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ORIGINAL ARTICLE

Epidemiology of malaria and hematological analysis in district Dir (lower), Pakistan

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ABSTRACT

Background: Malaria is considered as a tropical disease, in developing countries. Among all parasitic infections malaria is most widespread and devastating disease. According to WHO malaria is endemic in 24 countries. **Methods:** This cross-sectional study was conducted at Department of Medical Laboratory Technology University of Haripur. Total 995 samples were collected at District Head Quarter Hospital (DHQ), Tehsils Hospitals (THQs), and other private laboratories in District Dir (Lower). These samples were processed to observe the shape of RBCs as well as *plasmodium* species in the smear microscopically, and for hemoglobin estimation. Data was analyzed through SPSS version-21. **Results:** Highest percentage of malaria was recorded in Munda (35.17%) followed by Timergara (19.59%) whereas the lowest number of cases were found in Khall (5.02%). Prevalence of P. vivax was (98.0 %) and P. falciparum was (2 %) in district Dir Lower. Mean red blood cell count (RBCs) was 4.2±0.64 mm^3 while mean Hb was 11.0±1.99g/dl. Based on different age categories, the highest RBCs and Hb levels were found in age group 41-50 years, whereas the lowest RBCs were found in age group 11-20 years while the lowest Hb levels were recorded in group 1-10 years. In associated diseases, the upper respiratory tract infections (URTIs) were the most frequent (20%) followed by diarrhea (18%). Mean Hb of males was 11.8±1.53 g/dl while the mean Hb of female was 11.5±5.384 g/dl. Hb in both males and females were low as compared to the standard. However, as compared to females, Hb of males were significantly lower with p-value <0.001. **Conclusion:** We concluded that males are more commonly infected from malaria as compared to females. Males and children were found to have low Hb as compared to females and higher age group patients. URTIs and diarrhea were the most common associated illness.

Keywords: Hemoglobin, RBCs, Malaria, incidence

Introduction

Malaria is considered as a tropical disease (34). In developing countries malaria is the major cause of mortality and morbidity in the world, and of all parasitic infections malaria is the most widespread and devastating disease (34). Malaria is the biggest public health problem worldwide. In 2012 it is endemic in 104 countries while the transmission is ongoing in 99 countries (35).

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The major parasite is *Plasmodium vivax (P.vivax)* in Pakistan, and it accounts for 70 percent cases. Whereas during Peak period of transmission; *Plasmodium falciparum (P. falciparum)* is responsible for remaining 30 percent cases (36). Malaria is the tropical disease that is transmitted by the mosquito female anopheles of which Gambiae anopheles is the most efficient vector. In Nigeria *P. falciparum* causes the infection of malaria and the rate of mortality and morbidity is 98%.Children and adults both are at high risk of incidence (37). *P.vivax* infection has been considered life threatening rarely, but the study challenge this notion recently. Vivax malaria is confirmed with laboratory diagnosis in south-eastern Pakistan. Pediatric patients has severe illness in character and frequency admitted to the hospital (38).

It is the problem that concern public health globally because of high economic burden on the nation, in children the high mortality rate as well as prevalence in non-immune and pregnant women. In the world several organization operate malaria control programs, due to this malarial cases reduced from 244 million in 2005 to 225 million, and 21% death are reduced in 2009 from 2000 – 2009 globally (37).

The aims and objectives of the study were, to find out incidence of Malaria cases in different age groups and sex in District Dir Lower. To investigate red blood cells and hemoglobin level along with various complications in malaria patients.

Methods

Due to high incidence ratio of malaria in Pakistan, the present study was designed to check Malaria incidence in District Dir Lower Khyber Pakhtunkhwa Pakistan. Only smear positive 995 blood samples were collected from patients during the year 2017 in District Dir Lower Khyber Pakhtunkhwa Pakistan.

The data was collected at District Head Quarter Hospital (DHQ), Tehsils Hospitals (THQs), and other private laboratories in District Dir (Lower). Dir Lower is located at 34-35 N^{o} and 71-72 E^{o} in the north of Pakistan along the Pakistan and Afghanistan border. It is 1583 km^2 in area and is divided into seven Tehsil including Tehsil Adenzai, Timergara, Balambat, Munda, Samar Bagh, Lal Qilla and Khall. The population of Dir Lower as per 1998 census is 1,544,000 or (1.544) million. The topography of the district is hilly. The summer is moderate, winter is cold, and rainfall is expected throughout the year. The study was designed at the Department of Medical Laboratory Technology University of Haripur and approved by the ethical committee of the Department of Pathology; DHQ Hospital Timergara Dir Lower dated 20 July 2017.

