Elite Journal of Medicine. Volume 2 issue 1(2024), Pp.23-34
https://epjournals.com/journals/EJM

Antioxidant Supplementation in Pregnancy: Effects on Maternal and Infant Health

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

[1]*Department of Medical Laboratory Science, Kampala International University, Uganda.*
[2]*School of Nursing Science, Kampala International University, Uganda.*

*Corresponding authour: Emmanuel Ifeanyi Obeagu, Department of Medical Laboratory Science, Kampala International University, Uganda, emmanuelobeagu@yahoo.com, ORCID: 0000-0002-4538-0161

Abstract

Antioxidant supplementation during pregnancy has garnered significant attention due to its potential impact on mitigating oxidative stress and improving maternal and infant health outcomes. This comprehensive review explores the current literature on antioxidant supplementation during pregnancy, examining its effects on maternal well-being, pregnancy complications, and neonatal outcomes. The review discusses the underlying mechanisms of oxidative stress in pregnancy, the rationale for antioxidant intervention, and the diverse antioxidants commonly studied in this context. Furthermore, it delves into the potential benefits and risks associated with antioxidant supplementation, emphasizing the need for a nuanced approach tailored to individual patient profiles. Understanding the implications of antioxidant supplementation on placental function, birth weight, and long-term health outcomes for both mothers and infants is essential for guiding evidence-based practices in prenatal care.

Keywords*: Antioxidants, Pregnancy, Maternal Health, Infant Health, Oxidative Stress, Supplementation, Pregnancy Complications, Neonatal Outcomes, Placental Function, Birth Weight*

Introduction

Pregnancy represents a dynamic physiological state characterized by intricate changes that aim to support fetal development and ensure maternal well-being. However, the heightened metabolic demands and physiological alterations can induce oxidative stress, an imbalance between reactive oxygen species (ROS) production and the body's antioxidant defense mechanisms. Oxidative stress is implicated in various pregnancy complications, including preeclampsia, gestational diabetes, and preterm birth, emphasizing the need for interventions that counteract its adverse effects.[1-11] Antioxidant supplementation has emerged as a potential strategy to mitigate oxidative stress during

pregnancy and improve both maternal and infant health outcomes. Antioxidants, encompassing a diverse array of vitamins, minerals, and polyphenols, function by neutralizing ROS and preventing cellular damage.[12-21] This comprehensive review explores the current state of knowledge regarding antioxidant supplementation in pregnancy, aiming to shed light on its effects on maternal health, pregnancy complications, and neonatal outcomes.

The rationale for exploring antioxidant supplementation during pregnancy stems from the intricate interplay between oxidative stress and the physiological changes inherent to gestation. Oxidative stress can adversely impact placental function, leading to complications that pose risks to both maternal and fetal health. Antioxidants offer a potential therapeutic avenue by mitigating oxidative stress, thereby addressing a key contributor to pregnancy-related complications. This review seeks to provide a comprehensive overview of the current literature on antioxidant supplementation during pregnancy. Understanding the effects of antioxidant supplementation during pregnancy holds substantial clinical significance, offering the potential to enhance prenatal care and improve outcomes for both mothers and infants. By synthesizing current evidence and identifying areas for further research, this review aims to contribute to evidence-based practices, guide healthcare providers, and pave the way for personalized approaches to antioxidant interventions in the context of pregnancy.[22-31]

Oxidative Stress in Pregnancy

Pregnancy imposes significant physiological changes on the maternal-fetal unit, orchestrated to support the growing fetus. These changes include increased metabolic demands, heightened oxygen consumption, and alterations in hormonal profiles. While essential for fetal development, these physiological shifts create an environment prone to oxidative stress. Increased production of reactive oxygen species (ROS) can overwhelm the body's antioxidant defenses, leading to cellular damage and potential implications for maternal and fetal health.[32-41] Oxidative stress is intricately linked to the pathogenesis of several pregnancy complications. One notable condition is preeclampsia, characterized by hypertension and proteinuria, which has been associated with elevated oxidative stress markers. Similarly, gestational diabetes, preterm birth, and intrauterine growth restriction have been linked to oxidative stress, highlighting the broad impact of ROS on various aspects of pregnancy.[42]

The placenta, a critical organ for fetal development, is particularly susceptible to oxidative stress. The delicate balance between oxygen supply and demand in the placenta can be disrupted by an excess of ROS. This disturbance may compromise placental function, affecting nutrient exchange, hormone production, and overall fetal well-being. Understanding the role of oxidative stress in the placenta is crucial for unraveling its implications for pregnancy outcomes.[43-47] While oxidative stress poses challenges, the body is equipped with a robust antioxidant defense system to neutralize excessive ROS. Antioxidant enzymes, such as superoxide dismutase, catalase, and glutathione peroxidase, work synergistically to counteract oxidative damage. Additionally, non-enzymatic antioxidants, including vitamins C and E, play pivotal roles in scavenging free radicals and maintaining redox balance.

