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Ceruloplasmin and HIV-Associated Psychiatric Disorders: A Review

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Abstract

Psychiatric disorders represent a significant burden among individuals living with human immunodeficiency virus (HIV), contributing to impaired quality of life, treatment adherence, and overall health outcomes. The prevalence of psychiatric manifestations, including depression, anxiety, neurocognitive impairment, and psychosis, is disproportionately higher in HIV-infected individuals compared to the general population. These psychiatric disorders not only impact psychological well-being but also pose challenges for the management of HIV infection and its associated complications. Ceruloplasmin, a multifunctional glycoprotein primarily synthesized in the liver and present in the central nervous system, has emerged as a potential player in the pathogenesis of HIV-associated psychiatric disorders. Beyond its canonical role in copper metabolism and antioxidant defense, ceruloplasmin is involved in various neurological and psychiatric processes, including neurotransmitter regulation, neuroinflammation, and oxidative stress mitigation. Dysregulation of ceruloplasmin levels and activity may contribute to the pathophysiology of psychiatric symptoms observed in HIV-infected individuals, highlighting its potential significance as a biomarker and therapeutic target in this context. This review aims to explore the intricate relationship between ceruloplasmin and HIV-associated psychiatric disorders, synthesizing existing literature to elucidate the role of ceruloplasmin in disease pathogenesis, diagnosis, and management.

Keywords*: Ceruloplasmin, HIV, Psychiatric Disorders, Mental Health, Neurocognitive Disorders, Antiretroviral Therapy, Oxidative Stress, Neuroinflammation*

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Introduction

Psychiatric disorders pose a significant burden in individuals living with human immunodeficiency virus (HIV), complicating their clinical management and diminishing their quality of life. The prevalence of psychiatric manifestations, including depression, anxiety, neurocognitive impairment, and psychosis, is notably higher among HIV-infected individuals compared to the general population. These psychiatric comorbidities not only exacerbate the psychological distress experienced by affected individuals but also contribute to treatment non-adherence and poorer health outcomes. Ceruloplasmin, a multifunctional glycoprotein primarily synthesized in the liver, has garnered attention for its potential involvement in the pathogenesis of HIV-associated psychiatric disorders. Beyond its classical role in copper metabolism and antioxidant defense, ceruloplasmin exerts diverse neuroprotective effects within the central nervous system, influencing neurotransmitter regulation, neuroinflammation, and oxidative stress responses. Dysregulation of ceruloplasmin levels and activity may disrupt these neuroprotective mechanisms, contributing to the development or exacerbation of psychiatric symptoms in HIV-infected individuals.[1-10]

This review seeks to explore the intricate relationship between ceruloplasmin and HIV-associated psychiatric disorders, synthesizing current knowledge to elucidate the role of ceruloplasmin in disease pathogenesis, diagnosis, and management. By examining the impact of ceruloplasmin dysregulation on psychiatric outcomes in HIV-infected individuals, we aim to provide insights that may inform future research directions and clinical approaches for addressing mental health challenges in this population. Through a deeper understanding of the molecular mechanisms linking ceruloplasmin, HIV infection, and psychiatric manifestations, clinicians and researchers can develop targeted interventions to mitigate psychiatric morbidity and improve overall well-being. The pathophysiology of psychiatric disorders in HIV-infected individuals is multifactorial, involving a complex interplay of biological, psychosocial, and environmental factors. Ceruloplasmin's role in modulating oxidative stress, neuroinflammation, and neurotransmitter function makes it a compelling candidate for investigation in the context of HIV-associated psychiatric morbidity. By elucidating the specific mechanisms by which ceruloplasmin contributes to psychiatric symptomatology in HIV-infected individuals, we may uncover novel therapeutic targets and strategies for managing psychiatric disorders in this population.[11-20]

