



## Original Research Article

### Effects of malarial parasitic infections on human blood cells

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#### A B S T R A C T

##### Keywords

Malaria,  
haemoglobin,  
red blood cells,  
*Plasmodium*  
*vivax*,  
*Plasmodium*  
*falciparum*

The aim of this study was to find the effect of malarial infection on blood cells at tertiary care hospital, Navi Mumbai, India. Out of 4878 suspected cases of malaria, malarial parasites were detected in 809 blood smear (16.58%). Measurement of Hb, RBCs, WBCs and platelets count were done by using ADVIA® 2120i Hematology system (SIEMENS). The cell counts were cross check by experienced pathologists at Pathology laboratory. This study found that the *Plasmodium falciparum* infection have more effects on cells causing degradation than other malarial parasite All these findings were statistically significant.

## Introduction

Malaria is a disease of human which causes high morbidity and mortality. Disease is of global importance, results in 300–500 million cases yearly and 1.5–2.7 million deaths annually. Approximately 2.48 million malarial cases are reported annually from South Asia, of which 75% cases are from India alone. [1-2]

Blood is the most easily accessible diagnostic tissue. Changes in haematological parameters are likely to be influenced by any disease condition which affects the haemopoetic physiology at any level. This is likely to happen with an endemic disease such as malaria that affects the host homeostasis at various fronts resulting in a myriad of clinical presentation. Malaria is a

major cause of morbidity in the tropics. Two hundred and forty seven million cases were reported worldwide in 2006 [3]. Haematological changes are some of the most common complications in malaria and they play a major role in malaria pathology. These changes involve the major cell lines such as red blood cells, leucocytes and thrombocytes. In Western Kenya, severe anaemia is the predominant severe malaria syndrome peaking in the first two years of life and is attributed to *Plasmodium falciparum* [4].

Haematologic abnormalities are considered a feature in *Plasmodium falciparum* infection. The severity of haematologic disease caused by *Plasmodium* is related to

the ability of the parasites to invade and grow in different red cell populations as well as the intrinsic growth rate of the parasite [5].

## **Materials and Methods**

4878 malaria patients who presented clinically with signs and symptoms of malaria infection in the medicine OPD and IPD. This prospective study was carried out at Department of Microbiology, Central Pathology Laboratory, MGM Medical College and Hospital, Navi Mumbai, India, over a period of one year from January 2013 to December 2013.

### **Sampling strategy**

The patient's name, age, sex, details of history and clinical examination findings, history of blood transfusion, antimalarial treatment if any were recorded in requisition form. After obtaining informed consent, 3-5 ml blood specimens were collected in EDTA Vacutainer tube from antecubital vein of all patients by taking sterile precaution.

### **Microscopic examination**

After collection of blood samples thick and thin smear were prepared and stained with Field stain. After drying, the slides were examined under light microscope using an oil-immersion lens (100x magnification) after putting a drop of paraffin oil. Positive result of malaria given if at least one asexual form of parasite was detected in 100 microscopic fields in thick blood film otherwise the report was given as negative. Blood parasite density was determined from the thin films by counting the number of parasites in 200 white blood cells (WBCs).

### **Haematological tests**

Measurement of haemoglobin, red blood

cells, white blood cells and platelets count were done by using ADVIA<sup>®</sup> 2120i Hematology system (SIEMENS). The cell count was cross check by experienced pathologists at Pathology laboratory, MGM Medical College and Hospital, Kamothe, Navi Mumbai by using microscopy.

