



# Eosinophilic Modulation of Neonatal Vaccine Immune Responses in HIV-Exposed Infants

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## Abstract

The intricate interplay between eosinophils and neonatal vaccine immune responses in HIV-exposed infants has emerged as a captivating avenue of research, offering insights into the multifaceted dynamics of early-life immunity. This review synthesizes current knowledge on the eosinophilic modulation of immune responses following neonatal vaccination in the unique context of HIV exposure. We explore the potential roles of eosinophils in shaping adaptive immunity, influencing vaccine efficacy, and contributing to the delicate balance between tolerance and protective immunity during the critical early stages of life. Additionally, we discuss the implications of maternal HIV infection on eosinophil function and the subsequent impact on neonatal vaccine responses. Through a comprehensive analysis of existing literature, we aim to provide a foundation for future research directions and the development of tailored immunization strategies for this vulnerable population.

**Keywords:** Eosinophils; Neonatal Vaccination; HIV-Exposed Infants; Immune Responses; HIV; Immunomodulation; Eosinophils

**Abbreviations:** ART: Antiretroviral Therapy; HIV: Human Immunodeficiency Virus; BCG: Bacillus Calmette Guerin

## Introduction

Neonatal vaccination represents a pivotal strategy in safeguarding infants against a spectrum of infectious diseases during their vulnerable early months of life. This protective shield becomes even more crucial when considering the specific challenges faced by infants born to mothers living with HIV. The interplay between the neonatal immune system, maternal HIV infection, and the potential

modulatory role of eosinophils introduces a captivating and complex dimension to the field of pediatric immunology [1-11]. The initiation of neonatal vaccines aims to establish a foundation for lifelong immunity, yet infants born to HIV-positive mothers encounter unique obstacles. Maternal HIV infection and exposure to antiretroviral therapy can influence the neonatal immune landscape, potentially impacting vaccine responses. Amidst this intricate scenario, eosinophils, conventionally associated with parasitic and allergic responses, have surfaced as dynamic contributors to immune modulation during early life [12-23].

## Eosinophils and Neonatal Immune Development

Neonatal immune development is a highly orchestrated process crucial for establishing protection against infections early in life. While the immune system undergoes dynamic maturation, the role of eosinophils in this intricate developmental landscape is gaining recognition. Traditionally known for their involvement in parasitic infections and allergic responses, eosinophils are emerging as key contributors to neonatal immune regulation, influencing both innate and adaptive arms of immunity [24].

### Neonatal Vaccine Immune Responses

Neonatal vaccination is a critical strategy aimed at conferring protection against a spectrum of infectious diseases during the vulnerable early stages of life [25]. The unique immunological landscape of neonates, characterized by limited immunoglobulin production and a predisposition towards Th2 responses, presents both opportunities and challenges in eliciting effective and durable vaccine-induced immunity.

### Immune Responses to Specific Neonatal Vaccines

#### BCG Vaccination

- Induction of Th1 and Th17 responses.
- Impact on innate immunity and potential nonspecific effects.
- Challenges in achieving consistent efficacy across diverse populations.

#### Hepatitis B Vaccination

- Maternal antibody interference and implications for neonatal vaccination.
- Development of protective antibody levels in neonates.
- Strategies to overcome immunization barriers.

#### Polio Vaccination

- Induction of mucosal and systemic immunity.
- Challenges in eradicating polio and considerations for neonatal vaccination.
- Integration of inactivated polio vaccine (IPV) and oral polio vaccine (OPV).

#### Other Neonatal Vaccines

- Considerations for vaccines against pertussis, tetanus,

diphtheria, and Haemophilus influenzae type b.

- Challenges in eliciting robust and lasting immune responses.

### Eosinophils in Maternal-Fetal Interface

The maternal-fetal interface, a complex microenvironment crucial for a successful pregnancy, is characterized by intricate immunological interactions. Eosinophils, traditionally recognized for their roles in parasitic infections and allergic responses, are gaining prominence as dynamic contributors to immune regulation within the placental environment [26].

