# The Impact of Howell-Jolly Bodies on Quality of Life in HIV Patients: A Review

**Article** · May 2024

CITATIONS
0

READS
16

**1 author:**

Emmanuel Ifeanyi Obeagu
Kampala International University (KIU)
**1,630** PUBLICATIONS **21,998** CITATIONS

SEE PROFILE

Elite Journal of Public Health. Volume 2 Issue 5(2024), Pp. 32-42
https://epjournals.com/journals/EJPH

# The Impact of Howell-Jolly Bodies on Quality of Life in HIV Patients: A Review

*Emmanuel Ifeanyi Obeagu

Department of Medical Laboratory Science, Kampala International University, Uganda

*Corresponding authour: Emmanuel Ifeanyi Obeagu, Department of Medical Laboratory Science, Kampala International University, Uganda, emmanuelobeagu@yahoo.com, ORCID: 0000-0002-4538-0161

## Abstract

Howell-Jolly bodies (HJBs), typically associated with functional asplenia or splenic dysfunction, have gained recognition as potential indicators of hematological abnormalities in HIV patients. The morphological features of HJBs, characterized by small, round, basophilic inclusions within erythrocytes, signify underlying abnormalities in erythropoiesis and splenic function. While traditionally regarded as benign inclusions, the presence of HJBs in HIV patients reflects the complex interplay between viral pathogenesis, hematological abnormalities, and immune dysregulation. Beyond their prognostic significance, HJBs may contribute to clinical manifestations and complications in HIV patients, including anemia, fatigue, and decreased physical functioning. The presence of HJBs may exacerbate existing hematological abnormalities and impair QoL, highlighting the need for targeted therapeutic interventions to mitigate their impact. Optimizing QoL in HIV patients requires a multifaceted approach that addresses underlying hematological abnormalities, viral suppression, and immune reconstitution. Further research is warranted to elucidate the impact of HJBs on QoL outcomes and explore novel therapeutic strategies to mitigate their adverse effects, ultimately optimizing personalized approaches to care for individuals living with HIV.

***Keywords****: Howell-Jolly bodies, HIV, quality of life, hematological abnormalities, disease progression, therapeutic interventions*

## Introduction

Living with HIV constitutes a multifaceted challenge that extends beyond the realm of viral suppression to encompass various aspects of physical, psychological, and social well-being. Among the myriad of complications associated with HIV infection, hematological abnormalities

have garnered significant attention for their impact on the quality of life (QoL) of affected individuals. Howell-Jolly bodies (HJBs), cytoplasmic remnants of erythrocyte maturation, have emerged as intriguing markers of hematological abnormalities in HIV patients, offering valuable insights into disease progression and clinical outcomes. HIV remains a global public health challenge, with approximately 38 million people living with the virus worldwide. While advancements in antiretroviral therapy (ART) have transformed HIV infection into a manageable chronic condition, the burden of the disease persists, particularly in resource-limited settings where access to care and treatment may be limited. Individuals living with HIV face a myriad of challenges, including physical symptoms, psychological distress, social stigma, and socioeconomic disparities, all of which impact their QoL.[1-10]

Hematological abnormalities are common in individuals living with HIV and can manifest across various cell lineages, including erythrocytes, leukocytes, and platelets. Anemia, thrombocytopenia, and leukopenia are among the most prevalent hematological complications observed in HIV patients and are associated with disease progression, opportunistic infections, and impaired QoL. Understanding the underlying mechanisms driving hematological abnormalities in HIV is crucial for optimizing patient care and improving clinical outcomes. Howell-Jolly bodies (HJBs), traditionally regarded as benign inclusions indicative of functional asplenia or splenic dysfunction, have gained recognition as potential indicators of hematological abnormalities in HIV patients. The presence of HJBs on peripheral blood smears serves as a morphological hallmark of altered erythropoiesis and compromised splenic function, reflecting the complex interplay between viral pathogenesis, immune dysregulation, and hematological perturbations. The clinical significance of detecting HJBs in HIV patients extends beyond mere diagnostic curiosity, offering valuable insights into disease progression, clinical manifestations, and therapeutic considerations. Numerous studies have reported a positive correlation between the presence of HJBs and advanced stages of HIV disease, highlighting their potential as prognostic markers for disease severity and progression. Moreover, HJBs may contribute to clinical manifestations such as anemia, fatigue, and decreased physical functioning, further impacting the QoL of affected individuals.[11-20]

In light of the evolving understanding of HJBs in HIV patients, this review aims to comprehensively explore the impact of HJBs on QoL outcomes.

