Red Cell Distribution Width and its Association with Maternal Mortality in HIV-Infected Pregnancy

Article *in* Middle East Research Journal of Nursing · September 2024

DOI: 10.36348/merjn.2024.v04i05.002

1 author:

Emmanuel Ifeanyi Obeagu
Africa University
2,100 PUBLICATIONS **36,090** CITATIONS

SEE PROFILE

Middle East Research Journal of Nursing
ISSN 2789-8679 (Print) & ISSN: 2958-2016 (Online)
Frequency: Bi-Monthly
DOI: https://doi.org/10.36348/merjn.2024.v04i05.002

KUWAIT SCHOLARS PUBLISHER
Website: http://www.kspublisher.com/
Email: office@kspublisher.com

Red Cell Distribution Width and its Association with Maternal Mortality in HIV-Infected Pregnancy

Emmanuel Ifeanyi Obeagu[1*]
[1]Department of Medical Laboratory Science, Kampala International University, Uganda

Abstract: Red Cell Distribution Width (RDW), a measure of the variability in red blood cell size, has gained attention for its role in diagnosing and predicting outcomes in various medical conditions. In the context of HIV-infected pregnancies, RDW may serve as a significant marker for assessing maternal health and predicting complications. This review explores the association between RDW and maternal mortality in HIV-positive pregnant women, highlighting how fluctuations in RDW can indicate underlying issues such as anemia, inflammation, and the effects of antiretroviral therapy (ART). Elevated RDW levels may correlate with increased risk of adverse outcomes, making it a potentially valuable tool in managing HIV-infected pregnancies. HIV infection complicates pregnancy by increasing the risk of adverse outcomes, including preeclampsia, gestational diabetes, and anemia, all of which can contribute to maternal mortality. RDW, by reflecting red blood cell variability, offers insights into these complications and the overall impact of HIV on maternal health. ART, crucial for managing HIV, can also influence RDW levels, as some regimens may affect red blood cell production and contribute to anemia. Monitoring RDW in conjunction with ART and other clinical parameters can enhance the detection of complications and improve management strategies.

Keywords: Red Cell Distribution Width, maternal mortality, HIV-infected pregnancy, anemia, antiretroviral therapy.

Review Paper

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

How to cite this paper:
Emmanuel Ifeanyi Obeagu (2024). Red Cell Distribution Width and its Association with Maternal Mortality in HIV-Infected Pregnancy. *Middle East Res J Nursing*, *4*(5): 66-71.

Article History:
| Submit: 13.08.2024 |
| Accepted: 12.09.2024 |
| Published: 14.09.2024 |

INTRODUCTION

Pregnancy in women living with HIV presents a unique set of challenges that can significantly impact maternal and fetal health. HIV infection increases the risk of several complications during pregnancy, including preterm birth, low birth weight, and maternal mortality. As such, effective monitoring and management strategies are essential to ensure the health and well-being of both mother and infant. One emerging parameter of interest in this context is Red Cell Distribution Width (RDW), a measure of the variability in red blood cell size. RDW has been linked to various health conditions and may offer valuable insights into the management of HIV-infected pregnancies [1, 2]. RDW is derived from the complete blood count (CBC) and reflects the variation in red blood cell volume. Elevated RDW is commonly associated with conditions such as anemia, inflammation, and nutritional deficiencies. In the general population, high RDW levels have been linked to adverse outcomes, including cardiovascular events and mortality. In the context of pregnancy, RDW fluctuations can be indicative of underlying issues such as anemia and inflammation, which are particularly pertinent in HIV-infected women who may experience more pronounced hematological changes [3-5]. HIV infection can exacerbate pregnancy-related complications through its effects on the immune system and overall health. Chronic inflammation and immune system dysregulation associated with HIV can lead to alterations in hematological parameters, including RDW. Additionally, the impact of HIV on red blood cell production and turnover can influence RDW levels, making it a potential marker for assessing the severity of the infection and its implications for maternal health [6]. Antiretroviral therapy (ART), a cornerstone of HIV management, plays a crucial role in controlling viral load and reducing the risk of mother-to-child transmission. However, ART can also affect hematological parameters, including RDW. Some ART regimens may contribute to anemia or other conditions that influence RDW levels. Therefore, monitoring RDW in the context of ART is important for understanding how treatment impacts maternal health and for adjusting therapy to optimize outcomes [7].

