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Normal range of white blood cells among Sudanese in Wad-Medani, Gezira state, Sudan “2015 to 2022”

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Abstract

Introduction: The white blood cells (WBCs) count is a crucial parameter used to assess the immune system's function and diagnose various diseases, including infections, autoimmune disorders and certain types of cancers. Appropriate local reference values for hematological parameters are important for diagnosis, treatment, follow up and screening. It is well noticed by practicing medical personnel for many years that, WBCs count in Sudanese patients is much lower than standard references for the rest of the world. SO knowing the baseline values of WBCs in the Sudanese population is essential. Therefore, this study aimed to determine the normal range of WBCs among Sudanese people in Wad-Medani, Gezira state, Sudan.

Method and material: Retrospective descriptive cross-sectional study was conducted to patients attending Dr. Ahmed A. Adam private clinic in Wad-Medani city. Sample was selected from medical records from 2015 to 2022 and 1st of August to 2nd of November 2023, by trained medical students in the period from the 1st of August to the 2nd of November 2023. Semi-structured questionnaire containing personal data and other information related to health status was obtained from medical records.

Result: A total of 673 healthy participants were included, 357 males (53%) and 316 females (47), with age range between 14 to 100 years. The mean \pm SD of WBCs count for the Sudanese population in the study in Wad-Madani state was $6.04 \pm 1.31 \times 10^3 / \mu\text{l}$

Conclusion: The results of this study showed that normal WBCs Count of Sudanese people was similar to WBCs count in African countries but was less than the international count.

Keywords: Normal range; White blood cells count; Sudanese; Gezira state; Sudan

1. Introduction

The white blood cells (WBCs) count is a crucial parameter used to assess the immune system's function and diagnose various diseases, including infections, autoimmune disorders, and certain types of cancers. Appropriate local reference values for hematological parameters are important for diagnosis, treatment, follow-up, and screening of patients. Understanding the baseline values of WBCs in the Sudanese population is essential for accurate medical assessment and management. The WBC count varies significantly among different populations due to genetic, environmental, ethnic, geographical, and lifestyle factors. For instance, a study in Ethiopia highlighted the necessity of regional reference values

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for accurate clinical interpretations [1]. Sudan, located in northeastern Africa, has a diverse population with unique genetic characteristics and varying environmental conditions. Therefore, studying the normal WBC count in Sudan can provide valuable insights into the health status of its population and aid in establishing appropriate reference ranges for clinical diagnosis. Considering Sudan's high burden of infectious diseases such as malaria and tuberculosis, establishing reliable reference ranges for WBC counts becomes even more critical. The lack of appropriate hematological reference ranges may cause unnecessary additional investigations, treatment, and mismanagement of patients. The reference values currently used in Africa and Asia are often derived from data collected from populations in developed countries, which may not be applicable in regional settings [2]. Recent studies conducted in Asian and African countries have demonstrated lower hematological parameters compared to those from populations in developed countries [3, 4]. Another study found that neutropenia is a normal, genetically determined characteristic of many indigenous African peoples [5].

In Sudan, studies have shown varying results regarding WBC counts. For instance, a study in Algezira state found no significant difference between Sudanese people and universal reference values [6], while a study in Khartoum state reported significantly higher mean WBC counts compared to other African countries [7]. This discrepancy underscores the need for localized reference ranges. Moreover, research from Ghana emphasized the impact of local environmental and genetic factors on hematological parameters, indicating that such factors must be considered when interpreting WBC counts [3]. Similarly, a study in Togo established regional hematological reference values, which differed from international standards [8]. These findings are consistent with those from other African regions, where hematological parameters, including WBC counts, have been found to be generally lower than those in developed countries [9, 10, 11]. This study aims to determine the normal range of WBCs among Sudanese people in Wad-Medani, Gezira state, Sudan, from 2015 to 2022. By establishing these reference ranges, we hope to improve the accuracy of laboratory results interpretation and enhance patient management in Sudan.

Understanding the variations in WBC counts across different populations is critical for accurate diagnosis and treatment. Studies have demonstrated significant differences in hematological parameters based on ethnicity, geography, and other demographic factors.

1.1 Variations in WBCs

1.1.1 Ethnic and Regional Differences

- Olawumi et al. (2014) conducted a study in Nigeria and found that the mean WBC count among healthy adults was significantly lower than that of Caucasian populations, suggesting that ethnic and regional factors play a significant role in determining WBC counts [12].
- Tsegaye et al. (1999) reported similar findings in Ethiopia, where the WBC counts were lower compared to Western countries [13].