During pregnancy, the delicate balance between ROS production and antioxidant defenses may be disrupted. Factors such as maternal age, pre-existing medical conditions, and environmental influences can contribute to dysregulation in oxidative status. Identifying the triggers and consequences of this imbalance is essential for developing targeted interventions to mitigate oxidative stress-related complications.[48-52] Oxidative stress has been implicated in the initiation of preterm labor. Elevated oxidative stress markers, coupled with inflammation, may contribute to the premature rupture of membranes and uterine contractions. Understanding the intricate interplay between oxidative stress and preterm birth is essential for devising strategies to identify and manage at-risk pregnancies.[53-55]

Mechanisms of Action of Antioxidants

The primary mechanism through which antioxidants exert their protective effects is by neutralizing reactive oxygen species (ROS).[53] ROS, including superoxide anions, hydroxyl radicals, and hydrogen peroxide, are byproducts of normal cellular metabolism. However, an excess of ROS, as seen in oxidative stress, can lead to cellular damage. Antioxidants act as scavengers, donating electrons to stabilize and neutralize ROS, preventing them from causing harm to cellular structures.

Enzymatic antioxidants play a crucial role in maintaining redox balance. These include enzymes such as superoxide dismutase (SOD), catalase, and glutathione peroxidase. Non-enzymatic antioxidants include vitamins, minerals, and polyphenols, each with unique mechanisms of action. Beyond their direct antioxidant effects, certain antioxidants exhibit anti-inflammatory properties. Inflammation and oxidative stress often coexist, creating a cycle of cellular damage. Antioxidants can modulate inflammatory responses by inhibiting pro-inflammatory cytokines, such as interleukin-6 and tumor necrosis factor-alpha. This dual action addresses two interconnected facets of pathological processes during oxidative stress.

Nitric oxide (NO) is a crucial signaling molecule involved in vascular function and blood flow regulation.[57] Oxidative stress can reduce NO bioavailability, leading to endothelial dysfunction. Antioxidants, particularly vitamin C, can preserve NO bioavailability by scavenging superoxide anions, preventing their interaction with NO and promoting vascular health. Certain antioxidants, such as resveratrol (found in red grapes) and quercetin (found in fruits and vegetables), can interact with transcription factors involved in cellular stress responses. For example, activation of nuclear factor erythroid 2-related factor 2 (Nrf2) by antioxidants can enhance the expression of antioxidant enzymes, reinforcing the cellular defense against oxidative stress.

Effects on Maternal Well-being

Numerous studies have demonstrated that antioxidant supplementation during pregnancy contributes to a reduction in oxidative stress markers in maternal circulation. Lower levels of oxidative stress are associated with improved endothelial function, reduced inflammation, and overall cardiovascular health. This reduction in systemic oxidative stress may contribute to the prevention or amelioration of pregnancy complications associated with oxidative imbalance.

Oxidative stress has been implicated in cardiovascular complications during pregnancy, including preeclampsia. Antioxidants, particularly vitamins C and E, have shown potential in preserving vascular function and preventing endothelial dysfunction. By scavenging free radicals and preserving nitric oxide bioavailability, antioxidants may contribute to maintaining healthy blood vessels and reducing the risk of hypertensive disorders.[58]

