Elite Journal of Laboratory Medicine. Volume 2 issue 2(2024), Pp. 8-20
https://epjournals.com/journals/EJLM

CD4/CD8 Ratios: The Immunological Barometer in HIV

*Emmanuel Ifeanyi Obeagu[1] and Getrude Uzoma Obeagu[2]

[1]Department of Medical Laboratory Science, Kampala International University, Uganda.

[2]School of Nursing 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

The CD4/CD8 ratio is a pivotal immunological parameter that plays a crucial role in the comprehensive assessment of Human Immunodeficiency Virus (HIV) infection. This review offers a thorough examination of the CD4/CD8 ratio as an immunological barometer, encompassing its historical context, underlying mechanisms, clinical significance, evolving perspectives, and therapeutic implications in the context of HIV. The immunological basis of CD4/CD8 ratios is explored, shedding light on the intricate dynamics of T-cell subsets and their alterations in the presence of HIV. Emphasis is placed on the clinical significance of the CD4/CD8 ratio, elucidating its role in predicting disease progression, opportunistic infections, and guiding antiretroviral therapy (ART) decisions. The conclusion synthesizes current knowledge and outlines future directions, emphasizing the CD4/CD8 ratio's potential to refine HIV care through advanced technologies and tailored interventions. This review provides a comprehensive overview of the

Keywords*: CD4/CD8 ratio, HIV, immune health, prognosis, therapeutic implications.*

Introduction

The Human Immunodeficiency Virus (HIV) continues to pose a global public health challenge, demanding a nuanced understanding of immunological parameters for effective management. Among these parameters, the CD4/CD8 ratio has emerged as a pivotal indicator, reflecting the intricate balance of T-cell subsets in the immune system. This review endeavors to comprehensively explore the significance of the CD4/CD8 ratio in the context of HIV, shedding light on its historical evolution, underlying immunological mechanisms, clinical implications, and its role as a therapeutic guide. The dynamic interplay between CD4 and CD8 T-cell populations

serves as a fundamental aspect of immune surveillance, making alterations in their ratio a key barometer for assessing immune health in individuals living with HIV. The historical trajectory of the CD4/CD8 ratio's recognition as an immunological barometer parallels the evolving understanding of HIV pathogenesis. Initially identified as a diagnostic tool, it quickly gained prominence for its prognostic value in predicting disease progression. The journey from a diagnostic parameter to a comprehensive immunological barometer underscores the critical role that the CD4/CD8 ratio plays in unraveling the complex interplay between the virus and the host immune system.[1-20]

Understanding the immunological basis of CD4/CD8 ratios is fundamental to deciphering the intricacies of HIV progression. CD4 T-cells orchestrate immune responses, while CD8 T-cells are crucial effectors in eliminating infected cells. The dysregulation of this delicate equilibrium, often observed in HIV infection, reflects underlying immunological challenges. Immune activation, exhaustion, and senescence contribute to variations in the CD4/CD8 ratio, shaping its role as a critical parameter for monitoring immune health. The CD4/CD8 ratio extends beyond a diagnostic tool, holding profound clinical significance in HIV management. Altered ratios serve as prognostic indicators for disease progression, susceptibility to opportunistic infections, and the development of non-AIDS-related comorbidities. Moreover, the ratio dynamically responds to antiretroviral therapy (ART), providing insights into treatment efficacy and guiding therapeutic decisions. The clinical utility of the CD4/CD8 ratio thus spans both prognostication and therapeutic monitoring in the comprehensive care of individuals living with HIV.[21-30]

Immunological Basis of CD4/CD8 Ratios

The immunological basis of CD4/CD8 ratios lies at the core of understanding the intricate dynamics of T-cell populations and their critical roles in immune surveillance. CD4 and CD8 are two distinct T-cell subsets, each playing essential roles in orchestrating and executing immune responses. The balance between these subsets is a key determinant of overall immune system functionality. CD4 T-cells, often referred to as helper T-cells, serve as conductors of the immune orchestra. These cells play a central role in coordinating immune responses by releasing signaling molecules called cytokines that regulate the activities of other immune cells. CD4 T-cells are essential for activating B-cells, which produce antibodies, and cytotoxic CD8 T-cells, which directly eliminate infected cells. In the context of HIV, the virus primarily targets and infects CD4 T-cells, leading to their depletion and compromising the immune system's ability to mount effective responses against infections.[31-40]

