The prevalence of neutropenia among Sudanese in different age groups and genders

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KEYWORDS

leukocyte
neutrophil
neutropenia
prevalence

ABSTRACT:

Introduction: Neutropenia is a benign white blood cells (WBCs) disorder ranges from a normal variant to life-threatening acquired and congenital disorders.

Objectives: The aim of the study is to estimate the prevalence of neutropenia among Sudanese healthy subjects.

Methods: A prospective study was carried out in Khartoum State-Sudan among 300 Sudanese of different genders and age groups. The study was approved by ethical committee from at FMLS-Khartoum University. Venous blood sample was collected, TWBCs and differential counts were performed using Sysmex KX-21 blood analyser.

Results: Neutropenia prevalence was 20% among the enrolled subjects. Moderate neutropenia was detected in 6.7%, while a mild neutropenia was detected in 13.3%. The prevalence in males was 26.6% and in females, it was 13.3%. Furthermore, males had significantly lower mean of ANC (2.2× 109/L) compared to females (2.4× 10^9/L), P < 0.01. Among the age groups over 40 years, the prevalence was 25.3%, in the age group below 40 was 14.6%. In addition, age groups of >40 year had significantly lower mean of ANC (2.2× 109/L) compared to age groups of < 40 year (2.3× 10^9/L), P < 0.03. Neutropenia group had statistically significant lower TWBCs (P < .05) and neutrophil/lymphocyte (N/L) ratio (P < .00001) compared to normal group with ANC (> 1.5 × 10^9/L). A significant positive correlation between the neutropenia and neutrophil/lymphocyte (N/L) ratio was found (r = 0.74, P < .05).

Conclusions: Mild to moderate neutropenia is common among Sudanese residing in Khartoum. This frequency may be attributed to benign ethnic neutropenia

1. Introduction

Neutrophils are the most common type of white blood cells (WBCs) that circulate as granulocytes along the vascular endothelium in peripheral blood vessels. They play a crucial role in the immune system by defending against invading microorganisms. [1] A failure in this function can lead to immunodeficiency, often characterized by recurrent infections. [2] Neutrophil malfunction can be either quantitative, as seen in neutropenia, or qualitative, which refers to neutrophil dysfunction. The lower limit for a normal circulating neutrophil count is 1.5 x 10^9/L; an absolute neutrophil count (ANC) below this threshold is classified as neutropenia.

The severity of neutropenia is categorized based on the risk of infection: mild (ANC of 1 to 1.5 × 10^9/L), moderate (ANC of 0.5 to 1 × 10^9/L), severe (ANC < 0.5 × 10^9/L), and agranulocytosis (ANC < 0.2 x 10^9/L), where there are no precursors of neutrophils in the bone marrow. [3, 4]

Primary neutropenia arises from bone marrow hypoplasia and decreased production of neutrophils. It can be related to chronic benign neutropenia, cyclical neutropenia, or other congenital forms. Secondary neutropenia may result from drug reactions, autoimmune disorders, leukemia, or infections. [5]

Congenital neutropenias are rare, some being life-threatening, including Chediak-Higashi syndrome, leukocyte adhesion deficiency syndromes, and chronic granulomatous disease. [6, 7]

Among Americans, the prevalence of neutropenia is 0.38% in Mexican-Americans, 0.79% in Whites, and 4.5% in Black individuals. [8] Chronic neutropenia occurs in 0.12% to 1.4% of the European population. [9] Inherited neutropenias are more frequent in men than women[10] , while neutropenia induced by autoimmune diseases is more common in women. The prevalence of infection associated with neutropenia is directly proportional to both the ANC and its duration. [11] During routine checks, some healthy individuals are found to have a low ANC (< 1.5 x 10^9/L) that is not linked to any obvious disease burden. [8, 12, 13] This condition is defined as benign neutropenia, or chronic benign neutropenia (CBN) in some contexts. Specific population groups, such as those of African, Middle Eastern, and West Indian descent, often experience benign neutropenia without any distinct phenotype or genotype. [14, 15] This form is known as benign ethnic neutropenia (BEN) [14, 15] , with an estimated prevalence of 10-15% in the general population of Middle Eastern nations. [12]