In addition to their antioxidant properties, certain antioxidants, such as polyphenols, exhibit anti-inflammatory effects. By modulating inflammatory responses, antioxidants contribute to a balanced immune system during pregnancy. This is particularly relevant given the intricate interplay between oxidative stress and inflammation in the pathogenesis of pregnancy complications. Antioxidant supplementation has shown promise in mitigating the risk of gestational diabetes, a condition characterized by impaired glucose metabolism during pregnancy. Studies suggest that antioxidants, including vitamins C and E, may improve insulin sensitivity and reduce markers of oxidative stress, contributing to the prevention or management of gestational diabetes.[58] Preeclampsia, a hypertensive disorder of pregnancy, has been linked to oxidative stress and impaired vascular function. Antioxidant supplementation, particularly with vitamins C and E, has been explored as a potential preventive strategy. While research outcomes are variable, some studies suggest a reduction in the incidence of preeclampsia with antioxidant supplementation, emphasizing the need for further investigation.[57] Endothelial dysfunction, a key component of vascular complications in pregnancy, involves impaired function of the cells lining blood vessels. Antioxidants may contribute to the improvement of endothelial function by reducing oxidative stress and enhancing the bioavailability of nitric oxide. Preserving endothelial health is crucial for preventing complications such as preeclampsia and gestational hypertension.

Neonatal Outcomes

Antioxidant supplementation during pregnancy has been associated with improvements in neonatal outcomes, particularly birth weight.[59] Adequate birth weight is a critical determinant of neonatal health, influencing overall growth and development. Antioxidants, by mitigating oxidative stress and preserving placental function, contribute to optimal fetal growth. Studies suggest that the positive association between antioxidant supplementation and birth weight underscores the potential impact of antioxidants on neonatal well-being. Emerging evidence suggests that the benefits of antioxidant supplementation during pregnancy may extend beyond the neonatal period, influencing the long-term health of offspring. Antioxidants, by addressing oxidative stress during critical developmental stages, may reduce the risk of metabolic syndrome, cardiovascular diseases, and neurodevelopmental disorders in later life. Understanding the potential long-term health implications of antioxidant supplementation adds a valuable dimension to the assessment of neonatal outcomes.

The placenta plays a pivotal role in fetal development, and its optimal function is crucial for ensuring favorable neonatal outcomes. Antioxidants, by mitigating oxidative stress in the placenta, contribute to the preservation of nutrient exchange and hormonal regulation. This, in turn, positively influences neonatal health and development. Antioxidant supplementation has been

linked to a reduction in neonatal morbidity, including a decreased incidence of respiratory distress syndrome and other complications. While the precise mechanisms require further elucidation, it is hypothesized that antioxidants contribute to lung maturity and overall resilience, potentially reducing the risk of respiratory distress.[60] Premature infants are particularly vulnerable to oxidative stress due to their immature antioxidant defense systems. Antioxidant supplementation in mothers carrying preterm pregnancies may offer additional benefits by enhancing antioxidant status in both the mother and the developing fetus. This dual approach aims to optimize neonatal outcomes, especially for infants born before full gestation.

Risks and Considerations

Determining the optimal dosages and timing of antioxidant supplementation during pregnancy is a complex task. While antioxidants are essential for maintaining redox balance, excessive doses may have unintended consequences. High levels of certain antioxidants, such as vitamin E, have been associated with potential adverse effects. Striking the right balance is crucial, and individualized approaches based on maternal characteristics, pre-existing conditions, and gestational age should be considered. Antioxidant supplementation does not occur in isolation, and potential interactions with other prenatal interventions or medications should be carefully considered. For example, the interaction between antioxidants and iron supplementation warrants attention, as iron can act as a pro-oxidant under certain conditions. Understanding potential confounders and interactions ensures a comprehensive approach to prenatal care.[60] The effects of antioxidants may vary based on the specific context of pregnancy and the presence of underlying conditions. For instance, while antioxidants may offer benefits in mitigating oxidative stress, their impact on pregnancy complications may be influenced by factors such as maternal age, pre-existing medical conditions, and socioeconomic status. Tailoring antioxidant interventions to the unique characteristics of each pregnancy is essential.

Excessive antioxidant supplementation may carry risks, particularly when doses exceed recommended levels. High doses of certain antioxidants, such as beta-carotene, have been associated with adverse outcomes. Additionally, an imbalance between different antioxidants may disrupt the intricate antioxidant defense system, potentially leading to unintended consequences.[58] Iron is a vital nutrient in pregnancy, but excessive iron levels can contribute to oxidative stress. Considering the potential interaction between iron and antioxidants is crucial to prevent iron overload. Balancing iron supplementation with antioxidants requires careful consideration, especially in populations with varying iron status. The ability of antioxidants to cross the placental barrier raises questions about potential fetal exposure. While antioxidants aim to mitigate oxidative stress and promote optimal fetal development, the long-term consequences of fetal exposure to high levels of antioxidants remain an area of active research. Understanding the balance between maternal and fetal antioxidant needs is essential for guiding safe supplementation practices.[59] Given the complexity of antioxidant effects and potential risks, adopting an individualized approach to supplementation is paramount. Healthcare providers should consider the unique characteristics of each pregnancy, assess maternal antioxidant status, and tailor interventions based on a comprehensive understanding of potential risks and benefits.

