Leukocyte Counts in 7,739 Healthy Black Persons: Effects of Age and Sex*

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ABSTRACT

White blood cell counts (WBC) were measured in 7,739 healthy black individuals, ages one through 84 years, to determine normal values for different age and sex groups. The mean WBC was highest in children one to two years of age, regardless of sex. The mean count decreased progressively in both males and females during preschool years, reaching a nadir in females six to 10 years of age and in males 11 to 15 years of age. Females in the age groups 11 to 15, 16 to 20, 21 to 30, and 31 to 40 years had consistently higher mean WBC than males in the same groups (p < 0.001, p < 0.001, p < 0.001, and p = 0.01, respectively). These differences may be ultimately related to hormonal physiology during the reproductive years, since they were not present in the older age categories (41 to 50, 51 to 60, and over 60 years). In both males and females over 60 years of age, the mean WBC was lower than in the 21 to 50 years age group. The mean and percentile values for each age and sex group from this large, healthy, non-institutionalized population can be used as a reference for normal WBC in black subjects.

Introduction

Several studies have established that leukocyte counts in black individuals are lower than whites.\textsuperscript{2,3,5,9} However, the normal limits in different age and sex groups for blacks have not been defined. Results are reported of an analysis of leukocyte counts in 7,739 apparently healthy, non-institutionalized black persons ages one through 84 years of whom 3,393 were males and 4,346 females. All were presumably healthy individuals who requested sickle cell screening from a mobile health laboratory operating in the metropolitan Washington area.\textsuperscript{4}

For the purpose of this survey, black persons were individuals who presented themselves or their children for sickle cell screening after receiving information about the racially-related risks of carrying the sickle cell gene.
Methods

The prevalence of sickle cell trait found in the population was 7.3 percent. The investigation was carried out from 1977 through 1980. All tests were performed between 9:00 a.m. and 4:00 p.m. The subjects were not required to fast prior to the procedure. Heparinized capillary blood was collected by finger-stick and analyzed using an electronic blood cell counter* in the mobile unit. The cell counter was calibrated each day using commercial standards according to the manufacturer’s instructions. The coefficient of variation for WBC was measured twice by the electronic counter and found to be 1.5 and 2.7 percent, respectively.

The original data base included 7,783 individuals. Forty-four values (0.57 percent) were deleted because they were clearly abnormal or because the subjects had a major hemoglobinopathy. Statistical analysis was performed using a computer† and a standard statistical (SAS) software package. The significance of differences between the mean values was determined by student’s ‘t’ test.

Results

In table I are listed the mean and percentile values for leukocyte count (WBC) according to age and sex in the study population. The highest mean WBC was found in the one to two years age group in both males and females (7.86 × 10⁹ per L and 7.87 × 10⁹ per L, respectively). In male children, the mean WBC decreased progressively until a nadir of 5.97 × 10⁹ per L was reached in the 11 to 15 years age group. Thereafter, a gradual increase in the counts was observed which continued through the 51 to 60 years age group (6.93 × 10⁹ per L). In males over 60 years of age, the mean WBC then declined to 6.23 × 10⁹ per L.

In female children, an age related decline in WBC was also noted. The lowest mean count in girls was found in the six to 10 years age group (6.43 × 10⁹ per L). Girls three and four years of age had significantly higher mean WBC than boys in the same age group (p < 0.05). Females in the age group 11 to 15, 16 to 20, 21 to 30, and 31 to 40 also had higher mean WBC than males in the corresponding age groups (p < 0.001, p < 0.001, p < 0.001, and p = 0.01). No significant differences in WBC were found between males and females in the older age groups (over 40 years). In both males and females over the age of 60, the mean WBC was lower than in their counterparts in the 21 to 50 years age groups. In females this difference was significant (p < 0.001), but in males the p value was between 0.05 and 0.1.

Discussion

Although a number of studies have shown lower leukocyte counts in black than in white populations,²,³,⁵ this difference has not been a consistent finding.¹⁰ Recently, the second National Health and Nutrition Examination Survey (NHANES II) demonstrated that in all age groups black persons had lower mean WBC than white persons.⁸ The differences ranged from 0.6 to 1.3 × 10⁹ per L among males and 0.2 to 1.4 × 10⁹ per L among females. These findings clearly suggest the need for separate reference values for WBC for black populations. The data are offered from our large population sample as a reference for normal WBC in healthy ambulatory black individuals. The distribution of WBC values in each age and sex group did not follow a perfect gaussian curve. In most subgroups, the distribution was skewed because of the presence of indi-

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* JTB 700, J. T. Baker Instrument Division, Milford, CT.
† IBM 370 computer.
LEUKOCYTE COUNTS IN HEALTHY BLACK PERSONS

TABLE I

Leukocyte Count (x 10⁹ per L) in 7,739 Healthy Black Persons

<table>
<thead>
<tr>
<th>Age Years</th>
<th>Males</th>
<th>Females</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD+</td>
</tr>
<tr>
<td>1 - 2</td>
<td>7.00</td>
<td>2.68</td>
</tr>
<tr>
<td>3</td>
<td>7.06</td>
<td>2.13</td>
</tr>
<tr>
<td>4</td>
<td>6.86</td>
<td>1.79</td>
</tr>
<tr>
<td>5</td>
<td>6.85</td>
<td>1.78</td>
</tr>
<tr>
<td>6-10</td>
<td>6.60</td>
<td>2.00</td>
</tr>
<tr>
<td>11-15</td>
<td>5.97</td>
<td>1.56</td>
</tr>
<tr>
<td>16-20</td>
<td>6.53</td>
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<td>21-30</td>
<td>6.72</td>
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<td>51-60</td>
<td>6.88</td>
<td>1.99</td>
</tr>
<tr>
<td>&gt;60</td>
<td>6.23</td>
<td>1.51</td>
</tr>
</tbody>
</table>

SD+ = Standard deviation
P* = Percentile

Individuals with higher values. The variation in parameters such as the leukocyte count in any population is a consequence of complex biological, genetic and environmental factors.

To the best of our knowledge, the normal ranges of WBC in white populations are based on data with similar distribution. For example, the NHANES II data on WBC in approximately 15,500 individuals (all races) was also skewed to the right in all age and sex groups. At times, when the frequency distribution is obviously non-gaussian, manipulations of the data, such as logarithmic transformation, result in a distribution that approximates normal. No such transformations were attempted since nonparametric techniques, such as the use of percentiles adequately, describe the distribution for clinical purposes.¹³

A number of statistical significant differences in mean WBC were found between various age and sex groups. It is possible to speculate on the reason for these differences. For example, the WBC in the preschool and school years was found to be lower than in the one to two years age group. This may be related to a lower incidence of upper respiratory tract infections in the older children. Also, females in the 11 to 40 years age groups had significantly higher mean WBC than males of the same age. Pregnancy is known to increase the WBC,⁶¹¹ and pregnant females were not excluded from this study. However, the present authors do not believe that inclusion of pregnant subjects alone was responsible for the higher WBC in females. This sex related difference in WBC has been described in a European population study that excluded pregnant women.¹

The subjects over 60 years of age had lower mean WBC than younger individuals. This difference has also been described in white populations.¹² Recently Lipschitz et al have provided laboratory evidence for an overall decrease in hematopoiesis associated with aging; this may be responsible for lower WBC in older persons.⁷ The clinical significance of these age and sex related variations in leukocyte count remains to be determined. However, the percentile values reported here are helpful in establishing the criteria for leukopenia in black populations.

References


