Original Article

MALARIAL INFECTION IN POPULATION OF DISTRICT UMERKOT, SINDH & ITS EFFECTS ON HEMATOLOGICAL PARAMETERS

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ABSTRACT

Objective: To determine the effect of malarial infection on hematological parameters and gender distribution in relation to common parasite of malaria and seasonal variation in population of District Umerkot, Sindh.

Material and Methods: This cross-sectional study was conducted at CMH Chhor from 1st Jan 2019 to 31st Dec 2019 with approval of ethical review committee by IRB certificate number 03/2018. A total number of malaria positive 226 patients with different clinical symptoms of malaria were included and patients with other comorbids and refusal for consent were excluded. All patients with malarial parasite positive peripheral smear were included in the study and also analyzed for Hb, TLC, Platelets, age, gender and species of malarial parasites. The hematological parameters were analyzed using the WHO criteria.

Results: Total 226 malaria positive patients including 200 (88%) males and 26 (12%) females were analyzed with mean age of 33 years (range: 1-75 years). Out of total 226 cases, 215 (95%) were positive for *P vivax* malaria, 9 (4%) for *P. falciparum* malaria and 2 (1%) patients for mixed. About 161 (71%) of patients had thrombocytopenia, 70 (31%) had anemia and 28 (12%) patients had leukopenia. Highest cases were reported in July, August and September which suggest seasonal variation of malaria.

Conclusion: Malarial Infection has significant effect on hematological parameters of patients such as Hb, TLC & Platelets. *Plasmodium vivax* malaria was more significantly associated with thrombocytopenia whereas *Plasmodium falciparum* more linked to anemia and leucopenia that can assist in diagnosis and prognosis. Seasonal variation provides important information for strict implementation of preventive measures during high transmission months.

Key Words: Anemia, Hematological parameters, Leukopenia, Malaria, Seasonal variation, Thrombocytopenia.

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INTRODUCTION

Malaria is considered one of the life-threatening infectious disease with very high morbidity and mortality. About 228 million cases of malaria were reported and responsible for 4,00,000 deaths worldwide in 2019 [1]. Malaria was declared as 5th leading cause of death worldwide. According to WHO 40% of the world's population is at risk of developing malaria [2] and high burden of malarial infection is shared by African countries with 93% malaria cases and 94% of malarial deaths [3]. The malarial epidemiology is influenced by environmental factors in a region and socioeconomic conditions of the population [4].

Malaria is endemic in Pakistan and about 4 million confirmed malaria cases are reported each year [5]. Pakistan is one of the most affected countries in the world due to high temperature, high humidity, large irrigation network, agricultural lands and monsoon rains provides suitable breeding environment for mosquitoes and promotes life cycle of parasites [6]. Heavy rain falls in some parts of the country also favors malarial transmission and climate changes are also affecting the malarial transmission [6]. Pakistan is considered to be a moderate endemic malaria country, and there are still 177 million people at risk of malaria. Approximately 60% of Pakistan's population lives in malaria-endemic regions. Malaria is more common in rural areas because of poor socioeconomic conditions. *Plasmodium vivax* and *Plasmodium falciparum* is most commonly existing in Pakistan with *P vivax* is dominant but WHO reported six-fold increase in *P falciparum* malaria cases with high transmission rates in the months from July to November [6]. As reported by WHO in 2018, Pakistan is one of six Eastern Mediterranean countries with high transmission of malaria and about 100% of the population living at risk. Malaria endemicity varies in different provinces and even in different cities with variable climates [7]. The cumulative annual parasite index (API) for all of Pakistan in 2017 was 1.88. Province wise breakdown shows that the highest number of cases reported in 2017 was 30% from Khyber Pakhtunkhwa, 26.5% from Sindh, 21.9% from Federally Administered Tribal Areas (FATA), 20.5% from Baluchistan and 1.1% from Punjab [4].

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Malarial infection is caused by the bite of female Anopheles mosquitoes which inject unicellular parasite Plasmodium in human blood. There are five different types of plasmodium, including *P Vivax, P falciparum, P ovale, P malariae* and *P knowlesi* [9]. *Plasmodium knowlesi* mainly infects primates but malaria cases with this species are also reported in humans. A global battle against malaria started in 1955 and World Health Organization carries out a malaria control program on a global scale, focusing on local strengthening of primary health care, early diagnosis of the disease, timely treatment, and disease prevention [9].

Malaria causes several effects on human body including the changes in hematological parameters and difference in change of parameters in different gender is also observed. Various studies have been reported to evaluate anemia, thrombocytopenia and leukopenia but no such study has been carried out to highly endemic area of Sindh. The objective of this study is to know the effects of malaria on hematological parameters, to compare effects of gender on hematological parameters, common parasite specie of malaria and seasonal variation of malaria in the District Umerkot, Sindh. This study will contribute to know epidemiology and seasonal variation in Dist Umerkot and will help to formulate strategies for malarial control and education of local population.

