ISSN 2348-0319 International Journal of Innovative and Applied Research [2023]
(Volume 11, Issue 12)
110-121

Journal home page: http://www.journalijiar.com

INTERNATIONAL JOURNAL
OF INNOVATIVE AND APPLIED RESEARCH

RESEARCH ARTICLE

Article DOI:10.58538/IJIAR/2067
DOI URL: *http://dx.doi.org/10.58538/IJIAR/2067*

Anemia Management in Children with Malaria: Practical Interventions for Improved Health Outcomes

*Emmanuel Ifeanyi Obeagu[1], Getrude Uzoma Obeagu[2] and Edward Odogbu Odo [3]

[1]Department of Medical Laboratory Science, Kampala International University, Uganda.
[2]School of Nursing Science, Kampala International University, Uganda.
[3] School of General Studies (Physical and Health Education Unit) Michael Okpara University of Agriculture, Umudike, Nigeria.

Manuscript Info

Manuscript History
Received: 05 November 2023
Final Accepted: 22 December 2023
Published: December 2023

Keywords:
anemia, children, malaria, interventions, health outcomes

Abstract

Anemia remains a pervasive concern among children in malaria-endemic regions, presenting a significant health challenge compounded by the coexistence of malaria. This review aims to explore practical interventions and effective strategies for managing anemia specifically in children afflicted with malaria, with the overarching goal of improving health outcomes in this vulnerable population. The interplay between anemia and malaria is multifaceted, wherein the parasitic infection leads to hemolysis, compromised hemoglobin synthesis, and consequent anemia in affected children. Accurate diagnosis is pivotal, necessitating the utilization of rapid diagnostic tests for timely identification of both conditions amid overlapping symptoms. The management approach involves a comprehensive strategy encompassing prompt antimalarial therapy alongside targeted interventions addressing anemia. This includes the administration of iron supplements, folic acid, and vitamin B12, coupled with blood transfusions in severe cases to restore depleted stores and enhance erythropoiesis. Moreover, ensuring adequate nutrition, hydration, and community engagement are integral facets of holistic care. Promoting balanced diets rich in essential nutrients, alongside education programs emphasizing preventive measures and early recognition of symptoms, plays a crucial role in mitigating

morbidity and mortality rates. In conclusion, the effective management of anemia in children with malaria demands a multifaceted approach, integrating timely diagnosis, tailored treatment, nutritional support, and community-based interventions. Collaborative efforts among healthcare professionals, policymakers, and communities are imperative to address the complexities of these concurrent health challenges, aiming for improved health outcomes and a brighter future for affected children in malaria-endemic regions.

Corresponding Author: - Emmanuel Ifeanyi Obeagu, *Department of Medical Laboratory Science, Kampala International University, Uganda.*

Introduction

Anemia, a prevalent global health issue, disproportionately affects children in regions endemic to malaria, posing intricate challenges in pediatric healthcare. The coexistence of anemia and malaria amplifies the complexities in managing these conditions and necessitates a tailored approach for effective intervention [1-10]. This paper aims to delve into the intricate relationship between anemia and malaria in pediatric populations, exploring practical strategies and interventions aimed at mitigating the impact of these concurrent health burdens and improving overall health outcomes.

Malaria, caused by Plasmodium parasites transmitted through the bite of infected mosquitoes, remains a major public health concern, particularly in tropical and subtropical regions. Children bear a substantial burden of this parasitic infection, facing increased vulnerability to severe complications, with anemia being a prominent consequence. The pathophysiological mechanisms linking malaria to anemia involve multifaceted processes, including the destruction of red blood cells, impaired erythropoiesis, and the inflammatory response induced by the infection [11-20].

The diagnosis and management of anemia in children with malaria pose significant challenges due to the overlapping clinical manifestations and the intricate interplay between these conditions. Accurate and timely diagnosis is imperative for implementing targeted interventions to address both anemia and the underlying malaria infection effectively [21-30].

This paper aims to elucidate practical interventions encompassing prompt antimalarial therapy and tailored approaches to manage anemia in pediatric malaria cases. Strategies such as iron supplementation, folic acid and vitamin B12 administration, blood transfusions in severe cases, and nutritional support play pivotal roles in addressing the complex pathophysiology of anemia in the context of malaria. Furthermore, holistic care for children affected by malaria-induced anemia extends beyond medical interventions. Community engagement, education, and the promotion of adequate nutrition and hygiene practices are integral components in the comprehensive management of these conditions. This paper endeavors to explore the nuanced

interrelationship between anemia and malaria in pediatric populations, emphasizing the need for multifaceted interventions that encompass medical treatments, nutritional support, and community-based approaches. Addressing the challenges posed by these concurrent health burdens requires collaborative efforts among healthcare professionals, policymakers, and communities to ensure better health outcomes for children affected by malaria-associated anemia.