## **Results and Discussion**

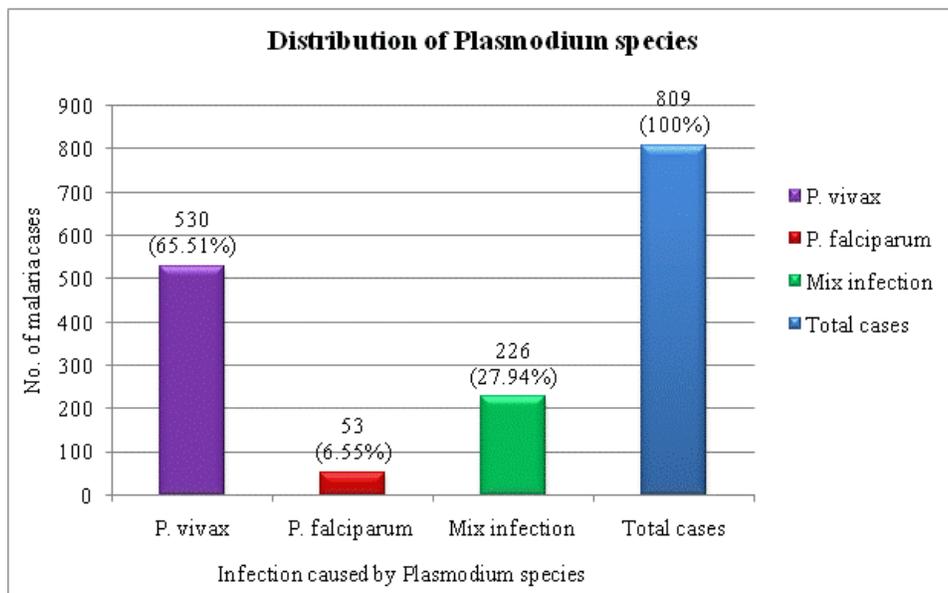
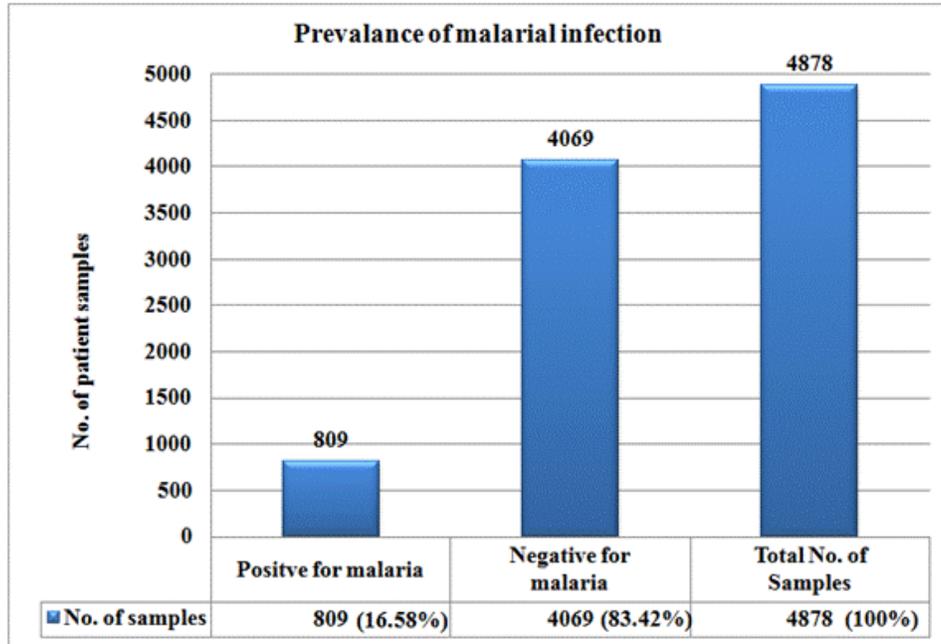
This prospective study was carried out at Microbiology laboratory and Pathology laboratory to find the prevalence of malarial infection at tertiary care centre. Total numbers of suspected cases 4,878 were studied. Out of which 809 cases were positive for malaria. Prevalence rate were 16.58%.