### Immunization Strategies for HIV-Exposed Infants

HIV-exposed infants present a unique set of challenges and considerations when it comes to immunization. This section explores current approaches to neonatal vaccination in the context of maternal HIV, highlighting strategies aimed at optimizing vaccine responses, ensuring long-term protection, and addressing the specific needs of this vulnerable population [27-40].

### Recommendations

Advocate for early initiation of ART in HIV-positive pregnant women to reduce maternal viral load and improve overall maternal and neonatal health. Ensure consistent and timely administration of ART throughout pregnancy and breastfeeding. Customize neonatal immunization schedules for HIV-exposed infants, considering individual immune profiles and potential eosinophilic modulation. Implement a flexible approach to accommodate variations in maternal HIV status, ART regimens, and neonatal health. Establish integrated care models that seamlessly coordinate maternal HIV care and child health services. Promote communication between healthcare providers to ensure a holistic and continuous approach to maternal and neonatal healthcare. Strengthen surveillance systems to monitor vaccine responses in HIV-exposed infants. Develop robust mechanisms for early detection and management of adverse events related to immunization.

Design and implement community-based educational programs to raise awareness about the importance of neonatal immunization in the context of maternal HIV. Address community concerns and misconceptions regarding vaccine safety and efficacy. Encourage and support research endeavors focused on understanding the immune dynamics in HIV-exposed infants. Invest in the development of innovative vaccine formulations, adjuvants, or delivery systems tailored to the specific needs of this population. Explore interventions aimed at enhancing eosinophilic modulation

of vaccine responses in HIV-exposed infants. Investigate the potential use of adjuvants or vaccine formulations designed to optimize eosinophil function during neonatal vaccination. Foster international collaboration to share best practices and strategies for immunizing HIV-exposed infants. Advocate for policies that prioritize and support immunization programs in the context of maternal HIV on a global scale. Provide ongoing training and education for healthcare professionals involved in the care of HIV-positive pregnant women and their infants. Ensure healthcare providers are updated on the latest recommendations and strategies for neonatal immunization in the context of maternal HIV. Advocate for the inclusion of HIV-exposed infants in global vaccination initiatives and frameworks. Work towards ensuring equitable access to vaccines and immunization programs for all infants, including those born to HIV-positive mothers.

## Conclusion

This review has synthesized current knowledge, highlighted challenges, and provided recommendations to optimize strategies for immunizing HIV-exposed infants. The immune dynamics of HIV-exposed infants are influenced by maternal HIV infection, early initiation of antiretroviral therapy (ART), and the potential modulatory roles of eosinophils. Tailoring immunization schedules based on individual immune profiles and considering the unique challenges posed by maternal HIV status is crucial for achieving optimal vaccine responses. By addressing the unique challenges, leveraging current knowledge, and embracing innovative approaches, we can pave the way for improved neonatal immunization outcomes for HIV-exposed infants. This endeavor not only contributes to individual health but also aligns with broader global efforts to enhance maternal and child health in the face of the HIV pandemic. As research advances and practices evolve, the collective commitment to optimizing immunization strategies will remain crucial for the well-being of the next generation.