1.1.2 Impact of Infectious Diseases

- The prevalence of infectious diseases such as malaria, tuberculosis, and HIV/AIDS in many African countries, including Sudan, can significantly affect WBC counts. Chronic infections often lead to immunosuppression, which can lower WBC counts [12].
- Research has shown that individuals living in regions with high infection rates typically have lower baseline WBC counts, reflecting the body's ongoing response to chronic infections.

1.1.3 Genetic Factors

- Genetic conditions prevalent in the African population, such as sickle cell disease and thalassemia, can also influence WBC counts. These genetic disorders are associated with chronic hemolysis and bone marrow stress, which can alter WBC production and turnover [14].

1.1.4 Comparative Studies

- Comparative studies between African countries and Western populations consistently show lower WBC counts in African populations. For example, a study by Wintrobe (1993) highlighted the lower baseline WBC counts in African populations compared to their Western counterparts [15].

1.2 Importance of Local Reference Ranges

Establishing local reference ranges for WBC counts is crucial for accurate medical diagnosis and treatment. Using international reference ranges may lead to misdiagnosis and inappropriate treatment in populations with different baseline values. For instance, using a higher international reference range might result in underdiagnosis of conditions associated with low WBC counts in Sudanese patients.

This literature review underscores the necessity of conducting region-specific studies to establish accurate reference ranges for WBC counts. Such efforts will enhance the precision of medical diagnoses and the effectiveness of treatments tailored to the specific needs of the population

2. Materials and Methods

Retrospective Descriptive Cross-sectional study was conducted to Cases came to Dr. Ahmed A. Adam private clinic at doctor's street opposite to Alshahideen pharmacy in Wad-Medani city, Gezira state, Sudan. Wad- Medani city is the capital of Gezira state and lies in the central region of Sudan around 180 kilometers southern to Khartoum, the capital of Sudan. The population of Gezira state is around 4 million and Wad-Medani city is the main medical centre for Gezira state. Sample was selected from medical records of Dr. Ahmed A. Adam private clinic from 2015 to 2022 and 1st of August to 2nd of November 2023, by trained medical students in the period from the 1st of August to the 2nd of November 2023. Males and females between 14 and 85 years were included in the study. any case less than 14 years, took antibiotic in last month, diagnosed with infectious, inflammatory disease, cancer, hypersplenism or any other condition affects TWBCS count was excluded from the study. Data was collected through Semi-structured questionnaire which included demographic data information (Age, Sex, residence), weight, Hb %, platelet count and TWBCS. All data that reviewed by medical student was written in a paper and then transferred to electronic sheet using Microsoft excel 2016. Out of 20,000 medical records were reviewed by trained medical students, only 720 sample fulfill criteria of selection mentioned above. 47 records were excluded due to incomplete information in the records, this made final sample 673. Data in the electronic sheet was analyzed using SPSS version 22.

2.1 Ethical Consideration

This research was conducted within the ethical supervision of Ministry of Health and Faculty of Medicine, University of Gezira, ethical committee.

3. Results

A total of 673 healthy participants were included, 357 males (53%) and 316 females (47), with age range between 14 to 100 (Table 2).

The mean \pm SD of WBCs count for Sudanese in Wad-Madani state was $6.04 \pm 1.31 \times 10^3 / \mu\text{l}$ comparable (lower than) to international value of $7.5 \times 10^3 / \mu\text{l}$, but comparable to African countries (Table 1). The minimal value was found to be 2.70 and maximal value 9.90

Table 1 Comparison of WBCs values of Sudanese with International values from Caucasians

Parameter	Mean for Sudanese	Mean for International
WBCs count	$6.0497 \times 10^3 / \mu\text{l}$	$7.500 \times 10^3 / \mu\text{l}$
Male WBCs count	$5.9238 \times 10^3 / \mu\text{l}$	$7.500 \times 10^3 / \mu\text{l}$
Female WBCs count	$6.1756 \times 10^3 / \mu\text{l}$	$7.500 \times 10^3 / \mu\text{l}$

Table 2 Percentage of male and female

	Sex	N	Mean
Age	Male	357	53.6863
	Female	316	49.0696

The mean for the WBC count was found to be $5.9238 \times 10^3/\mu\text{l}$ for men, with a higher mean of $6.1756 \times 10^3/\mu\text{l}$ for women. The difference was not significant; but when we compare the mean of WBCs count in Wad Madani state (Sudan) to the International values it is found to be significantly low ($6.0497 \times 10^3/\mu\text{l}$ and $7.500 \times 10^3/\mu\text{l}$ respectively). The WBCs count in Sudanese is similar as those from African countries, but significant lower than the International values.