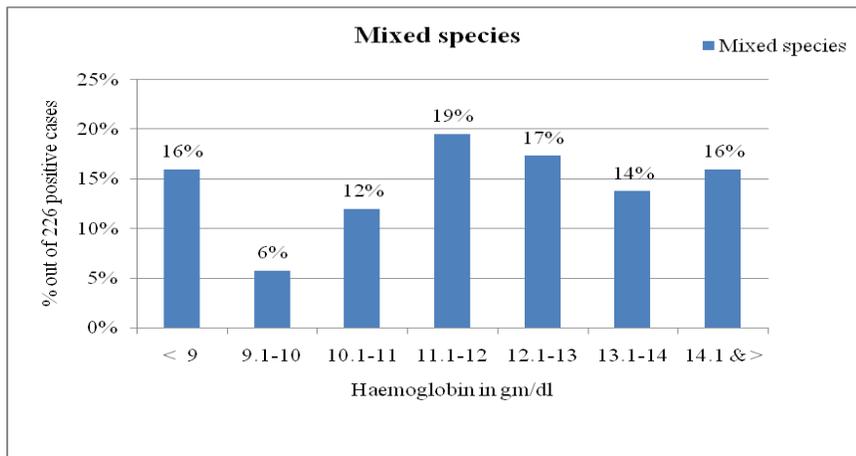
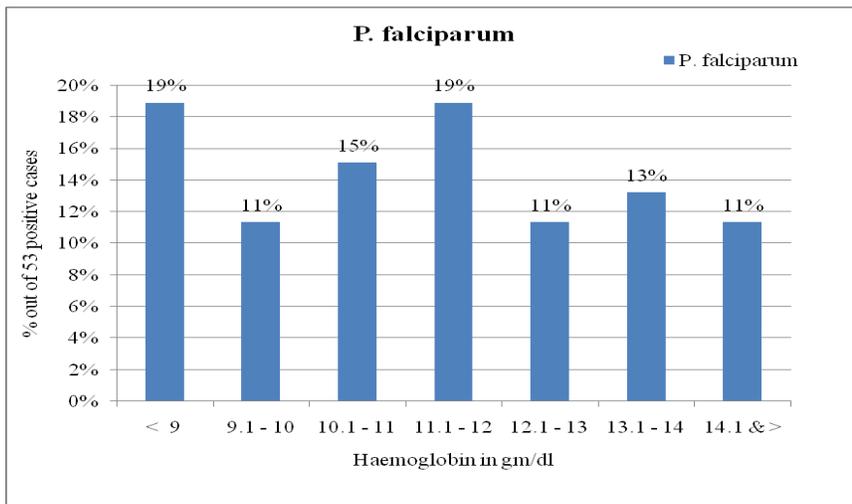
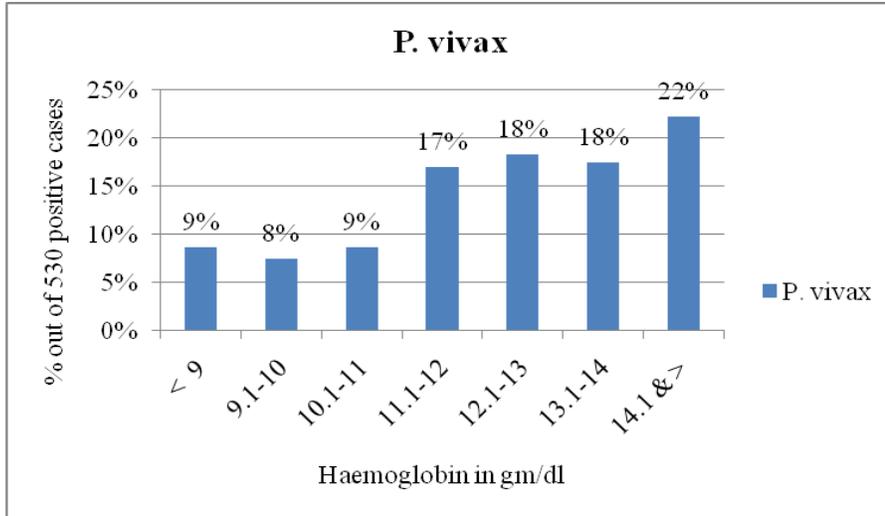
Effect of malarial parasitic infection on blood cells was studied on 809 blood smear diagnosed cases of malaria in a tertiary care hospital. Statistical analysis was done by using chi-square test, Z test and SPSS software (version 17.0).

Muhammad Idris et al.<sup>6</sup> from Abbottabad, Pakistan, reported on 1994 patients out of 145 (7.2%) patients were found infected to malaria.

S. Sahar et al.<sup>7</sup> from Muzaffargarh district, Punjab-Pakistan, reported on 10,028 suspected malaria cases, of which, 208 (2.07%) were confirmed as *P. falciparum* patients.