Interplay of Anemia and Malaria

Understanding the interplay between anemia and malaria in pediatric populations is crucial to effectively address these concurrent health challenges. Malaria, caused by Plasmodium parasites transmitted through the bite of infected mosquitoes, predominantly affects children in endemic regions, leading to a myriad of health complications. Among these, anemia stands as a significant consequence and complication of the disease, exacerbating the health burden in affected populations [31-30]. The intricate relationship between malaria and anemia involves multifaceted pathophysiological mechanisms. The malaria parasite's lifecycle within red blood cells leads to their destruction, causing hemolysis and subsequent reduction in the number of circulating red blood cells. Additionally, the inflammatory response triggered by the infection further impairs erythropoiesis, the process of red blood cell production, contributing to decreased hemoglobin levels and anemia [31-40]. Anemia, characterized by low hemoglobin levels, exacerbates the severity of malaria and its associated complications. Reduced oxygen-carrying capacity due to anemia intensifies the risk of tissue hypoxia, organ damage, and complications such as cerebral malaria, particularly in pediatric cases. Furthermore, anemia weakens the body's ability to combat the malaria parasite, establishing a vicious cycle wherein malaria-induced anemia perpetuates the severity of both conditions [41-49]. Diagnosing and managing anemia in children with malaria present significant challenges due to overlapping clinical manifestations and the need for prompt and accurate identification. Blood tests for hemoglobin levels, hematocrit, and red blood cell indices, alongside malaria diagnostic tools like rapid diagnostic tests and microscopic examination, are essential for precise identification and effective management of both conditions [50]. Addressing the interplay between anemia and malaria necessitates a multifaceted approach. Timely administration of antimalarial therapies to control the infection, coupled with targeted interventions to manage anemia, forms the cornerstone of effective treatment. Providing iron supplementation, folic acid, and vitamin B12, as well as blood transfusions in severe cases, helps replenish depleted stores and supports erythropoiesis, thereby mitigating anemia's impact.

Diagnostic Approaches and Challenges

Diagnostic approaches and challenges in identifying anemia in children with malaria represent a critical aspect of managing these concurrent health conditions. The coexistence of malaria and anemia poses significant hurdles in accurate diagnosis due to overlapping symptoms and complexities inherent to both conditions [51]. In regions where malaria is endemic, clinical suspicion for both malaria infection and anemia in children presenting with symptoms such as fever, fatigue, pallor, and weakness is paramount. Utilizing rapid diagnostic tests (RDTs) for malaria, including antigen-based assays and microscopic examination of blood smears, facilitates prompt identification of the parasitic infection. However, these tests may not always discern the

severity of the infection or its impact on concurrent anemia [52]. Anemia diagnosis typically involves assessing hemoglobin levels, hematocrit, and red blood cell indices. However, in malaria-endemic regions, interpreting these parameters can be challenging due to alterations caused by the parasitic infection. Malaria-induced hemolysis and changes in red blood cell morphology can confound the interpretation of standard hemoglobin tests, leading to potential underestimation or overestimation of anemia severity [53]. Further complicating the diagnostic landscape is the presence of other potential causes of anemia beyond malaria, such as nutritional deficiencies (iron, folate, vitamin B12), hemoglobinopathies, and other infectious diseases prevalent in these regions. Distinguishing between these various etiologies of anemia requires comprehensive diagnostic evaluations, often in resource-limited settings where access to sophisticated laboratory tests may be limited. Moreover, the challenges in diagnosing anemia in malaria-infected children extend to differentiating between uncomplicated and severe malaria cases. Severe malaria, particularly in pediatric populations, can manifest with complications like cerebral malaria, severe anemia, and multi-organ dysfunction, necessitating urgent and accurate diagnosis to guide appropriate management. Addressing these diagnostic challenges requires a multifaceted approach. Developing and implementing improved diagnostic tools specific to malaria-associated anemia is imperative. These tools should aim to differentiate between anemia caused by malaria and other contributing factors, providing accurate and timely assessments in resource-constrained settings. Additionally, capacity-building initiatives for healthcare providers in these regions are crucial to enhance their skills in recognizing and managing both malaria and anemia. Empowering healthcare professionals with the knowledge and resources to navigate the complexities of diagnosing and treating these concurrent conditions is essential for improving pediatric health outcomes in malaria-endemic areas.

