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ANEMIA AMONG CHILDREN HAVING MALARIA IN ODISHA, INDIA: A FACILITY BASED CROSS-SECTIONAL STUDY

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Abstract

Background

Odisha remains endemic for malaria. Additionally, anemia is a major public health challenge in Odisha. Both these diseases co-occur as syndemic as malaria destroys red blood cells leading to anemia. Furthermore, children are at a high risk of having anemia after malaria. Hence, we estimated the prevalence of anemia among children having malaria in Odisha, India.

Methods

A hospital based cross-sectional study was conducted among children aged 2-12 years in a tertiary care teaching hospital of Berhampur. 205 children having malaria were randomly enrolled in the study. We collected 5 ml of venous blood samples from each of the participant for serological evaluation of anemia. Descriptive statistics such as proportions were used to report the findings. Chi-squared test was applied to investigate the association between anemia and various socio-demographic characteristics.

Results

The overall prevalence of anemia was observed to be around 129 (51.5%). A significantly higher number of anemia cases (73.4% vs. 33.6%, $p<0.05$) were observed among females as compared to their male counterparts. We found a significantly higher prevalence of (56.8% vs. 40.7%, $p<0/05$) anemia among rural residents than those living in urban areas. There was a significantly higher anemia cases among those who do not use a mosquito net (76.2% vs. 43.3%, $p<0.05$) than those who use a mosquito net.

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Conclusion

We observed a high prevalence of anemia among children having malaria which necessitates the early diagnosis and prompt treatment of malaria along with interventions aiming to improve nutrition of this group in order to mitigate anemia.

Key Words: malaria, anemia, children, Odisha

Introduction

Anemia is a major public health challenge in low-and middle-income countries such as India (1). This becomes a life-threatening when it is accompanied with *Plasmodium falciparum* malaria (2). The pathogenesis of malaria remains unexplained (3). However, two mechanisms such as increased destruction and decreased production of red cells are proposed to explain this (3). The malaria patients usually exhibit acute hemolysis i.e. rapid decrease in blood hemoglobin levels, hemoglobinemia, hyperbilirubinemia, hypohaptoglobinemia and hemoglobinuria. Additionally, presence of fragmented red cells and reticulocytes in peripheral blood are also observed among malaria patients (4). The destruction of blood cells by malarial parasite is an important factor contributing to malaria related anemia.

In acute malarial infections, depression of erythropoiesis, dyserythropoiesis and ineffective erythropoiesis leads to decreased production of erythrocytes (5). Previous studies have showed a poor reticulocyte response to anemia among malaria patients (6). A study conducted among Gambian children having malaria showed gross dyserythropoietic changes (7). Another study conducted among Thai adults with malaria showed dyserythropoietic changes in bone-marrow samples which remained for up to 21 days after the acute infection (8).

Despite several programmes such as Weekly Iron Folic Acid Supplementation, iron-deficiency anemia widely persists in Odisha (9). Additionally, Odisha remains endemic for malaria (10). Nonetheless, children are at a major risk of contracting both of these diseases (11). Evidence suggests anemia among malaria patients may lead to inferior quality of life, rapid heart rate, loss of stamina, and shortness of breath (12). Estimates suggest almost half of the malaria related deaths are due to anemia (13). Various factors identified for this are poverty, gender discrimination, and ignorance (13). However, evidence on their co-existence remains scarce. Hence this study was conducted to estimate the prevalence of anemia among children suffering from malaria in a tertiary care hospital of Odisha, India.

Methods

Study Design and setting

A hospital based cross-sectional study was conducted in Berhampur district of Odisha, India. The patients attending in-patient departments (IPD) of Maharaja Krishna Chandra Gajapati

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Medical College and Hospital, Berhampur, Odisha. MKCG Medical College and Hospital, Berhampur is a tertiary level educational institute which caters to a large number of the patients in the region. Based on the case load, we chose this facility for the present study. This study was done from Aril 2021 to February 2022.

Study population

We included children aged 0-10 years attending the in-patient services of the facility. These children were diagnosed with malaria and were taking treatment for it. We excluded severely ill patients or those who did not give consent/assent prior to participation.

