**Patterns of lymphoma in North Kordofan State of Sudan**

**Abstract:**

**Background:** Lymphoma is a type of cancer that originates in the lymphatic system, which is a crucial part of the body’s immune system. According to the WHO, lymphoma is classified morphologically, immunophenotypically and genetically into Hodgkin lymphoma (HL) and non-Hodgkin lymphoma (NHL). The aim of this study was to assess various patterns of lymphoma types in north Kordofan. **Methodology:** In this retrospective study, we reported the patterns of lymphoma in 125 cases from North Kordofan state to determine the frequency of lymphoma in patients of different age groups and analyze the different sample sites associated with various lymphoma types.

**Results**: Clinical data showedthat our study population consisted of 70 males and 55 females, with an age range from 5 to 90 ~~years~~. 58% were nodular, while 42% were reported as extranodal sites.~~were reported as extra nodal site.~~ The most frequently observed extranodal abdominal site represented 62% of the cases, with skin biopsies following at 13%, all of which involved females. Cases from the nasopharynx made up 6%, all of which were males, while samples from the thyroid and kidneys each constituted 2%. Non-Hodgkin Lymphoma accounted for 89.6% of all histological diagnoses and 10.4% were Hodgkin lymphoma. **Conclusion**: This is the first statistical report of malignant lymphoma patterns in North Kordofan patients. The data suggest that lymphoma is more frequent in males than females; its incidence increases with age. Furthermore, non-Hodgkin lymphoma is more common than Hodgkin lymphoma. Nodal samples was the most frequent sample site.

**Keywords:** Lymphoma, Hodgkin, Non-Hodgkin, North Kordofan, Sudan**.**

**Introduction**

Lymphoma is characterized by the clonal expansion of lymphocytes, accounting for approximately 5% of all cancers. It is anticipated that 72% of individuals will survive overall [1]. Malignant lymphoma is becoming more prevalent and ranks among the ten most common cancers worldwide in terms of incidence [2]. Lymphomas are classified into two primary categories: (1) non-Hodgkin lymphoma (NHL), which includes B cell NHLs, T cell NHLs, and natural killer (NK) -cell NHLs, representing 80–85% of cases; and (2) Hodgkin lymphoma (HL), characterized by the presence of Reed-Sternberg cells, accounting for 10-15% of cases.[3]. Lymphoma typically presents as painless lymphadenopathy. In advanced stages, it may manifest with systemic symptoms such asfever, unexplained weight loss, and night sweats [4]. Diagnosing lymphoma is essential for evaluating its clinical and histological features through molecular and immunological studies, which enhance our understanding of the disease's severity and prognosis. Methods employed for the diagnosis of lymphoma include immunohistochemistry, flow cytometry, cytogenetics, molecular diagnostics, and various biopsy techniques such as excisional, core, and fine needle aspiration, if preferred [5 The available treatment options are as follows: chemotherapy, radiation therapy, and stem cell transplantation.. Biological drugs such as Rituxan (rituximab) and Gazyva (obinutuzumab) improve the immune system's capacity to target and eliminate cancer cells. Drugs for targeted therapy include Specific medications, such as Velcade (bortezomib), inhibit the proliferation of lymphoma cells and surgical intervention [6]. This study investigates the frequency and patterns of lymphoma types in North Kordofan State, based on the WHO classification of lymphoid neoplasms.

**Materials and methods**

This descriptive retrospective study utilized lymphoma data obtained from the El-Obeid Histopathology Center and Kordofan Oncology Center between 2022 to 2024. The study comprised 125 patients, from whom demographic, clinical, and histological data were collected to evaluate lymphoma patterns in North Kordofan Data on patients' identification, clinical, and histological information were collected.

**Statistical Analysis**

Data were initially organized in a spreadsheet and subsequently entered into the Statistical Package for Social Sciences (SPSS version 22, Chicago, USA), analyzed where frequencies, percentages, cross-tabulations, chi-square tests, and relative risks were computed.