Practical Interventions and Treatment Modalities

Practical interventions and treatment modalities for managing anemia in children afflicted with malaria encompass a multifaceted approach aimed at addressing the complex interplay between these concurrent health conditions. Tailored interventions targeting both the underlying malaria infection and the resultant anemia are pivotal for effective management and improved health outcomes in affected pediatric populations [54]. Initiating prompt and appropriate antimalarial treatment is fundamental in controlling the malaria infection. Antimalarial medications, such as artemisinin-based combination therapies (ACTs), are commonly recommended as first-line treatments. Early diagnosis and timely administration of these medications help curtail the progression of the parasitic infection and reduce the severity of associated complications, including anemia [55]. Iron supplementation, especially in areas with a high prevalence of iron-deficiency anemia, helps replenish depleted iron stores and supports erythropoiesis. Combining iron supplementation with other micronutrients and nutritional interventions can further enhance the effectiveness of anemia management strategies.[56] In severe cases of malaria-induced anemia, particularly when hemoglobin levels are critically low or when complications like severe anemia or cerebral malaria arise, blood transfusions become necessary. Transfusions aid in rapidly restoring hemoglobin levels and improving oxygen-carrying capacity, thereby mitigating the risks associated with severe anemia [57]. Ensuring proper hydration and supportive care are integral components of managing children with malaria-associated anemia. Maintaining adequate hydration levels supports overall health and aids in the recovery process. Hydration, when combined with nutritional support, helps optimize the body's response to treatment and fosters a

conducive environment for recovery. Regular monitoring of hemoglobin levels and clinical parameters is essential to assess the response to interventions and modify treatment plans accordingly. Follow-up visits enable healthcare providers to track progress, identify any complications or relapses, and make necessary adjustments to the management strategy. Implementing preventive measures against both malaria and anemia is crucial. These may include vector control strategies to reduce mosquito-borne infections, promoting the use of insecticide-treated bed nets, advocating for vaccination programs, and addressing socio-economic factors that contribute to malnutrition and anemia in affected communities. Educating communities about preventive measures, early recognition of symptoms, and the importance of seeking timely medical care is paramount. Empowering caregivers and community members with knowledge and resources fosters proactive healthcare-seeking behaviors and contributes to reducing the burden of malaria-associated anemia.

Nutritional Support and Hydration

Nutritional support and hydration play pivotal roles in the comprehensive management of anemia in children affected by malaria. Addressing nutritional deficiencies and ensuring adequate hydration are crucial components in supporting the body's recovery, bolstering the effectiveness of treatments, and mitigating the severity of anemia [58. Iron deficiency is a prevalent cause of anemia, especially in malaria-endemic regions. Providing iron supplements to affected children helps replenish depleted iron stores, supports erythropoiesis (red blood cell production), and aids in improving hemoglobin levels. Combining iron supplementation with other essential micronutrients like folic acid and vitamin B12 enhances the efficacy of treatment [59]. Encouraging a balanced diet rich in iron, vitamins, and minerals is fundamental in addressing nutritional deficiencies contributing to anemia. Promoting the consumption of iron-rich foods such as leafy green vegetables, beans, meat, fish, nuts, and fortified cereals aids in sustaining adequate iron levels and supports overall health. Adequate hydration is vital for children affected by malaria-induced anemia. Ensuring access to clean and safe drinking water and encouraging frequent intake of fluids helps maintain proper hydration levels. Proper hydration supports the body's physiological functions, aids in recovery, and enhances the efficacy of treatments. Promoting breastfeeding in infants and young children provides essential nutrients, including iron, and supports their overall growth and development. Additionally, implementing nutritional education programs within communities educates caregivers about the importance of a balanced diet, optimal feeding practices, and the significance of iron-rich foods in preventing and managing anemia. In severe cases or instances where nutritional deficiencies are prevalent, supplemental feeding programs can be beneficial. These programs provide additional nutritional support to children at risk of malnutrition and anemia, often incorporating fortified foods or specialized nutritional supplements to address deficiencies. Regular monitoring of nutritional status, including assessing dietary intake and nutritional markers, enables healthcare providers to evaluate the effectiveness of interventions and make necessary adjustments. Follow-up visits allow for ongoing assessment and support, ensuring sustained improvement in nutritional status and anemia management. Engaging communities in promoting nutrition-sensitive interventions, advocating for diverse diets, and providing access to nutritionally rich foods fosters a supportive environment for combating anemia. Empowering communities with knowledge about nutrition, healthy eating habits, and access to resources facilitates sustained improvements in nutritional status and overall health.

