Trends in Antenatal Laboratory Parameters in Primary Health Care Facilities in Ogbomoso North Local Government Area, Oyo State, Nigeria: A Four-Year Retrospective Review

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Background: Maternal health remains a key indicator of health system performance, especially in low- and middle-income countries like Nigeria, where antenatal care (ANC) is constrained by limited diagnostic capacity and delayed clinical interventions. Integrating routine laboratory screening into ANC enhances early detection of complications and improves pregnancy outcomes. The research examines laboratory parameter patterns from pregnant women who received antenatal care services at Primary Health Care facilities in Ogbomoso North Local Government Area of Oyo State Nigeria from 2019 to 2022.

Methods: This retrospective descriptive study analyzed routinely collected 312 antenatal laboratory records from a central facility serving primary health centers in the LGA. Parameters assessed included haemoglobin levels (anaemia), HBsAg status, blood glucose, urine pH, urinary protein, and Rhesus factor. Trends were evaluated using the Chi-square test for trend, with significance set at $p < 0.05$.

Results: Between 2019 and 2022, anaemia prevalence among pregnant women varied from 6.8% to 33.3%, though without a significant trend ($p = 0.174$). Rhesus-positive rates rose significantly over time ($p = 0.040$), peaking at 75.9% in 2022, while 46.8% were Rhesus-negative overall. Glucose positivity was consistently low and showed no significant pattern ($p = 0.423$). HBsAg positivity peaked at 11.5% in 2021 and 2022, but without a significant trend ($p = 0.360$). Abnormal urine pH dropped significantly from 93.8% in 2019 to 6.5% in 2022 ($p < 0.001$). Urinary protein positivity increased slightly but was not statistically significant ($p = 0.145$). Blood group O was most common, comprising 44.2% of all cases.

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Conclusion: Although most laboratory parameters showed no significant linear trends, notable increases in anaemia and urinary protein suggest ongoing maternal vulnerabilities, while the significant improvement in urine pH indicates progress in infection control. These findings underscore the need for strengthened antenatal screening protocols, sustained preventive interventions, and prospective studies to track maternal outcomes in low-resource settings.

Keywords: Maternal health, antenatal care, laboratory parameters, trend, gestational diabetes, Nigeria

INTRODUCTION

Maternal health remains a critical barometer for evaluating health system performance, particularly in low- and middle-income countries where pregnancy-related morbidity and mortality are still prevalent challenges.(1)(2) Globally, maternal health outcomes have improved over the past two decades, yet sub-Saharan Africa continues to account for a disproportionate burden of maternal deaths and complications due to limited access to antenatal care (ANC), under-resourced health facilities, and delayed medical interventions.(3) In Nigeria, the most populous country in Africa—maternal health indicators remain concerning, compounded by infrastructural gaps, poor ANC uptake, and inadequate diagnostic services across primary healthcare (PHC) levels.(4)

Integrating essential laboratory investigations into routine ANC has been shown to enhance early detection of pregnancy-related complications and guide timely interventions.(5)(6) Laboratory parameters such as haemoglobin concentration, packed cell volume (PCV), blood glucose, malaria parasitemia, hepatitis B surface antigen (HBsAg), and urine pH offer valuable clinical insight into maternal well-being and fetal risk.(7)(8) These indicators help detect anemia, gestational diabetes, infectious diseases, and urogenital infections, conditions known to contribute significantly to adverse maternal and neonatal outcomes across various epidemiological settings.(9)(10)

Despite national strategies to strengthen PHC systems and decentralize maternal care, there is a paucity of longitudinal data assessing trends in antenatal laboratory findings in rural and peri-urban communities in Nigeria.(11) Understanding such trends is critical for evidence-informed planning and resource allocation, especially in underserved regions where PHC facilities serve as the first point of contact for most pregnant women.(12)

This study analyzes a four-year trend in selected antenatal laboratory parameters among pregnant women attending PHC facilities in Oyo State, Nigeria. By examining changes in the prevalence of anemia, gestational hyperglycemia, malaria, HBV infection, and abnormal urinary profiles, the study aims to provide empirical insights to support improved ANC quality, context-sensitive screening protocols, and public health interventions tailored to maternal needs in comparable low-resource settings.

Routine HBsAg screening in ANC aligns with Nigeria's National Policy on Viral Hepatitis and the WHO's global strategy for hepatitis elimination, given the country's intermediate-to-high HBV endemicity and the risk of vertical transmission.(13)(14) Similarly, while urine pH testing is not universally standard, its role in detecting asymptomatic bacteriuria and vaginal infections, common in resource-limited settings, can help prevent preterm births and low birth weight .(15)(16) Contextualizing antenatal laboratory services in this way ensures ANC protocols are both evidence-based and responsive to local epidemiological realities.(17)

Ultimately, the study aims to bridge data gaps and contribute to maternal health policy and programmatic reforms by generating localized evidence to guide PHC-level ANC strengthening.

METHODS

Study Area

This study was carried out in Ogbomoso North Local Government Area (LGA) of Oyo State, Nigeria in the Southwestern part of the country. Ogbomoso is a major urban settlement which includes both the urban and

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the peri-urban population. The LGA covers a total land area of 183.6 square kilometers and with an estimated population of 350, 825. It is estimated that there are15,787 pregnant women in the LGA.(18) The area is located in the savannah ecosystem and is characterized by the presence of wet and dry seasons and the occurrence of seasonal diseases such as malaria. These seasonal fluctuations can affect maternal health and the use of antenatal care (ANC) services.