**Morphological Features of Howell-Jolly Bodies**

Howell-Jolly bodies (HJBs) are distinctive cytoplasmic inclusions found within erythrocytes, typically observed in peripheral blood smears stained with Wright-Giemsa or Romanowsky stains. These structures appear as small, round, basophilic inclusions, ranging from 1 to 3 micrometers in diameter, and are characterized by their uniform staining and well-defined borders. While normally, mature erythrocytes expel their nuclei during maturation in the bone marrow, the presence of HJBs indicates a failure of this process, leading to the retention of residual nuclear material within circulating erythrocytes. In the context of HIV infection, the presence of HJBs serves as a morphological hallmark of altered erythropoiesis and compromised splenic function. While the exact mechanisms underlying HJB formation in HIV are not fully understood, it is believed to result from a combination of factors, including dysregulated erythropoiesis, chronic

inflammation, and impaired splenic clearance. HIV-induced immunosuppression and chronic inflammation can disrupt erythropoietin production and impair erythrocyte maturation in the bone marrow, leading to the accumulation of abnormal erythrocytes containing HJBs. Clinically, the detection of HJBs in HIV patients offers valuable diagnostic insights and prognostic information. While HJBs are traditionally associated with functional asplenia or splenic dysfunction, their presence in HIV patients reflects the complex interplay between viral pathogenesis, hematological abnormalities, and immune dysregulation. Quantitative assessment of HJB abundance may provide clinicians with additional information for risk stratification and prognostication in HIV-infected individuals, guiding therapeutic interventions and optimizing patient care.[21-30]

**Association with Disease Progression**

The association between Howell-Jolly bodies (HJBs) and disease progression in HIV patients is of considerable interest, serving as a potential indicator of disease severity and clinical outcomes. Several studies have reported a positive correlation between the presence of HJBs and advanced stages of HIV infection. Elevated viral loads, decreased CD4+ T-cell counts, and increased susceptibility to opportunistic infections are often observed in HIV patients with a higher abundance of HJBs, suggesting their potential as prognostic markers for disease progression. The presence and abundance of HJBs reflect underlying abnormalities in erythropoiesis, splenic function, and immune dysregulation, all of which contribute to HIV disease progression. Dysregulated erythropoiesis and impaired splenic function, compounded by HIV-induced immunosuppression and chronic inflammation, result in the accumulation of HJBs in circulation. The degree of HJB abundance correlates with the severity of hematological abnormalities and immune dysfunction, providing clinicians with valuable insights into disease progression and clinical management. Clinically, the detection of HJBs prompts closer monitoring and may influence therapeutic decisions in HIV patients. Patients with a higher burden of HJBs may be at increased risk of disease progression, opportunistic infections, and complications, necessitating more aggressive management strategies. Furthermore, longitudinal assessment of HJB abundance over time may serve as a dynamic marker of treatment response and disease progression, guiding adjustments to antiretroviral therapy (ART) and adjunctive therapies to optimize clinical outcomes in HIV-infected individuals.[31-40]

**Clinical Manifestations**

The clinical manifestations associated with Howell-Jolly bodies (HJBs) in HIV patients encompass a spectrum of hematological abnormalities and systemic complications, ultimately impacting the overall quality of life (QoL) of affected individuals. Anemia, characterized by a reduction in red blood cell count or hemoglobin concentration, is among the most common clinical manifestations observed in HIV patients with detectable HJBs. The presence of HJBs reflects underlying disturbances in erythropoiesis and splenic function, contributing to the development of anemia and exacerbating existing hematological abnormalities. Fatigue and decreased physical functioning are prevalent symptoms reported by HIV patients with anemia and detectable HJBs, significantly impairing their QoL. Anemia-related fatigue can be debilitating, limiting the ability to perform daily activities, engage in social interactions, and maintain employment. Furthermore, decreased

physical functioning may compromise overall health and well-being, leading to diminished QoL outcomes and increased healthcare utilization among affected individuals. In addition to hematological manifestations, HIV patients with detectable HJBs may experience an increased susceptibility to opportunistic infections and complications, further impacting their QoL. The presence of HJBs reflects immune dysregulation and impaired splenic function, predisposing individuals to infections such as pneumocystis pneumonia (PCP), cytomegalovirus (CMV) retinitis, and disseminated mycobacterial infections. These infections can lead to significant morbidity and mortality, highlighting the clinical significance of detecting HJBs in HIV patients and guiding therapeutic interventions to mitigate their adverse effects.[41-50]