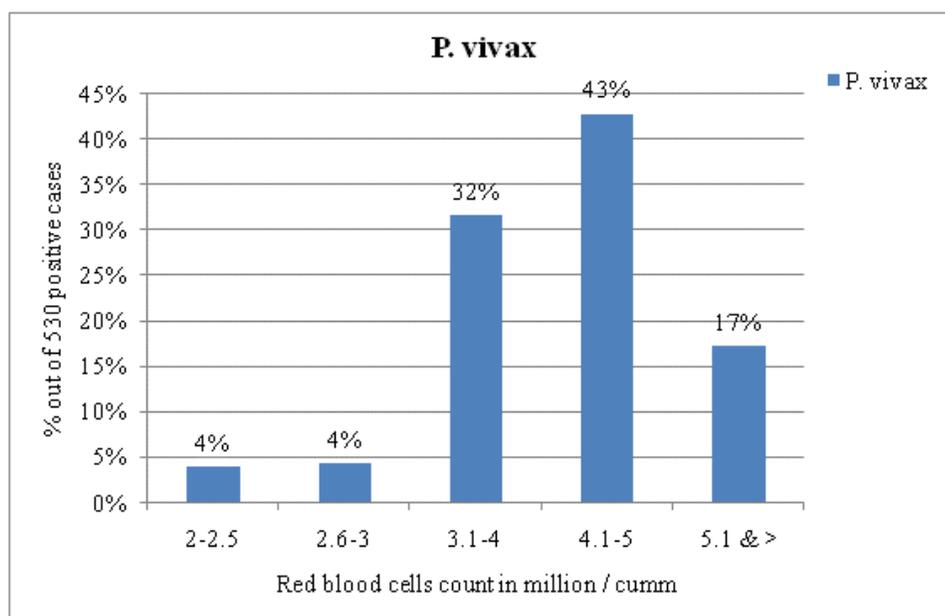
Effect of malarial infection on Haemoglobin (Hb) levels, low values of Hb were found consistently with *Plasmodium falciparum* as compared to *Plasmodium vivax*. More number of *Plasmodium falciparum* cases showed low levels of Hb in the range of < 9 gm/dl to 12 gm/dl.

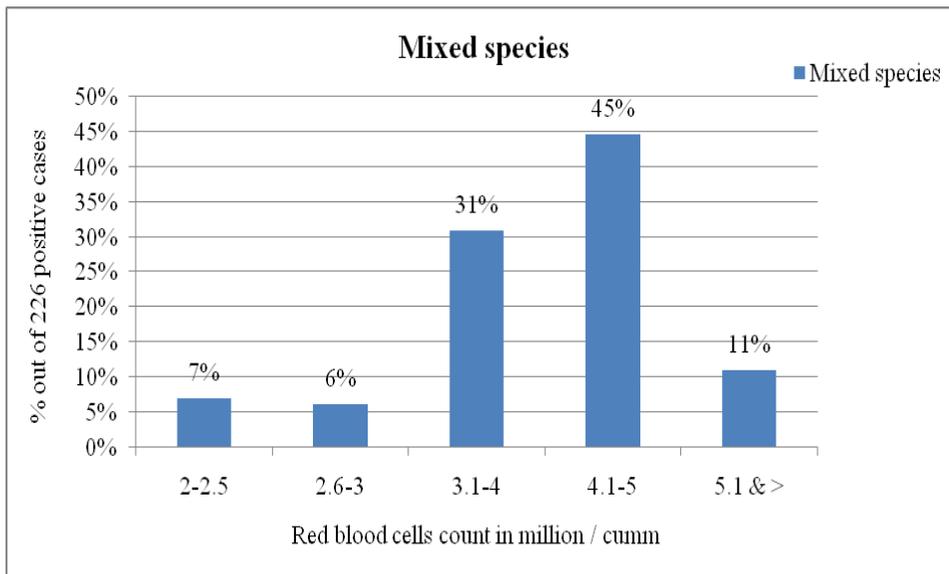
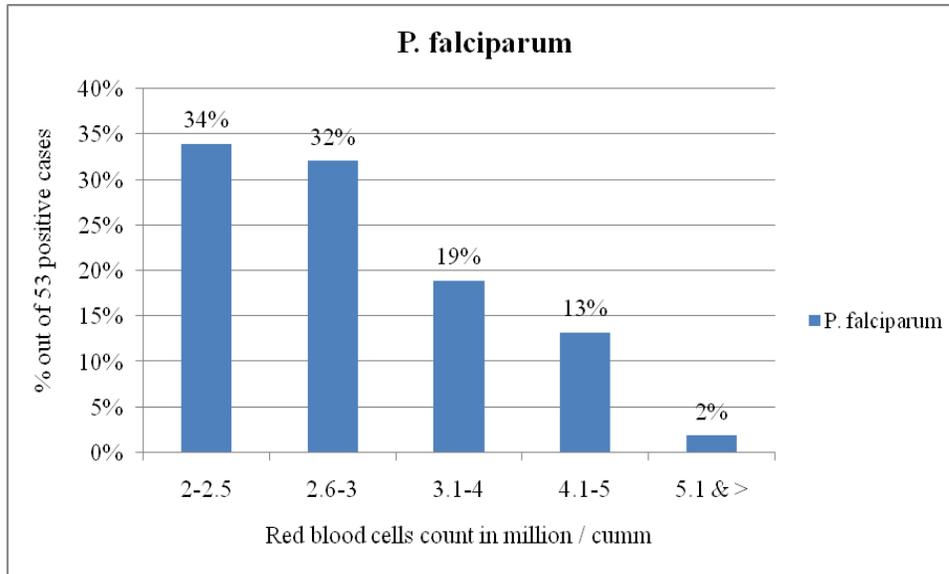