Recommendations

Healthcare providers should consider assessing the antioxidant status of pregnant individuals to tailor interventions based on individual needs. Monitoring biomarkers of oxidative stress and antioxidant levels can guide personalized supplementation strategies, ensuring that antioxidant interventions align with the unique characteristics of each pregnancy. Adopting a balanced approach to antioxidant supplementation is crucial. Healthcare providers should consider the synergistic effects of different antioxidants and aim for a well-rounded supplementation strategy that addresses the diverse antioxidant needs of pregnant individuals. Avoiding excessive doses of specific antioxidants while ensuring a comprehensive antioxidant defense system is maintained is key.

Careful consideration of the timing and duration of antioxidant supplementation is essential. Initiating supplementation early in pregnancy and maintaining it throughout gestation may offer optimal benefits. However, the duration and timing of supplementation may vary based on individual risk factors and pregnancy characteristics. Healthcare providers should work collaboratively with pregnant individuals to determine the most appropriate supplementation timeline. Antioxidant supplementation should be integrated into comprehensive prenatal care, considering potential interactions with other interventions. Collaborative and interdisciplinary approaches involving obstetricians, nutritionists, and other healthcare professionals can ensure that antioxidant supplementation aligns with overall prenatal care plans and addresses the specific needs of each pregnant individual.

Healthcare providers should remain vigilant for potential adverse effects associated with antioxidant supplementation. Regular monitoring of maternal and fetal well-being, along with assessments of antioxidant biomarkers, can help identify any unintended consequences. Adjustments to supplementation plans may be necessary based on ongoing evaluations. Providing education and counseling to pregnant individuals regarding the rationale, potential benefits, and risks of antioxidant supplementation is crucial. Clear communication about the uncertainties in the field, the need for individualized approaches, and the importance of a balanced and varied diet can empower pregnant individuals to make informed decisions about their prenatal care.

The field of antioxidant supplementation during pregnancy is dynamic, and ongoing research is necessary to refine recommendations. Collaboration among researchers, healthcare providers, and public health agencies is essential for advancing our understanding of the mechanisms of action, optimal dosages, and long-term effects of antioxidants. Multicenter studies and diverse population inclusion can enhance the generalizability of findings. As evidence accumulates, integrating recommendations for antioxidant supplementation into clinical guidelines for prenatal care can provide standardized guidance for healthcare providers. Inclusion in guidelines can help streamline practices, ensure consistency in recommendations, and contribute to evidence-based approaches to antioxidant interventions during pregnancy.

Conclusion

Citation: Obeagu EI, Obeagu GU. Antioxidant Supplementation in Pregnancy: Effects on Maternal and Infant Health. Elite Journal of Medicine, 2024; 2(1):23-34

The complex interplay between oxidative stress and pregnancy complications underscores the potential significance of antioxidant supplementation as a preventive and therapeutic strategy. Antioxidant supplementation has shown promise in improving maternal well-being by reducing oxidative stress markers, preserving cardiovascular health, and modulating inflammatory responses. The effects of antioxidants on gestational diabetes, preeclampsia, and endothelial function highlight their potential contributions to maternal health during pregnancy. Antioxidant supplementation has been associated with positive neonatal outcomes, including improvements in birth weight and reductions in neonatal morbidity. The potential long-term health implications of antioxidant exposure during critical developmental stages add a layer of complexity to understanding the enduring effects on offspring health.