On the other hand, CD8 T-cells, or cytotoxic T-cells, are the immune system's "killers." They recognize and directly destroy cells infected with intracellular pathogens, including viruses. In the context of HIV, CD8 T-cells play a crucial role in controlling viral replication by targeting and eliminating HIV-infected cells. However, chronic exposure to the virus can lead to immune exhaustion, characterized by a decreased functional capacity of CD8 T-cells, ultimately impacting their ability to control HIV replication effectively. The CD4/CD8 ratio serves as a quantitative reflection of the balance between these two T-cell subsets. A healthy immune system typically maintains a higher number of CD4 T-cells compared to CD8 T-cells, resulting in a CD4/CD8 ratio

greater than 1. In the context of HIV infection, the virus disrupts this balance by preferentially infecting and depleting CD4 T-cells. Consequently, a declining CD4/CD8 ratio becomes indicative of immune dysregulation and the progression of HIV disease.[41-50]

Clinical Significance

The clinical significance of the CD4/CD8 ratio in the context of HIV infection extends beyond its role as a diagnostic marker, serving as a crucial prognostic indicator and therapeutic guide. This ratio, reflecting the balance between two key T-cell subsets, holds valuable insights into the immune health of individuals living with HIV and aids in shaping clinical management strategies. The CD4/CD8 ratio serves as a robust prognostic indicator for individuals with HIV. A lower CD4/CD8 ratio is associated with an increased risk of disease progression, opportunistic infections, and mortality. Monitoring changes in the ratio over time provides clinicians with a dynamic measure of immune health, allowing for the identification of individuals at higher risk of developing AIDS-related complications. A declining CD4/CD8 ratio is closely linked to an elevated susceptibility to opportunistic infections, which are common and severe in individuals with advanced HIV disease. This ratio is particularly informative in predicting the risk of infections beyond those traditionally associated with AIDS, providing a comprehensive perspective on the individual's immune status and vulnerability to various pathogens.[51-70]

Beyond its role in predicting AIDS-related complications, the CD4/CD8 ratio has demonstrated significance in assessing the risk of non-AIDS-related comorbidities. Individuals with HIV are at an increased risk of conditions such as cardiovascular diseases, neurocognitive disorders, and certain cancers. The CD4/CD8 ratio has been recognized as a valuable marker in identifying those at higher risk for these non-AIDS comorbidities, contributing to a more holistic understanding of the long-term health implications of HIV. The CD4/CD8 ratio plays a pivotal role in evaluating the effectiveness of antiretroviral therapy (ART). Successful ART typically results in immune restoration, leading to an increase in the CD4/CD8 ratio. Monitoring this ratio over the course of treatment informs clinicians about the patient's response to therapy and aids in making informed decisions regarding treatment adjustments, adherence support, and potential modification of therapeutic regimens. As a therapeutic guide, the CD4/CD8 ratio informs clinicians about the overall immune status of individuals with HIV. Tailoring therapeutic interventions based on the CD4/CD8 ratio allows for a more personalized approach to patient care. Strategies aimed at optimizing immune health, managing opportunistic infections, and addressing non-AIDS comorbidities can be tailored according to the individual's unique immunological profile.[71-80]

Evolving Perspectives and Research Frontiers

One of the evolving perspectives in CD4/CD8 ratios and HIV revolves around persistent immune activation. As individuals with HIV age, there is growing interest in understanding the impact of immune senescence on CD4/CD8 ratios. Immune senescence, characterized by aging-related changes in immune function, may contribute to alterations in T-cell populations. Research exploring how immune senescence influences CD4/CD8 ratios in the aging HIV population can provide insights into potential age-specific considerations for HIV care. The persistence of HIV

reservoirs, even in individuals on suppressive ART, presents a challenge for achieving a functional cure. Exploring the relationship between HIV reservoirs and CD4/CD8 ratios is a burgeoning area of research. Understanding how viral reservoirs impact T-cell dynamics and the CD4/CD8 ratio may guide the development of strategies aiming for sustained viral suppression and potential eradication. While the CD4/CD8 ratio remains a cornerstone, there is a growing recognition of the need for complementary biomarkers to provide a more comprehensive assessment of immune health in HIV. Identifying and validating additional biomarkers that can offer nuanced insights into immune function, inflammation, and response to therapy is a research frontier that could enhance the precision of HIV care.[81-90]