**Therapeutic Interventions**

Therapeutic interventions aimed at mitigating the clinical manifestations associated with Howell-Jolly bodies (HJBs) in HIV patients encompass a multidimensional approach that targets underlying hematological abnormalities, viral suppression, and immune reconstitution. The cornerstone of management involves optimizing antiretroviral therapy (ART) to suppress viral replication, restore immune function, and mitigate hematological complications. Early initiation of ART in HIV patients with detectable HJBs is crucial for preventing disease progression, reducing viral burden, and improving overall clinical outcomes. For HIV patients with anemia and detectable HJBs, adjunctive therapies targeting hematological abnormalities may be considered to optimize erythropoiesis and hemoglobin levels. Erythropoiesis-stimulating agents (ESAs) or iron supplementation may be prescribed to address underlying nutritional deficiencies or erythropoietin insufficiency, thereby improving anemia and reducing fatigue in affected individuals. Furthermore, blood transfusions may be indicated in severe cases of anemia to rapidly restore hemoglobin levels and alleviate symptoms.[51-60]

In addition to hematological interventions, strategies aimed at enhancing immune function and splenic clearance may help mitigate the adverse effects of HJBs in HIV patients. Immunomodulatory therapies, such as cytokine therapy or immune checkpoint inhibitors, may be explored to augment immune responses and reduce viral replication in affected individuals. Moreover, adjunctive therapies targeting splenic dysfunction, such as splenectomy or splenic artery embolization, may be considered in select cases to improve erythrocyte clearance and reduce the burden of HJBs in circulation. Psychosocial support and holistic care are integral components of therapeutic interventions for HIV patients with detectable HJBs, aiming to address the multifaceted impact of the disease on physical, psychological, and social well-being. Comprehensive care models that integrate medical management with psychosocial support services, nutritional counseling, and adherence support can improve QoL outcomes and enhance treatment adherence in affected individuals.[61-70]

**Conclusion**

Howell-Jolly bodies (HJBs) represent significant markers of hematological abnormalities in HIV patients, with implications for disease progression, clinical manifestations, and therapeutic interventions. The detection of HJBs underscores the complex interplay between viral

pathogenesis, immune dysregulation, and hematological perturbations, shaping the clinical course and quality of life (QoL) outcomes of affected individuals. The association between HJBs and disease progression in HIV patients highlights their potential as prognostic markers for identifying individuals at higher risk of adverse clinical outcomes and complications. Furthermore, the clinical manifestations associated with HJBs, including anemia, fatigue, and increased susceptibility to opportunistic infections, underscore the need for targeted therapeutic interventions aimed at mitigating their adverse effects and optimizing patient care. Therapeutic interventions for HIV patients with detectable HJBs encompass a multidimensional approach that targets underlying hematological abnormalities, viral suppression, and immune reconstitution. Early initiation of antiretroviral therapy (ART), adjunctive hematological therapies, and strategies to enhance immune function and splenic clearance are integral components of management, aiming to improve clinical outcomes and enhance QoL in affected individuals.

**References**

1. Meyer-Myklestad MH, Medhus AW, Lorvik KB, Seljeflot I, Hansen SH, Holm K, Stiksrud B, Trøseid M, Hov JR, Kvale D, Dyrhol-Riise AM. Human immunodeficiency virus–infected immunological nonresponders have colon-restricted gut mucosal immune dysfunction. The Journal of infectious diseases. 2022;225(4):661-674.
2. Henderson DK, Dembry L, Fishman NO, Grady C, Lundstrom T, Palmore TN, Sepkowitz KA, Weber DJ, Society for Healthcare Epidemiology of America. SHEA guideline for management of healthcare workers who are infected with hepatitis B virus, hepatitis C virus, and/or human immunodeficiency virus. Infection Control & Hospital Epidemiology. 2010;31(3):203-232.
3. d'Arminio Monforte A, Cozzi-Lepri A, Castagna A, Antinori A, De Luca A, Mussini C, Lo Caputo S, Arlotti M, Magnani G, Pellizzer G, Maggiolo F. Risk of developing specific AIDS-defining illnesses in patients coinfected with HIV and hepatitis C virus with or without liver cirrhosis. Clinical Infectious Diseases. 2009;49(4):612-622.
4. Obeagu EI, Obeagu GU, Paul-Chima UO. Stigma Associated With HIV. AIDS: A Review. Newport International Journal of Public Health and Pharmacy (Nijpp). 2023;3(2):64-7.
5. Viola N, Kimono E, Nuruh N, Obeagu EI. Factors Hindering Elimination of Mother to Child Transmission of HIV Service Uptake among HIV Positive Women at Comboni Hospital Kyamuhunga Bushenyi District. Asian J Dental Health Sci [Internet]. 2023 Jun. 15 [cited 2024 May 4];3(2):7-14. Available from: http://ajdhs.com/index.php/journal/article/view/39
6. Obeagu EI, Obeagu GU. Hematological Changes Following Blood Transfusion in Young Children with Severe Malaria and HIV: A Critical Review. Elite Journal of Laboratory Medicine, 2024; 2(1): 33-45
7. Obeagu EI, Obeagu GU. The Role of Blood Transfusion Strategies in HIV Management: Current Insights and Future Directions. Elite Journal of Medicine, 2024; 2(1):10-22
8. Obeagu EI, Obeagu GU (2024). Transfusion-Related Complications in Children Under 5 with Coexisting HIV and Severe Malaria: A Review. Int. J. Curr. Res. Chem. Pharm. Sci. 2024; 11(2): 9-19.

