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Research Letter

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RESEARCH LETTER

# Malaria Parasite Density Estimation using Actual and Assumed White Blood Cells Count in Children in Eastern Sudan

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## ABSTRACT

**Background:** Estimating malaria parasite count is needed for estimating the severity of the disease and during the follow-up.
**Objective:** This study was conducted to determine the malaria parasite density among children using actual white blood cell (WBC) and the assumed WBC counts ($8.0 \times 10^9$/l).
**Methods:** A cross-sectional study was conducted at New Halfa Hospital, Sudan. WBC count and count of asexual malaria parasite were performed on blood films.
**Results:** One hundred and three children were enrolled. The mean (SD) WBCs was 6.2 (2.9) cells $\times 10^9$/l. The geometric mean (SD) of the parasite count using the assumed WBCs ($8.0 \times 10^9$/l cells/μl) was significantly higher than that estimated using the actual WBC count [7345.76 (31 038.56) vs. 5965 (28 061.57) rings/μl, $p = 0.042$].
**Conclusion:** Malaria parasitemia based on assumed ($8.0 \times 10^9$/) WBCs is higher than parasitemia based on actual WBCs.

**KEYWORDS**: malaria, parasite, white cell, children, Sudan.

## INTRODUCTION

Malaria should be confirmed by a parasitological test [1]. Microscopy is an important tool for parasite quantification / malaria parasite density, which is performed by counting parasites within a given number of microscopic fields, against counted white blood cells (WBCs) within the same fields [1, 2]. Owing to the scant resources in malaria-endemic countries for quantification of patients' WBCs, an assumed WBC count of $8.0 \times 10^9$/l is used to quantify malaria parasite densities [3]. However, WBCs vary greatly from individual to individual, are age dependent and are unreliable during febrile episodes [4]. With the advent of automated machines, researchers are evaluating the assumed WBCs method vs. the actual count of the WBCs [5–8]. This study

was conducted to compare the malaria parasite density among children using actual WBC and the assumed WBC counts ($8.0 \times 10^9$/l).

## METHODS

A cross-sectional study was conducted at New Halfa Hospital, Sudan, during the period from August to October 2013. After signing an informed consent form, febrile children (temperature $\geq 37.5^{\circ}$C) were examined and data sheet was used to collect demographic information.

Blood films for malaria and hematological analysis were performed as described in our previous work [8]. In summary, thick blood slides were 10% Giemsa stained and examined under the $\times$ 100 oil immersion objective lens of a light microscope. The asexual parasites density was counted against 200 WBCs. Parasite densities (parasite/µl of whole blood) were then calculated as follows:

(Number of parasites counted/WBC counted) $\times$ WBC count/µl of participant.

The complete blood count, including white cells, was analyzed using Sysmex KX-21N$^{TM}$ automated hematology analyzer according to the manufacturer's instruction manual.

**Table 1. Age and laboratory characteristics of children with malaria participating in the study**

| Variable | Mean (SD) [range] |
|---|---|
| Age in years | 7.71 (5.06) [0.25–15] |
| Hemoglobin concentration g/dl | 9.87 (2.6) [3.6–15.8] |
| White cell count $10^9$/l | 6.2 (2.9) [9.8–18.7] |
| Platelet count $10^9$/l | 154.44 (74.07) [26–400] |