Advancements in genomics and personalized medicine open new possibilities for tailoring HIV treatment based on individual characteristics. Research exploring how genetic factors influence CD4/CD8 ratios and how this information can be integrated into treatment decision-making represents a promising frontier. Personalized medicine approaches may optimize therapeutic strategies, improving outcomes for individuals with diverse immune profiles. The gut microbiota has emerged as a critical player in shaping immune responses. Investigating the interplay between the gut microbiota, T-cell populations, and CD4/CD8 ratios in the context of HIV is a developing research area. Understanding how microbiota modulation may impact immune reconstitution and overall health is crucial for advancing therapeutic interventions.[91-96]

Therapeutic Implications and Future Directions

Strategies aimed at modulating CD4/CD8 ratios present therapeutic opportunities for immune restoration in individuals with HIV. Moving towards individualized treatment approaches based on CD4/CD8 ratios marks a promising therapeutic direction. Tailoring antiretroviral therapy (ART) regimens and other interventions according to an individual's unique immunological profile may optimize treatment outcomes. Future research could explore how factors such as host genetics, viral reservoir size, and immune activation levels influence the response to personalized treatment strategies. Advancements in immunotherapy and vaccine development represent a frontier in HIV therapeutics. Investigating the potential of therapeutic vaccines to enhance CD4 T-cell responses and modulate CD4/CD8 ratios is an active area of research. Additionally, exploring the role of immune checkpoint inhibitors and other novel immunotherapies in restoring immune balance holds promise for improving long-term immune health.[92-93]

Persistent immune exhaustion, characterized by impaired function of CD8 T-cells, poses a challenge in achieving sustained viral control. Future therapeutic directions involve targeting immune exhaustion pathways to rejuvenate CD8 T-cell function. Investigating the safety and efficacy of interventions such as immune checkpoint blockade or immune stimulants is crucial for developing strategies to counteract immune exhaustion and enhance the immune response. The future of HIV therapeutics involves integrating a panel of biomarkers, beyond CD4/CD8 ratios, for comprehensive immune monitoring. Research into the use of additional biomarkers, including markers of inflammation, immune activation, and T-cell function, can refine our understanding of the immune landscape in HIV. A holistic approach to monitoring immune health will contribute to more precise therapeutic decision-making. Therapeutic strategies aimed at targeting and

eliminating residual viral reservoirs are critical for achieving sustained viral suppression and functional cure. Investigating the interplay between viral reservoir dynamics and CD4/CD8 ratios may uncover novel approaches to disrupt latency and enhance immune control. Future directions involve exploring combination therapies that simultaneously address both viral reservoirs and immune reconstitution. Advancements in technologies such as single-cell sequencing and high-dimensional flow cytometry offer unprecedented insights into immune cell dynamics. Future research should leverage these technologies to dissect the heterogeneity within T-cell populations, providing a more granular understanding of CD4/CD8 ratios at the single-cell level. This approach holds potential for uncovering subtle variations in immune responses and tailoring therapeutic interventions accordingly.[95-86]

Conclusion

The evolving landscape of CD4/CD8 ratios in the context of HIV represents a dynamic intersection of immunology, diagnostics, and therapeutics. The clinical significance of CD4/CD8 ratios extends beyond their role as diagnostic markers, acting as crucial prognostic indicators for disease progression, opportunistic infections, and non-AIDS-related comorbidities. Furthermore, these ratios play a pivotal role in guiding therapeutic decisions, especially in the era of antiretroviral therapy (ART), where monitoring immune reconstitution is paramount. Therapeutic implications and future directions underscore the potential for tailored interventions targeting immune restoration, individualized treatment approaches, novel immunotherapies, and the quest for a functional cure. The integration of advanced technologies and the exploration of combination therapies provide a glimpse into a future where precision medicine transforms HIV care.

