

Biological Reference Range for Total Leucocyte Count and Its Correlation with BMI among Adult Population of a Tertiary Care Teaching Hospital

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ABSTRACT

BACKGROUND

Appropriate reference intervals for total leucocyte count (TLC) and differential leucocyte (DLC) are needed for the diagnosis, management, follow up, and screening of various disease conditions. The aim of the study was to establish the reference ranges for WBC and DLC in South Indian population.

METHODS

100 healthy adults of the age group 18-22 years were enrolled in the study. Total WBC was counted manually with help of improved Neubauer's double counting chamber. Peripheral blood smear was prepared to find out the differential leucocyte count.

RESULTS

The present study showed that mean total leucocyte count with reference range in this population was $7.296 \times 10^9/L$ ($10.879 \times 10^9/L - 3.712 \times 10^9/L$). Differential leucocyte count among this population showed 58.8% percentage neutrophils and 34.4% lymphocytes. A trend of positive correlation between BMI and total leucocyte count ($r = 0.11$, p value 0.29, 95% confidence interval -0.09 to 0.29) was noted among this study population.

CONCLUSIONS

The present study concluded that the mean total leucocyte count with reference range was $7.296 \times 10^9/L$ ($10.879 \times 10^9/L - 3.712 \times 10^9/L$). A positive correlation was noted between BMI and total leucocyte count ($r = 0.11$, p value 0.29, 95% confidence interval -0.09 to 0.29) in this study population. Further studies must be done in a larger population to establish biological reference value based on BMI and gender in order to increase the quality of test parameters.

KEYWORDS

Reference Range, Leucocyte Count, BMI

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BACKGROUND

Interpretation of haematological parameters is mainly based on the reference interval obtained from a data base.^{1,2} Reference intervals (RI) act as a guide to interpret laboratory results. There are several factors that influence reference intervals like age, sex, ethnicity, body mass index (BMI), race, dietary habits etc.^{3,4,5} Appropriate reference intervals are needed for the diagnosis, management, follow up and screening. Inappropriate RI can lead to failure of identifying patients and their subsequent treatment.⁶ Therefore, reference values specific for each population needs to be established. This will help to increase the quality of test parameters. There are several studies done in other population to establish a reference range for haematological parameters.⁷⁻¹⁰ But limited studies were done in Indian population.

The aim of the present study was to establish a biological reference range of total leucocyte count (TLC) and differential leucocyte count (DLC) calculated for adult population in a tertiary care teaching Hospital in Kerala, South India.

METHODS

One hundred healthy adults in the age group 18-22 years were enrolled in the study after getting their informed consent. This study was conducted in the department of Physiology, Amala Institute of Medical Sciences, Thrissur, Kerala. Those students who are suffering from acute and chronic infections, anaemia, haemostatic disorders were excluded from the study. Anthropometric measurements like height (meters) and weight (Kg) were taken. Under aseptic precautions, left middle finger was pricked, wiped out the first drop and the second drop was pipetted in the WBC pipette, immediately followed by the WBC diluting fluid and kept for 2-3 minutes after mixing. Total WBC was counted manually with help of improved Neubauer's double counting chamber under low power lens of a compound microscope. A peripheral blood smear was prepared, stained using Leishman's stain and different types of leucocytes were counted manually.¹¹ Bleeding time was done using the Duke's method by mopping the blood on a filter paper after a sufficiently deep prick with the sterile lancet on the middle finger. Mopping of blood was repeated every 30 seconds from the onset of bleeding till it stops. The reading was taken in seconds. Clotting time was done using the Wright's capillary tube method after making a sufficiently deep finger prick.¹² The blood drop was transferred immediately to the capillary tube by touching it in tilted down position. The capillary tube was filled almost two third and time was noted from the onset of bleeding till the formation of fibrin thread.

Statistical Analysis

Anthropometric parameters were expressed in mean \pm SD. Upper and lower limit of reference interval was calculated from mean, SD and sample size using the formula given below.

$$\text{Lower Limit} = m - t_{0.975,11} \times \sqrt{\frac{n+1}{n}} \times s.d$$

$$\text{Upper Limit} = m + t_{0.975,11} \times \sqrt{\frac{n+1}{n}} \times s.d$$

RESULTS

The mean age of the study population was 19.32 ± 0.85 years. The mean BMI (Kg/m^2) obtained from height and weight of the study group was 22.16 ± 3.47 . Anthropometric parameters of the study population were given in the table 1. The mean with reference range for total leucocyte count (cells/L) was $7.296 \times 10^9/\text{L}$ ($10.879 \times 10^9/\text{L} - 3.712 \times 10^9/\text{L}$). The mean percentage of neutrophils and lymphocytes were 58.83%, 34.4% respectively and the mean percentage of the types of leucocytes is given in the table 2. The mean with the reference range for neutrophils, lymphocyte and monocyte were $4.292 \times 10^9/\text{L}$ ($4.509 \times 10^9/\text{L} - 4.075 \times 10^9/\text{L}$), $2.509 \times 10^9/\text{L}$ ($2.768 \times 10^9/\text{L} - 2.250 \times 10^9/\text{L}$) and $0.345 \times 10^9/\text{L}$ ($0.430 \times 10^9/\text{L} - 0.260 \times 10^9/\text{L}$), respectively. The mean eosinophil count and basophil count were $0.123 \times 10^9/\text{L}$ and $0.002 \times 10^9/\text{L}$ respectively. The mean bleeding time and clotting time of the study population in minutes with their reference range were 1.24 (1.95 - 0.54) and 2.10 (2.63 - 1.58) respectively. The details of the same were represented in the table 3. This study also noted a positive correlation between BMI and TLC ($r = 0.11$, p value 0.29, 95% confidence interval -0.09 to 0.29), which is given in the figure 1.