References

1. Obeagu EI, Agreen FC. Anaemia among pregnant women: A review of African pregnant teenagers. J Pub Health Nutri. 2023; 6 (1). 2023;138. links/63da799664fc860638054562/Anaemia-among-pregnant-women-A-review-of-African-pregnant-teenagers.pdf.
2. Obeagu EI, Ezimah AC, Obeagu GU. Erythropoietin in the anaemias of pregnancy: a review. Int J Curr Res Chem Pharm Sci. 2016;3(3):10-8. links/5710fae108ae846f4ef05afb/ERYTHROPOIETIN-IN-THE-ANAEMIAS-OF-PREGNANCY-A-REVIEW.pdf.
3. Obeagu EI, Adepoju OJ, Okafor CJ, Obeagu GU, Ibekwe AM, Okpala PU, Agu CC. Assessment of Haematological Changes in Pregnant Women of Ido, Ondo State, Nigeria. J Res Med Dent Sci. 2021 Apr;9(4):145-8. links/608a6728a6fdccaebdf52d94/Assessment-of-Haematological-Changes-in-Pregnant-Women-of-Ido-Ondo.pdf.
4. Obeagu EI, Obeagu GU. Sickle Cell Anaemia in Pregnancy: A Review. International Research in Medical and Health Sciences. 2023 Jun 10;6(2):10-3. http://irmhs.com/index.php/irmhs/article/view/111.
5. 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.
6. Obeagu EI, Obeagu GU, Chukwueze CM, Ikpenwa JN, Ramos GF. Evaluation of Protein C, Protein S and Fibrinogen of Pregnant Women with Malaria in Owerri Metropolis. Madonna University journal of Medicine and Health Sciences. 2022;2(2):1-9.
7. Obeagu EI, Ikpenwa JN, Chukwueze CM, Obeagu GU. Evaluation of protein C, protein S and fibrinogen of pregnant women in Owerri Metropolis. Madonna University Journal of Medicine and Health Sciences. 2022;2(1):292-8. https://madonnauniversity.edu.ng/journals/index.php/medicine/article/view/57.
8. Obeagu EI, Obeagu GU, Adepoju OJ. Evaluation of haematological parameters of pregnant women based on age groups in Olorunsogo road area of Ido, Ondo state. J. Bio. Innov11 (3). 2022:936-941.

Citation: Obeagu EI, Obeagu GU. Antioxidant Supplementation in Pregnancy: Effects on Maternal and Infant Health. Elite Journal of Medicine, 2024; 2(1):23-34

9. Obeagu EI. An update on utilization of antenatal care among pregnant Women in Nigeria. Int. J. Curr. Res. Chem. Pharm. Sci. 2022;9(9):21-6.DOI: 10.22192/ijcrcps.2022.09.09.003
10. Okoroiwu IL, Obeagu EI, Obeagu GU. Determination of clot retraction in preganant women attending antenatal clinic in federal medical centre Owerri, Nigeria. Madonna University Journal of Medicine and Health Sciences. 2022;2(2):91-7. https://madonnauniversity.edu.ng/journals/index.php/medicine/article/view/67.
11. Obeagu EI, Hassan AO, Adepoju OJ, Obeagu GU, Okafor CJ. Evaluation of Changes in Haematological Parameters of Pregnant Women Based on Gestational Age at Olorunsogo Road Area of Ido, Ondo State. Nigeria. Journal of Research in Medical and Dental Science. 2021;9(12):462-.links/61b1e32f0c4bfb675178bfa7/Evaluation-of-Changes-in-Haematological-Parameters-of-Pregnant-Women-Based-on-Gestational-Age-at-Olorunsogo-Road-Area-of-Ido-Ondo-State-Nigeria.pdf.
12. Anyiam AF, Obeagu EI, Obi E, Omosigho PO, Irondi EA, Arinze-Anyiam OC, Asiyah MK. ABO blood groups and gestational diabetes among pregnant women attending University of Ilorin Teaching Hospital, Kwara State, Nigeria. International Journal of Research and Reports in Hematology. 2022 Jun 21;5(2):113-121.
13. Obeagu EI. Gestational Thrombocytopaenia. J Gynecol Women's Health. 2023;25(3):556163. links/64b01aa88de7ed28ba95fccb/Gestational-Thrombocytopaenia.pdf.
14. 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 Aug 9;13(2):26-31.
15. 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):10-9.
16. Obeagu EI, Abdirahman BF, Bunu UO, Obeagu GU. Obsterics characteristics that effect the newborn outcomes. Int. J. Adv. Res. Biol. Sci. 2023;10(3):134-43.DOI: 10.22192/ijarbs.2023.10.03.016
17. Obeagu EI, Ogunnaya FU. PREGNANCYINDUCED HAEMATOLOGICAL CHANGES: A KEY TO MARTERNAL AND CHILD HEALTH. European Journal of Biomedical. 2023;10(8):42-3. links/64c890bddb38b20d6dad2c5c/PREGNANCY-INDUCED-HAEMATOLOGICAL-CHANGES-A-KEY-TO-MARTERNAL-AND-CHILD-HEALTH.pdf.
18. 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):10-9.
19. Okamgba OC, Nwosu DC, Nwobodo EI, Agu GC, Ozims SJ, Obeagu EI, Ibanga IE, Obioma-Elemba IE, Ihekaire DE, Obasi CC, Amah HC. Iron Status of Pregnant and Post-Partum Women with Malaria Parasitaemia in Aba Abia State, Nigeria. Annals of Clinical and Laboratory Research. 2017;5(4):206. links/5ea97df145851592d6a8acf2/Iron-Status-