**Ethical Approval**Authorization for patient data was obtained from the head of the pathology department at El-Obeid Histopathology Center, NK, Sudan, and the head of Kordofan Oncology Center.

**Ethical Approval**

#### The ethics committee at the Prof. Medical Research Consultancy Center approved the study protocol.

#### Results

#### Our study population consisted of 70 males and 55 females, with an age range from 5 to 90 years..**The majority of male age distribution,** was **between the ages of 21-40 years, followed by the age groups of > 61years ,<20 years, and 41-60years ,comprising 27%, 26%, 24% ,and 23%, respectively.** The age distribution for females was as follows: 41-60 years (40%), 21-40 years (33%), >61 years (14%), and less than 20 years (13%).**.** Most patients with lymphoma were within the age group of 41-60 years, followed by 21-40 years, constituting 30.4% and 29.6% of a total of 125 patients.**.Most patients sample present is nodal (59%) and extra nodal sample (41%) as shown in Table 1. Figure1** and **Figure 2.**

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| **Table1: Distribution of patients by sex, age group, and sample site**. |

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| **Total** | **Females** | **Males** | **Variables** |
|  |  |  | **Age group** |
| 24 | 7 | 17 | <20 years |
| 37 | 18 | 19 | 21- 40 |
| 38 | 22 | 16 | 41-60 |
| 26 | 8 | 18 | >61 |
| 125 | 27 | 40 | **Sample site** |
| 72 | 32 | 40 | Nodal  |
| 51 | 22 | 29 | Extra nodal |
| 123 | 54 | 69 | Total |

**Figure 1: Description of patients by sex, age group, and sample site.**Table 2 and Figure 2 illustrate the distribution of study patients by gender, sample site, and the lymphoma types. Among the 125 patients, 72 (58%) were reported from nodal sites, comprising 43% women and 57% men. Males exhibited a higher frequency in samples obtained from the nodal sample site. An additional nodal sitewas identified, with 53 out of 125 (42%) distributed across abdominal locations, comprising 33 out of 53 (62%). The gender distribution was 64% male and 36% female.
Seven patients were identified, representing 13.2% of the total sample, which included three males (5.6%) and four females (7.4%)The sample consisted of skin biopsy samples. Seven patients, all female, were reported from breast samples, while approximately three male patients had samples from the nasopharynx. There is one patient for each sample: one female with a thyroid condition and one male with nephritic conditions.

The incidence of non-Hodgkin lymphoma is higher in males, with 64 out of 112 cases (57%) compared to 48 out of 112 cases (42.8%) in females. In contrast, Hodgkin lymphoma comprises 53.8% of cases in females and 46.2% of cases in males, as indicated in Table 2 and Figure 2.
**Table 2. Distribution of study patients by gender, sample site, and lymphoma types**.

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| --- | --- | --- | --- |
| **Sample site/Gender** | **Males(n=70)** | **Females(n=55)** | **Total** |
| **Nodal** | 41 | 31 | 72 |
| Abdominal  | 21 | 12 | 33 |
| Skin biopsy | 3 | 4 | 7 |
| Breast  | 0 | 7 | 7 |
| Nasopharyngeal | 3 | 0 | 3 |
| Nephritic | 1 | 0 | 1 |
| Thyroid | 0 | 1 | 1 |
| **Total** | 70 | 55 | 125 |
| **Lymphoma types** |  |  |  |
| Hodgkin | 6 | 7 | 13 |
| Non Hodgkin | 64 | 48 | 112 |
| **Total** | 70 | 55 | 125 |

