

White Blood Cell Counts in Healthy Jamaican Adults

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ABSTRACT

The investigation of presumed neutropenia places a burden on the health services, especially those of developing countries, including Jamaica. This may be because the normal ranges used in the laboratory are based on the values generated from the Caucasian population. Previous studies looking at African and Afro-Caribbean groups have found lower counts for these populations compared with Caucasians. To address this issue, 195 healthy adults donating blood at the National Public Health Laboratory and the University Hospital of the West Indies blood banks in Kingston, Jamaica, were screened for complete blood count (CBC) differentials between June 2001 and June 2006. The geometric means for the neutrophil counts were found to be $2.4 \times 10^9/L$ for men and $2.7 \times 10^9/L$ for women, with 95% confidence intervals of $2.2-2.8 \times 10^9/L$ and $2.5-3.1 \times 10^9/L$ respectively. Values for the Jamaican population were similar to those of other Afro-Caribbean groups. Based on this distribution, 14% of healthy Jamaicans would fall below the normal ranges derived from Caucasians and therefore presumed to have neutropenia. We recommend that the lower reference ranges obtained for Afro-Caribbean adults be adopted for that population.

Conteo de Glóbulos Blancos en Adultos Jamaicanos Sanos

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RESUMEN

La investigación de una neutropenia presunta, representa una carga para los servicios de salud, sobre todo en los países en vías de desarrollo, incluyendo Jamaica. La razón de ello puede estribar en que los rangos normales usados en el laboratorio, se basan en valores generados a partir de la población caucásica. Estudios previos sobre los grupos africanos y afro-caribeños, han hallado conteos más bajos para estas poblaciones, en comparación con las caucásicas. A fin de abordar este problema, 195 adultos sanos que donaron sangre al Laboratorio Nacional de Salud Pública y a los bancos de sangre del Hospital Universitario de West Indies en Kingston, Jamaica, fueron tamizados en busca de diferenciales en conteos completos de sangre (CCS), entre junio de 2001 y Junio de 2006. Para los conteos de neutrófilos, se halló que las medias geométricas fueron $2.4 \times 10^9/L$ para los hombres y $2.7 \times 10^9/L$ para las mujeres, con intervalos de confianza del 95% equivalentes a $2.2-2.8 \times 10^9/L$ y $2.5-3.1 \times 10^9/L$ respectivamente. Los valores para la población jamaicana fueron similares a los de otros grupos afro-caribeños. Sobre la base de esta distribución, el 14% de los jamaicanos saludables caerían por debajo de los rangos normales derivados a partir de los caucásicos, y por consiguiente se presumiría que tienen neutropenia. Nosotros recomendamos que los rangos de referencia más bajos obtenidos para los adultos afro-caribeños sean adoptados para esa población.

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INTRODUCTION

The interpretation of any laboratory test requires that the normal range be established for the population in which the test is being used (1). Reference ranges used for blood cell counts in many laboratories, including those in the Caribbean, are based on data obtained from Caucasian populations. However, as early as 1941, Forbes *et al* (2) noted that

persons of African origin had lower white blood cell counts than Caucasians. Subsequent studies of the total white cell counts and neutrophil counts of healthy Afro-American, West African and Afro-Caribbean adults have consistently demonstrated significantly lower values for both the lower and upper limits of normal when compared with Caucasian adults (3–5). It has also been observed that low neutrophil counts are uncommon for Caucasians while high neutrophil counts are uncommon for Blacks (6). Inappropriate use of Caucasian reference values in populations of African origin could therefore result in unnecessary investigation of presumed neutropenia as well as failure to appreciate elevations of the neutrophil count (7, 8).

Knowledge of the normal ranges for white blood cell (WBC) and neutrophil counts in Afro-Caribbean adults would thus be of immediate clinical value to physicians involved in their management. It might be expected that white blood cell and neutrophil counts in Jamaicans would be comparable to those obtained in other populations of predominantly African origin. However, reference values obtained from other geographical locations cannot be assumed to be directly applicable to our population. Various environmental factors including endemic infections, as well as social factors, may impact on the results obtained. Also, many previous studies investigating the white blood cell counts of persons of African descent, especially Afro-Caribbeans, looked at migrant populations living in the developed world (2,3,6). The effect therefore of their new environment would be difficult to assess. It is necessary to obtain reference values from the population in their native habitat for a more accurate determination of the white blood cell count and to compare these results with those of previous studies involving a similar population. This study examines the total and differential white blood cell counts in healthy Jamaican blood donors.