Sampling and sample size

We used an exploratory study design spanning across one year of data and sample collection. First, we did a careful observation of the daily in-patient visit and marked the average number of patients attending the IPD daily. Then, we decided to enroll every alternate patient on alternate working days for a period of six months. Following this we included a total of 250 children in the study. This also allowed us to consider non-response and ineligibility. We did exit-interviews so that the normal clinical routine of the facility is not disturbed.

Data and sample collection

We collected information on socio-demographic characteristics of the study participants which included age, sex, place of residence (rural/urban), use of mosquito net while sleeping at night. Additionally, clinical parameters such as fever, presence of rigor, chills were also noted. We asked patients or their care-givers for information on these parameters.

We collected about 5ml of venous blood samples from each of the participant for serological evaluation of anemia as well investigation of malaria. Two different tubes with Ethylenediamine tetraacetic acid (EDTA), and one without anti-coagulant was used to collect the blood samples. Blood samples were collected by a trained phlebotomist under aseptic conditions and transported to the testing facility in cold chain. The first blood sample was collected while the patient was in the hospital while the second sample was collected two weeks after the discharge. The parents of enrolled children were asked to re-visit after two weeks of discharge and were followed-up through phone.

Hematological investigation procedures

We diagnosed malaria by examining a stained thick blood film. The thick blood film was made from each blood sample and allowed to dry in the air. We first stained the slides with 3% Giemsa stain for 30 minutes, then rinsed it in tap water, and allowed to air dry. These stained films were examined for malarial parasite by microscopy using a × 100 oil immersion objective lens. A total of 200 fields per film were examined. Hemoglobin concentration was determined using an autoanalyser – Sysmex KX-21 (Sysmex Corporation, Kobe, Japan). Anemia was defined as hemoglobin < 11 g/dL for children (14).

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Statistical Analysis

Data were analyzed using SATA v.16.0 software (Stata Corp, Texas). Mean and standard deviation (SD) were the measures to present continuous variables such as age. We used descriptive analysis such as frequency and proportions to report the prevalence of anemia among children. Chi-square test was used to assess statistical association between malaria and anemia.

Ethical Considerations

This study was approved by the Institutional Ethics Committee of Maharaja Krishna Chandra Gajapati Medical College and Hospital, Berhampur, Odisha. Informed written assent from participants and consent from their parents was obtained prior to the participation.

Results

We enrolled a total of 250 children having malaria. The mean age of participants was 6±1.3 years with a range of 0-10 years. We observed an almost equal distribution of respondents in three age groups classified as '0-3' years, '4-6' years and '7-10' years. There was a male predilection (54.8%) as compared to the females. We observed a higher number of rural patients (67.6% vs. 32.4%) than their urban counterparts. A higher proportion of respondents reported that they used a mosquito net while sleeping. The detailed characteristics of study population is presented in Table 1.

Table 1: Characteristics of study population

Characteristics	**n, %**
Age (years)	
0-3	77 (30.8)
4-6	86 (34.4)
7-10	87 (34.8)
Sex	
Male	137 (54.8)
Female	113 (45.2)
Residence	
Rural	169 (67.6)
Urban	81(32.4)
Use of Mosquito net	
Yes	187 (74.8)
No	63 (25.2)

The overall prevalence of anemia was observed to be around 129 (51.5%). We found the prevalence of anemia to be significant among children aged 4 to 6 years (62.8%) than other age groups. A significantly higher number of anemia cases (73.4% vs. 33.6%, $p<0.05$) were observed

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among females as compared to their male counterparts. We found a significantly higher prevalence of (56.8% vs. 40.7%, p<0/05) anemia among rural residents than those living in urban areas. There was a significantly higher anemia cases among those who do not use a mosquito net (76.2% vs. 43.3%, p<0.05) than those who use a mosquito net while sleeping. The detailed description of prevalence of anemia across various socio-demographic attributes is presented in Table 2.

Table 2: Prevalence of anemia across various socio-demographic characteristics

Characteristics	n, %	p-value
Age (years)		<0.05
0-3	39 (50.6)	
4-6	54 (62.8)	
7-10	36 (41.4)	
Sex		<0.05
Male	46 (33.6)	
Female	83 (73.4)	
Residence		<0.05
Rural	96 (56.8)	
Urban	33 (40.7)	
Use of Mosquito net		<0.05
Yes	81 (43.3)	
No	48 (76.2)	

We observed a significantly higher cases of malaria as well as anemia among those who did not use a mosquito net than the children who slept under a mosquito net (Table 3).