Elevated RDW levels in HIV-infected pregnant women may be indicative of various complications that

can contribute to maternal mortality. These complications include severe anemia, preeclampsia, and gestational diabetes, all of which are more prevalent in this population [8, 9]. Despite the potential significance of RDW, research on its specific role in HIV-infected pregnancies is still emerging. Existing studies have highlighted the association between RDW and various health outcomes, but the direct link between RDW and maternal mortality in this context remains less well-defined. Continued research is needed to explore how RDW levels correlate with pregnancy complications and mortality in HIV-positive women, and to establish guidelines for incorporating RDW into clinical practice [10, 11].

Red Cell Distribution Width

Red Cell Distribution Width (RDW) is a hematological parameter that measures the variability in red blood cell (RBC) size, as reflected in the coefficient of variation of red cell volume. It is typically reported as part of a complete blood count (CBC) and expressed as a percentage. RDW is calculated using the standard deviation of red blood cell volume divided by the mean cell volume, multiplied by 100. A higher RDW indicates greater variability in red blood cell size, while a lower RDW reflects more uniform cell sizes [12, 13]. RDW is an important diagnostic tool in assessing various health conditions. Elevated RDW is commonly associated with anemia, particularly when different types of anemia are present simultaneously, such as iron deficiency anemia and vitamin B12 deficiency. Additionally, increased RDW can be indicative of other underlying conditions, including inflammation, chronic disease, and certain malignancies. It serves as a complementary parameter to mean corpuscular volume (MCV) in diagnosing and differentiating types of anemia, as RDW can highlight the presence of anisocytosis, a condition where red blood cells vary significantly in size [14, 15]. Recent research has expanded the understanding of RDW beyond its traditional role in anemia. Elevated RDW levels have been associated with various adverse health outcomes, including cardiovascular disease, mortality, and chronic inflammatory conditions. RDW is thought to reflect not only changes in red blood cell production but also alterations in the bone marrow's response to stress or inflammation. Consequently, RDW has become a useful biomarker in predicting prognosis and assessing disease severity in a range of medical conditions [16, 17].

In pregnancy, RDW can fluctuate due to physiological changes such as hemodilution, increased red blood cell production, and alterations in nutritional status. These fluctuations can provide insights into maternal health and potential complications. Elevated RDW during pregnancy may be indicative of conditions such as anemia, preeclampsia, or gestational diabetes. Monitoring RDW can help identify women at risk for these complications and guide appropriate management to improve pregnancy outcomes [18, 19]. HIV infection can influence RDW levels through its effects on the immune system and red blood cell production. Chronic inflammation and immune dysregulation associated with HIV can lead to increased RDW. Furthermore, the impact of antiretroviral therapy (ART) on RDW levels is an area of interest, as some ART regimens may affect red blood cell production and turnover [20].

HIV and Pregnancy Complications

Pregnancy in women living with HIV presents a complex interplay of challenges that can impact both maternal and fetal health. HIV infection increases the risk of several complications during pregnancy, which can affect pregnancy outcomes and maternal mortality. Effective management of these risks is crucial for improving health outcomes. Preeclampsia is a significant pregnancy complication characterized by high blood pressure and organ dysfunction, often manifesting after the 20th week of gestation. HIV-infected women are at an increased risk for developing preeclampsia, which can lead to severe consequences if not managed appropriately. The risk is compounded by chronic inflammation and immune system dysregulation associated with HIV. Additionally, preeclampsia can exacerbate HIV-related health issues, making management more complex and necessitating careful monitoring and treatment to ensure maternal and fetal well-being [21, 22]. Gestational diabetes mellitus (GDM) is another common complication during pregnancy, characterized by elevated blood glucose levels that develop during pregnancy. Women with HIV are at a higher risk of developing GDM, potentially due to the interplay of HIV-related metabolic changes and antiretroviral therapy (ART) effects. GDM can lead to adverse outcomes such as macrosomia, preterm birth, and increased risk of type 2 diabetes later in life. Effective management of GDM is essential to minimize these risks and ensure a healthy pregnancy [23, 24].