MATERIAL AND METHODS

A cross sectional study was conducted from 1st Jan 2019 to 31st Dec 2019 in which 226 malaria positive patients, who were presented with different clinical symptoms of malaria, were included. Patients who were malaria positive but suffering from other comorbid such as Diabetes mellitus, Hepatitis B and refusal for consent were excluded from the study. The study was approved by the ethical review committee of CMH Chhor Hospital in Dec 2018. Informed consent was obtained from the enrolled patients. 3 ml of blood sample were drawn in EDTA tube through venipuncture by trained phlebotomist. Initially Malarial parasite was screened by ICT (Immuno chromatography) and confirmed through thin smear films which were prepared from each patient's sample. Blood complete picture tests were performed by using a hematology analyzer (Sysmex KX-21). All patients with malarial parasite positive peripheral smear were included in the study and also analyzed for Hb, TLC, Platelets, age, gender and species of malarial parasites. The hematological parameters were analyzed using the WHO criteria [6].

RESULTS

Total 226 malaria positive patients including 200 (88%) males and 26 (12%) females were analyzed with mean age of 33 years (range: 1-75 years). Out of total 226 cases, 215 (95%) were positive for *P vivax* malaria, 9 (4%) for *P. falciparum* malaria and 2 (1%) patients for mixed parasitemia including both *P. vivax* and *P. falciparum* malarial parasites (Figure-I). About 161 (71%) of patients had thrombocytopenia with *P* value 0.0002, 70 (31%) had anemia with *P* value 0.0009 and 28 (12%) patients had leukopenia with *P* value 0.0001 (Table-I). Female patients have more pronounced anemia with Hb mean 11.8 g/dl, platelets mean 141 x 10^9/L and TLC mean 6.5 x 10^9/L whereas male patients have less pronounced anemia with Hb mean 13.4 g/dl, and significant decrease in platelets and TLC mean that is 126 x 10^9/L and 5.7 x 10^9/L respectively. Females were more infected with *Plasmodium falciparum* malaria (15%) as compared to males (3%). *Plasmodium vivax* was more significantly associated with thrombocytopenia with *P* value 0.0006 as compared to *Plasmodium falciparum* which can assist in diagnosis and prognosis (Table-II). Age group from 20-40 years is most commonly affected age. The month of July, Aug and Sep bears about half of the cases in whole year which also suggest seasonal variation of malaria (Figure-II).

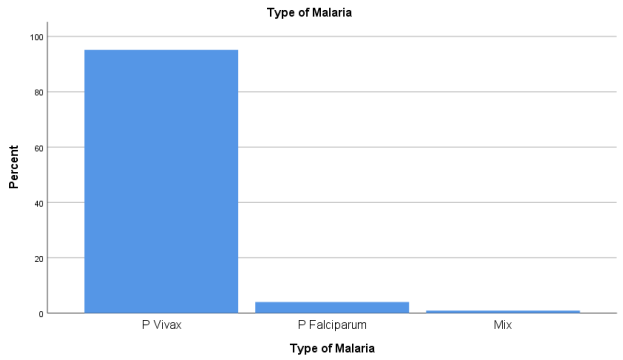

Figure-I: Frequency of common plasmodium species at Dist Umerkot, Sindh.

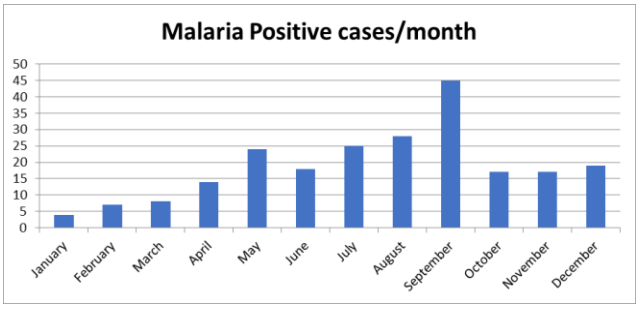

Figure-II: Seasonal variation of malaria at Dist Umerkot, Sindh.

Table-I: Effect of malarial infection on TLC, Hb & Platelets.

Parameter	Male Mean ± SD	Female Mean ± SD	P value
TLC (10^9/L)	5.75±1.74	6.47±2.46	.0001
Hb (g/dl)	13.46±1.34	11.84±2.05	.0009
PLT (10^9/L)	126.06±49.38	141.58±50.91	.0002

Table-II: Common species of malaria.