Moreover, the diagnostic and prognostic implications of ceruloplasmin in HIV-associated psychiatric disorders warrant exploration. Elevated serum ceruloplasmin levels have been reported in HIV-infected individuals with psychiatric symptoms, suggesting its potential utility as a biomarker for neurocognitive dysfunction and mood disturbances. Understanding the relationship between ceruloplasmin levels and psychiatric outcomes may facilitate early detection, risk stratification, and treatment monitoring in this vulnerable population. In addition to its diagnostic potential, ceruloplasmin may serve as a therapeutic target for mitigating psychiatric symptoms in HIV-infected individuals. Strategies aimed at modulating ceruloplasmin expression or activity could offer novel approaches for managing psychiatric comorbidities in this population. Further research is needed to elucidate the efficacy and safety of ceruloplasmin-targeted interventions in

clinical settings and to identify optimal strategies for integrating ceruloplasmin modulation into comprehensive psychiatric care for HIV-infected individuals.[21-30]

Ceruloplasmin Function and Regulation

Ceruloplasmin, a versatile glycoprotein predominantly synthesized in the liver, serves as a crucial component in various physiological processes, including copper metabolism, iron homeostasis, and antioxidant defense mechanisms. Its multifaceted functions underscore its significance in maintaining cellular integrity and overall health. Ceruloplasmin acts as the principal copper transporter in the bloodstream, facilitating the transport of copper ions from the liver to peripheral tissues. Copper is an essential micronutrient involved in a myriad of enzymatic reactions, including those crucial for energy production, neurotransmitter synthesis, and connective tissue formation. Ceruloplasmin ensures the efficient distribution of copper throughout the body, thereby supporting vital biological processes. In addition to its role in copper transport, ceruloplasmin influences iron metabolism by facilitating the conversion of ferrous iron (Fe^2+) to its ferric form (Fe^3+). This enzymatic activity, known as ferroxidase activity, promotes the incorporation of iron into transferrin, the primary iron transport protein in the bloodstream. By enhancing iron binding to transferrin, ceruloplasmin contributes to the regulation of systemic iron levels, thereby preventing iron toxicity and maintaining iron homeostasis.[31-40]

Ceruloplasmin exerts potent antioxidant effects through its ability to scavenge free radicals and mitigate oxidative stress. Free radicals, generated as byproducts of cellular metabolism or in response to environmental stressors, can cause cellular damage by oxidizing lipids, proteins, and DNA. Ceruloplasmin acts as a ferroxidase enzyme, converting toxic ferrous ions (Fe^2+) into less reactive ferric ions (Fe^3+), thereby preventing the generation of harmful hydroxyl radicals through the Fenton reaction. This antioxidant function helps protect cells and tissues from oxidative damage, mitigating the risk of oxidative stress-related diseases. Ceruloplasmin synthesis and secretion are tightly regulated at the transcriptional and post-transcriptional levels. Hormonal factors, such as estrogen and growth hormone, have been implicated in the regulation of ceruloplasmin expression, with estrogen stimulating ceruloplasmin synthesis in the liver. Additionally, inflammatory mediators, including interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α), can induce ceruloplasmin production in response to acute-phase reactions. Genetic polymorphisms in the ceruloplasmin gene (CP) may also influence ceruloplasmin levels and activity, potentially impacting individual susceptibility to copper-related disorders and oxidative stress-related diseases.[41-50]

Role of Ceruloplasmin in HIV-Associated Psychiatric Disorders

The role of ceruloplasmin in HIV-associated psychiatric disorders is an emerging area of interest, with growing evidence suggesting its involvement in the pathogenesis and progression of mental health complications in individuals living with HIV. Ceruloplasmin, beyond its canonical functions in copper metabolism and antioxidant defense, has been implicated in various neurological processes, including neurotransmitter regulation, neuroinflammation, and oxidative