**Citation**: Obeagu EI. The Impact of Howell-Jolly Bodies on Quality of Life in HIV Patients: A Review. Elite Journal of Public Health, 2024; 2 (5): 32-42

9. Obeagu EI, Okwuanaso CB, Edoho SH, Obeagu GU. Under-nutrition among HIV-exposed Uninfected Children: A Review of African Perspective. Madonna University journal of Medicine and Health Sciences. 2022;2(3):120-127.
10. Obeagu EI. A Review of Challenges and Coping Strategies Faced by HIV/AIDS Discordant Couples. Madonna University journal of Medicine and Health Sciences. 2023 ;3(1):7-12. https://madonnauniversity.edu.ng/journals/index.php/medicine/article/view/91.
11. Obeagu EI, Obeagu GU. An update on premalignant cervical lesions and cervical cancer screening services among HIV positive women. J Pub Health Nutri. 2023; 6 (2). 2023; 141:1-2. links/63e538ed64252375639dd0df/An-update-on-premalignant-cervical-lesions-and-cervical-cancer-screening-services-among-HIV-positive-women.pdf.
12. Ezeoru VC, Enweani IB, Ochiabuto O, Nwachukwu AC, Ogbonna US, Obeagu EI. Prevalence of Malaria with Anaemia and HIV status in women of reproductive age in Onitsha, Nigeria. Journal of Pharmaceutical Research International. 2021;33(4):10-19.
13. Omo-Emmanuel UK, Chinedum OK, Obeagu EI. Evaluation of laboratory logistics management information system in HIV/AIDS comprehensive health facilities in Bayelsa State, Nigeria. Int J Curr Res Med Sci. 2017;3(1): 21-38.DOI: 10.22192/ijcrms.2017.03.01.004
14. Obeagu EI, Obeagu GU. An update on survival of people living with HIV in Nigeria. J Pub Health Nutri. 2022; 5 (6). 2022;129. links/645b4bfcf3512f1cc5885784/An-update-on-survival-of-people-living-with-HIV-in-Nigeria.pdf.
15. Offie DC, Obeagu EI, Akueshi C, Njab JE, Ekanem EE, Dike PN, Oguh DN. Facilitators and barriers to retention in HIV care among HIV infected MSM attending Community Health Center Yaba, Lagos Nigeria. Journal of Pharmaceutical Research International. 2021;33(52B):10-19.
16. Obeagu EI, Ogbonna US, Nwachukwu AC, Ochiabuto O, Enweani IB, Ezeoru VC. Prevalence of Malaria with Anaemia and HIV status in women of reproductive age in Onitsha, Nigeria. Journal of Pharmaceutical Research International. 2021;33(4):10-19.
17. Odo M, Ochei KC, Obeagu EI, Barinaadaa A, Eteng UE, Ikpeme M, Bassey JO, Paul AO. TB Infection Control in TB/HIV Settings in Cross River State, Nigeria: Policy Vs Practice. Journal of Pharmaceutical Research International. 2020;32(22):101-119.
18. Obeagu EI, Eze VU, Alaeboh EA, Ochei KC. Determination of haematocrit level and iron profile study among persons living with HIV in Umuahia, Abia State, Nigeria. J BioInnovation. 2016; 5:464-471. links/592bb4990f7e9b9979a975cf/DETERMINATION-OF-HAEMATOCRIT-LEVEL-AND-IRON-PROFILE-STUDY-AMONG-PERSONS-LIVING-WITH-HIV-IN-UMUAHIA-ABIA-STATE-NIGERIA.pdf.
19. Ifeanyi OE, Obeagu GU. The values of prothrombin time among HIV positive patients in FMC owerri. International Journal of Current Microbiology and Applied Sciences. 2015;4(4):911-916. https://www.academia.edu/download/38320140/Obeagu_Emmanuel_Ifeanyi_and_Obeagu__Getrude_Uzoma2.EMMA1.pdf.
20. Izuchukwu IF, Ozims SJ, Agu GC, Obeagu EI, Onu I, Amah H, Nwosu DC, Nwanjo HU, Edward A, Arunsi MO. Knowledge of preventive measures and management of HIV/AIDS