Anemia is prevalent among pregnant women with HIV and can significantly impact maternal health. HIV can contribute to anemia through several mechanisms, including bone marrow suppression, chronic inflammation, and nutritional deficiencies. Anemia in pregnancy is associated with adverse outcomes such as preterm birth, low birth weight, and increased maternal mortality. Monitoring and managing anemia in HIV-positive pregnant women are critical for improving health outcomes and reducing complications [25, 26]. Pregnant women with HIV are also at an increased risk of infections and opportunistic diseases, which can further complicate pregnancy. Infections such as tuberculosis, cytomegalovirus, and certain sexually transmitted infections can adversely affect maternal health and increase the risk of transmission to the infant. The management of these infections requires a comprehensive approach, including appropriate use of ART and prophylactic measures to minimize risks [27, 28]. Antiretroviral therapy (ART) is essential for managing HIV and reducing the risk of mother-to-child transmission. However, ART can influence pregnancy

outcomes by affecting maternal hematological parameters, including red cell distribution width (RDW). Certain ART regimens may contribute to anemia or other complications that impact RDW levels. Monitoring the effects of ART on pregnancy and adjusting treatment as needed are important for optimizing maternal and fetal health [29]. Effective prevention and management strategies are critical for addressing the complications associated with HIV in pregnancy. Regular prenatal care, including monitoring for signs of preeclampsia, gestational diabetes, and anemia, is essential for early detection and intervention. Collaboration among obstetricians, infectious disease specialists, and other healthcare providers can help ensure comprehensive care and improve outcomes for HIV-infected pregnant women [30].

Impact of ART on RDW

Antiretroviral therapy (ART) is the cornerstone of HIV treatment, significantly improving the prognosis for individuals living with HIV by reducing viral load and preventing the progression of the disease. However, ART can also have various effects on hematological parameters, including Red Cell Distribution Width (RDW). RDW is a measure of the variability in red blood cell (RBC) size, and its levels can be influenced by multiple factors, including the use of ART [31].

Mechanisms of ART Impact on RDW

The impact of ART on RDW can be multifaceted. ART can affect RDW through several mechanisms:

1. **Bone Marrow Suppression**: Some ART regimens may lead to bone marrow suppression, which can impair red blood cell production and contribute to variations in RBC size. This suppression can result in elevated RDW as the body attempts to compensate for reduced RBC production and increased cell turnover.
2. **Anemia and Hematological Changes**: ART-induced anemia is a known side effect of certain antiretroviral medications. Anemia, characterized by reduced red blood cell count and hemoglobin levels, can be associated with increased RDW. ART-related anemia may arise from direct effects on bone marrow, interactions with other medications, or as a consequence of chronic inflammation.
3. **Chronic Inflammation**: HIV infection is associated with chronic inflammation, which can be modulated by ART. Chronic inflammation can affect RDW by altering red blood cell production and turnover. ART that affects inflammatory pathways may indirectly influence RDW levels by modifying the inflammatory environment.

Clinical Implications

Understanding the relationship between ART and RDW has important clinical implications:

1. **Monitoring and Adjustment**: Regular monitoring of RDW can help detect ART-related hematological changes early. Elevated RDW in the context of ART may warrant further investigation into potential causes such as anemia or bone marrow suppression. Adjustments to ART regimens may be necessary to manage these effects and minimize impact on RDW [32].
2. **Predictive Value**: RDW may serve as a predictive marker for potential ART-related complications. Elevated RDW could indicate underlying issues such as anemia or other hematological disturbances, prompting timely interventions to address these problems and improve patient outcomes.
3. **Patient Management**: Personalized management strategies that consider RDW fluctuations can enhance care for HIV-infected individuals on ART. By integrating RDW monitoring into routine care, healthcare providers can better address the effects of ART on hematological health and tailor treatment plans to individual patient needs.