stress modulation. Ceruloplasmin influences neurotransmitter systems within the central nervous system, potentially impacting mood regulation, cognition, and behavior. Dysregulation of neurotransmitter function is implicated in the pathogenesis of psychiatric disorders, including depression and anxiety, commonly observed in HIV-infected individuals. Ceruloplasmin's interactions with neurotransmitter systems, such as dopamine and serotonin, may contribute to the development or exacerbation of psychiatric symptoms in this population. Neuroinflammation plays a pivotal role in the pathophysiology of HIV-associated neurological complications, including psychiatric disorders. Ceruloplasmin has been shown to modulate inflammatory responses within the central nervous system, exerting both pro-inflammatory and anti-inflammatory effects depending on the context. Dysregulated neuroinflammatory processes, characterized by elevated levels of pro-inflammatory cytokines and oxidative stress, may contribute to the pathogenesis of psychiatric symptoms in HIV-infected individuals, with ceruloplasmin potentially influencing the neuroinflammatory milieu.[51-60]

Oxidative stress, resulting from an imbalance between reactive oxygen species (ROS) production and antioxidant defenses, is implicated in the neurodegenerative processes observed in HIV-associated psychiatric disorders. Ceruloplasmin exerts potent antioxidant effects, scavenging free radicals and mitigating oxidative damage within the central nervous system. Dysregulation of ceruloplasmin levels or activity may compromise antioxidant defenses, leading to increased susceptibility to oxidative stress-induced neuronal injury and psychiatric symptomatology in HIV-infected individuals. Ceruloplasmin levels have been reported to be altered in various neuropsychiatric disorders, including depression, schizophrenia, and neurodegenerative diseases. Similarly, dysregulated ceruloplasmin levels have been observed in HIV-infected individuals with psychiatric manifestations. Serum ceruloplasmin levels may serve as a potential biomarker for identifying individuals at risk of developing psychiatric complications or for monitoring disease progression and treatment response in this population.[61-62]

Diagnostic and Prognostic Implications

Diagnostic and prognostic implications of ceruloplasmin in HIV-associated psychiatric disorders offer valuable insights into disease severity, progression, and treatment response, facilitating early detection, risk stratification, and personalized management strategies in affected individuals. Altered ceruloplasmin levels have been reported in individuals with psychiatric disorders, including depression, anxiety, and cognitive impairment, suggesting its potential utility as a diagnostic biomarker in HIV-infected individuals with psychiatric symptoms. Serum ceruloplasmin levels may serve as an adjunctive tool for identifying individuals at risk of developing psychiatric complications, aiding in the early detection of mental health disorders in this population. Integration of ceruloplasmin measurements into routine clinical assessments may enhance diagnostic accuracy and facilitate timely intervention. Ceruloplasmin levels may correlate with the severity of psychiatric symptoms and cognitive impairment in HIV-infected individuals, providing valuable prognostic information. Studies have suggested that higher ceruloplasmin levels are associated with more severe psychiatric symptomatology and cognitive dysfunction in this population. Monitoring changes in ceruloplasmin levels over time may help clinicians assess

disease progression and tailor treatment strategies accordingly, thereby improving clinical outcomes and quality of life.[63-64]

Ceruloplasmin levels may predict treatment response and outcomes in HIV-infected individuals with psychiatric disorders. Changes in ceruloplasmin levels following initiation of psychiatric interventions, such as pharmacotherapy or psychotherapy, may reflect improvements or worsening of psychiatric symptoms. Monitoring ceruloplasmin levels during treatment may help clinicians evaluate treatment efficacy, optimize therapeutic regimens, and adjust management strategies to maximize patient outcomes. Ceruloplasmin levels may serve as a prognostic indicator for long-term psychiatric outcomes and overall prognosis in HIV-infected individuals. Elevated ceruloplasmin levels have been associated with increased risk of psychiatric morbidity, cognitive decline, and poorer functional outcomes in this population. Incorporating ceruloplasmin measurements into prognostic models may enhance risk stratification and inform decision-making regarding treatment intensity and follow-up care.[65-66]