Parameter	Mean	SD
Age (years)	19.35	0.85
Height (m)	1.63	0.10
Weight (Kg)	59.08	11.64
BMI (Kg/m^2)	22.16	3.47

Table 1. Anthropometric Parameters of the Study Population

Type of WBC	Mean (% Distribution of Cells)	SD
Neutrophil	58.83	6.06
Lymphocyte	34.40	7.22
Monocyte	4.74	2.35
Eosinophil	1.69	1.49
Basophil	0.03	0.17

Table 2. Percentage Distribution of WBCs in the Study Population

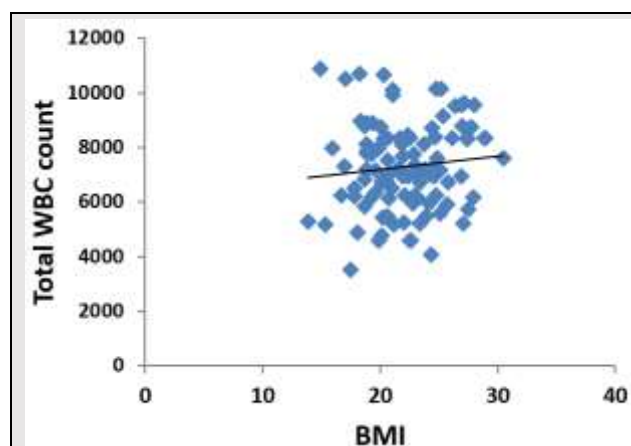


Figure 1. Correlation between BMI and Total Count

Cell Count (x10 ⁹ /L)	Mean	Upper Limit	Lower Limit
Total WBC	7.296	10.878	3.712
Neutrophil	4.292	4.509	4.075
Lymphocyte	2.509	2.768	2.250
Monocyte	0.345	0.430	0.260
Eosinophil	0.123	0.176	0.069
Basophil	0.002	0.008	0.00
Bleeding time (min)	1.24	1.95	0.54
Clotting time (min)	2.10	2.63	1.58

Table 3. Mean and Reference Range (Upper Limit and Lower Limit) of White Blood Cells, Bleeding Time and Clotting Time

DISCUSSION

The present study showed that the mean total leucocyte count with reference range was $7.296 \times 10^9/L$ ($10.879 \times 10^9/L - 3.712 \times 10^9/L$). The international range¹³ for total leucocyte count was $7.0 \pm 3.07.29 \times 10^9/L$. According to a study done among male healthy adults among eastern India,¹⁴ the mean and SD of total leucocyte count obtained was $7.21 \times 10^9/L \pm 3.43 \times 10^9/L$. The total leucocyte count obtained in this study population seems to be in accordance with the international standards as well as other study done in India. According to the study done in Sudanese population,¹⁵ the mean TLC, neutrophil and leucocyte count were $5.103 \times 10^9/L$, $2.43 \times 10^9/L$, and $2.116 \times 10^9/L$ respectively. This is lower compared to the Indian population, which implies that race is one of the factors that contribute to variation in total leucocyte count. Changes in genetic, dietary and environmental factors also could contribute to the same.^{16,17} Differential leucocyte count (DLC) among this population showed 58.8% percentage neutrophils and 34.4% lymphocytes. The study done among Sudanese population¹⁵ showed 47% of neutrophils and 41.1% of lymphocytes. Other studies done by Badenhorst et al,¹⁸ Sahr et al¹⁹ and Shaper et al¹⁷ have also shown a lower neutrophil count in black African and American population. Mechanism of this variation in DLC among different population remains unclear. Further studies among a bigger sample size will be needed to establish the reference range of total leucocyte count as well as DLC among males and females. The bleeding time (BT) of the study group was lower than the normal universal range of 2-10 min. The present study is in accordance with the study done in West of Iran²⁰ which showed a mean BT of 2.79 min with the range 1.23-4.35 min. This could be due to the fact that bleeding time depends on factors such as platelet count, temperature, race, diet etc.^{21,22} Similarly the clotting time of the study population was also lower than the universal range. It is important to know about the reference range of bleeding time and clotting time in a population, since it has an important in adjusting the dose of anti-platelets and anticoagulants respectively.

A trend of positive correlation between BMI and total leucocyte count ($r = 0.11$, p value 0.29, 95% confidence interval -0.09 to 0.29) was noted among this study population. Similar observation was seen in studies done by Taha et al,¹⁵ Tenorio et al²³ Jamshidi et al²⁴ done among subjects of non-obese as well as obese subjects. Further

studies need to be done in a larger population of different BMI to prove the same in our population.

CONCLUSIONS

The present study showed that the mean total leucocyte count with reference range was $7.296 \times 10^9/L$ ($3.712 \times 10^9/L - 10.879 \times 10^9/L$). A positive correlation between BMI and total leucocyte count ($r = 0.11$, p value 0.29, 95% confidence interval -0.09 to 0.29) was noted in this study population and further studies must be done in larger population of different BMI to prove the same.

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