Association Between RDW and Maternal Mortality

Maternal mortality remains a significant public health challenge, with various factors contributing to adverse outcomes during pregnancy. Red Cell Distribution Width (RDW), a measure of variability in red blood cell (RBC) size, has emerged as a potential indicator of maternal health and risk. Elevated RDW levels have been associated with various adverse health outcomes, including increased mortality. RDW reflects the heterogeneity in red blood cell volume and can be influenced by several conditions that impact maternal health. Elevated RDW levels are often associated with anemia, inflammation, and nutritional deficiencies. In the context of pregnancy, these factors can contribute to complications that increase the risk of maternal mortality. Anemia, in particular, is a well-established risk factor for adverse pregnancy outcomes, including maternal death. RDW provides additional information on the underlying variability of red blood cells, offering a more nuanced view of hematological health [33]. Several studies have explored the association between RDW and maternal mortality, revealing a notable correlation between elevated RDW levels and increased risk of adverse outcomes. For instance, elevated RDW has been linked to complications such as preeclampsia, gestational diabetes, and severe anemia—all of which can contribute to maternal mortality. The increased RDW levels often reflect underlying pathophysiological processes such as chronic inflammation, poor nutritional status, or inadequate response to treatment, which can exacerbate risks during pregnancy. In HIV-infected pregnancies, the association between RDW and maternal mortality may be particularly significant due to the additional complexities introduced by the virus and its treatment. HIV-related anemia, chronic inflammation, and the effects of antiretroviral therapy (ART) can influence RDW levels. Elevated RDW in this population may indicate not only the presence of anemia but also the impact of HIV and ART on overall health. Monitoring RDW in HIV-positive pregnant women can help identify those at higher risk for complications and guide more

tailored management strategies [34]. Regular monitoring of RDW during pregnancy can be an effective strategy for identifying women at risk of adverse outcomes and mortality. Elevated RDW levels may prompt further investigation into potential underlying issues such as anemia or inflammatory conditions. Appropriate management, including addressing anemia, optimizing nutritional status, and managing chronic conditions, can help mitigate risks and improve maternal outcomes. In HIV-positive pregnancies, careful monitoring and adjustment of ART regimens may also play a role in managing RDW and associated risks.

Clinical Implications and Management

Clinical Implications

1. **Risk Assessment and Early Intervention:** Elevated Red Cell Distribution Width (RDW) levels can serve as an early indicator of potential complications in pregnant women. Elevated RDW is often associated with conditions such as anemia, inflammation, and nutritional deficiencies, all of which can contribute to adverse pregnancy outcomes and increased maternal mortality. By incorporating RDW into routine prenatal assessments, healthcare providers can better identify women at higher risk for these complications and implement early interventions to mitigate risks [35].
2. **Enhanced Monitoring of High-Risk Populations:** In populations with additional health challenges, such as HIV-infected pregnant women, RDW can be a critical parameter for monitoring health status and treatment efficacy. The impact of HIV and antiretroviral therapy (ART) on RDW levels can provide insights into the management of HIV-related anemia and other complications. Elevated RDW in these patients may signal issues such as inadequate ART response or exacerbated inflammation, necessitating closer monitoring and potential adjustment of treatment plans.
3. **Guidance for Treatment Adjustments:** Elevated RDW levels may prompt healthcare providers to investigate underlying causes such as anemia or inflammatory conditions. For instance, if elevated RDW is associated with anemia, addressing the anemia through nutritional supplementation, iron therapy, or other interventions may be necessary. In HIV-positive patients, adjusting ART regimens or addressing HIV-related complications may also be required. Effective management of RDW-related issues can help improve maternal health and reduce the risk of adverse outcomes.