Ogbomoso North LGA has 10 political wards that are all served by well-equipped Primary Health Care (PHC) facilities of approximately category two status. These facilities provide basic health services that include routine ANC and maternal screening, and most pregnant women in the community report to them as their first point of contact. They get quarterly funding from the Basic Health Care Provision Fund (BHCPF), which is a statutory fund from the Federation Consolidated Account as stipulated in the National Health Act. Besides that, the facilities also get funding from the Immunization Plus and Malaria Progress by Accelerating Coverage and Transforming Services (IMPACT) World Bank Project, which is a loan from the World Bank to support them. In order to support diagnostic services, the LGA has a central laboratory where all samples collected from the various PHC facilities are brought in for analysis to enhance the use of laboratory facilities and standardization of diagnostic procedures.

All Primary Health Care (PHC) facilities operate under the clinical, technical, and administrative oversight of the Local Government Health Authority (LGHA), which comprises various staff cadres. The LGHA is led by a Medical Officer of Health and is technically supported by senior health professionals, including nurses, Community Health Officers (CHOs), and Community Health Extension Workers (CHEWs).

Study Setting

The research took place at the central laboratory which serves Ogbomoso North LGA in Oyo State Nigeria. The laboratory operates as a referral center because it accepts biological samples from all Primary Health Care (PHC) facilities that provide antenatal care (ANC) services throughout the LGA. The central laboratory also receives basic laboratory test results from PHC sites that perform on-site testing for documentation at the central facility. The central laboratory maintains complete aggregated records of diagnostic findings which represent the total diagnostic patterns from all PHC facilities that offer ANC services in the LGA.

Study Design

In this research, a retrospective epidemiological review was used to evaluate the patterns of certain laboratory results among 312 pregnant women visiting PHC facilities in Ogbomoso North LGA for antenatal services. The period under review was from January 1, 2019 to December 31, 2022.

Data Source and Sampling

This study used only the central laboratory records from Ogbomoso North LGA as the source of data. This laboratory is the one that gets and processes all the ANC samples from all the PHC facilities within the LGA. The analysis only included the records of pregnant women whose laboratory test results were documented during 2020 and 2023. Any records that were unreadable, incomplete or did not contain essential details were not included.

Study Variables

The laboratory parameters extracted included:

1. Hemoglobin (Hb) concentration (g/dL) – to determine anemia status,
2. Packed Cell Volume (PCV) (%) – to determine the hematological state,
3. Random blood glucose levels (mg/dL) – to test for gestational diabetes,
4. Malaria parasitemia – confirmed existence or nonexistence of Plasmodium species
5. Hepatitis B Surface antigen – It is included in ANC screening due to Nigeria's intermediate-to-high HBV endemicity and to prevent vertical transmission during childbirth.

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6. Urine pH – to detect early urinary tract infections and monitor maternal metabolic status, especially in low-resource settings where diagnostic infrastructure is limited.

Data Collection Procedure

A specific data extraction tool known as a data abstraction form was used to manually select relevant information from the central laboratory registers. Data extraction was performed by research assistants who were trained for the purpose and closely monitored by the principal investigator. All the extracted entries were double-checked for consistency and correctness in order to guarantee data quality and reliability. There was no personally identifiable information obtained throughout the research process to protect privacy and maintain ethical standards.

Data Analysis

The research team used Microsoft Excel 2019 for data entry and cleaning and IBM SPSS Statistics version 26.0 for data analysis. The analysis displayed year-by-year patterns for laboratory parameters through line charts that showed changes from 2020 to 2023. The research did not require any inferential statistical tests.

Ethical Considerations

The Oyo State Ministry of Health Ethical Review Committee granted ethical clearance for the study. The heads of selected PHC facilities granted permission for the study. The waiver of informed consent applied because the research analyzed de-identified retrospective data. The research maintained human subject ethical standards during data management.

RESULTS

Anaemia Rate and Actual Anemia Cases Among Pregnant Women in Ogbomoso North LGA (2019–2022).

Figure 1 shows a marked increase in anemia cases from 3 cases (6.8%) in 2019 to 33 cases (28.9%) in 2020**,** followed by 31 cases (26.5%) in 2021 and 18 cases (33.3%) in 2022. Although the number of cases and rate fluctuated over the years, a Chi-square test for trend showed no statistically significant linear trend in anemia prevalence **(**$p = 0.174$**).**

Rhesus Status Distribution and Positive Rate Among Pregnant Women in Ogbomoso North LGA (2019–2022).

Figure 2 displays the yearly distribution of Rhesus-positive and Rhesus-negative pregnant women, with a line showing the Rhesus-positive rate. Rhesus-positive cases increased from 10 cases (76.9%) in 2019 to 44 cases (75.9%) in 2022**,** after a decline to 56 cases (47.9%) in 2021**.** The highest positive rate was recorded in 2022 (75.9%)**,** while the lowest was in 2021 (47.9%)**.** A Chi-square test for trend revealed a statistically significant increasing trend in Rhesus positivity over time **(**$p = 0.040$**).**

Glucose Positive Cases and Positivity Rate Among Pregnant Women in Ogbomoso North LGA (2019–2022)

Figure 3 shows the yearly count of glucose-positive pregnant women and the corresponding positivity rate. Glucose-positive cases rose from 0 in 2019 to 2 cases (3.0%) in 2020**,** declined to 1 case (1.2%) in 2021, and then returned to 2 cases (5.1%) in 2022. Despite this fluctuation, the Chi-square test for trend indicated no statistically significant trend in glucose positivity across the four-year period **(**$p = 0.423$**).**

HBsAg Positive Cases and Positivity Rate Among Pregnant Women in Ogbomoso North LGA (2019–2022).