SUBJECTS AND METHODS

Study Population

The study population for this analysis were participants of the Jamaica Blood Donors (JBD) study, a case-control study of human T-cell lymphotropic virus type-I (HTLV-I) infection, conducted at the University of the West Indies in collaboration with the National Cancer Institute, National Institutes of Health (NCI/NIH) in Maryland, USA. Between June 2001 and June 2006, adults aged 16 years or older donating blood at the National Public Health Laboratory and the University Hospital of the West Indies blood banks in Kingston, Jamaica, were recruited into an epidemiologic investigation of HTLV-I infection, a retrovirus infection endemic in this part of the world. Blood donors came from all parishes of Jamaica, with the majority being from Kingston and St Andrew. All donors who gave consent to be enrolled in the study were entered into the computer database for selection. After HIV-1 and HTLV-I infection screenings were done, all HTLV-I positive persons and randomly selected

HTLV-I negative controls, all free of HIV-1, matched by age (± 5 years), gender and timing of donation (± 3 months) were enrolled at the case: control ratio of 2:1. All enrolled subjects were then invited to a central clinic and provided demographic data, as well as comprehensive past and present medical history by questionnaire and underwent physical examination, urinalysis and electrocardiogram. Information on ethnicity was ascertained from the answer to the question: "What is your ethnic background (or race)?" Subjects chose from one of the following – Black, White, Chinese, other Asian (specify), East Indian, mixed (specify), and other (specify). Blood samples were obtained for complete blood count and differential by venepuncture using EDTA tubes which were kept at room temperature until assay within two hours. The complete blood count was performed on an automatic counter (Coulter Electronic Counter) and differential WBC counts were done by the Haematology Laboratory staff at the University Hospital of the West Indies by counting 100 cells on slides.

Serum was analyzed for electrolytes, urea, creatinine, alkaline phosphatase, γ -glutamyl transferase, aspartate aminotransferase, uric acid, calcium, phosphorus and C-reactive protein. Confidentiality was assured by assigning anonymous identification codes to each participant. Ethical approval was obtained from the ethical committees of the University of the West Indies and the National Institutes of Health, and informed consent was obtained from all participants. Persons found to have abnormal examination findings or abnormal laboratory results were referred appropriately for further investigation and excluded from the analysis.

Study Participants

Between June 2001 and June 2006, blood donors 17–61 years of age were enrolled in the study. For the purpose of this analysis, records of the total and differential WBC were obtained for 333 HTLV-I negative participants. Ages of the HTLV-I-negative participants ranged from 18–61 years and all subjects indicated that they were of African descent, by selecting "Black" or "mixed" (including Black) as their ethnic category. There were initially 333 participants; 143 participants were eliminated as a result of current illness, history of chronic illness, abnormal examination findings or abnormal laboratory results (Table 1), as these may be associated with inflammatory conditions that may affect WBC counts and differentials. The WBC counts and differential of the remaining 190 were then utilized for this analysis.

Statistical Methods

Distribution of the total WBC count and differential were skewed and therefore these variables were transformed using natural logarithms to approximate normality. The geometric mean and 95% confidence intervals (CI) were derived for the total WBC count and absolute counts of neutrophils, lym-

Table 1: Reasons for exclusion from the white blood cell analysis

Criteria	Number of persons
CRP > 0.5 mg/dL	38
Anaemia	52
Eosinophilia	16
Reactive lymphocytes (8%)	1
Toxic neutrophils	1
Elevated PSA	1
Elevated CPK	1
Elevated LDH	11
Significant proteinuria	1
Asthma	3
Seizure disorder	1
Conjunctivitis	2
Pregnant or postpartum	2
Elevated creatinine	8
Elevated bilirubin (76 and 77 µmol/L)	2
Haematuria	2
Rheumatoid arthritis	1
Total	143