of-Pregnant-and-Post-Partum-Women-with-Malaria-Parasitaemia-in-Aba-Abia-State-Nigeria.pdf.
20. Eze RI, Obeagu EI, Edet FN. Frequency of Rh Antigen C And c among pregnant women in Sub-Urban area in Eastern Nigeria. Madonna Uni J Med Health Sci. 2021;1(1):19-30.
21. Obeagu EI, Ofodile AC, Okwuanaso CB. A review of urinary tract infections in pregnant women: Risks factors. J Pub Health Nutri. 2023; 6 (1). 2023;137:26-35. links/63c3a9116fe15d6a571e8bba/A-review-of-urinary-tract-infections-in-pregnant-women-Risks-factors.pdf.
22. Obeagu EI, Obeagu GU, Musiimenta E. Post partum haemorrhage among pregnant women: Update on risks factors. Int. J. Curr. Res. Med. Sci. 2023;9(2):14-7.DOI: 10.22192/ijcrms.2023.09.02.003
23. Obeagu EI, Obeagu GU, Ogunnaya FU. Deep vein thrombosis in pregnancy: A review of prevalence and risk factors. Int. J. Curr. Res. Chem. Pharm. Sci. 2023;10(8):14-21.DOI: 10.22192/ijcrcps.2023.10.08.002
24. Jakheng SP, Obeagu EI, Jakheng EW, Uwakwe OS, Eze GC, Obeagu GU, Vidya S, Kumar S. Occurrence of Chlamydial Infection Based on Clinical Symptoms and Clinical History among Pregnant Women Attending Clinics in Zaria Metropolis, Kaduna State, Nigeria. International Journal of Research and Reports in Gynaecology. 2022;5(3):98-105.
25. Okorie HM, Obeagu EI, Eze EN, Jeremiah ZA. Assessment of some haematological parameters in malaria infected pregnant women in Imo state Nigeria. Int. J. Curr. Res. Biol. Med. 2018;3(9):1-4.DOI: 10.22192/ijcrbm.2018.03.09.001
26. Onyenweaku FC, Amah HC, Obeagu EI, Nwandikor UU, Onwuasoanya UF. Prevalence of asymptomatic bacteriuria and its antibiotic susceptibility pattern in pregnant women attending private ante natal clinics in Umuahia Metropolitan. Int J Curr Res Biol Med. 2017;2(2):13-23.DOI: 10.22192/ijcrbm.2017.02.02.003
27. Okoroiwu IL, Chinedu-Madu JU, Obeagu EI, Vincent CC, Ochiabuto OM, Ibekwe AM, Amaechi CO, Agu CC, Anoh NV, Amadi NM. Evaluation of Iron Status, Haemoglobin and Protein Levels of Pregnant Women in Owerri Metropolis. Journal of Pharmaceutical Research International. 2021;33(27A):36-43.
28. Obeagu EI, Njar VE, Obeagu GU. Infertility: Prevalence and Consequences. Int. J. Curr. Res. Chem. Pharm. Sci. 2023;10(7):43-50.
29. Emeka-Obi OR, Ibeh NC, Obeagu EI, Okorie HM. Evaluation of levels of some inflammatory cytokines in preeclamptic women in owerri. Journal of Pharmaceutical Research International. 2021;33(42A):53-65.
30. Obeagu EI, Faduma MH, Uzoma G. Ectopic Pregnancy: A Review. Int. J. Curr. Res. Chem. Pharm. Sci. 2023;10(4):40-4.DOI: 10.22192/ijcrcps.2023.10.04.004
31. Obeagu EI, Gamade SM, Obeagu GU. The roles of Neutrophils in pregnancy. Int. J. Curr. Res. Med. Sci. 2023;9(5):31-5.DOI: 10.22192/ijcrms.2023.09.05.005
32. Eze R, Obeagu EI, Nwakulite A, Okoroiwu IL, Vincent CC, Okafor CJ, Chukwurah EF, Chijioke UO, Amaechi CO. Evaluation of Copper Status and Some Red Cell Parameters of Pregnant Women in Enugu State, South Eastern Nigeria. Journal of Pharmaceutical Research International. 2021 May 29;33(30A):67-71.