victims among parents in Umuna Orlu community of Imo state Nigeria. Int. J. Adv. Res. Biol. Sci. 2016;3(10): 55-65.DOI; 10.22192/ijarbs.2016.03.10.009

21. Chinedu K, Takim AE, Obeagu EI, Chinazor UD, Eloghosa O, Ojong OE, Odunze U. HIV and TB co-infection among patients who used Directly Observed Treatment Short-course centres in Yenagoa, Nigeria. IOSR J Pharm Biol Sci. 2017;12(4):70-75. links/5988ab6d0f7e9b6c8539f73d/HIV-and-TB-co-infection-among-patients-who-used-Directly-Observed-Treatment-Short-course-centres-in-Yenagoa-Nigeria.pdf
22. Oloro OH, Oke TO, Obeagu EI. Evaluation of Coagulation Profile Patients with Pulmonary Tuberculosis and Human Immunodeficiency Virus in Owo, Ondo State, Nigeria. Madonna University journal of Medicine and Health Sciences. 2022;2(3):110-119.
23. Nwosu DC, Obeagu EI, Nkwocha BC, Nwanna CA, Nwanjo HU, Amadike JN, Elendu HN, Ofoedeme CN, Ozims SJ, Nwankpa P. Change in Lipid Peroxidation Marker (MDA) and Non enzymatic Antioxidants (VIT C & E) in HIV Seropositive Children in an Urban Community of Abia State. Nigeria. J. Bio. Innov. 2016;5(1):24-30. links/5ae735e9a6fdcc5b33eb8d6a/CHANGE-IN-LIPID-PEROXIDATION-MARKER-MDAAND-NON-ENZYMATIC-ANTIOXIDANTS-VIT-C-E-IN-HIV-SEROPOSITIVE-CHILDREN-IN-AN-URBAN-COMMUNITY-OF-ABIA-STATE-NIGERIA.pdf.
24. Mehta AB, Hoffbrand AV. Haematology at a Glance. John Wiley & Sons; 2009.
25. Sadelov IO, Bobrynina V, Krasilnikova M, Smetanina N. 1Federal scientific clinical center of pediatric hematology, oncology and immunology named after Dmitriy Rogachev, Moscow, Russian Federation Background: Hemoglobinopathies are heterogeneous group of diseases caused by qualitative (abnormal Hb) or quantitative (thalassemia) failure in. In18TH CONGRESS OF THE EUROPEAN HEMATOLOGY ASSOCIATION STOCKHOLM, SWEDEN JUNE 13-16, 2013 2008; 93(s1):699.
26. Ifeanyi OE, Obeagu GU, Ijeoma FO, Chioma UI. The values of activated partial thromboplastin time (APTT) among HIV positive patients in FMC Owerri. Int J Curr Res Aca Rev. 2015; 3:139-144. https://www.academia.edu/download/38320159/Obeagu_Emmanuel_Ifeanyi3__et_al.IJCRAR.pdf.
27. Obiomah CF, Obeagu EI, Ochei KC, Swem CA, Amachukwu BO. Hematological indices o HIV seropositive subjects in Nnamdi Azikiwe University teaching hospital (NAUTH), Nnewi. Ann Clin Lab Res. 2018;6(1):1-4. links/5aa2bb17a6fdccd544b7526e/Haematological-Indices-of-HIV-Seropositive-Subjects-at-Nnamdi-Azikiwe.pdf
28. Omo-Emmanuel UK, Ochei KC, Osuala EO, Obeagu EI, Onwuasoanya UF. Impact of prevention of mother to child transmission (PMTCT) of HIV on positivity rate in Kafanchan, Nigeria. Int. J. Curr. Res. Med. Sci. 2017;3(2): 28-34.DOI: 10.22192/ijcrms.2017.03.02.005
29. Aizaz M, Abbas FA, Abbas A, Tabassum S, Obeagu EI. Alarming rise in HIV cases in Pakistan: Challenges and future recommendations at hand. Health Science Reports. 2023;6(8):e1450.
30. Obeagu EI, Amekpor F, Scott GY. An update of human immunodeficiency virus infection: Bleeding disorders. J Pub Health Nutri. 2023; 6 (1). 2023;139.

links/645b4a6c2edb8e5f094d9bd9/An-update-of-human-immunodeficiency-virus-infection-Bleeding.pdf.

