alam

Final Approval of version: Aysha Sarwar Khan

**Conflict of Interest:** The study has no conflict of interest to declare by any author.

## REFERENCES

1. Irfan Ullah. Iron Deficiency Anemia in School Age Children in District Karak Khyber Pakhtunkhwa Province, Pakistan. *Open J Blood Diseases* 2018;4:7.
2. Sembulingam K, Sembulingam P. *Essentials of medical physiology*. JP Medical Ltd 2012.
3. Gabu A, Taye S, Aynalem M, et al. Prevalence and associated factors of intestinal parasitic infections among patients attending Shahura Health Center, Northwest Ethiopia. *BMC Res Notes* 2019;12:333.
4. Trebi, Nicholas IN. Emerging and neglected infectious diseases: Insights, advances, and challenges. *Bio Med Res Int* 2017. Article ID 5245021 Available from: <https://doi.org/10.1155/2017/5245021>
5. Darlan DM, Ananda FR, Sari MI, Arrasyid NK, Sari DI. Correlation between iron deficiency anemia and intestinal parasitic infection in school-age children in Medan. In *IOP Conference Series: Earth and Environmental Science* 2018;125(1): 012059.
6. Haque R. Human intestinal parasites. *Journal of health, population, and nutrition* 2007;25(4): 387-391.
7. Yourgenome.org. 2015. What are helminths?. [online] Available at: <<https://www.yourgenome.org/facts/what-are-helminths>>

8. Al-Niaemi BH, Khazal FM, Dawood MH. Incidence rates of anemia among patients with some intestinal pathogens in Telkeif district/ Nineveh plains. *Int Med J* 2020;25(4): 1899-1906.
9. WHO 2015. The global prevalence of anemia in 2011 (Geneva: World Health Organization)
10. Center for Disease Control and Prevention 2017 Parasites-neglected tropical disease (Atlanta: CDC)
11. Gopalakrishnan S, Eashwar V, Muthulakshmi M, Geetha A. Intestinal parasitic infestations and anemia among urban female school children in Kancheepuram district, Tamil Nadu. *J Family Medicine Primary Care* 2017;7(6):1395–1400.
12. Mahmoud A, Abdul Fattah M, Zaher T, Abdel-Rahman S, Mosaad N. Intestinal Parasitic Infections and Iron Deficiency Anaemia among School Children in El Khalige Village, Dakhalia, Egypt. *Afro-Egyptian J Infectious and Endemic Diseases* 2017;7(1):28-36.
13. da Silva JVL, Fontes G, dos Santos RV, et al. Factors associated with gastrointestinal parasitic infections among young population in Northeast Brazil *Can J Infect Dis Med Microbiol* 2016.