Haemoglobin	<b>P. vivax</b> n=530 (%)	<b>P. falciparum</b> n=53 (%)	<b>Mixed species</b> n=226 (%)
< 9	46 (9%)	10 (19%)	36 (16%)
9.1 - 10	40 (8%)	6 (11%)	13 (6%)
10.1 - 11	46 (9%)	8 (15%)	27 (12%)
11.1 - 12	90 (17%)	10 (19%)	44 (19%)
12.1 - 13	97 (18%)	6 (11%)	39 (17%)
13.1 - 14	93 (18%)	7 (13%)	31 (14%)
14.1 and more	118 (22%)	6 (11%)	36 (16%)
<b>Total</b>	<b>530 (100%)</b>	<b>53 (100%)</b>	<b>226 (100%)</b>

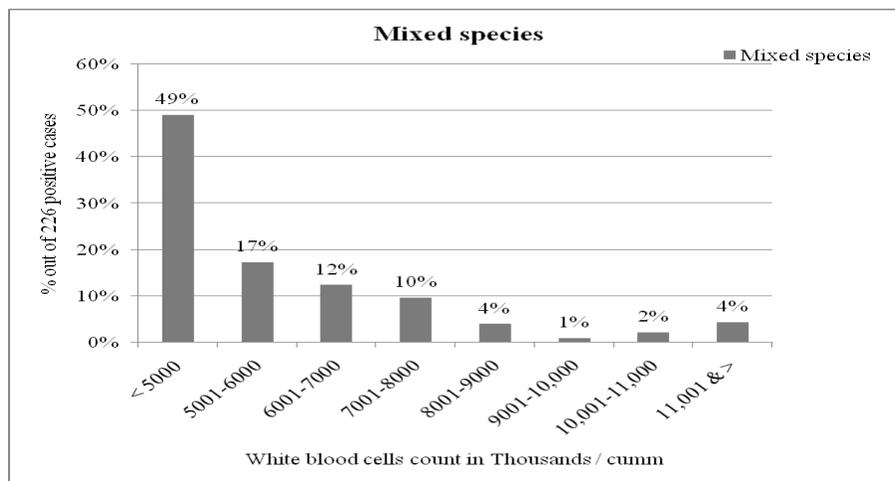
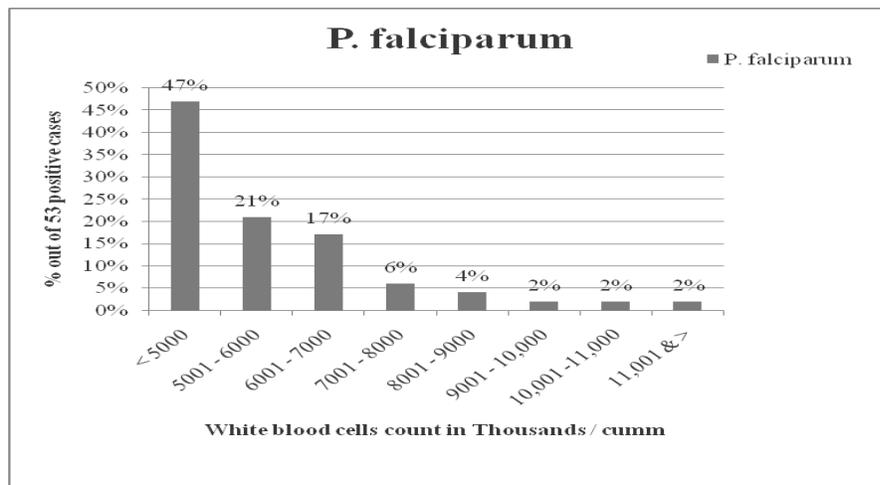
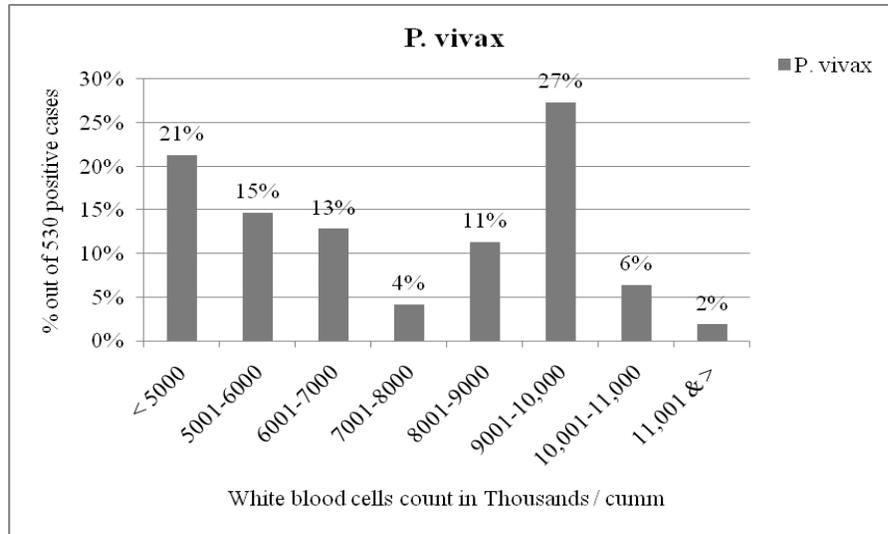
$\chi^2 = 24.194$ , df=12, p < 0.019, significant.





