

Standard white blood cell count for malaria density estimation: A need for review?

Innocent C. Omalu, S. Oguche¹, V. P. Gyang², T. M. Akindigh³, D. Z. Egah³, B. Gokop⁴

Department of Biological Science, Federal University of Technology, Minna, Nigeria, ¹Department of Paediatrics, Jos University Teaching Hospital, Jos, Nigeria, ²Department of Zoology, University of Jos, Jos, Nigeria, ³Department of Medical Microbiology, Jos University Teaching Hospital, Jos, Nigeria, ⁴Department Laboratory, Barkin Ladi General Hospital, Jos, Plateau State, Nigeria

SUMMARY

To compare the actual white blood cell (WBC) counts, used to calculate malaria parasite densities against the standard WBC counts of 8000/ μ l. The WBC counts of 111 *Plasmodium falciparum*-infected children in north central Nigeria, Aged 1-4 (<5) and 5-14 (>5) years were estimated in a cross-sectional study. These gave average values of 7487/ μ l and 5985/ μ l against the assumed standard count of 8000/ μ l. A comparison of blood samples grouped into those with WBC counts of 8000/ μ l (3.95% and 8.57%), those below (57.89% and 82.86%) and above (38.16% and 8.57%) showed a significantly higher number in the group below the standard value for the two age groups (X^2 , $df = 3$, $P > 0.05$). This paper draws attention to the disparity between the assumed standard WBC counts and the real values encountered among Nigerian children and proposes a review for achieving more accurate malaria parasite density estimation among other reasons. To best of our knowledge, the present study is the first such report from north central Nigeria.

Key words: Children, parasite density, review, standard, white blood cell count.

Introduction

White blood cells (WBCs) are one of the numbers of different cells that play a part in the body's defenses and give immunity against disease. Their numbers may be reduced (leucopenia) by starvation, pernicious anemia, and certain infections, such as typhoid and malaria. An increase in their numbers (leucocytosis) is a reaction to normal events such as digestion, exertion, and pregnancy, and to abnormal ones such as loss of blood, cancer, and most infections. WBC counts during malaria are generally characterized as being low to normal, a phenomenon that is widely thought to reflect localization of leukocytes away from the peripheral circulation and to the spleen and other marginal pools, rather than actual depletion or stasis. Leucocytosis is typically reported in a fraction of cases and may be associated with concurrent infections and/or poor prognosis.^[1] Remarkably, few published studies have compared actual and standard WBC counts in malarial parasite-infected people in endemic areas. Although several methods for estimation of densities of blood-stage parasites by microscopy are in use, the most common is to count the number of asexual parasites seen relative to a given count of WBCs (usually 200 or 500 cells) and then to multiply the parasite: WBC ratio by 8000, the assumed number of WBCs per microliter of blood. This

assumed standard value; most often does not give the true value instead, it under or overestimates it.

Materials and Methods

Patients were those who presented to Barkin Ladi General Hospital in Plateau state, Nigeria, during a drug study between February 23, 2007 and May 23, 2007 and had fever (oral temperature of $>37.5^\circ\text{C}$), headache, or a self-reported history of fever within the previous 72 h. The oral temperatures of each patient were taken immediately before blood was obtained. Blood was tested immediately for malaria parasites using the giemsa staining technique and about 3 ml in tubes, were transported on ice within 2 h to a laboratory, and, within 6 h of the initial sample collection, WBCs were counted by a Coulter automated cell counter (Beckman-Coulter) in Jos, Nigeria and a QBC centrifugal hematology system (Becton-Dickinson Diagnostic Systems). Simple means, standard deviation, and chi-square were used in comparing WBCs indifferent age groups (<5 and ≥ 5 years old).

Results

Table 1 shows the actual values of WBC counts against the standard values. For the two groups, the values

Correspondence:

Innocent CJ Omalu, Department of Biological Science, Federal University of Technology, Minna, Nigeria. E-mail: omalucj@hotmail.com

Table 1: Mean values (\pm SD) for white blood cell counts of subjects below and above 5 years old against the standard value

Age (years)	Standard value (μ l)	Actual value (μ l)
>5	8000	7487 \pm 3
\geq 5	8000	5985 \pm 1

is below the standard and it is significant using the Chi-square at 5%, though there are more WBC counts in children above the age of 5 years. Table 2 gives the percentage distribution of WBCs for which a higher percentage of children from the two groups fall below the standard value. The difference in these values against the standard is also significant at 5%.

Discussion

Our analysis of WBC counts in individuals presenting at Barkin Ladi General Hospital in which all children tested positive for *P. falciparum* showed that most children fall below the standard value, which grossly overestimates the parasite density for such children. This can be compared to the work of Jeremiah *et al.* when they studied the comparative analysis of malaria parasite density using actual and assumed WBC counts, in which they showed that parasite density estimation using the assumed count of $8.0 \times 10^9/l$ might result in overestimation of the parasite burden.^[2]

Previous study in India showed a discrepancy between the actual WBC counts and the standard with patients having as low as $4000/\mu l$, which overestimated the parasite density, though they did not describe the methods used for determination of WBC.^[3] Rzepczyk and Swan also got similar observations in their various studies.^[4,5]

It is important that the actual WBC counts are used especially when conducting drug therapeutic efficacy

Table 2: Percentage distribution of white blood cell counts below and above the standard value in children

Age (years)	>5 No. (%)	\geq 5 No. (%)
= 8000/ μ l	3 (3.95)	3 (8.75)
< 8000/ μ l	44 (57.89)	29 (82.86)
\geq 8000/ μ l	29 (38.16)	3 (8.57)
	76	35

studies in other to get the true picture of the efficacy of malaria drugs.

Conclusion

The use of actual WBC counts is more appropriate than the assumed WBCs.

Acknowledgments

We thank the management of Barkin Ladi General Hospital and Jos University Teaching Hospital, for their dedication and technical assistance, and gratefully acknowledge the contributions Late Prof. N. B. Molta who started this study but could not finish it.

References

- McKenzie FE, Prudhomme WA, Magill AJ, Forney JR, Permpnich B, Lucas C, *et al.* White blood cell counts and malaria. *J Infect Dis* 2005;192:323-30.
- Jeremiah AZ, Uko EK. Comparative analysis of malaria parasite density using actual and assumed white blood cell counts. *Ann Trop Paediatr* 2007;27:75-9.
- Jadhav UM, Singhvi R, Shah R. Prognostic implications of white cell differential count and white cell morphology in malaria. *J Postgrad Med* 2003;49:218-21.
- Rzepczyk CM, Stamatiou S, Anderson K, Stowers A, Cheng Q, Saul A, *et al.* Experimental human *Plasmodium falciparum* infections: Longitudinal analysis of lympho-cyte responses with particular reference to gamma delta T cells. *Scand J Immunol* 1996;43:219-27.
- Swan JM. A contribution to the question of the leucocyte formula in malaria. *Am J Trop Med Hyg* 1922;2:283-8.

Source of Support: Nil, **Conflict of Interest:** None declare