31. Obeagu EI, Scott GY, Amekpor F, Ofodile AC, Edoho SH, Ahamefula C. Prevention of New Cases of Human Immunodeficiency Virus: Pragmatic Approaches of Saving Life in Developing Countries. Madonna University journal of Medicine and Health Sciences. 2022;2(3):128-134. https://madonnauniversity.edu.ng/journals/index.php/medicine/article/view/86.
32. Walter O, Anaebo QB, Obeagu EI, Okoroiwu IL. Evaluation of Activated Partial Thromboplastin Time and Prothrombin Time in HIV and TB Patients in Owerri Metropolis. Journal of Pharmaceutical Research International. 2022:29-34.
33. Odo M, Ochei KC, Obeagu EI, Barinaadaa A, Eteng EU, Ikpeme M, Bassey JO, Paul AO. Cascade variabilities in TB case finding among people living with HIV and the use of IPT: assessment in three levels of care in cross River State, Nigeria. Journal of Pharmaceutical Research International. 2020;32(24):9-18.
34. Jakheng SP, Obeagu EI. Seroprevalence of human immunodeficiency virus based on demographic and risk factors among pregnant women attending clinics in Zaria Metropolis, Nigeria. J Pub Health Nutri. 2022; 5 (8). 2022;137. links/6317a6b1acd814437f0ad268/Seroprevalence-of-human-immunodeficiency-virus-based-on-demographic-and-risk-factors-among-pregnant-women-attending-clinics-in-Zaria-Metropolis-Nigeria.pdf.
35. Obeagu EI, Obeagu GU. A Review of knowledge, attitudes and socio-demographic factors associated with non-adherence to antiretroviral therapy among people living with HIV/AIDS. Int. J. Adv. Res. Biol. Sci. 2023;10(9):135-142.DOI: 10.22192/ijarbs.2023.10.09.015 links/6516faa61e2386049de5e828/A-Review-of-knowledge-attitudes-and-socio-demographic-factors-associated-with-non-adherence-to-antiretroviral-therapy-among-people-living-with-HIV-AIDS.pdf
36. Lutgendorf SK. Cognitive-behavioral stress management in a symptomatic HIV-1 seropositive population: Effects on mood, coping, immune and neuroendocrine factors. University of Miami; 1994.
37. Obeagu EI, Onuoha EC. Tuberculosis among HIV Patients: A review of Prevalence and Associated Factors. Int. J. Adv. Res. Biol. Sci. 2023;10(9):128-134.DOI: 10.22192/ijarbs.2023.10.09.014 links/6516f938b0df2f20a2f8b0e0/Tuberculosis-among-HIV-Patients-A-review-of-Prevalence-and-Associated-Factors.pdf.
38. Obeagu EI, Ibeh NC, Nwobodo HA, Ochei KC, Iwegbulam CP. Haematological indices of malaria patients coinfected with HIV in Umuahia. Int. J. Curr. Res. Med. Sci. 2017;3(5):100-104.DOI: 10.22192/ijcrms.2017.03.05.014 https://www.academia.edu/download/54317126/Haematological_indices_of_malaria_patients_coinfected_with_HIV.pdf
39. Jakheng SP, Obeagu EI, Abdullahi IO, Jakheng EW, Chukwueze CM, Eze GC, Essien UC, Madekwe CC, Madekwe CC, Vidya S, Kumar S. Distribution Rate of Chlamydial Infection According to Demographic Factors among Pregnant Women Attending Clinics in Zaria Metropolis, Kaduna State, Nigeria. South Asian Journal of Research in Microbiology. 2022;13(2):26-31.