Type of Malaria		Hb	TLC	Platelets
P Vivax	Mean	13.260	5.823	126.55
	N	215	215	215
	Std. Deviation	1.5224	1.8613	49.635
P Falciparum	Mean	13.322	6.156	152.56
	N	9	9	9
	Std. Deviation	1.7145	1.6957	78.136
Mix	Mean	14.300	5.700	155.50
	N	2	2	2
	Std. Deviation	.8485	.5657	.707
Total	Mean	13.271	5.835	127.84
	N	226	226	226
	Std. Deviation	1.5237	1.8448	50.923

DISCUSSION

Malaria has shown to be a more of a concern in endemic areas of Sindh with poor socioeconomic conditions and malnutrition. Malaria typically changes the hematological profile of affected individuals, notably Hb, TLC and Platelets. Many studies have concluded that thrombocytopenia is a sensitive marker for malaria diagnosis in the presence of acute febrile infection.

A study conducted at Ghana showed *Plasmodium falciparum* 87% and *Plasmodium malariae* 13% in malarial positive patients [3]. Our study showed *Plasmodium vivax* in 95%, *P. falciparum* malaria in 4 & and 1% mix malaria containing *Plasmodium vivax* and *Plasmodium falciparum* both. This difference in *Plasmodium* specie differs from region to region and also explains the more complications and deaths associated with *Plasmodium falciparum*. A study conducted at KPK province of Pakistan showed *Plasmodium vivax* 57%, *Plasmodium falciparum* 4% and mixed malaria in 1% of patients [6] whereas our study showed more *plasmodium vivax* and less *Plasmodium falciparum*. Two studies in India showed *Plasmodium vivax* 55% and 41% whereas *Plasmodium falciparum* 45% and 59% respectively [10,11]. Our study showed *Plasmodium vivax* 95% and *Plasmodium falciparum* in 4% of malarial patients. The rise in *Plasmodium falciparum* is also observed in south East Asian countries which is alarming situation and needs more focus on malaria eradication program than earlier.

A study conducted at Ghana showed thrombocytopenia in 48%, anemia in 55% and leukopenia in 56% malarial patients [3] whereas our study showed thrombocytopenia in 71%, anemia in 31% and leukopenia in 12% of malaria positive patients. This difference describes the difference in plasmodium species of both research and concludes that *Plasmodium vivax* is more associated with thrombocytopenia and *Plasmodium falciparum* is more linked with anemia and leukopenia. A study conducted at Khyber teaching hospital Peshawar, showed thrombocytopenia in 54%, anemia in 77% and leukopenia in 9 % of malaria positive patients [6]. When these results are compared with our study, we observed that thrombocytopenia is much more significant and anemia is less prevalent in population of Dist Umerkot whereas leukopenia is nearly equal results which may be due to increase in plasmodium *falciparum malaria* in KPK.

A Study conducted at Thailand showed, thrombocytopenia in 85%, anemia in 33% and leukopenia in 28 % of malaria positive patients [12] when compared with our results showed nearly similar results except leukopenia which is more common in Thai population. Studies conducted by Kochar *et al*, Khan *et al* and Shrivastava *et al* also concluded that thrombocytopenia is more commonly associated *P. vivax* infection when compared with *P. falciparum* infection [13,14,15]. Our study also showed results in agreement of these studies. Studies from Columbia and Uganda also showed anemia in 77% and 76% of malarial patients respectively [16,17]. Our study showed anemia in 31% of malaria cases which is very less as compared to these studies which is due to difference in plasmodium specie as Columbian and Ugenda population have more *Plasmodium falciparum* infection when compare to our population. Studies conducted by Erhart *et al*, Mckenzie *et al* and Sharma *et al* concluded that leucopenia is significantly associated with malaria and more specifically with *Plasmodium falciparum* malaria [18,19,20]. Our study showed leukopenia in only 12% of malarial patients which is quite low as compared to these studies. This difference can be explained as our population is mainly affected by *Plasmodium vivax* specie.

CONCLUSION

Malarial Infection has significant effect on hematological parameters of patients such as Hb, TLC & Platelets. Thrombocytopenia and anemia are more significantly associated with malarial infections in Pakistan. Plasmodium vivax is more significantly associated with thrombocytopenia whereas Plasmodium falciparum is more linked to anemia and leukopenia which can assist in diagnosis and

prognosis. Pakistan has been facing all four seasons with different weather conditions and, as a result of agricultural activities, malaria species also have unequal distribution throughout Pakistan. Malaria control poses a big challenge in developing countries such as Pakistan, and seasonal variation provides important information for the strict implementation of preventive measures in these months.

AUTHOR CONTRIBUTION

Muhammad Hussain: Concept & write-up
Abdul Fatah: Study design
Waqas Akhtar & Farah Javeed: Literature review
Muhammad Kashif: Data collection
Waqas Ahmed: Data analysis

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