## References

- Obeagu EI, Okwuanaso CB, Edoho SH, Obeagu GU (2022) Under-Nutrition among HIV-Exposed Uninfected Children: A Review of African Perspective. *Madonna University journal of Medicine and Health Sciences* 2(3): 120-127.
- Obeagu EI, Alum EU, Obeagu GU (2023) Factors Associated with Prevalence of HIV among Youths: A Review of Africa Perspective. *Madonna University Journal of Medicine and Health Sciences* 3(1): 13-18.
- Obeagu EI (2023) A Review of Challenges and Coping Strategies Faced by HIV/AIDS Discordant Couples. *Madonna University journal of Medicine and Health Sciences* 3(1): 7-12.
- Obeagu EI, Obeagu GU (2023) An Update on Premalignant Cervical Lesions and Cervical Cancer Screening Services among HIV Positive Women. *J Pub Health Nutri* 6(2): 141.
- Ezeoru VC, Enweani IB, Ochiabuto O, Nwachukwu AC, Ogbonna US, et al. (2021) Prevalence of Malaria with Anaemia and HIV Status in Women of Reproductive Age in Onitsha, Nigeria. *Journal of Pharmaceutical Research International* 33(4): 10-19.
- Omo-Emmanuel UK, Chinedum OK, Obeagu EI (2017) Evaluation of Laboratory Logistics Management Information System in HIV/AIDS Comprehensive Health Facilities in Bayelsa State, Nigeria. *Int J Curr Res Med Sci* 3(1): 21-38.
- Obeagu EI, Obeagu GU, Musiimenta E, Bot YS, Hassan AO (2023) Factors Contributing to Low Utilization of HIV Counseling and Testing Services. *Int J Curr Res Med Sci* 9(2): 1-5.
- Obeagu EI, Obeagu GU (2022) An Update on Survival of People Living with HIV in Nigeria. *J Pub Health Nutri* 5(6): 129.
- Offie DC, Obeagu EI, Akueshi C, Njab JE, Ekanem EE, et al. (2021) Facilitators and Barriers to Retention in HIV Care among HIV Infected MSM Attending Community Health Center Yaba, Lagos Nigeria. *Journal of Pharmaceutical Research International* 33(52B): 10-19.
- Obeagu EI, Ogbonna US, Nwachukwu AC, Ochiabuto O, Enweani IB, et al. (2021) Prevalence of Malaria with Anaemia and HIV Status in Women of Reproductive Age in Onitsha, Nigeria. *Journal of Pharmaceutical Research International* 33(4): 10-19.
- Odo M, Ochei KC, Obeagu EI, Barinaadaa A, Eteng UE, et al. (2020) TB Infection Control in TB/HIV Settings in Cross River State, Nigeria: Policy Vs Practice. *Journal of Pharmaceutical Research International* 32(22): 101-109.
- Obeagu EI, Eze VU, Alaebob EA, Ochei KC (2016) Determination of Haematocrit Level and Iron Profile Study among Persons Living with HIV in Umuahia, Abia State, Nigeria. *J Bio Innovation* 5(4): 464-471.
- Ifeanyi OE, Obeagu GU (2015) The Values of Prothrombin Time among HIV Positive Patients in FMC Owerri. *International Journal of Current Microbiology and Applied Sciences* 4(4): 911-916.