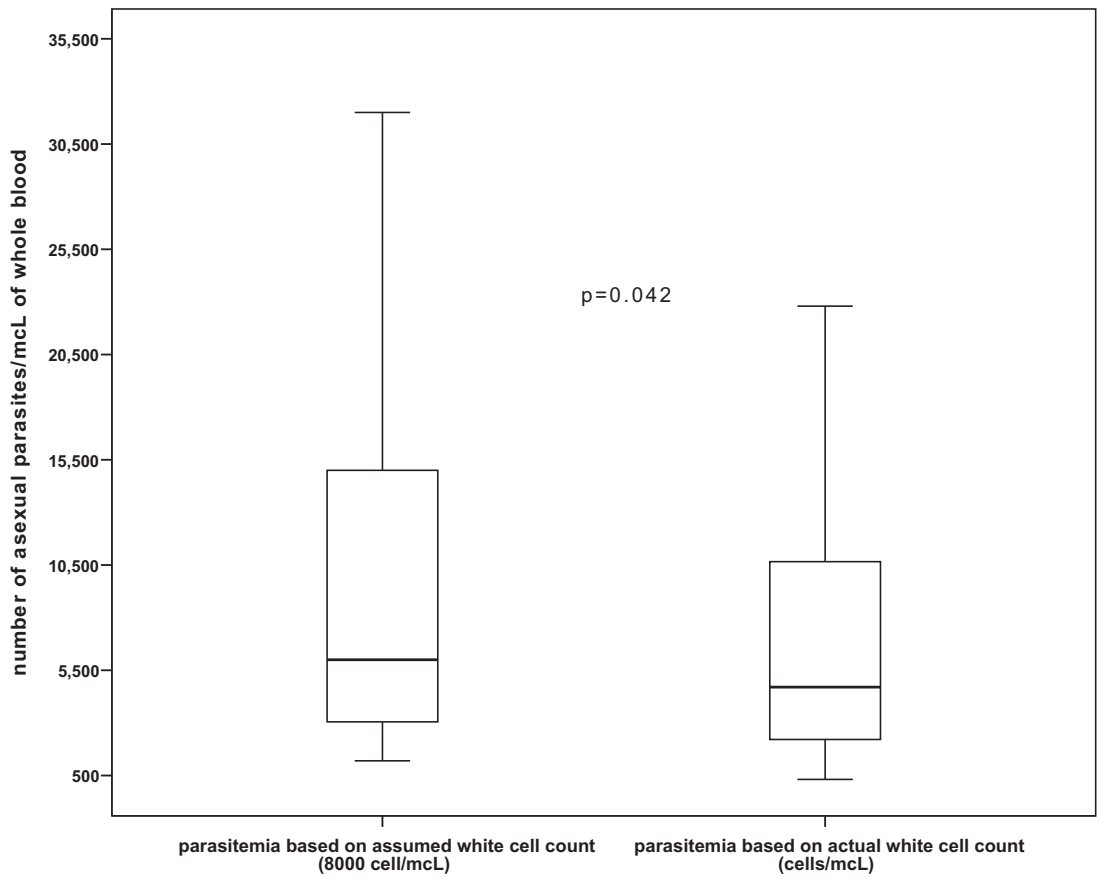


**Fig. 1** Comparison of parasitemia in children using assumed and actual WBC counts of 8000 cell/µl.

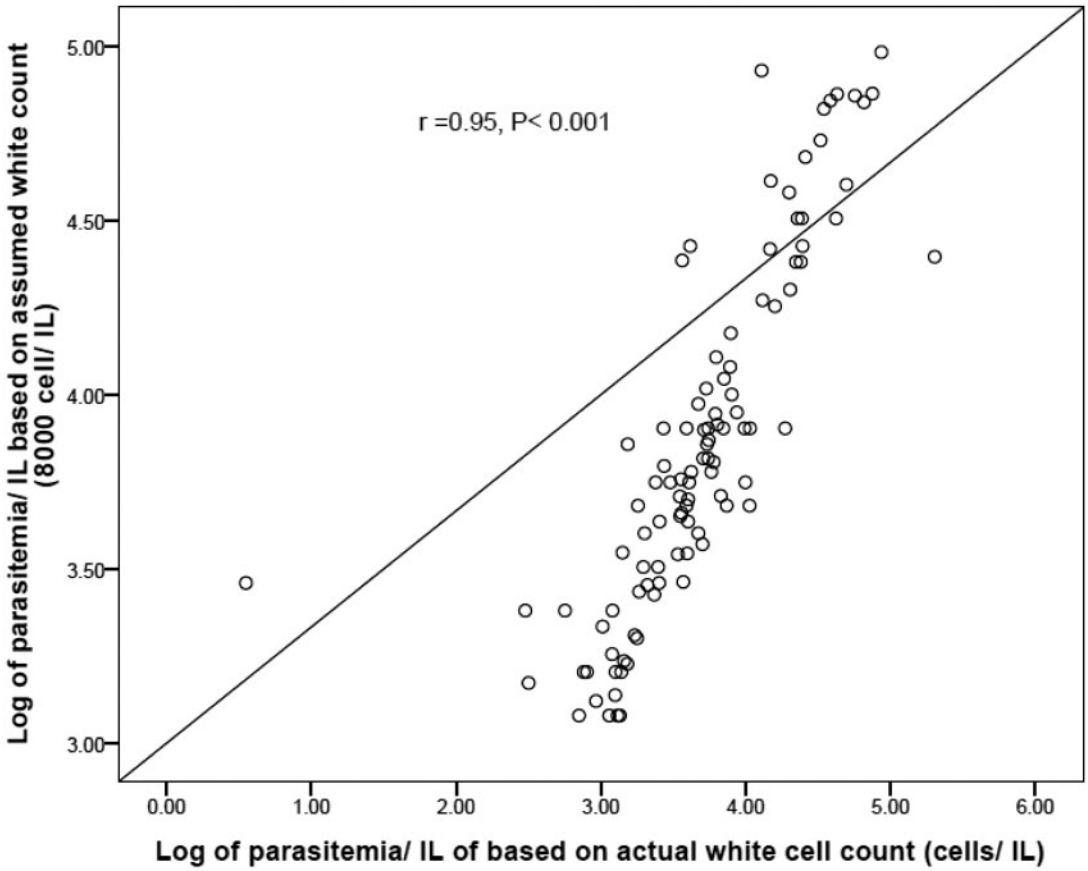


**Fig. 2.** Correlations between log of parasitemias using actual and assumed white cell count of 8000 cell/μl.

### Ethics

This study received ethical clearance from Board of the Faculty of Medicine, University of Khartoum, Sudan.

### Statistics

Data were entered in computer using SPSS for Windows. Mann–Whitney U-test was used to compare the geometric means of the parasite count using the actual count and the assumed $(8.0 \times 10^9/l)$ WBCs for each patient. Nonparametric correlation was used to detect the relation between continuous variables.

## RESULTS

Of the 103 children enrolled, 53.4% were males; major characteristics and blood indices are illustrated in Table 1. The mean (SD) WBC count was 6.2 (2.9) cells/μl, with a range of 1.2–18.7 and a median of 6.1 cells $\times 10^9$/l.

The geometric mean (SD) of the parasite count using the assumed WBCs $(8.0 \times 10^9/l)$ was significantly higher than that estimated using the actual WBC count [7345.76 (31 038.56) vs. 5965 (28 061.57) rings/μl, $p = 0.042$]; figure 1. The two parasitemias were positively correlated ($r = 0.95$, $p < 0.001$); figure 2. There was no significant difference in the mean (SD) WBCs count [6.4 (3.6) vs. 5.9 (2.2) cell $\times 10^9$/l, $p = 0.558$] and parasitemia (using both assumed and actual WBCs) in children when correlated by the age; figure 3.