33. Obeagu EI, Obeagu GU. Molar Pregnancy: Update of prevalence and risk factors. Int. J. Curr. Res. Med. Sci. 2023;9(7):25-8.DOI: 10.22192/ijcrms.2023.09.07.005
34. Obeagu EI, Bunu UO. Factors that influence unmet need for family planning. International Journal of Current Research in Biology and Medicine. 2023;8(1):23-7.
35. Ibebuike JE, Ojie CA, Nwokike GI, Obeagu EI, Nwosu DC, Nwanjo HU, Agu GC, Ezenwuba CO, Nwagu SA, Akujuobi AU. Barriers to utilization of maternal health services in southern senatorial district of Cross Rivers state, Nigeria. International Journal of Advanced Multidisciplinary Research. 2017;4(8):1-9.DOI: 10.22192/ijamr.2017.04.08.001
36. Emannuel G, Martin O, Peter OS, Obeagu EI, Daniel K. Factors Influencing Early Neonatal Adverse Outcomes among Women with HIV with Post Dated Pregnancies Delivering at Kampala International University Teaching Hospital, Uganda. Asian Journal of Pregnancy and Childbirth. 2023 Jul 29;6(1):203-11. http://research.sdpublishers.net/id/eprint/2819/.
37. Okorie HM, Obeagu EI, Eze EN, Jeremiah ZA. Assessment of coagulation parameters in malaria infected pregnant women in Imo state, Nigeria. International Journal of Current Research in Medical Sciences. 2018;4(9):41-9.DOI: 10.22192/ijcrms.2018.04.09.006
38. Obeagu EI, Obeagu GU. Postpartum haemorrhage among women delivering through spontaneous vaginal delivery: Prevalence and risk factors. Int. J. Curr. Res. Chem. Pharm. Sci. 2023;10(8):22-6.DOI: 10.22192/ijcrcps.2023.10.08.003
39. Obeagu E, Eze RI, Obeagu EI, Nnatuanya IN, Dara EC. ZINC LEVEL IN APPARENTLY PREGNANT WOMEN IN URBAN AREA. Madonna University journal of Medicine and Health Sciences ISSN: 2814-3035. 2022 Mar 2;2(1):134-48. https://www.journal.madonnauniversity.edu.ng/index.php/medicine/article/view/40.
40. Ogomaka IA, Obeagu EI. Malaria in Pregnancy Amidst Possession of Insecticide Treated Bed Nets (ITNs) in Orlu LGA of Imo State, Nigeria. Journal of Pharmaceutical Research International. 2021 Aug 25;33(41B):380-6.
41. Obeagu EI, Ogunnaya FU, Obeagu GU, Ndidi AC. SICKLE CELL ANAEMIA: A GESTATIONAL ENIGMA. migration. 2023;17:18.
42. Barron A, McCarthy CM, O'Keeffe GW. Preeclampsia and neurodevelopmental outcomes: potential pathogenic roles for inflammation and oxidative stress? Molecular Neurobiology. 2021;58(6):2734-2756.
43. Ifeanyi OE, Uzoma OG. A review on erythropietin in pregnancy. J. Gynecol. Womens Health. 2018;8(3):1-4. https://www.academia.edu/download/56538560/A_Review_on_Erythropietin_in_Pregnancy.pdf.
44. Ifeanyi OE. A review on pregnancy and haematology. Int. J. Curr. Res. Biol. Med. 2018;3(5):26-8.DOI: 10.22192/ijcrbm.2018.03.05.006
45. Nwosu DC, Nwanjo HU, Obeagu EI, Ibebuike JE, Ezeama MC. Ihekireh. Changes in liver enzymes and lipid profile of pregnant women with malaria in Owerri, Nigeria. International Journal of Current Research and Academic Review. 2015;3(5):376-83.
46. Ibebuike JE, Ojie CA, Nwokike GI, Obeagu EI, Nwosu DC, Nwanjo HU, Agu GC, Ezenwuba CO, Nwagu SA, Akujuobi AU. Factors that influence women's utilization of