Figure 4 illustrates the number of pregnant women who tested positive for Hepatitis B surface antigen (HBsAg) and the corresponding positivity rate each year. HBsAg-positive cases increased from 2 cases

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(13.3%) in 2019 to 5 cases (9.1%) in 2020**,** then rose to 7 cases (11.5%) in both 2021 and 2022. Despite this upward shift in absolute numbers, the Chi-square test for trend showed no statistically significant linear trend in HBsAg positivity over the period **(**$p = 0.360$**).**

Abnormal Urine pH Cases and Abnormal pH Rate Among Pregnant Women in Ogbomoso North LGA

Figure 5 shows a decline in both the number of abnormal urine pH cases and the abnormal pH rate over the four-year period. In 2019, there were 15 abnormal cases with a rate of 93.8%**,** which dropped to 3 cases and a rate of 6.5% by 2022. Statistical testing using a Chi-square test for trend confirmed a significant downward pattern **(**$p < 0.001$**).**

Trend in Urinary Protein Positivity Among Pregnant Women in Ogbomoso North LGA (2019–2022)

Figure 6 illustrates that from 2019 to 2022, the number of pregnant women who tested positive for urinary protein increased from 2 cases in 2019 to 7 cases in 2022, with varying counts in the intervening years. While this upward shift is visually observable, statistical analysis using a Chi-square test for trend did not confirm a significant linear trend in urinary protein positivity over the four-year period **(**$p=0.145$)

Distribution of Blood Groups Among Pregnant Women attending ANC in PHC Facilities in Ogbomoso North LGA

The pie chart illustrates the distribution of blood groups among the pregnant women studied. Blood group O accounted for 44.2% of the cases, followed by B (25.0%), A (24.7%), and AB (6.1%) (Figure 7).

Prevalence of rhesus factor among pregnant women attending ANC at PHC facilities in Ogbomoso North LGA

The pregnant women population showed Rhesus positive status in 53.2% of cases while Rhesus negative status occurred in 46.8% of cases. The Rhesus groups show a balanced distribution with Rhesus positive women slightly outnumbering Rhesus negative women (Figure 8)

DISCUSSION

This study explored trends in key antenatal laboratory parameters among pregnant women in Ogbomoso North LGA from 2019 to 2022. Although most findings were not statistically significant, they reveal important maternal health patterns relevant to antenatal surveillance in low-resource contexts.

Anaemia prevalence showed an upward trend, reflecting persistent nutritional and infectious burdens. This aligns with Ugwu *et al.*, who linked anaemia to malnutrition, malaria, and helminthiasis in southeastern Nigeria.(19) In contrast, stable rates in Abuja and Ogun State were associated with structured antenatal interventions like iron supplementation and deworming.(20)(21) Internationally, Black *et al.* highlighted systemic nutritional inequities in LMICs as key drivers (22), while studies from Switzerland showed lower rates where nutrition-focused ANC is optimized.(5) These findings highlight the urgency of strengthening antenatal nutrition and infection control to reduce anaemia-related maternal and fetal risks.

The observed Rhesus-negative rate (46.8%) significantly exceeds regional norms (5–8%) reported in Lagos and Enugu.(23)(24) This outlier ($p = 0.040$) may result from population genetics or diagnostic limitations. Rh-negative prevalence is higher in Western populations (15–17%) (25), but remains rare in West Africa. The significant trend observed ($p = 0.040$) suggests either unique population genetics or potential misclassification. This highlights the critical need for accurate Rh typing and timely administration of anti-D immunoglobulin to prevent alloimmunization and hemolytic disease of the fetus and newborn.(26)(25)(27)

Glucose positivity remained low and inconsistent, supporting findings from Lagos and Benin where urine glucose is used for early GDM screening.(28)(29) Agboola *et al.* reported even lower rates in Ilorin, likely due to regional differences.(30) Globally, OGTT offers higher sensitivity and is increasingly recommended in routine ANC, especially in settings experiencing rising GDM rates.(31)

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HBsAg positivity increased modestly, consistent with intermediate-to-high endemicity seen in Ibadan and Abeokuta, Nigeria.(32)(33) Lower rates in another have been linked to expanded vaccination and education.(34) In Vietnam, Nguyen *et al.* showed that antenatal screening and neonatal immunization can significantly reduce vertical transmission.(35) These findings underscore the need to scale HBV screening and vaccine access in Nigeria's antenatal programs.

Urinary pH abnormalities declined significantly ($p < 0.001$), likely due to improved hydration and urinary tract infection (UTI) management. This aligns with the studies of Oladeinde et al. and Ezeome et al., who recommended urine pH as a low-cost indicator for predicting urinary tract infections during pregnancy.(36)(37) Acidic urine has been linked to increased UTI risk by Foxman *et al.* (10), affirming urinalysis as a vital part of antenatal care.

Blood group distribution showed O predominance (44.2%), similar to studies in Oyo and Lagos.(38)(7) Zaria reported more group B cases, reflecting genetic variation .(39) Group O has been associated with lower vWF levels, increasing hemorrhagic risk during childbirth (8), necessitating improved blood banking and delivery preparedness.

Proteinuria rose slightly ($p = 0.145$), aligning with reports from Ogun and Kaduna, where it was an early sign of preeclampsia.(40)(41) Sibai *et al.* emphasized the value of early detection to prevent hypertensive complications in pregnancy.(15) Continued use of dipstick urinalysis remains essential for early risk identification in resource-limited antenatal settings.

CONCLUSION AND RECOMMENDATIONS

This study reveals ongoing maternal health issues in Ogbomoso North LGA, including anaemia, gestational diabetes, HBV infection, abnormal urine pH, and proteinuria. The high prevalence of Rhesus-negative status and group O blood type underscores the need for targeted obstetric care. Strengthening ANC to include routine screening for haemoglobin, HBsAg, glycosuria, urine pH, and proteinuria is recommended. Expanding iron-folate supplementation, deworming, point-of-care glucose testing, and timely HBV vaccination can enhance outcomes. Prospective studies are needed to assess the effectiveness of these interventions over time.