Management Strategies

1. **Regular Monitoring and Screening:** Regular monitoring of RDW during prenatal visits can help track changes over time and identify potential issues early. For pregnant women with elevated RDW, additional screening for anemia, inflammation, or nutritional deficiencies may be warranted. This proactive approach allows for timely interventions and better management of potential complications [35].
2. **Addressing Anemia:** If elevated RDW is associated with anemia, appropriate treatment is crucial. Management may include:
    1. **Iron Supplementation**: For iron deficiency anemia, oral or intravenous iron supplements may be prescribed.
    2. **Vitamin and Mineral Supplements**: Addressing deficiencies in folate, vitamin B12, or other essential nutrients.
    3. **Blood Transfusions**: In severe cases of anemia, blood transfusions may be necessary to stabilize hemoglobin levels and improve maternal health.
3. **Managing Inflammatory Conditions:** Elevated RDW may reflect underlying inflammation. In such cases, managing inflammatory conditions through appropriate treatment strategies is important. For example, if inflammation is linked to an infection or chronic disease, addressing the underlying condition with targeted therapies can help normalize RDW levels and improve overall health.
4. **Optimizing Antiretroviral Therapy (ART):** For HIV-infected pregnant women, ART management is crucial. Regular monitoring of RDW can help identify potential ART-related hematological effects. Adjusting ART regimens or addressing side effects related to ART can help manage RDW levels and reduce associated risks. Collaborating with infectious disease specialists to ensure optimal ART management is essential for maintaining both maternal and fetal health.
5. **Nutritional Support:** Adequate nutrition is vital for managing RDW and overall pregnancy health. Providing dietary counseling and support to ensure sufficient intake of essential nutrients can help prevent and address deficiencies that contribute to elevated RDW. Nutritional interventions should be tailored to individual needs, particularly in cases where specific deficiencies are identified.
6. **Personalized Care Plans:** Developing personalized care plans based on RDW measurements and associated clinical findings can enhance pregnancy management. Tailoring interventions to the individual's specific health conditions and needs allows for more effective management and improved outcomes. This approach is particularly beneficial in managing complex cases, such as those involving HIV or other chronic conditions.

CONCLUSION

Red Cell Distribution Width (RDW) has emerged as a significant hematological parameter with considerable clinical relevance, particularly in the context of pregnancy. Its association with maternal mortality highlights the need for its integration into routine prenatal care, especially for high-risk groups such as HIV-infected pregnant women. Elevated RDW

levels often reflect underlying conditions like anemia, inflammation, or nutritional deficiencies, which are critical factors contributing to adverse pregnancy outcomes and increased mortality risk. The management of RDW in pregnant women requires a multifaceted approach, including regular monitoring, targeted interventions to address anemia and inflammation, and personalized care plans tailored to the specific needs of each patient. In HIV-infected populations, the relationship between RDW and the impact of antiretroviral therapy (ART) is particularly important, as it may influence treatment strategies and overall maternal health.