primary health care services in Calabar Cros river state, Nigeria. Int. J. Curr. Res. Chem. Pharm. Sci. 2017;4(7):28-33.
47. Eze R, Ezeah GA, Obeagu EI, Omeje C, Nwakulite A. Evaluation of iron status and some haematological parameters of pregnant women in Enugu, South Eastern Nigeria. World Journal of Pharmaceutical and Medical Research. 2021;7(5):251-254.
48. Elemchukwu Q, Obeagu EI, Ochei KC. Prevalence of Anaemia among Pregnant Women in Braithwaite Memorial Specialist Hospital (BMSH) Port Harcourt. IOSR Journal of Pharmacy and Biological Sciences. 2014;9(5):59-64.
49. Akandinda M, Obeagu EI, Katonera MT. Non Governmental Organizations and Women's Health Empowerment in Uganda: A Review. Asian Research Journal of Gynaecology and Obstetrics. 2022 Dec 14;8(3):12-6.
50. Vidya S. Sunil Kumar Shango Patience Emmanuel Jakheng, Emmanuel Ifeanyi Obeagu, Emmanuel William Jakheng, Onyekachi Splendid Uwakwe, Gloria Chizoba Eze, and Getrude Uzoma Obeagu (2022). Occurrence of Chlamydial Infection Based on Clinical Symptoms and Clinical History among Pregnant Women Attending Clinics in Zaria Metropolis, Kaduna State, Nigeria. International Journal of Research and Reports in Gynaecology.;5(3):98-105.
51. Gamde MS, Obeagu EI. IRON DEFICIENCY ANAEMIA: ENEMICAL TO PREGNANCY. European Journal of Biomedical. 2023;10(9):272-5. links/64f63358827074313ffaae7b/IRON-DEFICIENCY-ANAEMIA-ENEMICAL-TO-PREGNANCY.pdf.
52. Emeka-Obi OR, Ibeh NC, Obeagu EI, Okorie HM. Evaluation of levels of some inflammatory cytokines in preeclamptic women in owerri. Journal of Pharmaceutical Research International. 2021 Aug 25;33(42A):53-65.
53. Emeka-Obi OR, Ibeh NC, Obeagu EI, Okorie HM. Studies of Some Haemostatic Variables in Preeclamptic Women in Owerri, Imo State, Nigeria. Journal of Pharmaceutical Research International. 2021;33(42B):39-48.
54. Obeagu EI, Obeagu GU. Postpartum haemorrhage among women delivering through spontaneous vaginal delivery: Prevalence and risk factors. Int. J. Curr. Res. Chem. Pharm. Sci. 2023;10(8):22-26.
55. Obeagu EI, Obeagu GU. Sickle Cell Anaemia in Pregnancy: A Review. International Research in Medical and Health Sciences. 2023;6(2):10-13.
56. He L, He T, Farrar S, Ji L, Liu T, Ma X. Antioxidants maintain cellular redox homeostasis by elimination of reactive oxygen species. Cellular Physiology and Biochemistry. 2017;44(2):532-553.
57. Gkaliagkousi E, Ferro A. Nitric oxide signalling in the regulation of cardiovascular and platelet function. Front Biosci. 2011;16(1):1873-1897.
58. Phoswa WN, Khaliq OP. The role of oxidative stress in hypertensive disorders of pregnancy (preeclampsia, gestational hypertension) and metabolic disorder of pregnancy (gestational diabetes mellitus). Oxidative medicine and cellular longevity. 2021; 2021:1-0.
59. Sebastiani G, Navarro-Tapia E, Almeida-Toledano L, Serra-Delgado M, Paltrinieri AL, García-Algar Ó, Andreu-Fernández V. Effects of antioxidant intake on fetal development and maternal/neonatal health during pregnancy. Antioxidants. 2022;11(4):648.

60. Marseglia L, D'Angelo G, Granese R, Falsaperla R, Reiter RJ, Corsello G, Gitto E. Role of oxidative stress in neonatal respiratory distress syndrome. Free Radical Biology and Medicine. 2019; 142:132-137.