Study limitation

Despite limitations, mitigation measures were applied. Use of centralized laboratory data with standardized diagnostics reduced bias. Incomplete records were excluded to ensure validity, though this may have introduced selection bias. Without a control group, four-year trend analysis served as a proxy for comparison. While external influences like policy changes and COVID-19 were uncontrolled, their potential confounding effects were noted. These steps improved the study's internal validity.

Acknowledgement

The author expresses deep appreciation to the Medical Officer of Health, Ogbomoso North LGA, the Head of Laboratory Unit, who coordinated data collection and collation, and the entire staff of the Unit for their support and cooperation during the entire period of the study.

List of abbreviations

- ANC - Antenatal Care
- PHC - Primary Health Care
- LGA - Local Government Area
- Hb – Hemoglobin
- PCV - Packed Cell Volume
- GDM - Gestational Diabetes Mellitus
- HBsAg - Hepatitis B Surface Antigen
- ITN - Insecticide-Treated Net

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- IPTp - Intermittent Preventive Treatment in Pregnancy
- OGTT - Oral Glucose Tolerance Test
- Rhesus - Rhesus Factor
- UTI – Urinary Tract Infection
- HDFN - Hemolytic Disease of the Fetus and Newborn
- SPSS - Statistical Package for the Social Sciences
- WHO - World Health Organization
- BHCPF - Basic Health Care Provision Fund

Declarations

- **Ethical approval and consent to participate**
  The study titled *"Trends in Antenatal Laboratory Parameters in Primary Health Care Facilities in Ogbomoso North Local Government Area, Oyo State, Nigeria: A Four-Year Retrospective Review"* followed the ethical guidelines of the Declaration of Helsinki (2013 revision). The Oyo State Ministry of Health Research Ethical Review Committee (AD 13/479/2085) provided ethical approval for this study. The study analyzed anonymized secondary data from antenatal facility records and laboratory documentation through a retrospective approach without requiring patient contact. The research team maintained absolute confidentiality during data handling while using the information exclusively for research purposes.
  Consent for Publication
  Not applicable
- **Availability of data and materials**
  Researchers can access the analyzed data through the Directorate of Public Health which is situated at the State Secretariat in Agodi, Ibadan, Oyo State, Nigeria. Dr. Olaniyan Akintunde Babatunde at the Directorate of Public Health should be contacted by researchers to receive access instructions.
  Competing interests

  The authors declared no competing interests.

- **Funding**

  No financial support was received for this research

- **Author's contributions**

  OAB conceptualized the study; SAS, ZOH and VB contributed to the design; AAA, BOO and OT contributed to the methodology and administration; OAB drafted the initial manuscript; AMB supervised the resources Software; OAB, SAS, ZOH, VB, AAA, STS, AMB, and MDD contributed to the validation, visualization, analysis, interpretation of the results and made substantial revision to the initial draft. All authors read and approved the final version of the manuscript.

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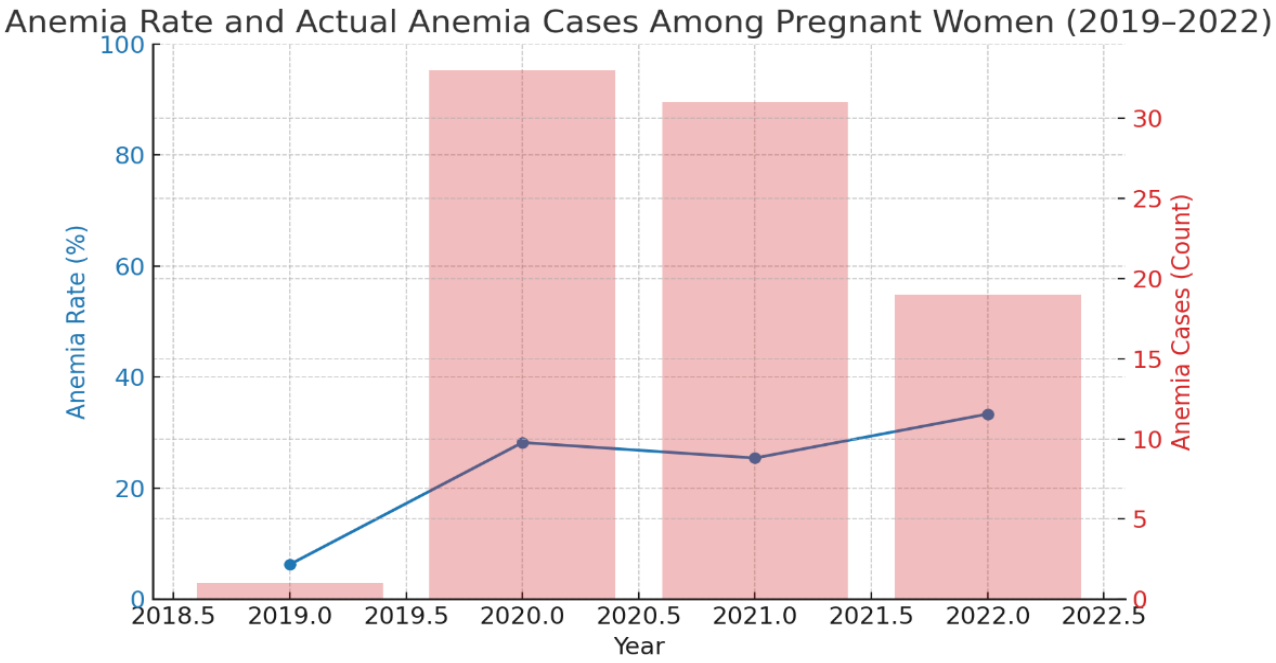

Figure 1*:* Anaemia Rate and Actual Anemia Cases Among Pregnant Women in Ogbomoso North LGA (2019–2022).