Community Engagement and Education

Community engagement and education are fundamental pillars in addressing anemia in children afflicted with malaria. Empowering communities through education, raising awareness, and fostering active participation are crucial strategies in preventing, managing, and reducing the burden of these concurrent health conditions [60]. Launching targeted awareness campaigns within communities helps disseminate vital information about malaria, anemia, and their interrelationship. These campaigns can include educational materials, workshops, community meetings, and media outreach to inform caregivers, parents, and community members about the signs, symptoms, and preventive measures. Educating communities about preventive measures, such as the use of insecticide-treated bed nets, indoor residual spraying, and environmental sanitation, helps mitigate the risk of malaria transmission. Emphasizing these measures reduces exposure to malaria vectors, thereby decreasing the incidence of malaria and subsequent complications like anemia [61]. Educating caregivers and community members about the early signs and symptoms of malaria and anemia encourages prompt healthcare-seeking behavior. Encouraging timely visits to healthcare facilities for proper diagnosis and treatment aids in preventing the progression of both conditions to severe stages. Conducting educational sessions on nutrition, emphasizing the importance of a balanced diet rich in iron, vitamins, and minerals, helps address nutritional deficiencies contributing to anemia. Educating caregivers about suitable feeding practices, including breastfeeding and introducing nutrient-rich foods, supports children's growth and development. Providing training programs for local healthcare workers and community health volunteers equips them with the necessary skills to recognize, diagnose, and manage malaria and anemia. This builds the capacity to deliver healthcare services and education within the community. Encouraging community involvement and participation in health-related activities fosters a sense of ownership and accountability. Establishing community-led initiatives, support groups, or committees dedicated to health promotion creates a sustainable framework for continued advocacy and support. Recognizing cultural beliefs and practices is crucial when implementing education and engagement programs. Tailoring interventions to align with cultural norms and values ensures greater acceptance and participation within the community. Facilitating access to healthcare facilities, diagnostic tools, treatments, and nutritional support within communities enhances the effectiveness of educational efforts. Improving access to resources enables community members to act on the knowledge gained from education initiatives.

Health and Clinical Implications

The coexistence of anemia in children afflicted with malaria carries significant health and clinical implications, necessitating comprehensive approaches to mitigate its impact. Understanding the intricate interplay between these conditions is crucial in addressing their implications on individual health and broader public health concerns.

Increased Disease Severity and Complications: Anemia exacerbates the severity of malaria and its associated complications. Reduced hemoglobin levels compromise oxygen-carrying capacity, leading to tissue hypoxia and exacerbating the risk of severe manifestations such as cerebral malaria, multi-organ dysfunction, and increased mortality, especially in pediatric cases.

Heightened Vulnerability in Pediatric Populations: Children are particularly susceptible to the detrimental effects of malaria-associated anemia. The developing physiology and increased demands for nutrients exacerbate the impact of anemia on growth, cognitive development, and overall well-being. Severe anemia in children can lead to long-term developmental delays if not promptly addressed.

Diagnostic Challenges: The overlapping symptoms and complexities inherent in diagnosing anemia within the context of malaria present significant challenges. Accurate and timely diagnosis is crucial for initiating appropriate interventions, but distinguishing between the contributions of malaria, nutritional deficiencies, and other causes of anemia can be arduous, particularly in resource-limited settings.

Impact on Treatment Response: Anemia influences the response to malaria treatment. Reduced hemoglobin levels can affect the efficacy of antimalarial medications, potentially leading to treatment failure or increased susceptibility to recurrent infections. Moreover, severe anemia may necessitate blood transfusions, impacting the overall management of both conditions.

Long-Term Health Consequences: Chronic or recurrent episodes of malaria-associated anemia in childhood may have enduring health consequences into adulthood. Prolonged or severe anemia during critical developmental stages can impair cognitive function, physical growth, and immune responses, potentially affecting overall health throughout life.

Public Health Burden: Malaria-associated anemia contributes significantly to the overall disease burden in malaria-endemic regions, imposing economic strains on healthcare systems and communities. Addressing anemia in the context of malaria is crucial not only for individual health but also for reducing the overall societal burden of disease.

Addressing these health and clinical implications requires a multi-faceted approach. Implementing strategies that encompass prompt diagnosis, effective treatment of both conditions, nutritional support, preventive measures, community engagement, and education are paramount. Additionally, investing in research and healthcare infrastructure in endemic regions to improve diagnostic tools, treatments, and access to healthcare services is essential in reducing the morbidity and mortality associated with malaria-associated anemia in children.