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**Figure 2: Patient classification by sex, sample site, and lymphoma type.**
Table 3 and Figure 3 illustrate the distribution of patients by the lymphoma type, age group, and sample site. Out of 125 patients with lymphoma, the majority were between the ages of 41-60 years (30.4%), followed by 21-40 years (29.6%), >60 years (21%), and <20 years (19%). Hodgkin lymphoma is most common in individuals under the age of 20, while non-Hodgkin lymphoma is more prevalent in those aged 21 to 40 and 41to 60.
Non-Hodgkin lymphoma patients had a higher rate of samples from nodal sites (68 out of112 or 61%) compared to samples from other sites (44 out of 112 or 39%). The sites where the higher rates were found Included the abdomen (61%), skin biopsy (23%), breast (6%), nasopharynx, nephritic, thyroid, neck, and prostate (all at 1%). Hodgkin lymphoma is found in 4 out of 13 (31%) nodal sites and 9/13 (69%) extranodal sites, including 46% from the abdominal site, 8% from skin biopsies, and 15% from nasopharyngeal and abdominal samples. Table 3, Figure 3, displays the most common extranodalsample for both Hodgkin and non-Hodgkin lymphoma.

**Table 3 shows the distribution of patients by lymphoma type, sample site, and age group.**

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| **Total** | **Non Hodgkin** | **Hodgkin** | **Variables** |
|  | **Age group** |
| 24 | 16 | 8 | <20 years |
| 37 | 35 | 2 | 21- 40 |
| 38 | 35 | 3 | 41-60 |
| 26 | 26 | 0 | >61 |
| 125 | 112 | 13 | Total |
|  | **Sample site** |
| 72 | 68 | 4 | Nodal (L.N) |
| 32 | 26 | 6 |  Abdominal  | Extranodal |
| 8 | 7 | 1 |  Skin biobsy |
| 6 | 6 | 0 |  Breast  |
| 3 | 1 | 2 | Nasopharyngeal |
| 1 | 1 | 0 |  Nephritic |
| 1 | 1 | 0 |  Thyroid |
| 1 | 1 | 0 |  Neck |
| 1 | 1 | 0 |  prostatic |
| 125 | 112 | 13 | Total |

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**Figure 3: Description of patients by lymphoma type, age group, and sample site**.

**Discussion**

Lymphoma is a challengingbut manageable cancer that affects lymphocytes, which are white blood cells that fight infections. Early detection and treatment have led to higher survival rates for lymphoma.. However, in Sudan, due to limited healthcare facilities and persistent violence, a variety of malignancies, including lymphoma, are on the rise because of economic hardship and ongoing conflict. The current study's findings suggest a significantly greater prevalence rate of lymphoma in males than females, with 56% males and 44% females ranging in age from 5 to 90 years. The study reported similar findings, identifying 36,795 lymphoma cases (56.4%) in males and 43.6% in females [7]. Another study discovered that the average risk of lymphoma is higher in men than in women. Men are more likely to develop. Other research, however, suggests that the specific hormonal changes that a woman experiences during pregnancy (and if she receives hormone therapy for menopause) may be associated with a lower risk. Reproductive factors, or biological characteristics that enable reproduction, may explain why men are diagnosed with lymphoma at a higher rate than women.[8]. In this study, non-Hodgkin lymphoma is more prevalent than Hodgkin lymphoma across all age groups. NHL cases are more prevalent in older age groups, especially those over 21, while Hodgkin lymphoma cases are more common in younger individuals (<20 years old). This finding is consistent with previous research, which found that non-Hodgkin lymphoma is more common than Hodgkin lymphoma, with both kinds being slightly more prevalent in men. Although both diseases can be diagnosed at any age, Hodgkin lymphoma is more common in young people aged 15 to 40 and in those over the age of 55. Non-Hodgkin lymphoma is typically diagnosed in adults over the age of 60 [9]. Our study shows that there is a higher rate of lymphoma from the nodal sample site (59%) than from the extranodalsample site (41%). This is based on the non-Hodgkin lymphoma sample from the nodal site (57%), which is higher than the extra-nodal sample (43%), and Hodgkin lymphoma (69% from the nodal site and 31% from the extra-nodal site). This is consistent with the study, which found that the extranodalonset type of HL is rare, with a 5% incidence rate. A much higher percentage of NHLs are found in areas outside of lymph nodes, around 10 to 35% [10]. Other research shows that 25% to 40% of NHL patients also have extranodalnon-Hodgkin lymphoma (ENL). Extra nodal locations (EN-NHL) accounted for 235 (42%) instances [11]. Another study found that extra nodal lymphomas, which account for 30% of lymphomas that do not begin in the bone marrow, spleen, or lymph nodes, have become more common in the last decade. Patients continue to have a poor prognosis even after routine radiation and chemotherapy therapies [12].
**Conclusion:** The study concluded that lymphoma is the most common type of cancer observed in Western Sudan/Kordofan. The study found that males made up the majority of cases, that non-Hodgkin lymphoma was the most common type, and that nodal samples were the most common sample site. A special emphasis should be placed on improving lymphoma diagnosis. Western Sudan requires more comprehensive research.