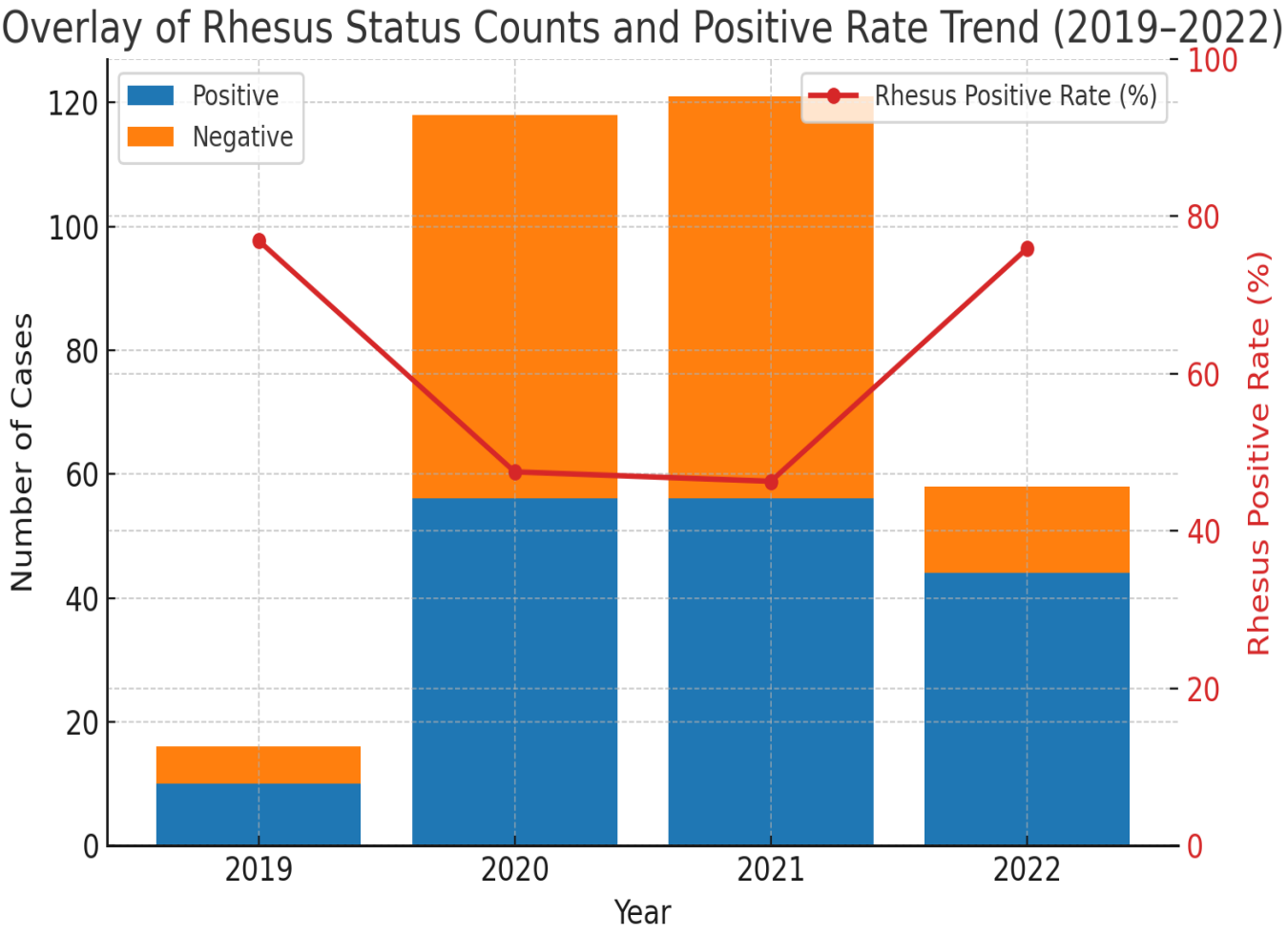

Figure 2**.** Rhesus Status Distribution and Positive Rate Among Pregnant Women in Ogbomoso North LGA (2019–2022).