Chronic neutropenia is typically defined as an ANC < 1.5 × 10^9/L lasting for more than three months. [16-19] The ANC in healthy Asians and Caucasians ranges between 1.5 and 7.0 × 10^9/L. Individuals of African descent may have an ANC < 1.5; a survey in the U.S. found that about 4.5% of black participants had an ANC below this threshold. However, this neutropenia is believed to be due to cyclical fluctuations in neutrophil levels among healthy individuals, though available evidence suggests that these fluctuations may not fully explain the variance. [8, 20, 21]

2. Objectives

The present study aims to provide baseline information regarding the prevalence and spectrum of neutropenia in a large random sample (n = 300) of apparently healthy Sudanese individuals.

3. Methods

A prospective cross-sectional study was conducted in Khartoum State, Sudan, involving 300 Sudanese individuals of varying genders and age groups. Ethical approval for the study was obtained from the Ethical Committee of the Research Review Board at FMLS-Khartoum University (decision No: 13/17/FMLS). Participants were selected from different age groups. Venous blood specimens were collected in K2EDTA tubes, and the complete blood count (CBC) was analyzed using the Sysmex KZ-21 Hematology Analyzer. Data were analyzed using SPSS and Microsoft Office Excel 2010 for Windows, presented in tables and figures. A statistical T-Test for two independent means and the coefficient of variation were applied for analysis.

4. Results

A total of 300 Sudanese participants (150 females and 150 males) were included in the final analysis. The prevalence of neutropenia (absolute neutrophil count [ANC] < 1.5×10^9/L) among the 300 individuals was found to be 20%. Moderate neutropenia, identified by an ANC of 0.5 to 1×10^9/L, was detected in 6.7%, while mild neutropenia, indicated by an ANC of 1 to 1.5×109/L, was present in 13.3%. The prevalence was notably higher in males (26.6%) compared to females (13.3%). Furthermore, males had a significantly lower mean ANC (2.2×10^9/L) than females (2.4 × 10^9/L), with P < 0.01, table-1. When comparing different age groups, participants over 40 years of age exhibited a prevalence of neutropenia of 25.3%, compared to 14.6% in those younger than 40. Additionally, the age group of over 40 years had a significantly lower mean ANC (2.2 × 10^9/L) compared to the group under 40 (2.3 × 10^9/L), with P < 0.03, table-1. The neutropenic group (ANC < 1.5×10^9/L) showed significantly lower total white blood cell counts (P < 0.05), higher absolute lymphocyte counts (P < 00001), and a lower neutrophil/lymphocyte ratio (P < 00001) compared to the group without neutropenia (ANC > 1.5×10^9/L), table-1. A significant positive correlation was found between neutropenia and the neutrophil/lymphocyte ratio (r = 0.74, P < 0.05).

Table1:Comparing WBCs Mean & SD among different groups of the study population.

Variable	Mean (SD)			
	TWBCsX10^9/L	**ANLX10^9/L**	**ALCX10^9/L**	**N/L ratio**
Males (N/150)	5.1 (0.6)	2.2 (0.6)	2.3 (0.6)	1.1 (0.3)
Females (N/150)	5.4 (1.6)	2.4 (0.5)	2.3 (0.6)	1.2 (0.5)
P-value	0.9	0.01	0.37	0.02
Age <40 year (N/150)	5.1 (0.47)	2.3 (0.5)	2.4 (0.6)	1.2 (0.5)
Age >40 year (N/150)	5.3 (10.8)	2.2 (0.6)	2.3 (0.6)	1.1 (0.4)
P-value	0.24	0.03	0.27	0.75
Normal ANC >1.5 X10^9/L (N/240)	5.4 (6.8)	2.5 (0.3)	2.2 (0.4)	1.3 (0.4)
Neutropenia <1.5 X10^9/L (N/60)	4.8 (0.5)	1.2 (0.1)	3.0 (0.6)	0.4 (0.04)
P-value	0.55	< .00001	< .00001	< .00001

Table2: Comparing WBCs mean(SD) of the study populations with others in literature.