Conclusion

The intersection of anemia and malaria in children represents a complex health challenge with profound implications for individual well-being and public health. The intricate interplay between these conditions underscores the critical need for tailored and holistic approaches aimed at prevention, diagnosis, and management to alleviate their burden on affected pediatric populations. Malaria-induced anemia significantly amplifies the severity of both the parasitic infection and the resulting hematological consequences. Reduced hemoglobin levels compromise oxygen delivery, heightening the risk of severe complications, particularly in children. Moreover, diagnostic challenges and the multifaceted nature of anemia in the context of malaria demand comprehensive strategies for accurate identification and appropriate intervention.

Efforts to combat malaria-associated anemia must encompass a multifaceted approach. This includes timely diagnosis utilizing improved diagnostic tools, prompt initiation of antimalarial therapies, targeted interventions to address anemia, and nutritional support tailored to address deficiencies. Additionally, community engagement, education, and empowerment initiatives play pivotal roles in promoting preventive measures, early recognition of symptoms, and timely healthcare-seeking behavior. Furthermore, investing in healthcare infrastructure, research, and capacity-building initiatives in malaria-endemic regions is crucial for sustained progress. Enhancing access to healthcare services, diagnostic facilities, and affordable treatments strengthens the ability to combat both malaria and anemia effectively. Addressing the complexities of malaria-associated anemia in children requires concerted efforts from healthcare providers, policymakers, communities, and global stakeholders. Collaborative endeavors aimed at implementing integrated and sustainable interventions are vital in reducing the health burden, improving outcomes for affected children, and advancing towards the goal of eliminating malaria-associated anemia. By fostering continued research, advocating for resource allocation, and fostering community involvement, we can collectively work towards mitigating the impact of malaria-associated anemia, ensuring healthier futures for children in malaria-endemic regions worldwide.

References

1. Obeagu, E. I., Nimo, O. M., Bunu, U. O., Ugwu, O. P. C., & Alum, E. U. (2023). Anaemia in children under five years: African perspectives. *Int. J. Curr. Res. Biol. Med*, *1*, 1-7.
2. Obeagu, E. I., Babar, Q., & Obeagu, G. U. (2021). Megaloblastic anaemia-a review. *Int J Curr Res Med Sci*, *7*(5), 17-24.
3. Obeagu, E. I., Obeagu, G. U., & Habimana, J. B. (2023). Iron Deficiency Anaemia in Children. *International Research in Medical and Health Sciences*, *6*(4), 26-32.
4. Obeagu, E. I. (2021). Comparative Study of Serum Iron and Hemoglobin Levels of Cord Blood of Normal Neonates and that of Maternal Blood in Federal Medical Centre Owerri. *Journal of Clinical and Laboratory Research*, *4*(1), 2768-0487.
5. Obeagu, E. I., Opoku, D., & Obeagu, G. U. (2023). Burden of nutritional anaemia in Africa: A Review. *Int. J. Adv. Res. Biol. Sci*, *10*(2), 160-163.
6. Obeagu, E. I. (2018). Sickle Cell Anaemia: Haemolysis and Anemia. *Int. J. Curr. Res. Chem. Pharm. Sci*, *5*(10), 20-1.
7. Obeagu, E. I., Ali, A. A., Francisca, U., Onwuasoanya, A. O. N., Vandu, D. C., Obeagu, G. U., & Paul-Chima, U. O. Anaemia among pregnant women: a review in Africa.
8. Obeagu, E. I., Ali, M. M., Alum, E. U., Obeagu, G. U., Ugwu, P. O., & Bunu, U. O. (2023). An Update of Aneamia in Adults with Heart Failure. *INOSR Experimental Sciences*, *11*(2), 1-16.
9. Obeagu, E. I. (2020). Erythropoeitin in Sickle Cell Anaemia: A Review. *International Journal of Research Studies in Medical and Health Sciences*, *5*(2), 22-8.
10. Obeagu, E. I., Obeagu, G. U., Akinleye, C. A., & Igwe, M. C. (2023). Nosocomial infections in sickle cell anemia patients: Prevention through multi-disciplinary approach: A review. *Medicine*, *102*(48), e36462.
11. Obeagu, E. I., Chijioke, U. O., & Ekelozie, I. S. (2018). Malaria rapid diagnostic test (RDTs). *Ann Clin Lab Res*, *6*(4), 275.