References

1. Vinhaes CL, Araujo-Pereira M, Tibúrcio R, Cubillos-Angulo JM, Demitto FO, Akrami KM, Andrade BB. Systemic inflammation associated with immune reconstitution inflammatory syndrome in persons living with HIV. Life. 2021 Jan 18;11(1):65.
2. Obeagu EI, Anyanwu CN, Obeagu GU. Challenges and Considerations in Managing Blood Transfusion for Individuals with HIV. Elite Journal of HIV. 2024;2(2):1-7.
3. 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.
4. Obeagu EI, Obeagu GU. Synergistic Effects of Blood Transfusion and HIV in Children Under 5 Years with Severe Malaria: A Review. Elite Journal of HIV. 2024;2(1):31-50.
5. Obeagu EI, Anyiam AF, Obeagu GU. Unveiling B Cell Mediated Immunity in HIV Infection: Insights, Challenges, and Potential Therapeutic Avenues. Elite Journal of HIV. 2024;2(1):1-5.
6. Sokhela S, Lalla-Edward S, Siedner MJ, Majam M, Venter WD. Roadmap for achieving universal antiretroviral treatment. Annual review of pharmacology and toxicology. 2023; 63:99-117.
7. Kaya H. Safeguarding strategies and current HIV treatment in the UK. World Journal of Advanced Research and Reviews. 2024;21(2):1644-1651.

8. 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.
9. Obeagu EI, Alum EU, Obeagu GU. Factors associated with prevalence of HIV among youths: A review of Africa perspective. Madonna University journal of Medicine and Health Sciences. 2023;3(1):13-18. https://madonnauniversity.edu.ng/journals/index.php/medicine/article/view/93.
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, Musiimenta E, Bot YS, Hassan AO. Factors contributing to low utilization of HIV counseling and testing services. Int. J. Curr. Res. Med. Sci. 2023;9(2): 1-5.DOI: 10.22192/ijcrms.2023.09.02.001
15. 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.
16. 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.
17. 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.
18. 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.
19. 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.

20. 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.
21. 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
22. 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
23. 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.
24. 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.
25. Igwe CM, Obeagu IE, Ogbuabor OA. Clinical characteristics of people living with HIV/AIDS on ART in 2014 at tertiary health institutions in Enugu, Nigeria. J Pub Health Nutri. 2022; 5 (6). 2022;130. links/645a166f5762c95ac3817d32/Clinical-characteristics-of-people-living-with-HIV-AIDS-on-ART-in-2014-at-tertiary-health-institutions-in-Enugu.pdf.
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. 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.
37. 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
38. 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.

39. 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 Journal of Dental and Health Sciences. 2023;3(2):7-14. http://ajdhs.com/index.php/journal/article/view/39.
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. 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.
42. 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/.
43. Igwe MC, Obeagu EI, Ogbuabor AO, Eze GC, Ikpenwa JN, Eze-Steven PE. Socio-Demographic Variables of People Living with HIV/AIDS Initiated on ART in 2014 at Tertiary Health Institution in Enugu State. Asian Journal of Research in Infectious Diseases. 2022;10(4):1-7.
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. Igwe MC, Obeagu EI, Ogbuabor AO. ANALYSIS OF THE FACTORS AND PREDICTORS OF ADHERENCE TO HEALTHCARE OF PEOPLE LIVING WITH HIV/AIDS IN TERTIARY HEALTH INSTITUTIONS IN ENUGU STATE. Madonna University journal of Medicine and Health Sciences. 2022;2(3):42-57. https://madonnauniversity.edu.ng/journals/index.php/medicine/article/view/75.
46. 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
47. 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

48. 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.
49. 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.
50. 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.
51. 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.
52. 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.
53. Ifeanyi OE, Obeagu GU. The Values of CD4 Count, among HIV Positive Patients in FMC Owerri. Int. J. Curr. Microbiol. App. Sci. 2015;4(4):906-910. https://www.academia.edu/download/38320134/Obeagu_Emmanuel_Ifeanyi_and_Obeagu__Getrude_Uzoma.EMMA2.pdf.
54. Obeagu EI, Okeke EI, Anonde Andrew C. Evaluation of haemoglobin and iron profile study among persons living with HIV in Umuahia, Abia state, Nigeria. Int. J. Curr. Res. Biol. Med. 2016;1(2):1-5.
55. Alum EU, Ugwu OP, Obeagu EI, Okon MB. Curtailing HIV/AIDS Spread: Impact of Religious Leaders. Newport International Journal of Research in Medical Sciences (NIJRMS). 2023;3(2):28-31.
56. 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):64-67.
57. Alum EU, Obeagu EI, Ugwu OP, Aja PM, Okon MB. HIV Infection and Cardiovascular diseases: The obnoxious Duos. Newport International Journal of Research in Medical Sciences (NIJRMS). 2023;3(2):95-99.
58. Ibebuike JE, Nwokike GI, Nwosu DC, Obeagu EI. A Retrospective Study on Human Immune Deficiency Virus among Pregnant Women Attending Antenatal Clinic in Imo State University Teaching Hospital. *International Journal of Medical Science and Dental Research,* 2018; 1 (2):08-14. https://www.ijmsdr.org/published%20paper/li1i2/A%20Retrospective%20Study%20on%20Human%20Immune%20Deficiency%20Virus%20among%20Pregnant%20Women%2

0Attending%20Antenatal%20Clinic%20in%20Imo%20State%20University%20Teaching%20Hospital.pdf.