REFERENCES

1. Chilaka, V. N., & Konje, J. C. (2021). HIV in pregnancy–An update. *European Journal of Obstetrics & Gynecology and Reproductive Biology*, *256*, 484-491.
2. Obeagu, E. I., Anyiam, A. F., & Obeagu, G. U. (2024). Managing Anemia in HIV through Blood Transfusions: Clinical Considerations and Innovations. *Elite Journal of HIV*, *2*(1), 16-30.
3. 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.
4. Obeagu, E. I., & Obeagu, G. U. (2024). Counting Cells, Shaping Fates: CD4/CD8 Ratios in HIV. *Elite Journal of Scientific Research and Review*, *2*(1), 37-50.
5. Obeagu, E. I., & Obeagu, G. U. (2024). Eosinophil Dynamics in Pregnancy among Women Living with HIV: A Comprehensive Review. *Int. J. Curr. Res. Med. Sci*, *10*(1), 11-24.
6. Agreen, F. C., & Obeagu, E. I. (2023). Anaemia among pregnant women: A review of African pregnant teenagers. *Journal of Public Health and Nutrition*, *6*(1), 138.
7. Figueroa-Mujica, R., Ccahuantico, L. A., Ccorahua-Rios, M. S., Sanchez-Huaman, J. J., Vásquez-Velasquez, C., Ponce-Huarancca, J. M., ... & Gonzales, G. F. (2022). A critical analysis of the automated hematology assessment in pregnant women at low and at high altitude: association between red blood cells, platelet parameters, and iron status. *Life*, *12*(5), 727.
8. Yılmaz, Z. V., Yılmaz, E., İçer, B., & Küçüközkan, T. (2017). Association of complete blood count parameters with gestational diabetes mellitus. *Gynecology obstetrics & reproductive medicine*, *23*(2), 65-69.
9. 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.
10. Obeagu, E. I., Obeagu, G. U., Hauwa, B. A., & Umar, A. I. Neutrophil Dynamics: Unveiling Their Role in HIV Progression within Malaria Patients. *Journal home page: http://www. journalijiar. com*, *12*(01).
11. Obeagu, E. I., Abdirahman, B. F., Bunu, U. O., & Obeagu, G. U. (2023). Obsterics characteristics that effect the newborn outcomes. *Int. J. Adv. Res. Biol. Sci*, *10*(3), 134-143.
12. Obeagu, E. I., & Obeagu, G. U. (2024). Eosinophilic Changes in Placental Tissues of HIV-Positive Pregnant Women: A Review. *Elite Journal of Laboratory Medicine*, *2*(1), 14-32.
13. Obeagu, E. I., & Obeagu, G. U. (2024). P-Selectin and Platelet Activation in HIV: Implications for Antiviral Therapy. *Elite Journal of Scientific Research and Review*, *2*(1), 17-41.
14. Duguma, N., Tesfaye Kiya, G., Adissu Maleko, W., & Bimerew, L. G. (2021). Hematological parameters abnormalities and associated factors in HIV-positive adults before and after highly active antiretroviral treatment in Goba Referral Hospital, southeast Ethiopia: a cross-sectional study. *SAGE open medicine*, *9*, 20503121211020175.
15. Aaron, U. U., Okonko, I. O., & Frank-Peterside, N. (2021). Haematological Indices of HIV-1 Infected Subjects on Antiretroviral Therapy from Selected Tertiary Hospitals in Port Harcourt, Nigeria. *Asian Hematology Research Journal*, *5*(3), 12-19.
16. Tinarwo, P., Zewotir, T., Yende-Zuma, N., Garrett, N. J., & North, D. (2019). An evaluation to determine the strongest CD4 count covariates during HIV disease progression in women in South Africa. *Infectious diseases and therapy*, *8*, 269-284.
17. Caporal, F. A., & Comar, S. R. (2013). Evaluation of RDW-CV, RDW-SD, and MATH-1SD for the detection of erythrocyte anisocytosis observed by optical microscopy. *Jornal Brasileiro de Patologia e Medicina Laboratorial*, *49*, 324-331.
18. Constantino, B. T. (2013). Red cell distribution width, revisited. *Laboratory Medicine*, *44*(2), e2-e9.
19. Poz, D., De Falco, E., Pisano, C., Madonna, R., Ferdinandy, P., & Balistreri, C. R. (2019). Diagnostic and prognostic relevance of red blood cell distribution width for vascular aging and cardiovascular diseases. *Rejuvenation Research*, *22*(2), 146-162.
20. Figueroa-Mujica, R., Ccahuantico, L. A., Ccorahua-Rios, M. S., Sanchez-Huaman, J. J., Vásquez-Velasquez, C., Ponce-Huarancca, J. M., ... & Gonzales, G. F. (2022). A critical analysis of the automated hematology assessment in pregnant women at low and at high altitude: association between red blood cells, platelet parameters, and iron status. *Life*, *12*(5), 727.
21. Obeagu, E. I., & Obeagu, G. U. (2024). The Intricate Relationship Between Erythropoietin and HIV-Induced Anemia: Unraveling Pathways for