12. Obeagu, E. I., Obeagu, G. U., Chukwueze, C. M., Ikpenwa, J. N., & Ramos, G. F. (2022). EVALUATION OF PROTEIN C, PROTEIN S AND FIBRINOGEN OF PREGNANT WOMEN WITH MALARIA IN OWERRI METROPOLIS. *Madonna University journal of Medicine and Health Sciences ISSN: 2814-3035*, *2*(2), 1-9.
13. Obeagu, E. I., Ibeh, N. C., Nwobodo, H. A., Ochei, K. C., & Iwegbulam, C. P. (2017). Haematological indices of malaria patients coinfected with HIV in Umuahia. *Int. J. Curr. Res. Med. Sci*, *3*(5), 100-104.
14. Hassan, A. O., Oso, O. V., Obeagu, E. I., & Adeyemo, A. T. (2022). Malaria Vaccine: Prospects and Challenges. *Madonna University journal of Medicine and Health Sciences ISSN: 2814-3035*, *2*(2), 22-40.
15. Ezeoru, V. C., Enweani, I. B., Ochiabuto, O., Nwachukwu, A. C., Ogbonna, U. S., & Obeagu, E. I. (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.
16. Ogomaka, I. A., & Obeagu, E. I. (2019). Methods of Breast Feeding as Determinants of Malaria Infections among Babies in IMO State, Nigeria. *International Journal of Medical Science and Dental Research*, *2*(01), 17-24.
17. Okorie, H. M., Obeagu, E. I., Obarezi, H. C., & Anyiam, A. F. (2019). Assessment of some inflammatory cytokines in malaria infected pregnant women in Imo State Nigeria. *International Journal of Medical Science and Dental Research*, *2*(1), 25-36.
18. Obeagu, E. I., Ogbonna, U. S., Nwachukwu, A. C., Ochiabuto, O., Enweani, I. B., & Ezeoru, V. C. (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.
19. Obeagu, E. I., Busari, A. I., Uduchi, I. O., Ogomaka, I. A., Ibekwe, A. M., Vincent, C. C. N., ... & Adike, C. N. (2021). Age-Related Haematological Variations in Patients with Asymptomatic Malaria in Akure, Ondo State, Nigeria. *Journal of Pharmaceutical Research International*, *33*(42B), 218-224.
20. Ogomaka, I. A., & Obeagu, E. I. (2021). Malaria in Pregnancy Amidst Possession of Insecticide Treated Bed Nets (ITNs) in Orlu LGA of Imo State, Nigeria. *Journal of Pharmaceutical Research International*, *33*(41B), 380-386.
21. Obeagu, E. I., Okwuanaso, C. B., Edoho, S. H., & Obeagu, G. U. (2022). Under-nutrition among HIV-exposed Uninfected Children: A Review of African Perspective. *Madonna University journal of Medicine and Health Sciences ISSN: 2814-3035*, *2*(3), 120-127.
22. Opeyemi, A. A., & Obeagu, E. I. (2023). Regulations of malaria in children with human immunodeficiency virus infection: A review. *Medicine*, *102*(46), e36166.
23. Obeagu, E. I., & Ogunnaya, F. U. (2023). Pregnancyinduced Haematological Changes: A Key To Marternal And Child Health. *European Journal of Biomedical*, *10*(8), 42-3.
24. Esimai, B. N., & Obeagu, E. I. (2022). Prevalence of Isolated Agent in Diarrheal Infections of Children O-3 Years in Anambra State in Relation to Sex: A Survey of Five Rural Communities. *J Biomed Sci*, *11*(8), 73.
25. Gamde, M. S., & Obeagu, E. I. (2023). Iron Deficiency Anaemia: Enemical to Pregnancy. *European Journal of Biomedical*, *10*(9), 272-5.
26. Nwosu, D. C., Obeagu, E. I., Ezenwuba, C., Agu, G. C., Amah, H., Ozims, S. J., ... & Emesowum, A. C. (2016). Antioxidant status of children with Plasmodium falciparum

malaria in Owerri municipal council of Imo state. *Int. J. Curr. Res. Chem. Pharm. Sci*, *3*(8), 40-46.