Therapeutic Considerations

Therapeutic considerations regarding ceruloplasmin in the context of HIV-associated psychiatric disorders encompass strategies aimed at modulating ceruloplasmin levels, optimizing psychiatric treatments, and addressing underlying neurobiological mechanisms to improve mental health outcomes in affected individuals. Pharmacological interventions targeting ceruloplasmin expression or activity may offer therapeutic potential for managing psychiatric symptoms in HIV-infected individuals. Agents that enhance ceruloplasmin synthesis or stabilize its enzymatic activity could potentially mitigate neuroinflammation, oxidative stress, and neurotransmitter dysregulation implicated in the pathogenesis of psychiatric disorders. Further research is warranted to identify and evaluate ceruloplasmin-targeted therapies for their efficacy and safety in clinical settings. Integrating ceruloplasmin modulation into existing psychiatric treatment paradigms may enhance treatment outcomes in HIV-infected individuals with psychiatric disorders. Tailoring psychiatric interventions, such as antidepressant or antipsychotic medications, to target neurobiological pathways influenced by ceruloplasmin dysregulation could improve treatment response and symptom remission rates. Additionally, psychosocial interventions, including cognitive-behavioral therapy and support groups, may complement pharmacotherapy by addressing psychosocial stressors and promoting resilience in this population.[67-68]

Addressing comorbid medical conditions, including HIV-related neurocognitive disorders, substance use disorders, and metabolic disturbances, is integral to comprehensive psychiatric care in HIV-infected individuals. Coordinated multidisciplinary care involving psychiatrists, infectious disease specialists, neurologists, and social workers is essential for addressing the complex medical, psychosocial, and behavioral aspects of comorbidities contributing to psychiatric symptomatology. Optimizing management of comorbidities may help alleviate psychiatric symptoms and improve overall health outcomes in this population. Lifestyle modifications, including physical exercise, dietary interventions, and stress management techniques, play a crucial role in promoting mental health and well-being in HIV-infected individuals with

psychiatric disorders. Regular physical activity has been shown to improve mood, cognition, and quality of life, while dietary modifications rich in antioxidants and omega-3 fatty acids may mitigate oxidative stress and inflammation in the brain. Additionally, stress reduction techniques, such as mindfulness meditation and relaxation exercises, may help alleviate psychiatric symptoms and enhance coping skills in this population. Optimizing ART regimens to minimize neurotoxicity and drug interactions are paramount in managing HIV-associated psychiatric disorders. Antiretroviral medications with favorable central nervous system penetration and neuropsychiatric profiles should be selected to minimize the risk of psychiatric adverse effects and optimize treatment tolerability. Close monitoring of ART adherence and viral suppression is essential for preventing disease progression and minimizing the risk of psychiatric complications in HIV-infected individuals.[68-70]

Conclusion

Ceruloplasmin emerges as a promising avenue for understanding and addressing the complex interplay between HIV infection and psychiatric disorders. The multifaceted roles of ceruloplasmin in neurobiology, including its involvement in neurotransmitter regulation, neuroinflammation, oxidative stress modulation, and as a potential biomarker, underscore its significance in the pathogenesis, diagnosis, and management of psychiatric complications in HIV-infected individuals. Therapeutic considerations surrounding ceruloplasmin offer a comprehensive approach to managing HIV-associated psychiatric disorders, encompassing strategies aimed at modulating ceruloplasmin levels, optimizing psychiatric treatments, addressing comorbidities, promoting lifestyle modifications, and optimizing ART regimens.