59. Obeagu EI, Obarezi TN, Omeh YN, Okoro NK, Eze OB. Assessment of some haematological and biochemical parametrs in HIV patients before receiving treatment in Aba, Abia State, Nigeria. Res J Pharma Biol Chem Sci. 2014; 5:825-830.
60. Obeagu EI, Obarezi TN, Ogbuabor BN, Anaebo QB, Eze GC. Pattern of total white blood cell and differential count values in HIV positive patients receiving treatment in Federal Teaching Hospital Abakaliki, Ebonyi State, Nigeria. International Journal of Life Science, Biotechnology and Pharama Research. 2014; 391:186-189.
61. 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.
62. Oloro OH, Obeagu EI. A Systematic Review on Some Coagulation Profile in HIV Infection. International Journal of Innovative and Applied Research. 2022;10(5):1-11.
63. Nwosu DC, Obeagu EI, Nkwuocha BC, Nwanna CA, Nwanjo HU, Amadike JN, Ezemma MC, Okpomeshine EA, Ozims SJ, Agu GC. Alterations in superoxide dismutiase, vitamins C and E in HIV infected children in Umuahia, Abia state. International Journal of Advanced Research in Biological Sciences. 2015;2(11):268-271.
64. Obeagu EI, Malot S, Obeagu GU, Ugwu OP. HIV resistance in patients with Sickle Cell Anaemia. Newport International Journal of Scientific and Experimental Sciences (NIJSES). 2023;3(2):56-59.
65. Ifeanyi OE, Uzoma OG, Stella EI, Chinedum OK, Abum SC. Vitamin D and insulin resistance in HIV sero positive individuals in Umudike. Int. J. Curr. Res. Med. Sci. 2018;4(2):104-108.
66. Ifeanyi OE, Leticia OI, Nwosu D, Chinedum OK. A Review on blood borne viral infections: universal precautions. Int. J. Adv. Res. Biol. Sci. 2018;5(6):60-66.
67. Nwovu AI, Ifeanyi OE, Uzoma OG, Nwebonyi NS. Occurrence of Some Blood Borne Viral Infection and Adherence to Universal Precautions among Laboratory Staff in Federal Teaching Hospital Abakaliki Ebonyi State. Arch Blood Transfus Disord. 2018;1(2).
68. 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.
69. 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.
70. Obeagu EI, Obeagu GU, Ede MO, Odo EO, Buhari HA. Translation of HIV/AIDS knowledge into behavior change among secondary school adolescents in Uganda: A review. Medicine (Baltimore). 2023;102(49): e36599. doi: 10.1097/MD.0000000000036599. PMID: 38065920; PMCID: PMC10713174.
71. Anyiam AF, Arinze-Anyiam OC, Irondi EA, Obeagu EI. Distribution of ABO and rhesus blood grouping with HIV infection among blood donors in Ekiti State Nigeria. Medicine (Baltimore). 2023;102(47): e36342. doi: 10.1097/MD.0000000000036342. PMID: 38013335; PMCID: PMC10681551.