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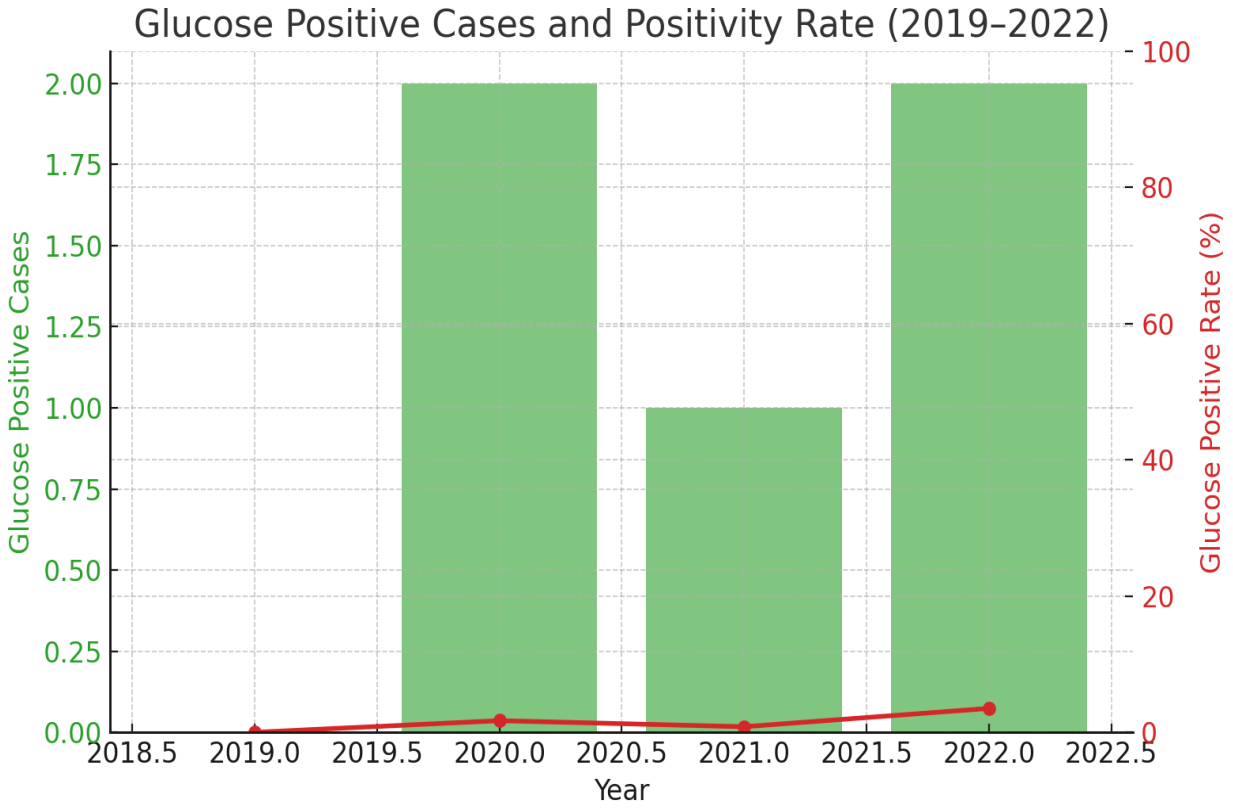

Figure 3**:** Glucose Positive Cases and Positivity Rate Among Pregnant Women in Ogbomoso North LGA (2019–2022).

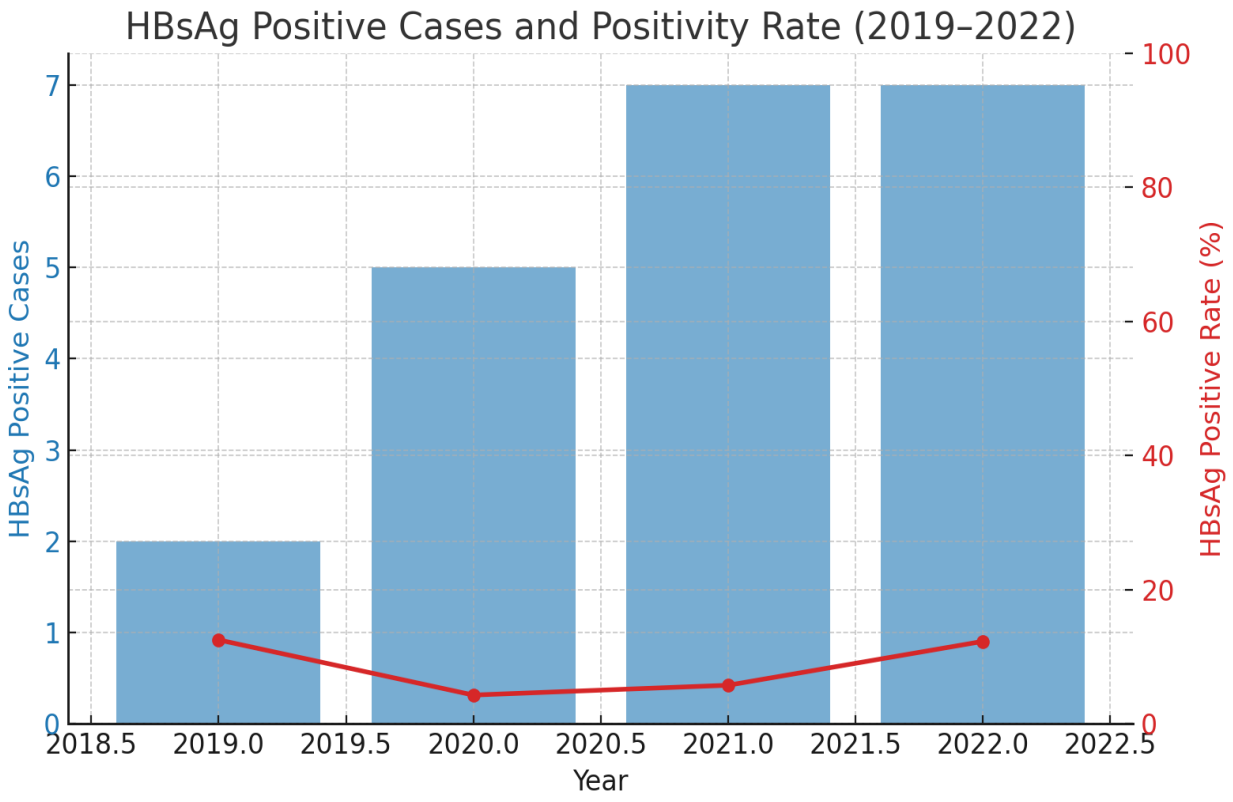

Figure 4**:** HBsAg Positive Cases and Positivity Rate Among Pregnant Women in Ogbomoso North LGA (2019–2022).