27. Ogbonna, C. O., Obeagu, E. I., Ufelle, S. A., & Ogbonna, L. N. (2021). Evaluation of haematological alterations in children infected by Plasmodium falciparum Species in Enugu, Enugu State, Nigeria. *Journal of Pharmaceutical Research International*, *33*(1), 38-45.
28. Obeagu, E. I., Njar, V. E., & Obeagu, G. U. (2023). Infertility: Prevalence and consequences. *Int. J. Curr. Res. Chem. Pharm. Sci*, *10*(7), 43-50.
29. Obeagu, E. I., Ochei, K. C., Nwachukwu, B. N., & Nchuma, B. O. (2015). Sickle cell anaemia: a review. *Scholars Journal of Applied Medical Sciences*, *3*(6B), 2244-2252.
30. Obeagu, E. I. (2022). A Systematic review on childhood immunization among men with infants: Africa perspective. *International Journal of Current Research in Medical Sciences*, *8*(9), 15-24.
31. Okamgba, O. C., Nwosu, D. C., Nwobodo, E. I., Agu, G. C., Ozims, S. J., Obeagu, E. I., ... & Ifeanyichukwu, M. O. (2017). Iron Status of Pregnant and Post-Partum Women with Malaria Parasitaemia in Aba Abia State, Nigeria. *Annals of Clinical and Laboratory Research*, *5*(4), 206.
32. Madekwe, C. C., Madekwe, C. C., & Obeagu, E. I. (2022). Inequality of monitoring in Human Immunodeficiency Virus, Tuberculosis and Malaria: A Review. *Madonna University journal of Medicine and Health Sciences ISSN: 2814-3035*, *2*(3), 6-15.
33. Anyiam, A. F., Arinze-Anyiam, O. C., Omosigho, P. O., Ibrahim, M., Irondi, E. A., Obeagu, E. I., & Obi, E. (2022). Blood Group, Genotype, Malaria, Blood Pressure and Blood Glucose Screening Among Selected Adults of a Community in Kwara State: Implications to Public Health. *Asian Hematology Research Journal*, *6*(3), 9-17.
34. Okorie, H. M., Obeagu, E. I., Eze, E. N., & Jeremiah, Z. A. (2018). Assessment of some haematological parameters in malaria infected pregnant women in Imo state Nigeria. *Int. J. Curr. Res. Biol. Med*, *3*(9), 1-14.
35. Offie, D. C., Ibekwe, A. M., Agu, C. C., Esimai, B. N., Okpala, P. U., Obeagu, E. I., ... & Ogbonna, L. N. (2021). Fibrinogen and C-Reactive Protein Significance in Children Infected by Plasmodium falciparum Species in Enugu, Enugu State, Nigeria. *Journal of Pharmaceutical Research International*, *33*(15), 1-8.
36. Okorie, H. M., Obeagu, E. I., Eze, E. N., & Jeremiah, Z. A. (2018). Assessment of coagulation parameters in malaria infected pregnant women in Imo state, Nigeria. *International Journal of Current Research in Medical Sciences*, *4*(9), 41-49.
37. Ogbonna, L. N., Ezeoru, V. C., Ofodile, A. C., Ochiabuto, O. M. T. B., Obi-Ezeani, C. N., Okpala, P. U., ... & Obeagu, E. I. (2021). Gender Based Variations of Haematological Parameters of Patients with Asymptomatic Malaria in Akure, Ondo State, Nigeria. *Journal of Pharmaceutical Research International*, *33*(8), 75-80.
38. Obeagu, E. I., Ofodile, A. C., & Okwuanaso, C. B. A review on socio economic and behavioral aspects of malaria and its control among children under 5 years of age in Africa. J Pub Health Nutri. 2023; 6 (1): 136.
39. Ifeanyi, O., Uzoma, O., Amaeze, A., Ijego, A., Felix, C., Ngozi, A., ... & Chinenye, K. (2020). Maternal expressions (serum levels) of alpha tumour necrosis factor, interleukin 10, interleukin 6 and interleukin 4 in malaria infected pregnant women based on parity in a Tertiary Hospital in Southeast, Nigeria. *Journal of Pharmaceutical Research International*, *32*(23), 35-41.