The data was collected on designed Questionnaire including patient name, age, sex, address, occupation, chief complaints, other diseases, RBCs, Hb, and species. All the patients were counseled regarding our project and those willing to participate in the study, 5ml blood were withdrawn from each patient in EDTA tube. All the tubes were labeled properly and stored for further analysis. Total 995 smear positive samples were included in the study.

Complete blood count (CBC) performed for the purposes of RBCs count and Hb estimation. It was done using Beckman Coulter hematology analyzer while parasite detection was done by Giemsa staining. A drop of blood was placed on glass slide and spread with help of cover slip or slide to make thick smear. It was very useful for the

parasite's detection, while thin smear helped to identify the parasite or species of malaria. On the staining rack, glass slides were placed individually. Cover the slide with stain gently. The stained slides were left for 50-60 minutes with 3% Giemsa solution 10-15 minutes with 10% Giemsa solution. Internal quality control (IQC) of stain indicated the optimum staining time. Flood buffer water was used on the slide to float off the iridescent on the stained surface; the PH of water buffer was 7.2. Slides were allowed to dry on rack. Both thick and thin smear were observed under 100X with oil immersion to identify the species of *plasmodium*.

The data were analyzed through SPSS version-21. Descriptive statistics model was used to describe the overall data. For numerical values, means and standard deviation was done while for categorical variables were described in frequency and percentages. One sample t-test was used to find the differences in biochemical parameters with the standard one. P-value <0.05 was considered significant.

Results

In total 995 patients, 631 (63.4%) were males and 364 (36.6%) were females. The highest percentage of malaria was recorded in Munda (35.17%) followed by Timergara (19.59%) whereas the lowest number of cases were found in Khall (5.02%). All the details are shown in table 1 below. The classical symptoms of malaria including fever with chill, fatigue, nausea, vomiting, headache, body ache, abdominal pain, myalgia and chest pain as described previously(39) were present in all cases.

Table 1: Tehsil wise distribution of malaria patients

Tehsils	Male N (%)	Female N (%)	Total patients N (%)
Adenzai	82 (59.4)	56 (40.6)	138 (13.8)
Khall	30 (60)	20 (40)	50 (5.02)
Lal Qilla	69 (72.6)	26 (27.4)	95 (9.54)
Munda	215 (61.4)	135 (38.6)	350 (35.17)
Timergara	132 (67.7)	63 (32.3)	195 (19.59)
Samar Bagh	67 (57.2)	50 (42.8)	117 (11.75)
Others	36 (72)	14 (28)	50 (5.02)
Total	631 (63.4)	364 (36.6)	995 (100)

The overall species wise distribution of P. vivax and P. falciparum in different Tehsils of District Dir Lower is summarized in table 2. The prevalence of P. vivax was 976 (98.0 %) and P. falciparum was 19 (2 %) in district Dir Lower.

Table 2: Distribution of malarial species

Tehsils	P. falciparum N(%)		P. vivax N(%)	
	M	F	M	F
Adenzai	-	-	82 (59.4)	56 (40.6)
Khall	-	-	30 (60)	20 (40)
Lal Qila	3 (75)	1 (25)	66 (72.5)	25 (27.5)
Munda	1 (50)	1 (50)	214 (61.4)	134 (38.6)
Timergara	3 (75)	1 (25)	129 (67.5)	62 (32.5)
Samar Bagh	5 (55.5 %)	4 (44.5%)	62 (57.4%)	46 (42.6 %)
Others	-	-	36 (72%)	14 (28 %)
Sub-total	12 (63.1%)	7 (36.9%)	619 (62.2%)	357 (35.8 %)
Overall results	**19 (2 %)**		**976 (98.0 %)**	

The mean red blood cell count (RBCs) was 4.2±0.64 mm^3 while the mean Hb was 11.0±1.99g/dl. Based on different age categories, the highest RBCs and Hb levels were found in age group 41-50 years followed by age group 31-40 years, whereas the lowest RBCs were found in age group 11-20 years while the lowest Hb levels were recorded in group 1-10 years. All the details are shown in table 3.