72. Echefu SN, Udosen JE, Akwiwu EC, Akpotuzor JO, Obeagu EI. Effect of Dolutegravir regimen against other regimens on some hematological parameters, CD4 count and viral load of people living with HIV infection in South Eastern Nigeria. Medicine (Baltimore). 2023;102(47): e35910. doi: 10.1097/MD.0000000000035910. PMID: 38013350; PMCID: PMC10681510.
73. Opeyemi AA, Obeagu EI. Regulations of malaria in children with human immunodeficiency virus infection: A review. Medicine (Baltimore). 2023;102(46): e36166. doi: 10.1097/MD.0000000000036166. PMID: 37986340; PMCID: PMC10659731.
74. Alum EU, Obeagu EI, Ugwu OPC, Samson AO, Adepoju AO, Amusa MO. Inclusion of nutritional counseling and mental health services in HIV/AIDS management: A paradigm shift. Medicine (Baltimore). 2023;102(41): e35673. doi: 10.1097/MD.0000000000035673. PMID: 37832059; PMCID: PMC10578718.
75. Aizaz M, Abbas FA, Abbas A, Tabassum S, Obeagu EI. Alarming rise in HIV cases in Pakistan: Challenges and future recommendations at hand. Health Sci Rep. 2023;6(8): e1450. doi: 10.1002/hsr2.1450. PMID: 37520460; PMCID: PMC10375546.
76. Obeagu EI, Obeagu GU, Obiezu J, Ezeonwumelu C, Ogunnaya FU, Ngwoke AO, Emeka-Obi OR, Ugwu OP. Hematologic Support in HIV Patients: Blood Transfusion Strategies and Immunological Considerations. APPLIED SCIENCES (NIJBAS). 2023;3(3).
77. Obeagu EI, Ubosi NI, Uzoma G. Storms and Struggles: Managing HIV Amid Natural Disasters. Int. J. Curr. Res. Chem. Pharm. Sci. 2023;10(11):14-25.
78. Obeagu EI, Obeagu GU. Human Immunodeficiency Virus and tuberculosis infection: A review of prevalence of associated factors. Int. J. Adv. Multidiscip. Res. 2023;10(10):56-62.
79. Obeagu EI, Malot S, Obeagu GU, Ugwu OP. HIV resistance in patients with Sickle Cell Anaemia. Newport International Journal of Scientific and Experimental Sciences (NIJSES). 2023;3(2):56-9.
80. Alum EU, Ugwu OP, Obeagu EI, Aja PM, Okon MB, Uti DE. Reducing HIV Infection Rate in Women: A Catalyst to reducing HIV Infection pervasiveness in Africa. International Journal of Innovative and Applied Research. 2023;11(10):01-6.
81. Claiborne DT, Prince JL, Scully E, Macharia G, Micci L, Lawson B, Kopycinski J, Deymier MJ, Vanderford TH, Nganou-Makamdop K, Ende Z. Replicative fitness of transmitted HIV-1 drives acute immune activation, proviral load in memory CD4+ T cells, and disease progression. Proceedings of the National Academy of Sciences. 2015;112(12):E1480-1489.
82. Obeagu EI, Obeagu GU. Unmasking the Truth: Addressing Stigma in the Fight Against HIV. Elite Journal of Public Health. 2024;2(1):8-22.
83. 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.
84. Obeagu EI, Obeagu GU. Utilization of immunological ratios in HIV: Implications for monitoring and therapeutic strategies. Medicine. 2024 Mar 1;103(9):e37354.
85. Obeagu EI, Obeagu GU. CD8 Dynamics in HIV Infection: A Synoptic Review. Elite Journal of Immunology. 2024;2(1):1-3.

86. Obeagu EI, Obeagu GU. Implications of B Lymphocyte Dysfunction in HIV/AIDS. Elite Journal of Immunology. 2024;2(1):34-46.
87. Obeagu EI, Obeagu GU. Maternal Influence on Infant Immunological Responses to HIV: A Review. Elite Journal of Laboratory Medicine. 2024;2(1):46-58.
88. Obeagu EI, Obeagu GU. Understanding B Lymphocyte Functions in HIV Infection: Implications for Immune Dysfunction and Therapeutic Strategies. Elite Journal of Medicine. 2024;2(1):35-46.
89. Obeagu EI, Obeagu GU. Platelet-Driven Modulation of HIV: Unraveling Interactions and Implications. Journal home page: http://www. journalijiar. com.;12(01).
90. Obeagu EI, Anyiam AF, Obeagu GU. Managing Hematological Complications in HIV: Erythropoietin Considerations. Elite Journal of HIV. 2024;2(1):65-78.
91. 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.
92. Obeagu EI, Obeagu GU, Hauwa BA, Umar AI. Neutrophil Dynamics: Unveiling Their Role in HIV Progression within Malaria Patients. Journal home page: http://www. journalijiar. com.;12(01).
93. 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.
94. Obeagu EI, Obeagu GU. The Crucial Involvement of CD8 in HIV Progression: A Review. Int. J. Curr. Res. Med. Sci. 2024;10(2):15-25.
95. Obeagu EI, Obeagu GU. Eosinophil Dynamics in Pregnancy among Women Living with HIV: A Comprehensive Review. Int. J. Curr. Res. Med. Sci. 2024;10(1):11-24.
96. 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.