Author	**Population**	**TWBCsX10^9/L**		**ANC X10^9/L**		**ALC X10^9/L**	
		Female	Male	Female	Male	Female	Male
Current (2025)	Sudanese	5.4 (1.6)	5.1 (0.6)	2.4 (0.5)	2.2 (0.6)	2.3 (0.6)	2.3 (0.6)
Yassin et al,(2022)	Asian	6.8 (4.4)	7.2 (2.6)	2.5 (1.8)	3.8 (2.1)	2.1 (0.7)	3.4 (3.5)
	African	7.2(4.9)	6.2 (2.2)	2.6 (1.8)	3.2 (1.9)	1.9 (0.6)	3.5 (3.5)
Zhou et al,(2023)	Black	6.8	6.4	3.4	3.1	2.6	2.3
	White	7.4	7.2	4.1	3.9	2.5	2.4
	Mexican American	7.8	7.6	4.3	4.1	2.6	2.5

TWBCs: Total White Blood Cells, ANC: Absolute Neutrophil Count, Absolute Lymphocyte Count

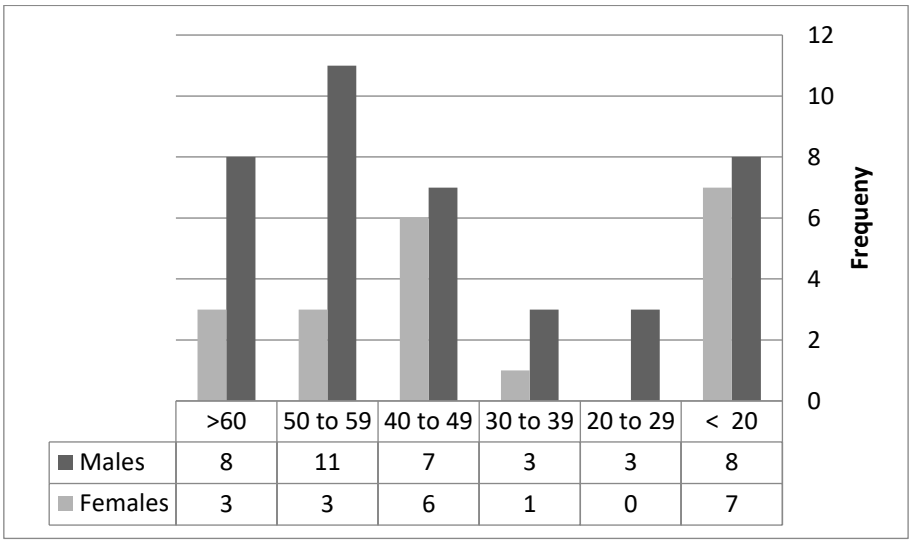

Fig 1: Frequency of Neutropenia (<1.5 X10^9/L) among the study population (N/300)

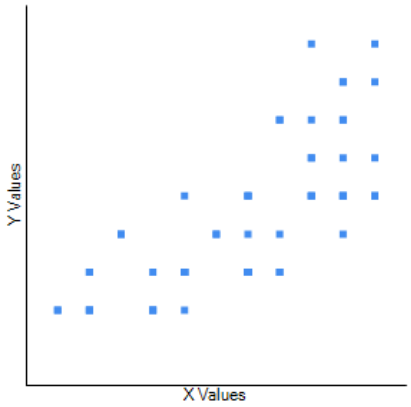

Fig 2: Correlation between neutropenia and N/L (r = 0.74, P < 0.05)

5. Discussion

Worldwide, the prevalence of benign ethnic neutropenia (BEN) is more common in certain endemic areas, although the exact cause of this disorder remains unclear. [12] There is limited data on neutropenia among the Sudanese population. In the present study, we assessed the prevalence of neutropenia (absolute neutrophil count [ANC] < 1.5×10^9/L) in 300 prospective venous blood samples from apparently healthy Sudanese individuals (150 females and 150 males at different age groups), revealing an overall prevalence of 20%. The prevalence was significantly higher in males (26.6%) compared to females (13.3%). Additionally, individuals over 40 years had a higher prevalence (25.3%) than those under 40 years (14.6%). Moderate neutropenia was observed in 6.7% of the samples, while mild neutropenia was noted in 13.3%.