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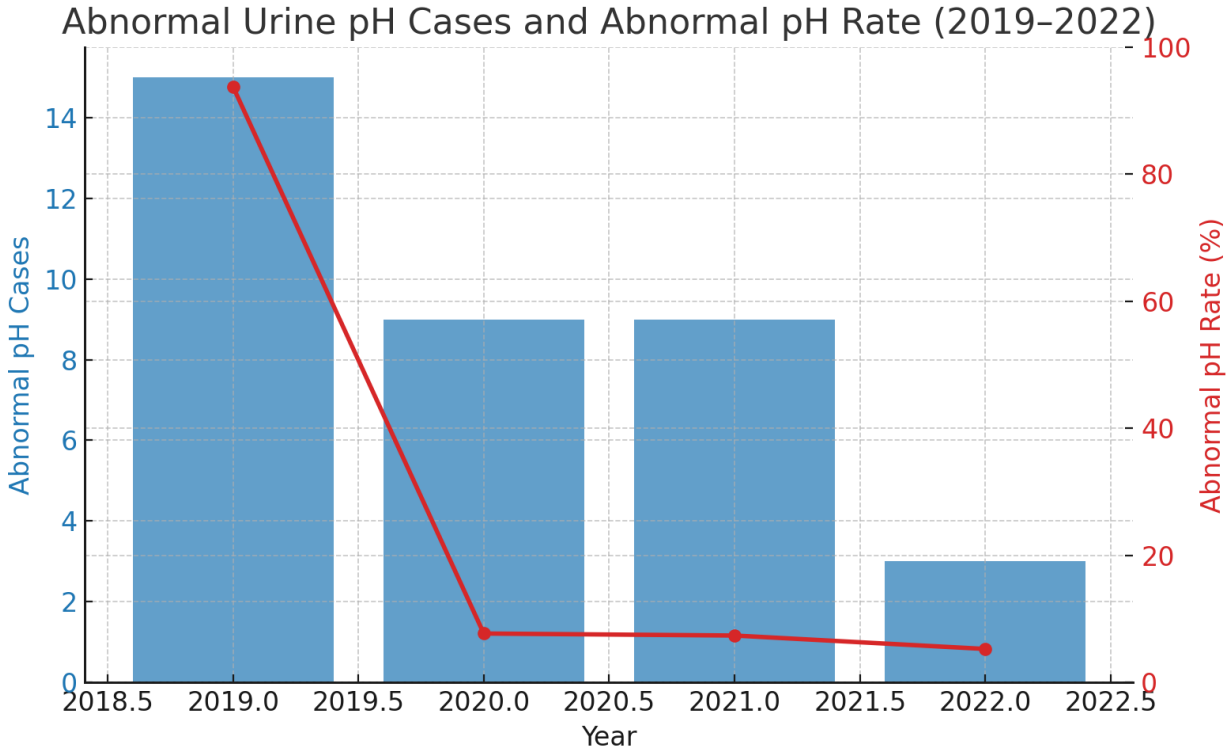

Figure 5*:* Abnormal Urine pH Cases and Abnormal pH Rate Among Pregnant Women in Ogbomoso North LGA (2019–2022).

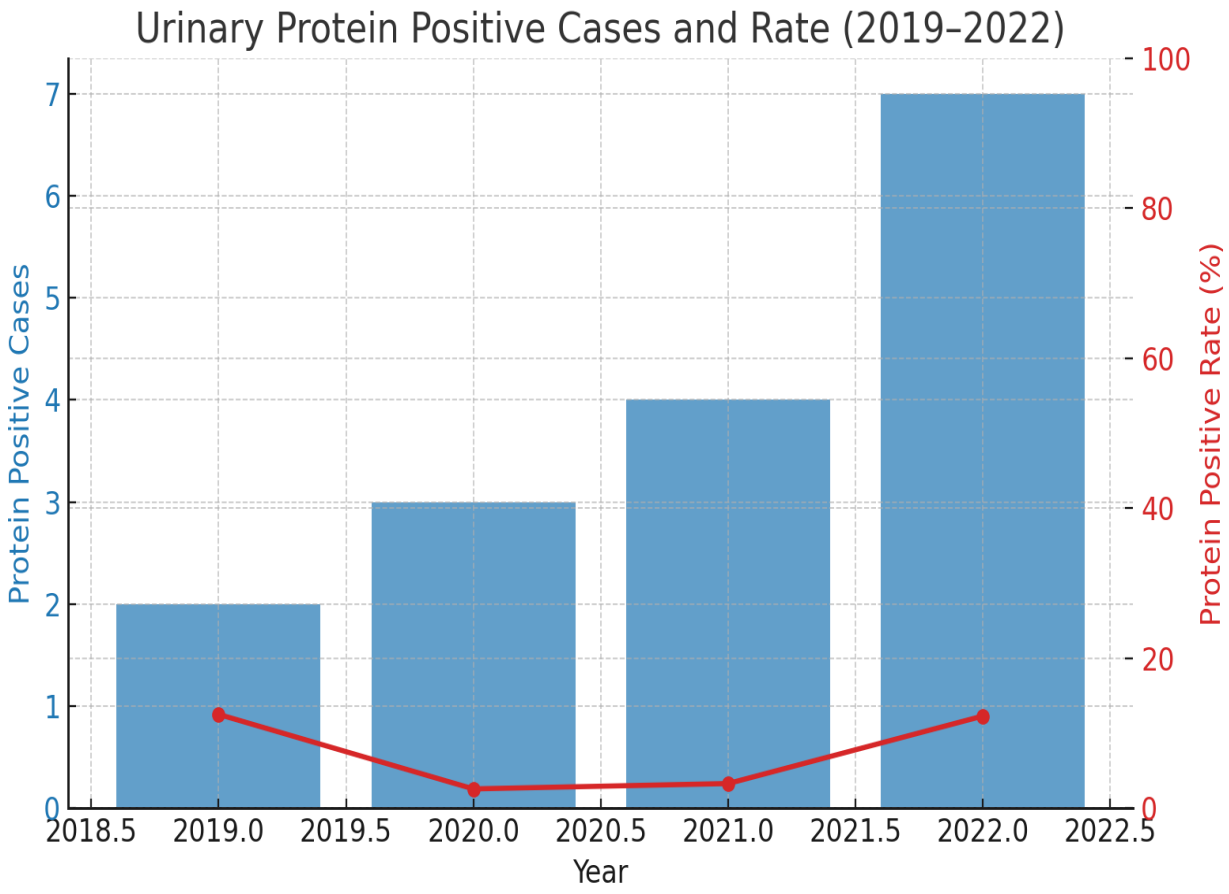

Figure 6: Trend in Urinary Protein Positivity Among Pregnant Women in Ogbomoso North LGA (2019–2022)