## DISCUSSION

The main finding in this study was that parasite density calculated using the actual WBC count was significantly lower than that calculated using the

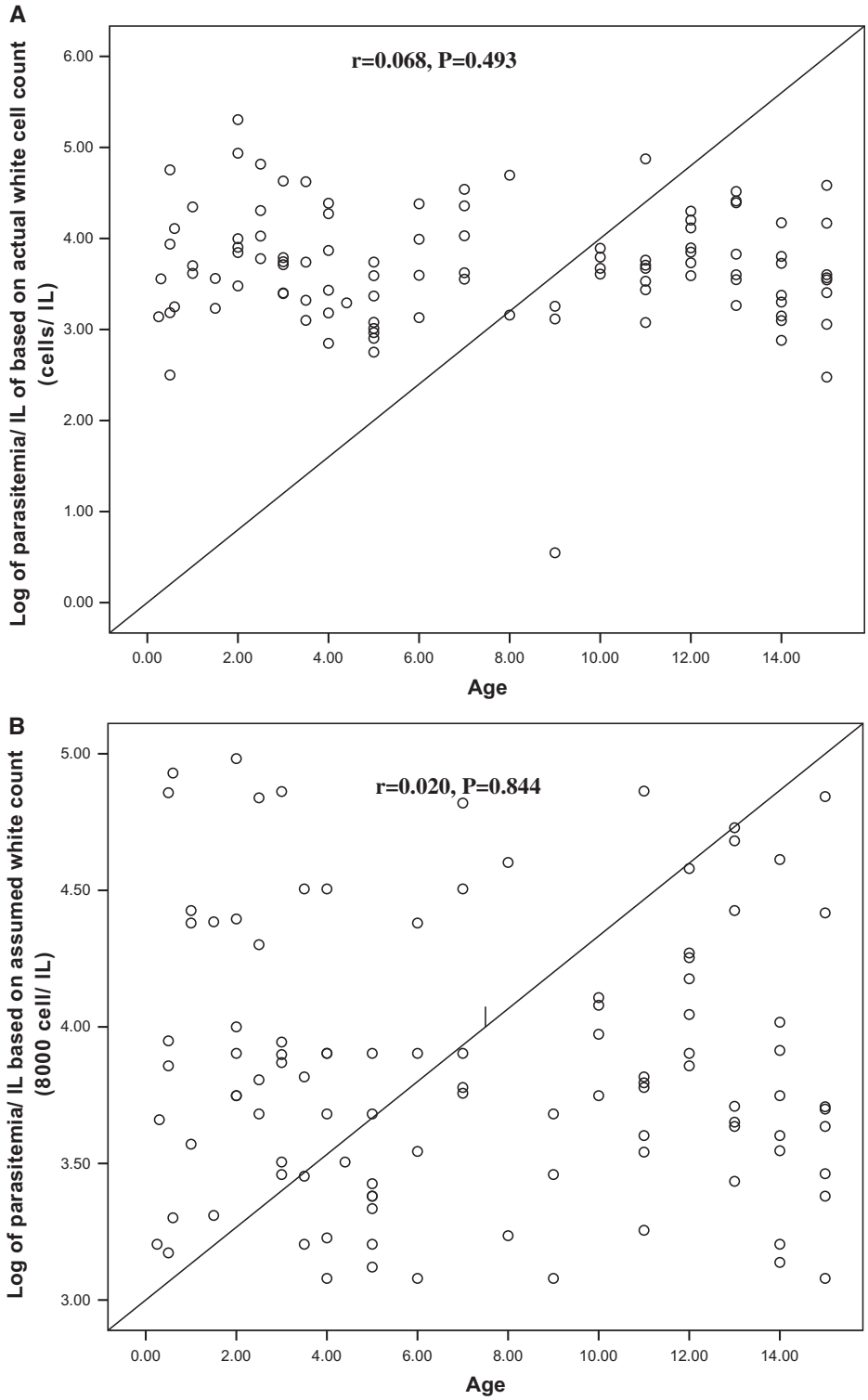


**Fig. 3** (A, B) Comparison between log parasitemia counted on assumed (8000 cell/µl) and actual white cell count in children correlated by age.

assumed WBCs. This is in agreement with our previous results [8] and findings of Adu-Gyasi *et al.* [6] and Jeremiah and Uko [9].

## CONCLUSION

Malaria parasitemia based on assumed ($8.0 \times 10^9$/l) WBCs is higher than parasitemia based on actual WBCs.

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