Table 3: Distribution of biochemical parameters among age groups

Age group (years)	RBCs/mm³ Mean ± SD	Hemoglobin (g/dl) Mean ± SD
1-10	4.1±0.85	10.6±1.37
11-20	4.0±0.46	11.0±0.51
21-30	4.5±0.51	12.6±131
31-40	4.5±035	12.7±1.00
41-50	4.7±0.98	14.8±0.85
51-60	4.0±0.12	11.0±1.06
Total	4.2±0.64	11.0±1.99

The pie chart showing the distribution of other diseases associated with malaria during history and examination as shown in figure 1. No associated diseases were found in 35% of the population. In others, the upper respiratory tract infections (URTIs) were the most frequent (20%) followed by diarrhea (18%). Furthermore, acute hepatitis, lower respiratory tract infections (LRTIs), typhoid fever and acute gastritis were also found in study populations.

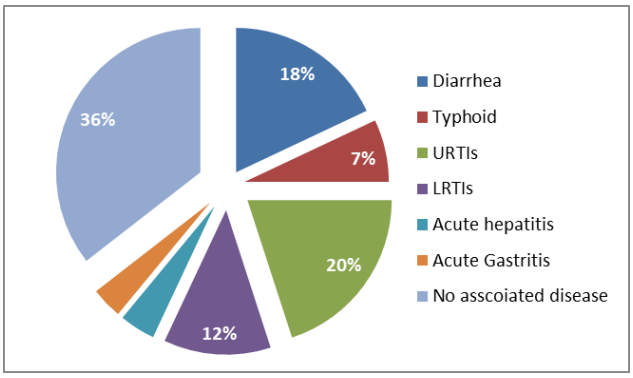

Figure 1: Distribution of other associated diseases with malaria

The distribution of RBCs and Hb levels are shown in table 4 below. Mean RBC count in male and females were 4.2±0.52 mm³ and 4.0±0.48mm³ respectively. No statistical significant differences were observed when compared it with the standard value. Similarly, the mean Hb of males was 11.8±1.53 g/dl while the mean Hb of female was 11.5±5.384 g/dl. The Hb in both males and females were low as compared to the standard. However, as compared to females, Hb of males were significantly lower with p-value <0.001.

Table 4: Gender wise distribution of RBCs and Hb levels

Gender	RBCs/mm³ Mean ± SD	p-value	Hb (g/dl) Mean ± SD	p-value
Male	4.2±0.52	0.12	11.8±1.53	<0.001
Female	4.0±0.48	0.25	11.5±5.384	0.10

*One sample t-test

Discussion

Prevalence of Malaria in males was higher in our study as compared to females. Similar findings regarding higher prevalence of males patients were reported previously in which out of 824 patients, 616 (75%) were male and 208 (25%) were female(40). In consistent with our findings, another study also reported higher percentage of males (62.77%) as compared to females (37.23%) (34). The possible reason for high number of cases in males is that they work in the field and not fully covered their body and have chance of infection as compared to female (41).

The prevalence of *P. vivax* was 976 (98.0 %) and *P. falciparum* was 19 (2 %) in our study. A similar study that was conducted elsewhere also shows higher precentages of *P. vivax* (97%) and lower percentages of *P. falciparum* (3%) (42). Similarly, other studies also reported higher prevalence of *P. vivax* (79.6%) as compared to *P. falciparum* (42, 43).

The prevalence of other diseases was also common in patients with malaria. In our study, the URTIs and diarrhea were the most frequent infections associated with malaria. Similar reports were published in the past

also reported higher prevalence of diarrhea and respiratory infection associated with malaria (44, 45).

Low Hb levels or anemia associated with malaria is very common throughout the world. In our study, most the patients were presented with low Hb levels. The most anemic group in our study was children (age group 1-10 years) with mean Hb 10.6±1.37 g/dl followed by age group 11-20 years with mean Hb 11.0±0.51 g/dl. Low Hb levels were also reported by different studies conducted in the past. In a report by White et al also reported anemia associated with malaria specially in younger age group(46). Another report by Shankar et al also presented low Hb levels in patients with malaria (47). In another study conducted in Gujrat India also reported low Hb levels in malaria patients (48). All these reports are consistent with our findings especially in younger age group.

The overall RBC count and Hb levels in male patients were 4.2±0.52 mm^3 and 11.8±1.53 g/dl respectively. Similarly, in females, it was 4.0±0.48mm^3 and 11.5±5.384 g/dl. The one sample t-test reveals significant lower Hb levels particularly in male patient when compared with the reference range of p-value 0.001. The findings of our study were similar to a research published by Omarine et al, who reported low Hb levels in adult patients with malaria(49).

Conclusion

In this study it was observed that the incidence of malaria is high among all tehsils and *P. vivax* is the predominant species. It was concluded that males are more infected from malaria as compared to females. Hb levels in children and males were lower than females. URTIs and Diarrhea are the most associated diseases related to malaria

Conflict of Interest:

The authors have no conflict of interest

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