The present findings are consistent with data from some Middle Eastern countries, where a high prevalence of neutropenia has been reported, supporting previously documented prevalence rates of chronic neutropenia in the general population. [12, 22]

Previous reports on the prevalence of neutropenia among Arab populations in the Middle East (including Jordanians, Kuwaiti, Yemeni, and Saudi populations) also align with current study data. [12, 22-27]

For example, a study conducted in Jeddah, Saudi Arabia, by Saif et al., [28] found a prevalence of benign neutropenia at 19.64%, a figure that is close to this study estimate of 20%. In contrast, a study among the Arab population living in Qatar reported a lower prevalence of 10.7%. [29] This study noted that individuals diagnosed with benign neutropenia had significantly lower total white blood cell counts (TWBCs) and differential counts compared to those with normal neutrophil counts. In this study, a decrease in TWBCs and neutrophil counts, along with a significant positive correlation between neutropenia and the neutrophil/lymphocyte ratio were observed, suggesting a common mechanism in regulating white blood cell differentiation. [12]

Numerous studies indicate that ethnicity can impact absolute neutrophil counts [12], and our study found variations in neutropenia prevalence among Sudanese individuals, who are a mix of Afro-Arab populations, compared to the ANC counts of Asian Arabs. Sudanese, as African Arabs, exhibited lower ANC and WBC counts compared to Asian Arab males. Similarly, studies on Western populations, including African Americans and Afro-Caribbean individuals, have revealed that their normal ANC limits are lower than those observed in Caucasians. Furthermore, significant differences in ANC counts have been noted between Saudi and non-Saudi populations, with low ANC reported in Yemenite Jews and certain Arab populations compared to others. [8, 30-36]

Despite this, our study population exhibited a prevalence of neutropenia that was significantly higher than that reported in various ethnic groups within Western populations. For instance, Hsieh et al., [8] reported a prevalence of neutropenia of 4.5% among Black individuals, 0.79% among Whites, and 0.38% among Mexican Americans. Neutrophil counts less than 1.0×10^9/L were found in fewer than 1% of the overall sample (0.57% in Black individuals, 0.11% in Whites, and 0.08% in Mexican Americans). Finding of the present, along with others from the Arabian Peninsula, suggest that Arabs generally have lower ANCs compared to other populations.

Zhou eta l., [37] in a population based analysis of NHANES 2011– 2018 among US residents, they found that Black participants had significantly lower mean leukocyte count and lower neutrophil count compared with white participants after adjusting for age and sex.

The findings of this study revealed a significant variation in absolute neutrophil count (ANC) based on gender. We discovered that neutropenia was notably more prevalent among males (26.6%) than females (13.3%). In Qatar, a retrospective study conducted by Yassin et al., [29] among 600 Arab blood donors reported a 10.7% prevalence of neutropenia, with a significantly higher rate in healthy adult Arab females (32%) compared to males (6%). Similarly, in the UAE, a prospective study of a healthy indigenous population (n = 1032) found a 10.7% prevalence of benign neutropenia (BN). However, unlike our results, this study did not find any statistically significant differences in prevalence between males and females. [12]

Yassin and his colleagues [29] also demonstrated that both neutropenic males and females had significantly lower white blood cell (WBC) counts ($P < .001$) compared to those with normal ANC (greater than 1.5×10^9/L). Their findings aligned with our results (see Table 1).

Furthermore, Hsieh et al., [8] found that the prevalence of neutropenia was higher among males. Their results were consistent with our findings, which indicated a high prevalence of neutropenia among Sudanese males and individuals under 40 years of age, with 75% (40/60) of estimated neutropenia cases occurring in males.

In conclusion, mild to moderate neutropenia is common among Sudanese individuals of different genders and age groups living in central Sudan (the capital, Khartoum). This frequency may be attributed to benign ethnic neutropenia. The clinician should consider the patient's age and gender when evaluating neutropenia.

Limitations of the study:
The sample size and demographic characteristics may restrict the generalizability of our findings to the broader Sudanese population. Moreover, variations in absolute neutrophil counts among Sudanese individuals might be influenced by environmental or lifestyle factors rather than ethnicity alone.

Acknowledgement: Not applicable

Conflict of Interest: No conflict of interest.

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