40. Okorie HM, Obeagu Emmanuel I, Okpoli Henry CH, Chukwu Stella N. Comparative study of enzyme linked immunosorbent assay (Elisa) and rapid test screening methods on HIV, Hbsag, Hcv and Syphilis among voluntary donors in. Owerri, Nigeria. J Clin Commun Med. 2020;2(3):180-183.DOI: **DOI:** 10.32474/JCCM.2020.02.000137 links/5f344530458515b7291bd95f/Comparative-Study-of-Enzyme-Linked-Immunosorbent-Assay-ElISA-and-Rapid-Test-Screening-Methods-on-HIV-HBsAg-HCV-and-Syphilis-among-Voluntary-Donors-in-Owerri-Nigeria.pdf.
41. Nikolouzakis TK, Falzone L, Lasithiotakis K, Krüger-Krasagakis S, Kalogeraki A, Sifaki M, Spandidos DA, Chrysos E, Tsatsakis A, Tsiaoussis J. Current and future trends in molecular biomarkers for diagnostic, prognostic, and predictive purposes in non-melanoma skin cancer. Journal of Clinical Medicine. 2020;9(9):2868.
42. Ezugwu UM, Onyenekwe CC, Ukibe NR, Ahaneku JE, Onah CE, Obeagu EI, Emeje PI, Awalu JC, Igbokwe GE. Use of ATP, GTP, ADP and AMP as an Index of Energy Utilization and Storage in HIV Infected Individuals at NAUTH, Nigeria: A Longitudinal, Prospective, Case-Controlled Study. Journal of Pharmaceutical Research International. 2021;33(47A):78-84.
43. Emannuel G, Martin O, Peter OS, Obeagu EI, Daniel K. Factors Influencing Early Neonatal Adverse Outcomes among Women with HIV with Post Dated Pregnancies Delivering at Kampala International University Teaching Hospital, Uganda. Asian Journal of Pregnancy and Childbirth. 2023 Jul 29;6(1):203-211. http://research.sdpublishers.net/id/eprint/2819/.
44. Vincent CC, Obeagu EI, Agu IS, Ukeagu NC, Onyekachi-Chigbu AC. Adherence to Antiretroviral Therapy among HIV/AIDS in Federal Medical Centre, Owerri. Journal of Pharmaceutical Research International. 2021;33(57A):360-368.
45. Madekwe CC, Madekwe CC, Obeagu EI. Inequality of monitoring in Human Immunodeficiency Virus, Tuberculosis and Malaria: A Review. Madonna University journal of Medicine and Health Sciences. 2022;2(3):6-15. https://madonnauniversity.edu.ng/journals/index.php/medicine/article/view/69
46. Echendu GE, Vincent CC, Ibebuike J, Asodike M, Naze N, Chinedu EP, Ohale B, Obeagu EI. WEIGHTS OF INFANTS BORN TO HIV INFECTED MOTHERS: A PROSPECTIVE COHORT STUDY IN FEDERAL MEDICAL CENTRE, OWERRI, IMO STATE. European Journal of Pharmaceutical and Medical Research, 2023; 10(8): 564-568
47. Nwosu DC, Nwanjo HU, Okolie NJ, Ikeh K, Ajero CM, Dike J, Ojiegbe GC, Oze GO, Obeagu EI, Nnatunanya I, Azuonwu O. BIOCHEMICAL ALTERATIONS IN ADULT HIV PATIENTS ON ANTIRETRQVIRAL THERAPY. World Journal of Pharmacy and Pharmaceutical Sciences, 2015; 4(3): 153-160**.** links/5a4fd0500f7e9bbc10526b38/BIOCHEMICAL-ALTERATIONS-IN-ADULT-HIV-PATIENTS-ON-ANTIRETRQVIRAL-THERAPY.pdf.
48. Obeagu EI, Obeagu GU. Effect of CD4 Counts on Coagulation Parameters among HIV Positive Patients in Federal Medical Centre, Owerri, Nigeria. Int. J. Curr. Res. Biosci. Plant Biol. 2015;2(4):45-49.
49. Obeagu EI, Nwosu DC. Adverse drug reactions in HIV/AIDS patients on highly active antiretro viral therapy: a review of prevalence. Int. J. Curr. Res. Chem. Pharm. Sci. 2019;6(12):45-8.DOI: 10.22192/ijcrcps.2019.06.12.004

links/650aba1582f01628f0335795/Adverse-drug-reactions-in-HIV-AIDS-patients-on-highly-active-antiretro-viral-therapy-a-review-of-prevalence.pdf.