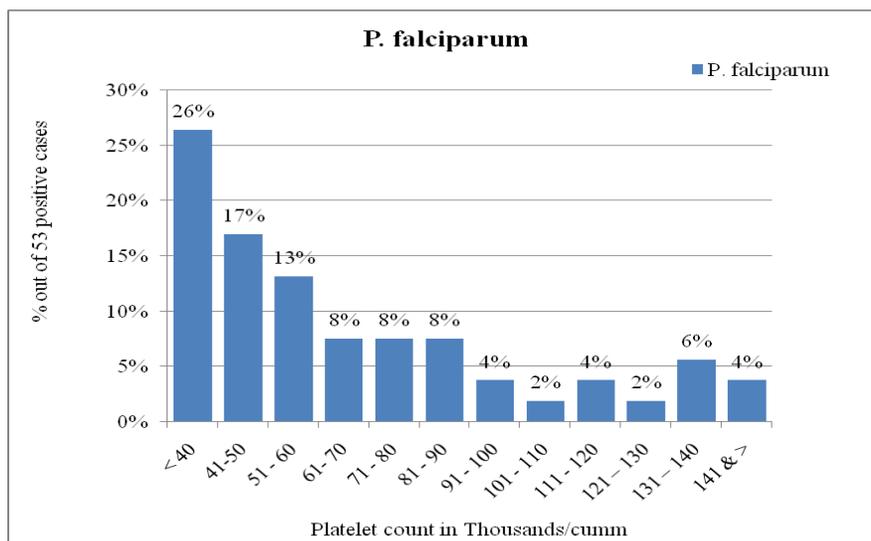
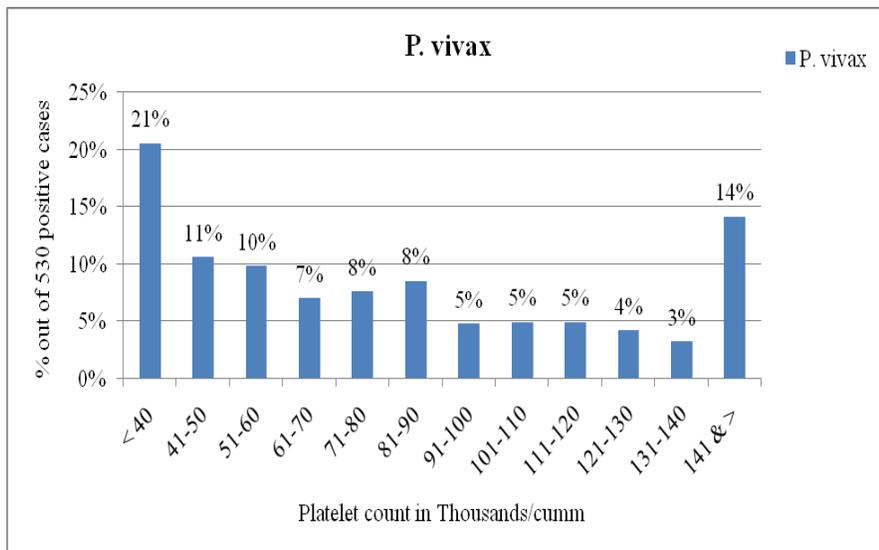
RBC count	P. vivax n=530 (%)	P. falciparum n=53 (%)	Mixed malaria n=226 (%)
2-2.5	21 (4%)	18 (34%)	16 (7%)
2.6 - 3	23 (4%)	17 (32%)	14 (6%)
3.1 - 4	168 (32%)	10 (19%)	70 (31%)
4.1 - 5	227 (43%)	7 (13%)	101(45%)
5.1 and above	91 (17%)	1 (2%)	25 (11%)
Total	530 (100%)	53 (100%)	226 (100%)

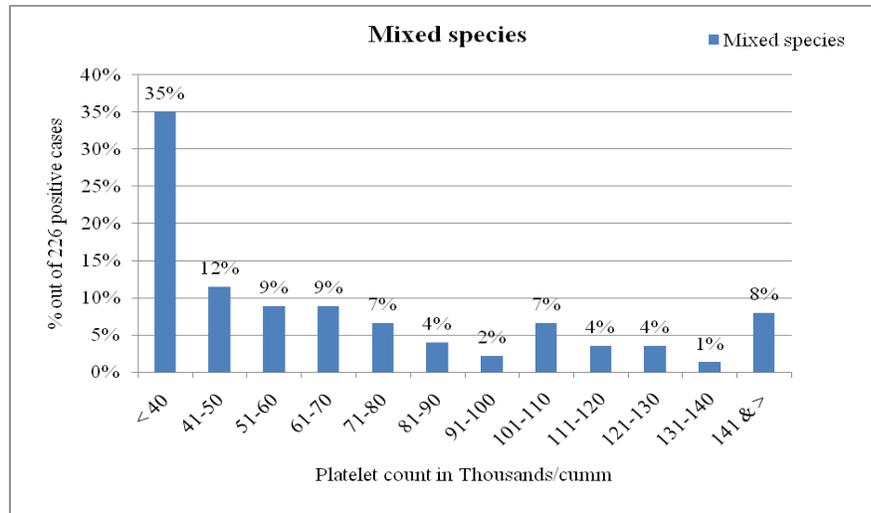
$\chi^2 = 27.185$ ,  $df=8$ ,  $p < 0.001$ , significant.



WBC count	<b>P. vivax</b> n=530 (%)	<b>P. falciparum</b> n=53 (%)	<b>Mixed malaria</b> n=226 (%)
< 5000	113 (21%)	25 (47%)	111 (49%)
5001 - 6000	78 (15%)	11 (21%)	39 (17%)
6001 - 7000	68 (13%)	9 (17%)	28 (12%)
7001 - 8000	22 (4%)	3 (6%)	22 (10%)
8001 - 9000	60 (11%)	2 (4%)	9 (4%)
9001 - 10,000	145 (27%)	1 (2%)	2 (1%)
10,001 -11,000	34 (6%)	1 (2%)	5 (2%)
11,001 & >	10 (2%)	1 (2%)	10 (4%)
<b>Total</b>	<b>530 (100%)</b>	<b>53 (100%)</b>	<b>226 (100)</b>