Anaemia in excluded subjects – Haemoglobin < 13g/dl or PCV < 39 L/L in males
 Haemoglobin < 11.5 g/dl or PCV < 35 L/L in females
 Hypochromic/ microcytic film
 Vitamin B₁₂ deficiency
 Eosinophilia – eosinophils >0.5 x 10⁹/L
 Elevated PSA – > 4 µg/L
 Elevated CPK – > 240 u/L in males, >170 u/L in females
 Elevated LDH – > 200 U/L
 Elevated creatinine – > 124 µmol/L

phocytes, monocytes and eosinophils. T-tests were done to compare log transformed means. All statistical significance was based on two-sided tests at alpha level of $p < 0.05$.

RESULTS

There were 125 men of mean (standard deviation (SD) age of 35.6 (9.9) years and 65 women of mean (SD) age 37.3 (12.1) years who were eligible for analysis. The untransformed total WBC ranged from 2.3 to 9.4 x 10⁹/L for men and from 3.0 to 11.4 x 10⁹/L for women. The median percentages of neutrophils and lymphocytes respectively were 50% and 39% in men and 49% and 40% in women.

Table 2: Geometric mean x 10⁹/L (95% confidence interval) for total and differential white cell counts in 190 healthy Jamaican adults

	Men n = 125	Women n = 65	
	Geometric mean x 10 ⁹ /L (95% confidence interval)		p-value
WBC count	5.0 (4.8–5.2)	5.6 (5.1–6.0)	0.02
Neutrophils	2.4 (2.2–2.8)	2.7 (2.5–3.1)	0.04
Lymphocytes	1.9 (1.8–2.0)	2.1 (1.9–2.3)	0.07
Monocytes	0.31 (0.28–0.35)	0.28 (0.25–0.33)	0.23
Eosinophils	0.16 (0.14–0.18)	0.16 (0.14–0.19)	0.96

The geometric mean for the WBC count was found to be 5.0 x 10⁹/L for men, with a higher mean of 5.6 x 10⁹/L for women. The difference was significant ($p = 0.02$). Neutrophil and lymphocyte counts were also significantly higher in women (Table 2). The 5% centile for WBC counts for men and women were 2.5 x 10⁹/L and 3.3 x 10⁹/L respectively, while those for the neutrophil counts were 0.9 x 10⁹/L and 1.1 x 10⁹/L. (Table 3)

Overall, 14% of participants had a neutrophil count below 1.7 X 10⁹/L. For men this was 15% and for women 12%.

Table 3: Geometric mean x 10⁹/L (95% CI) for total and differential white blood cell counts in Caucasian, African, Afro-Caribbean and geometric mean x 10⁹/L (5–95% centile range) in Jamaican men and women

	Geometric mean x 10 ⁹ /L (95% CI or 5–95% centile range)			
	Caucasian	African	Afro-Caribbean	Jamaican*
Men				
WBC count	5.7 (3.6–9.2)	4.5 (2.8–7.2)	5.2 (2.8–9.5)	5.0 (2.5–8.8)
Neutrophil	3.2 (1.7–6.1)	1.95 (0.9–4.2)	2.5 (1.0–5.8)	2.4 (0.9–6.8)
Lymphocyte	1.7 (1.0–2.9)	1.8 (1.0–3.2)	1.9 (1.0–3.6)	1.9 (0.6–3.7)
Monocyte	0.34 (0.18–0.62)	0.29 (0.15–0.58)	0.33 (0.18–0.58)	0.31 (0–0.8)
Eosinophil	0.12 (0.03–0.48)	0.12 (0.02–0.79)	0.13 (0.03–0.59)	0.16 (0–0.5)
Women				
WBC count	6.2 (3.5–10.8)	5.0 (3.2–7.8)	5.7 (3.3–9.85)	5.6 (3.3–11.0)
Neutrophil	3.6 (1.7–7.5)	2.4 (1.3–4.2)	3.0 (1.4–6.5)	2.7 (1.1–7.4)
Lymphocyte	1.8 (0.95–3.5)	2.0 (1.1–3.6)	2.0 (1.2–3.4)	2.1 (1.0–4.3)
Monocyte	0.30 (0.14–0.61)	0.28 (0.15–0.39)	0.31 (0.16–0.59)	0.28 (0.1–0.9)
Eosinophil	0.13 (0.04–0.44)	0.10 (0.02–0.41)	0.10 (0.03–0.33)	0.16 (0–0.4)