**References:**

**1.**Jamil A, Mukkamalla SKR. Lymphoma. [Updated 2023 Jul 17]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK560826/>.

**2.** Z. Shen, Z. Tan, L. Ge, Y. Wang, X. Xing, W. Sang, G. Cai,The global burden of lymphoma: estimates from the Global Burden of Disease 2019 study,PublicHealth,Volume226,2024,Pages199206,ISSN00333506,https://doi.org/10.1016/j.puhe.2023.11.023. (<https://www.sciencedirect.com/science/article/pii/S0033350623004535>)

**3.**García- Domínguez, D.J.; Hontecillas-Prieto, L.; Palazón-Carrión, N.; Jiménez-Cortegana, C.; Sánchez-Margalet, V.; de la Cruz-Merino, L. Tumor Immune Microenvironment in Lymphoma: Focus on Epigenetics. Cancers 2022, 14, 1469.https://doi.org/10.3390/ cancers14061469.

4.Lewis WD, Lilly S, Jones KL. Lymphoma: Diagnosis and Treatment. Am Fam Physician. 2020 Jan 1;101(1):34-41. PMID: 31894937.

5. Cho J. Basic immunohistochemistry for lymphoma diagnosis. Blood Res. 2022 Apr 30;57(S1):55-61. doi: 10.5045/br.2022.2022037. PMID: 35483927; PMCID: PMC9057666.

6.Jacob, D.(n.d) Can Lymphoma Be Completely Cured?Medicine Net .retrivedfebrauary 5,2025 from https://www.medicinenet.com/can\_lymphoma\_be\_completely\_cured/article.htm

7. Radkiewicz C, Bruchfeld JB, Weibull CE, Jeppesen ML, Frederiksen H, Lambe M, Jakobsen L, El-Galaly TC, Smedby KE, Wästerlid T. Sex differences in lymphoma incidence and mortality by subtype: A population-based study. Am J Hematol. 2023 Jan;98(1):23-30. doi: 10.1002/ajh.26744. Epub 2022 Oct 10. PMID: 36178436; PMCID: PMC10092431.

8.Gersten, T(medically revied by),and Mwanza, N.(2022, January27).Why are Why Are Men More Likely To Develop Most Lymphomas? My lymphomaTeam.Retrived from https://www.mylymphomateam.com.

9. Adams,M.(2021, January 6). Hodgkin vs. non-Hodgkin lymphoma: What’s the difference? MD Anderson Cancer Center Retrieved fromhttps://www.mdanderson.org.

10.Sorrentino, A., Ferragina, F., Barca, I., Arrotta, A., &Cristofaro, M. G. (2022). Extra-Nodal Lymphomas of the Head and Neck and Oral Cavity: A Retrospective Study. Current Oncology, 29(10), 7189-7197. <https://doi.org/10.3390/curroncol29100566>

11. VeenitaYogi, Om Prakash Singh, PallaviRedhu, Bibin Francis, Middle East Journal of Cancer; October 2019; 10(4): 324-332, https://mejc.sums.ac.ir/article\_45547\_7b7f2a807a7f6b2ed8cc9b92f6cb08dc.pdf

12.Yang, H., Xun, Y., Ke, C. *et al.*Extranodal lymphoma: pathogenesis, diagnosis and treatment. *Mol Biomed***4**, 29 (2023). https://doi.org/10.1186/s43556-023-00141-3