14. Izuchukwu IF, Ozims SJ, Agu GC, Obeagu EI, Onu I, et al. (2016) 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* 3(10): 55-65.
15. Chinedu K, Takim AE, Obeagu EI, Chinazor UD, Eloghosa O, et al. (2017) HIV and TB Co-Infection among Patients Who Used Directly Observed Treatment Short-Course Centres in Yenagoa, Nigeria. *IOSR J Pharm Biol Sci* 12(4): 70-75.
16. Oloro OH, Oke TO, Obeagu EI (2022) 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* 2(3): 110-119.
17. Nwosu DC, Obeagu EI, Nkwocha BC, Nwanna CA, Nwanjo HU, et al. (2016) 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* 5(1): 24-30.
18. Igwe CM, Obeagu IE, Ogbuabor OA (2022) Clinical Characteristics of People Living with HIV/AIDS on ART in 2014 at Tertiary Health Institutions in Enugu, Nigeria. *J Pub Health Nutri* 5(6): 130.
19. Ifeanyi OE, Obeagu GU, Ijeoma FO, Chioma UI (2015) The Values of Activated Partial Thromboplastin Time (APTT) among HIV Positive Patients in FMC Owerri. *Int J Curr Res Aca Rev* 3(4): 139-144.
20. Obiomah CF, Obeagu EI, Ochei KC, Swem CA, Amachukwu BO (2018) Hematological Indices O HIV Seropositive Subjects in Nnamdi Azikiwe University Teaching Hospital (NAUTH), Nnewi. *Ann Clin Lab Res* 6(1): 1-4.
21. Omo EUK, Ochei KC, Osuala EO, Obeagu EI, Onwuasoanya UF (2017) Impact of Prevention of Mother to Child Transmission (PMTCT) of HIV on Positivity Rate in Kafanchan, Nigeria. *Int J Curr Res Med Sci* 3(2): 28-34.
22. Aizaz M, Abbas FA, Abbas A, Tabassum S, Obeagu EI (2023) Alarming Rise in HIV Cases in Pakistan: Challenges and Future Recommendations at Hand. *Health Science Reports* 6(8): e1450.
23. Obeagu EI, Amekpor F, Scott GY (2023) An Update of Human Immunodeficiency Virus Infection: Bleeding Disorders. *J Pub Health Nutri* 6 (1): 139.
24. Tsafaras GP, Ntontsi P, Xanthou G (2020) Advantages and Limitations of the Neonatal Immune System. *Frontiers in Pediatrics* 8: 5.
25. Kollmann TR, Kampmann B, Mazmanian SK, Marchant A, Levy O (2017) Protecting the Newborn and Young Infant From Infectious Diseases: Lessons from Immune Ontogeny. *Immunity* 46(3): 350-363.
26. Bian Q, Fu B (2022) Immunological Microenvironment at the Maternal-Fetal Interface. *Journal of Reproductive Immunology* 151: 103632.
27. Obeagu EI, Scott GY, Amekpor F, Ofodile AC, Edoho SH, et al. (2022) Prevention of New Cases of Human Immunodeficiency Virus: Pragmatic Approaches of Saving Life in Developing Countries. *Madonna University Journal of Medicine and Health Sciences* 2(3): 128-134.
28. Walter O, Anaabo QB, Obeagu EI, Okoroiwu IL (2022) Evaluation of Activated Partial Thromboplastin Time and Prothrombin Time in HIV and TB Patients in Owerri Metropolis. *Journal of Pharmaceutical Research International* 34(3A): 29-34.
29. Odo M, Ochei KC, Obeagu EI, Barinaadaa A, Eteng EU, et al. (2020) 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* 32(24): 9-18.
30. Jakheng SP, Obeagu EI (2022) Seroprevalence of Human Immunodeficiency Virus Based on Demographic and Risk Factors among Pregnant Women Attending Clinics in Zaria Metropolis, Nigeria. *J Pub Health Nutri* 5(8): 127.
31. Obeagu EI, Obeagu GU (2023) 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* 10(9): 135-142.
32. Obeagu EI, Onuoha EC (2023) Tuberculosis among HIV Patients: A Review of Prevalence and Associated Factors. *Int J Adv Res Biol Sci* 10(9): 128-134.
33. Obeagu EI, Ibeh NC, Nwobodo HA, Ochei KC, Iwegbulam CP (2017) Haematological Indices of Malaria Patients Coinfected with HIV in Umuahia. *Int J Curr Res Med Sci* 3(5): 100-104.
34. Jakheng SP, Obeagu EI, Abdullahi IO, Jakheng EW, Chukwueze CM, et al. (2022) 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* 13(2): 26-31.
35. Viola N, Kimono E, Nuruh N, Obeagu EI (2023) 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* 3(2): 7-14.
36. Okorie HM, Emmanuel OI, Henry CHO, Stella NC (2020) 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* 2(3): 180-183.
  37. Ezugwu UM, Onyenekwe CC, Ukibe NR, Ahaneku JE, Onah CE, et al. (2021) 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* 33(47A): 78-84.
  38. Emmanuel G, Martin O, Peter OS, Obeagu EI, Daniel K (2023) 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* 6(1): 203-211.
  39. Igwe MC, Obeagu EI, Ogbuabor AO, Eze GC, Ikpenwa JN, et al. (2022) 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* 10(4): 1-7.
  40. Vincent CC, Obeagu EI, Agu IS, Ukeagu NC, Onyekachi-Chigbu AC (2021) Adherence to Antiretroviral Therapy among HIV/AIDS in Federal Medical Centre, Owerri. *Journal of Pharmaceutical Research International* 33(57A): 360-368.