Data for Caucasian, African and Afro-Caribbean populations taken from: Bain BJ. Ethnic and sex differences in the total and differential white cell count and platelet count. J Clin Pathol 1996 pg.665

Table 1

*5–95 percentile range

DISCUSSION

The results of the Jamaican study were compared to results of a previous study, conducted in London, comparing Caucasians, Africans and Afro-Caribbeans (3) (Table 3). In that study, venous blood was obtained from 417 adult volunteers including Caucasian, African and Afro-Caribbean persons. The present study, with 190 Jamaicans, is almost twice as large as their Afro-Caribbean group which comprised 102 persons. The results showed that Africans and Afro-Caribbeans had lower WBC and neutrophil counts than Caucasians, with Africans having lower counts than Afro-Caribbeans.

The results of the present study confirm these findings. The larger sample size in this study has led to narrow 95% CIs. Hence the 5% to 95% centile range was used to compare findings of the present study with that of the study by Bain (Table 3).

In the present study, the 5% to 95% centile range for WBC for men was comparable to the 95% CI for the Afro-Caribbean group though slightly lower with the geometric mean falling between the African and Afro-Caribbean values. The geometric mean for neutrophils was comparable to the Afro-Caribbean group for men though the 5% to 95% centile range was wider in the study. For women, the geometric mean for WBC and neutrophils fell between African and Afro-Caribbean values, while again the 5% to 95% centile ranges were wider.

The findings of this study of Jamaican adults is in keeping with the results of previous studies which showed that persons of African descent had lower total WBC and neutrophil counts compared with Caucasians (4, 5, 10–12). The consistency of this finding across a diversity of geographic locations suggests that this difference may have a genetic basis and that environmental factors have minimal impact (7, 11, 13, 14). The values we obtained for Jamaicans corresponded closely with those previously obtained for Afro-Caribbean people, falling between those of Caucasians and Africans. This is likely to be a result of ethnic mixing between Caucasians and Africans in the Caribbean region.

The participants in this study were voluntary blood donors from the general population and their health status was rigorously evaluated by clinical history, examination and laboratory tests, in contrast to many published studies of normal white blood cell counts where the subjects were drawn from a single institution or occupational group and health status was ascertained by self-report. The reference ranges obtained are therefore likely to be representative of healthy Jamaican adults. It was noted however that the HTLV-I negative subjects who were excluded from the analysis were similar to those used to derive reference ranges with respect to mean age ($p = 0.59$) and total WBC ($p = 0.74$).

The subjects were recruited in an urban area; however, approximately 50% of the Jamaican population is urban so this is unlikely to affect the validity of the results. The ethnic

origin of the subjects was ascertained by self-report but the Jamaican population is more than 90% of African descent so misclassification is unlikely to be major. The sample size was comparable to that of previous studies examining normal values for total and differential white cell counts. This study did not address normal ranges for total and differential white cell counts in childhood or in the elderly, and therefore further studies are needed to provide normal ranges for these age groups in the Jamaican and similar populations.

The lower limit in the 95% reference range for neutrophil counts for male Caucasians is $1.7 \times 10^9/L$. Our results show that about 14% of the Jamaican population would fall into the "neutropenic" range if reference ranges from the Caucasian population are inappropriately applied. In fact, Caucasian reference ranges are utilized by the majority of clinical laboratories in Jamaica, resulting in many unnecessary referrals for investigation of "neutropenia". This causes unnecessary anxiety and expense, wasting of health-care resources and unwarranted denial of employment and insurance coverage. In addition, a clinically relevant neutrophil leucocytosis can be overlooked if Caucasian reference ranges are employed. We recommend that the reference ranges obtained in our study be used for the interpretation of white cell counts in healthy Jamaicans and other Afro-Caribbean adults.

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