Therapeutic Insights. *Int. J. Curr. Res. Chem. Pharm. Sci*, *11*(2), 30-40.
22. Obeagu, E. I., Anyiam, A. F., & Obeagu, G. U. (2024). Erythropoietin Therapy in HIV-Infected Individuals: A Critical Review. *Elite Journal of HIV*, *2*(1), 51-64.
23. Obeagu, E. I., & Obeagu, G. U. (2024). Strength in Unity: Building Support Networks for HIV Patients in Uganda. *Elite Journal of Medicine*, *2*(1), 1-16.
24. Kyeong, K. S., Shim, J. Y., Lee, M. Y., Lee, K. A., Won, H. S., Lee, P. R., & Kim, A. (2012). Perinatal/Maternal-Fetal Medicine. *Parameters*, *1*, 004.
25. Garofoli, F., Ciardelli, L., Mazzucchelli, I., Borghesi, A., Angelini, M., Bollani, L., ... & Stronati, M. (2014). The red cell distribution width (RDW): value and role in preterm, IUGR (intrauterine growth restricted), full-term infants. *Hematology*, *19*(6), 365-369.
26. Malandrino, N., Wu, W. C., Taveira, T. H., Whitlatch, H. B., & Smith, R. J. (2012). Association between red blood cell distribution width and macrovascular and microvascular complications in diabetes. *Diabetologia*, *55*, 226-235.
27. Salvagno, G. L., Sanchis-Gomar, F., Picanza, A., & Lippi, G. (2015). Red blood cell distribution width: a simple parameter with multiple clinical applications. *Critical reviews in clinical laboratory sciences*, *52*(2), 86-105.
28. Patxot, M., Stojanov, M., Ojavee, S. E., Gobert, R. P., Kutalik, Z., Gavillet, M., ... & Robinson, M. R. (2022). Haematological changes from conception to childbirth: An indicator of major pregnancy complications. *European Journal of Haematology*, *109*(5), 566-575.
29. De Ruiter, A., Taylor, G. P., Clayden, P., Dhar, J., Gandhi, K., Gilleece, Y., ... & Wilkins, E. (2012). Guidelines for the management of HIV infection in pregnant women 2012. *HIV med*, *13*(Suppl 2), 87-157.
30. Dong, Y., Guo, W., Gui, X., Liu, Y., Yan, Y., Feng, L., & Liang, K. (2020). Preventing mother to child transmission of HIV: lessons learned from China. *BMC Infectious Diseases*, *20*, 1-10.
31. Sturt, A. S., Dokubo, E. K., Sint, T. T., & Cochrane HIV/AIDS Group. (1996). Antiretroviral therapy (ART) for treating HIV infection in ART-eligible pregnant women. *Cochrane Database of Systematic Reviews*, *2010*(6).
32. Cardenas, M. C., Farnan, S., Hamel, B. L., Mejia Plazas, M. C., Sintim-Aboagye, E., Littlefield, D. R., ... & Chakraborty, R. (2023). Prevention of the Vertical Transmission of HIV; A Recap of the Journey so Far. *Viruses*, *15*(4), 849.
33. Mahmood, N. A., Mathew, J., Kang, B., DeBari, V. A., & Khan, M. A. (2014). Broadening of the red blood cell distribution width is associated with increased severity of illness in patients with sepsis. *International journal of critical illness and injury science*, *4*(4), 278-282.
34. Ziske, J., Kunz, A., Sewangi, J., Lau, I., Dugange, F., Hauser, A., ... & Theuring, S. (2013). Hematological changes in women and infants exposed to an AZT-containing regimen for prevention of mother-to-child-transmission of HIV in Tanzania. *PloS one*, *8*(2), e55633.
35. Ositadinma, I. M., Ikponmwosa, O. S., & Okechukwu, O. C. (2015). Haemorheology and Red Cell indices in HIV Positive Individuals on Antiretroviral Therapy in Delta State, Nigeria. *International Journal of Current Research and Review*, *7*(12), 24.