Table 3 Mean values of other parameters

Sex		Mean
Male	Weight	71.4048
	Haemoglobin	93.9195
	TWBCs	5.9238
	Platelets	259.5014
Female	Weight	66.5298
	Haemoglobin	84.4663
	TWBCs	6.1756
	Platelets	296.0703

4. Discussion

The aim of this study was to establish the reference range of WBC counts in adult Sudanese individuals residing in Wad-Medani, Gezira state, Sudan, between 2015 and 2022. Our findings indicate that the mean WBC count for the Sudanese population in this region is $6.04 \pm 1.31 \times 10^3/\mu\text{l}$, which is significantly lower than the international reference value of $7.5 \times 10^3/\mu\text{l}$ commonly used for Caucasians. This result aligns with several studies conducted in other African populations, which have also reported lower WBC counts compared to those from developed countries. For example, a study conducted in Ethiopia reported similar findings, emphasizing the necessity for regional reference values for accurate clinical interpretations [1]. In Ghana, researchers also noted the impact of local environmental and genetic factors on hematological parameters, suggesting that these factors contribute to the observed differences in WBC counts between African and non-African populations [3]. Additionally, research conducted in Togo established regional hematological reference values that were lower than the international standards, further supporting the need for localized reference ranges [8].

In Sudan, varying results regarding WBC counts have been reported. Abbas et al. found no significant difference between the WBC counts of Sudanese people and universal reference values in Algezira state [6]. However, Eldin et al. reported significantly higher mean WBC counts in Khartoum state compared to other African countries, highlighting regional differences within Sudan itself [9]. These discrepancies underscore the importance of establishing specific reference ranges for different regions to ensure accurate medical assessments.

Furthermore, studies from Nigeria and South Africa have also reported lower WBC counts among their populations compared to international values. Reid and Famodu documented lower serum fibrinogen levels in Nigerians, which can be indicative of lower WBC counts [9]. Similarly, Griesel et al. established reference values for WBC counts in healthy South African adults, which were lower than those used internationally [10].

The lower WBC counts observed in our study and other African populations may be attributed to genetic, dietary, environmental, and lifestyle factors. Shaper and Lewis suggested that genetic neutropenia is a normal characteristic of many indigenous African peoples, which could explain the consistently lower WBC counts observed across various African studies [4]. Additionally, the high prevalence of infectious diseases such as malaria and tuberculosis in Sudan and other African countries may also influence WBC counts, necessitating the establishment of region-specific reference ranges for accurate clinical diagnosis and patient management.

To sum up, our study establishes that the mean WBC count for the Sudanese population in Wad-Medani, Gezira state, is lower than the international reference values but comparable to those of other African countries. These findings highlight the importance of using localized hematological reference values to improve the accuracy of laboratory results and enhance patient management in Sudan. Future research should continue to explore the factors contributing to these differences and validate the established reference ranges in other regions of Sudan.

5. Conclusion

This study determined the reference range of white blood cell (WBC) counts in adults from Wad-Medani, Gezira state, Sudan, between 2015 and 2022. The mean WBC count was found to be $6.04 \pm 1.31 \times 10^3/\mu\text{l}$, lower than the international reference value of $7.5 \times 10^3/\mu\text{l}$, aligning with findings from other African countries. The lower WBC counts are likely due to genetic, environmental, dietary, and lifestyle factors.

Establishing localized reference values is crucial for accurate medical assessment and patient management, as international values may lead to misdiagnosis and inappropriate treatments. The study emphasizes the need for region-specific WBC reference ranges, especially in areas with high infectious disease burdens. Future research should validate these ranges in other Sudanese regions and investigate factors influencing WBC counts.

Overall, this study provides essential baseline data, enhancing clinical practice and patient care in Sudan by promoting the use of localized hematological reference values.

Limitations

- Geographical Scope: Study limited to Wad-Medani, may not represent other regions of Sudan.
- Retrospective Design: Relies on medical records' accuracy, which may affect reliability.
- Exclusion Criteria: Excludes individuals with conditions affecting WBC counts, limiting generalizability.
- Sample Size: May not capture full variability across different demographics.
- Temporal Scope: Data from 2015-2022; changes over time could influence results.
- Comparative Data: Differences in methodologies and population characteristics may affect comparability with other studies.
- Genetic Diversity: Did not account for genetic variations within Sudan's diverse population.

Future research should address these limitations for a more comprehensive understanding and applicability of WBC reference ranges in Sudan.

Compliance with ethical standards

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Disclosure of conflict of interest.

All authors have no conflict of interest

Statement of Ethical Approval

Ethical approval was obtained from Ministry of health and faculty of Medicine, University of Gezira ethical committee.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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