References

1. Vachon ML, Perumalswami P, Dieterich DT. Hepatobiliary manifestations of human immunodeficiency virus. Schiff's Diseases of the Liver. 2011:1060-1082.
2. Neuman MG, Monteiro M, Rehm J. Drug interactions between psychoactive substances and antiretroviral therapy in individuals infected with human immunodeficiency and hepatitis viruses. Substance use & misuse. 2006;41(10-12):1395-1463.
3. Kuczkowski KM. Human immunodeficiency virus in the parturient. Journal of clinical anesthesia. 2003;15(3):224-233.
4. Perovic O, Singh A. Nosocomial Infections in patients with human immunodeficiency virus (HIV). In HIV Infection in the Era of Highly Active Antiretroviral Treatment and Some of Its Associated Complications 2011. IntechOpen.
5. Cordie A, Gaber Y, AbdAllah M, Vergori A, Kharono B, Omran S, Afify S, Karkouri M, Chakroun M, Musa S, Moorhouse M. Gastrointestinal manifestations of human immunodeficiency virus and coronavirus disease 2019: Understanding the intersecting regions between the two epidemics. Arab Journal of Gastroenterology. 2021;22(2):75-87.
6. 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.

Citation: Obeagu EI, Obeagu GU. Ceruloplasmin and HIV-Associated Psychiatric Disorders: A Review. Elite Journal of Laboratory Medicine, 2023; 1(1): 43-53

7. 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.
8. 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.
9. 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.
10. 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
11. 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.
12. 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.
13. 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.
14. 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.
15. 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.
16. 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.
17. 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

Citation: Obeagu EI, Obeagu GU. Ceruloplasmin and HIV-Associated Psychiatric Disorders: A Review. Elite Journal of Laboratory Medicine, 2023; 1(1): 43-53

18. 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
19. 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.
20. 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.
21. 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.
22. 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
23. 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
24. 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.
25. 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.
26. 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.

Citation: Obeagu EI, Obeagu GU. Ceruloplasmin and HIV-Associated Psychiatric Disorders: A Review. Elite Journal of Laboratory Medicine, 2023; 1(1): 43-53

27. 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.
28. 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.
29. 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.
30. 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
31. Linder MC. Ceruloplasmin and other copper binding components of blood plasma and their functions: an update. Metallomics. 2016;8(9):887-905.
32. Shukla N, Maher J, Masters J, Angelini GD, Jeremy JY. Does oxidative stress change ceruloplasmin from a protective to a vasculopathic factor? Atherosclerosis. 2006;187(2):238-250.
33. 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.
34. 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
35. 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.
36. 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.

37. 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.
38. 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;6(1):203-211. http://research.sdpublishers.net/id/eprint/2819/.
39. 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.
40. 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
41. 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
42. 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.
43. 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.
44. 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.
45. 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.
46. 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.

47. 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.
48. 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.
49. 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%20Attending%20Antenatal%20Clinic%20in%20Imo%20State%20University%20Teaching%20Hospital.pdf.
50. 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.
51. 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.
52. 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.
53. 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.
54. 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.
55. 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.
56. 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.
57. 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).

58. 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.
59. 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.
60. 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.
61. 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.
62. 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.
63. Nallagangula KS, Nagaraj SK, Venkataswamy L, Chandrappa M. Liver fibrosis: a compilation on the biomarkers status and their significance during disease progression. Future science OA. 2017;4(1): FSO250.
64. 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.
65. Obeagu EI, Obeagu GU, Obiezu J, Ezeonwumelu C, Ogunnaya FU, Ngwoke AO, Emeka-Obi OR,
66. 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.
67. 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.
68. Ianiro G, Niro A, Rosa L, Valenti P, Musci G, Cutone A. To Boost or to Reset: The Role of Lactoferrin in Energy Metabolism. International Journal of Molecular Sciences. 2023;24(21):15925.
69. Bavaro DF, Laghetti P, Poliseno M, De Gennaro N, Di Gennaro F, Saracino A. A step closer to the “Fourth 90”: A practical narrative review of diagnosis and management of nutritional issues of people living with HIV. Diagnostics. 2021;11(11):2047.
70. Obeagu EI, Obeagu GU. Ceruloplasmin and HIV-Associated Hepatobiliary Disorders: A Review. Elite Journal of HIV, 2023; 1(1): 43-54

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