40. Ogalue, U. M., Ekejindu, I. M., Ochiabuto, O. M., Obi, M. C., Obeagu, E., & Ekelozie, I. S. (2018). Intestinal parasites, Malaria and Anaemia among school children in some flood affected areas of Ogbaru Local Government Area of Anambra State, Nigeria. *Archives of Clinical Microbiology*, *9*(2), 1-6.
41. Perkins, D. J., Were, T., Davenport, G. C., Kempaiah, P., Hittner, J. B., & Ong'echa, J. M. (2011). Severe malarial anemia: innate immunity and pathogenesis. *International journal of biological sciences*, *7*(9), 1427.
42. Leticia, O. I., Ifeanyi, O. E., Queen, E., & Chinedum, O. K. (2014). Some hematological parameters in malaria parasitaemia. *IOSR Journal of Dental and Medical Sciences*, *13*(9).
43. Obeagu, E. I., Uzoije, N. U., Afoma, I., Ogbodo, O. R., & Onyenweaku, F. C. (2013). Malaria, ABO blood group and haemoglobin genotypes in Michael Okpara University of Agriculture, Umudike, Abia State. *Nigeria. PHARMANEST*, *4*(5), 1110-1113.
44. Ifeanyi, E. O., & Uzoma, G. O. (2020). Malaria and The Sickle Cell Trait: Conferring Selective Protective Advantage to Malaria. *J Clin Med Res*, *2*, 1-4.
45. Obeagu, E. I., Ochei, K. C., & Mbah, P. C. (2019). Haemolysis associated with malaria infection: A threat to human existence. *World Journal of Pharmaceutical and Medical Research*, *5*(6), 47-49.
46. Nwosu, D. C., Nwanjo, H. U., Obeagu, E. I., Ibebuike, J. E., & Ezeama, M. C. (2015). Ihekireh. Changes in liver enzymes and lipid profile of pregnant women with malaria in Owerri, Nigeria. *International Journal of Current Research and Academic Review*, *3*(5), 376-83.
47. Ifeanyi, O. E. (2020). Iron Status of Malarial Infected Pregnant Women: A Review. *International Journal of Research*, *5*(1), 08-18.
48. Ifeanyi, O., Nonyelum, E., Stella, E., Ijego, A. E., Amaeze, A. A., Nchekwubedi, C., ... & Kyrian, C. (2020). Maternal Serum Levels of Alpha Tumour Necrotic Factor, Interleukin 10, Interleukin 6 and Interleukin 4 in Malaria Infected Pregnant Women Based on Their Gestational Age in Southeast, Nigeria. *Journal of Pharmaceutical Research International*, *32*(14), 64-70.
49. Felix, C. E., Ifeanyi, O. E., & Edith, O. C. (2019). Prevalence of Malaria Parasiteamia among Antenatal Pregnant Women Attending Selected Clinics in Hospitals within Abakiliki.
50. Greenberg, P. L., Gordeuk, V., Issaragrisil, S., Siritanaratkul, N., Fucharoen, S., & Ribeiro, R. C. (2001). Major hematologic diseases in the developing world—new aspects of diagnosis and management of thalassemia, malarial anemia, and acute leukemia. *ASH Education Program Book*, *2001*(1), 479-498.
51. Garcia-Casal, M. N., Dary, O., Jefferds, M. E., & Pasricha, S. R. (2023). Diagnosing anemia: Challenges selecting methods, addressing underlying causes, and implementing actions at the public health level. *Annals of the New York Academy of Sciences*, *1524*(1), 37-50.
52. Mills, M., Holley, S. L., Coly, P., & DeJoy, S. (2021). Malaria in Pregnancy: Considerations for Health Care Providers in Nonendemic Countries. *Journal of Midwifery & Women's Health*, *66*(3), 343-350.
53. Buttarello, M. (2016). Laboratory diagnosis of anemia: are the old and new red cell parameters useful in classification and treatment, how? *International journal of laboratory hematology*, *38*, 123-132.

54. Martial, M. A. (2019). *Determining the Effectiveness of an Anemia-Prevention Program for Children Aged 6 to 59 Months in a Rural Community in Haiti: A Mixed-Method Study* (Doctoral dissertation, The University of Utah).
55. World Health Organization. (2015). *Guidelines for the treatment of malaria*. World Health Organization.
56. Sukla, K. K., Nagar, R., & Raman, R. (2014). Vitamin-B12 and folate deficiency, major contributing factors for anemia: A population based study. *e-SPEN Journal*, *9*(1), e45-e48.
57. Akinosoglou, K. S., Solomou, E. E., & Gogos, C. A. (2012). Malaria: a haematological disease. *Hematology*, *17*(2), 106-114.
58. Fançony, C., Soares, Â., Lavinha, J., Barros, H., & Brito, M. (2019). Efficacy of nutrition and WASH/malaria educational community-based interventions in reducing anemia in preschool children from Bengo, Angola: study protocol of a randomized controlled trial. *International journal of environmental research and public health*, *16*(3), 466.
59. Mbunga, B. K., Mapatano, M. A., Strand, T. A., Gjengedal, E. L. F., Akilimali, P. Z., & Engebretsen, I. M. S. (2021). Prevalence of anemia, iron-deficiency anemia, and associated factors among children aged 1–5 years in the rural, malaria-endemic setting of Popokabaka, Democratic Republic of Congo: A cross-sectional study. *Nutrients*, *13*(3), 1010.
60. Brooker, S., Okello, G., Njagi, K., Dubeck, M. M., Halliday, K. E., Inyega, H., & Jukes, M. C. (2010). Improving educational achievement and anaemia of school children: design of a cluster randomised trial of school-based malaria prevention and enhanced literacy instruction in Kenya. *Trials*, *11*, 1-14.
61. Musoke, D., Miiro, G., Ndejjo, R., Karani, G., Morris, K., Kasasa, S., ... & Musoke, M. B. (2018). Malaria prevention practices and associated environmental risk factors in a rural community in Wakiso district, Uganda. *PLoS One*, *13*(10), e0205210.