Table 3: Effect of use of mosquito net on malaria and anemia positivity

Use of mosquito net	Malaria Positive n, %	Anemia Positive n, %	p-value
Yes	187 (74.8)	81 (43.3)	<0.05
No	63 (25.2)	48 (76.2)	

Discussion

Despite the significant improvements in healthcare facilities, both malaria and anemia remains a significant healthcare challenge in Odisha. This could be attributed to the hilly terrains, forest and hard to reach areas which suffers seasonal cut offs during monsoon. Children being one of the most vulnerable group, we aimed to estimate the prevalence of anemia among children

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having malaria at a tertiary care teaching hospital. We observed a high prevalence of anemia among children having malaria. The prevalence of anemia was higher among children aged 4-6 years, females, rural residents, and those who did not use a mosquito net while sleeping.

We observed a high prevalence of anemia among malaria patients which is similar to a study conducted among children in Odisha which found anemia to be prevalent among children having malaria (15). A probable reason for this could be increased hemolysis among malaria patients. However, another study also found that after two weeks of malaria, the levels of blood hemoglobin, hematrocrit, and haptoglobin increased which signifies towards the need for a nutritious diet during and post illness (16). Nonetheless, the prevalence of anemia reported in our study is higher than that showed by a study conducted among children in Nigeria (17). Although both the countries are from low-and middle-income group still the minor difference may be attributed to the regional socio-cultural and dietary differences.

We observed children aged 4-6 years had a higher prevalence of anemia. Here it is worth noting that anemia among malaria patients is multifactorial which involves hemolysis and accelerated clearance of red blood cells (18). This continues for months even after the clearance of malarial parasites (19). This implies that many children may persist to be anemic till their next episode of malarial infection (20). This raises a major concern for the anemia control programmes. Additionally, a study conducted among tribal population in India observed malaria and anemia to co-exist rampantly among pregnant women also which could again lead to low-birth weight babies and complications in pregnancy thus, giving rise to a vicious cycle of inter-generational malnutrition (21).

Further, we observed rural residents had a significantly higher prevalence of anemia. This could be attributed to the urban-rural differences in terrains along with socio-economic differences. Additionally, the healthcare utilization of the rural residents vary with that of urban people which could further potentially be the cause of higher anemia levels in the former. Nonetheless, we also identified that people who do not use mosquito nets had a higher prevalence of malaria and thus anemia. Hence, people should be motivated for higher use of mosquito nets.

Implications for policy and practice

The findings of the present study suggest a high prevalence of anemia among children having malaria which cannot be overlooked. There is an urgent need for behavioral change communication among masses to increase the use of mosquito nets. Although mosquito nets have been distributed under National Vector Borne Disease Control Programme (NVBDCP) but its use have been low, but its need should be explained to people. Additionally, the nutritional status of children should be taken care of. Locally available food items comprising of multi colors should be given to children to fulfill their daily nutrient requirement which would also include micro-nutrients such as iron and folic acid to prevent anemia. Diet of children should especially be taken care of during acute illnesses such as malaria. This will also increase their immunity to fight against secondary infections. Nonetheless, there is a need to increase uptake of

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food supplementation programmes such as at anganwadi centres, mid-day meal scheme and Integrated Child Development Services (ICDS) Scheme so as to improve the overall, nutritional status of the children.

Strengths and limitations

This study investigated anemia among children having malaria which has important implications for strengthening the existing health programmes. Additionally, the randomization in selecting patients increased the generalizability of the study. However, our study was limited by its exploratory design and small sample size. Furthermore, this being a cross-sectional study could not establish causality.

Conclusion

We observed a high prevalence of anemia among children having malaria which calls for the early diagnosis and prompt treatment of malaria along with interventions aiming to improve nutrition of this group in order to mitigate anemia. Additionally, anemia status of children having malaria should be investigated in the routine programme so that proper required measures can be taken well in time. Further studies investigating the causality are warranted.

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