$\chi^2 = 151.788, df=14, p < 0.001, \text{significant.}$





Platelet count	<b>P. vivax</b> n=530 (%)	<b>P. falciparum</b> n=53 (%)	<b>Mixed malaria</b> n=226 (%)
< 40	109 (21%)	14 (26%)	79 (35%)
41-50	56 (11%)	9 (17%)	26 (12%)
51 - 60	52 (10%)	7(13%)	20(9%)
61- 70	37 (7%)	4 (8%)	20(9%)
71 - 80	40 (8%)	4(8%)	15 (7%)
81 - 90	45 (8%)	4 (8%)	9 (4%)
91 - 100	25 (5%)	2 (4%)	5 (2%)
101 - 110	26 (5%)	1 (2%)	15 (7%)
111 - 120	26 (5%)	2 (4%)	8 (4%)
121 – 130	22 (4%)	1 (2%)	8 (4%)
131 – 140	17 (3%)	3 (6%)	3 (1%)
141 & >	75 (14%)	2 (4%)	18 (8%)
Total	530 (100%)	53 (100%)	226 (100%)

$\chi^2 = 36.222$ ,  $df=22$ ,  $p < 0.029$ , significant.

However after 12.1 gm/dl Hb values, the Plasmodium vivax cases were more than Plasmodium falciparum. This study was statistically significant  $\chi^2 = 24.194$ ,  $df=12$ , ( $p < 0.019$ ).

Effect of malarial infection on Red blood cell (RBC) counts, low values of RBC count were seen with Plasmodium falciparum {2-2.5 million (34%), 2.6-3(32%), 3.1-4 million (19%) and 4.1-5 million (13%)} as compared to

Plasmodium vivax. Mixed species showed values closer to Plasmodium falciparum.  $\chi^2 = 27.185$ ,  $df=8$ , ( $p < 0.001$ ), significant.

Effect of malarial infection on White blood cell (WBC) count, Plasmodium falciparum cases showed low WBC counts {< 500 (47%), 5001-6000 (17%)} as compared to Plasmodium vivax (21% and 15%). This study was statistically significant  $\chi^2 = 151.788$ ,  $df=14$ , ( $p < 0.001$ ).

Effect of malarial infection on platelet counts, *Plasmodium falciparum* consistently showed low platelet count {< 40 thousand (47%), 41-50 thousand (17% and 51-60 thousand (13%)} as compared to *Plasmodium vivax* (21%, 11% and 10%) respectively. This study was statistically significant  $\chi^2 = 36.222$ ,  $df=22$ , ( $p < 0.029$ ).

Christopher Igbeneghu et al.<sup>8</sup> from Southwestern Nigeria reported on 733 malaria subjects. Mean values of haematocrit, leucocyte, platelet and haemoglobin concentration for subjects with mixed *Plasmodium* spp. were significantly lower than those for subjects with *P. falciparum* only or *P. malariae* only. Mean parasite density of mixed *Plasmodium* spp. infection was significantly higher than that of *P. falciparum* only or *P. malariae*. Mixed *Plasmodium* spp. exhibited positive interactions resulting in aggravated effect. Manas Kotepui et al.<sup>9</sup> from Thailand studied that red blood cells (RBCs) count, haemoglobin (Hb), platelets count, white blood cells (WBCs) count, neutrophil, monocyte, lymphocyte and eosinophil counts were significantly lowered in malarial infection. Thrombocytopenia was present in 84.9% of malaria-infected patients ( $P$  value  $< 0.0001$ ).

The conclusion of the study is out of 4878 suspected cases of malaria, malarial parasites were detected in 809 blood smear (16.58%). Effect of malarial infection on Haemoglobin (Hb) levels, low values of Hb were found consistently with *Plasmodium falciparum* On Red blood cell (RBC) counts, low values of RBC count were seen with *Plasmodium falciparum* and mixed species showed values closer to it. *Plasmodium falciparum* cases showed low WBC counts. *Plasmodium falciparum*

consistently showed low platelet counts. This study suggests that *Plasmodium falciparum* infection have more effects on blood cells than other malarial parasite. All these findings were statistically significant.

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