50. Obeagu EI, Scott GY, Amekpor F, Obeagu GU. Implications of CD4/CD8 ratios in Human Immunodeficiency Virus infections. Int. J. Curr. Res. Med. Sci. 2023;9(2):6-13.DOI: 10.22192/ijcrms.2023.09.02.002 links/645a4a462edb8e5f094ad37c/Implications-of-CD4-CD8-ratios-in-Human-Immunodeficiency-Virus-infections.pdf.
51. Obeagu EI, Ochei KC, Okeke EI, Anode AC. Assessment of the level of haemoglobin and erythropoietin in persons living with HIV in Umuahia. Int. J. Curr. Res. Med. Sci. 2016;2(4):29-33. links/5711c47508aeebe07c02496b/Assessment-of-the-level-of-haemoglobin-and-erythropoietin-in-persons-living-with-HIV-in-Umuahia.pdf.
52. Obeagu EI. Erythropoietin in HIV: Bridging the Gap Between Hematology and Virology. Elite Journal of HIV. 2024;2(3):42-54.
53. Obeagu EI, Obeagu GU, Ukibe NR, Oyebadejo SA. Anemia, iron, and HIV: decoding the interconnected pathways: A review. Medicine. 2024 Jan 12;103(2):e36937.
54. Obeagu EI, Obeagu GU. GATA-1 Regulation of Erythroid Progenitor Cell Differentiation in HIV/AIDS: Molecular Insights and Therapeutic Implications. Elite Journal of Haematology, 2024; 2 (4).:141-59.
55. Reddy R. *Study of Hematological Profile in HIV Infected Patients* (Doctoral dissertation, Rajiv Gandhi University of Health Sciences (India)). 2018.
56. Canny SP, Orozco SL, Thulin NK, Hamerman JA. Immune Mechanisms in Inflammatory Anemia. Annual review of immunology. 2023; 41:405-429.
57. Checconi P, De Angelis M, Marcocci ME, Fraternale A, Magnani M, Palamara AT, Nencioni L. Redox-modulating agents in the treatment of viral infections. International Journal of Molecular Sciences. 2020;21(11):4084.
58. Lanser L, Fuchs D, Kurz K, Weiss G. Physiology and inflammation driven pathophysiology of iron homeostasis—mechanistic insights into anemia of inflammation and its treatment. Nutrients. 2021;13(11):3732.
59. Chin-Hong PV, Palefsky JM. Natural history and clinical management of anal human papillomavirus disease in men and women infected with human immunodeficiency virus. Clinical Infectious Diseases. 2002;35(9):1127-1134.
60. Obeagu EI, Obeagu GU. Understanding ART and Platelet Functionality: Implications for HIV Patients. Elite Journal of HIV. 2024;2(2):60-73.
61. Obeagu EI, Obeagu GU. Utilization of immunological ratios in HIV: Implications for monitoring and therapeutic strategies. Medicine. 2024;103(9):e37354.
62. Obeagu EI, Obeagu GU. Counting Cells, Shaping Fates: CD4/CD8 Ratios in HIV. Elite Journal of Scientific Research and Review. 2024;2(1):37-50.
63. Obeagu EI, Anyiam AF, Obeagu GU. Managing Anemia in HIV through Blood Transfusions: Clinical Considerations and Innovations. Elite Journal of HIV. 2024;2(1):16-30.
64. Obeagu EI, Obeagu GU, Okwuanaso CB. Optimizing Immune Health in HIV Patients through Nutrition: A Review. Elite Journal of Immunology. 2024;2(1):14-33.
65. Obeagu EI, Obeagu GU. P-Selectin and Platelet Activation in HIV: Implications for Antiviral Therapy. Elite Journal of Scientific Research and Review. 2024;2(1):17-41.

66. Esté JA, Cihlar T. Current status and challenges of antiretroviral research and therapy. Antiviral research. 2010 Jan 1;85(1):25-33.
67. Channaveerappanavar PB. *Study of Immunological Recovery in Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome Patients on Second Line Anti Retroviral Drugs-A Prospective Study* (Doctoral dissertation, Rajiv Gandhi University of Health Sciences (India)). 2017.
68. Obeagu EI, Obeagu GU. GATA-1 and Hematopoietic Stem Cell Quiescence in HIV: Implications for Therapy. Elite Journal of Medicine. 2024;2(4):19-36.
69. Obeagu EI. Howell-Jolly Bodies in HIV: Unveiling Morphological Insights into Disease Progression. *Elite Journal of Haematology*, *2024; 2(5):* 126-137
70. Obeagu. Howell-Jolly Bodies in Pediatric HIV: Clinical Considerations and Management Strategies. Elite Journal of Nursing and Health Science, 2024; 2(5):1-11