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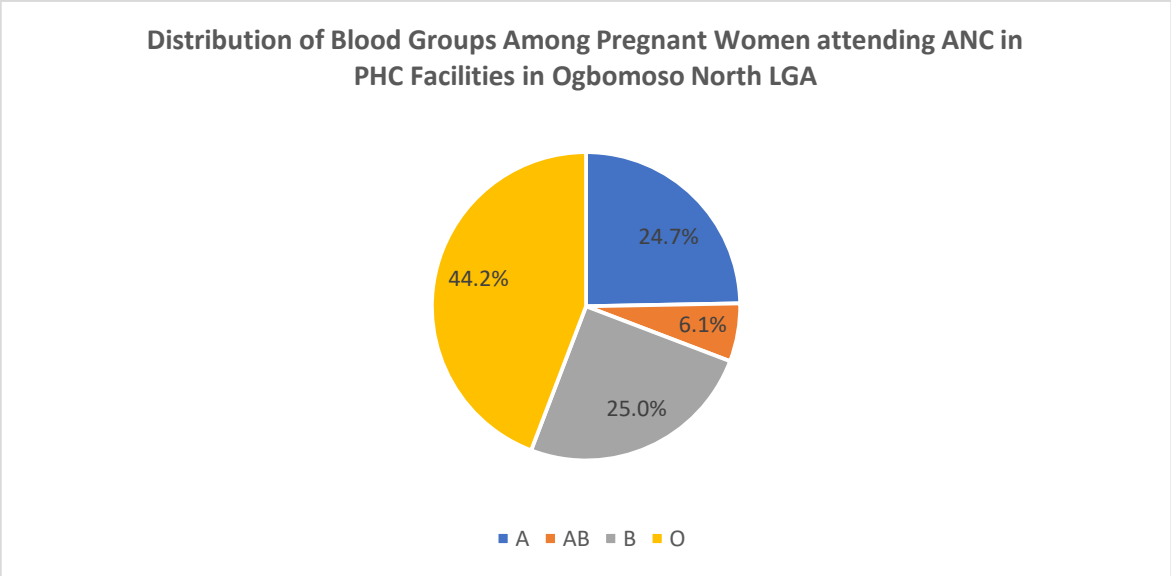

Figure 7: Distribution of Blood Groups Among Pregnant Women attending ANC in PHC Facilities in Ogbomoso North LGA (2019 – 2022)

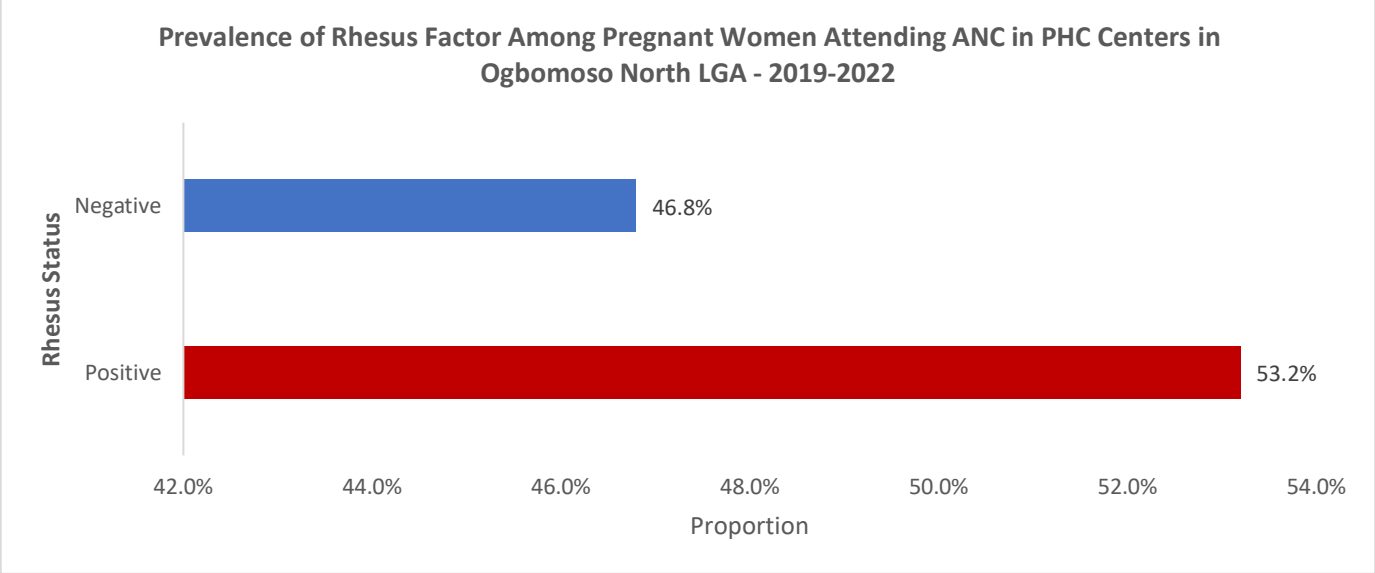

Figure 8: Prevalence of rhesus factor among pregnant women attending ANC at PHC facilities in Ogbomoso North LGA (2019–2022)

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