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ORIGINAL ARTICLE

Effectiveness of Iron and Folic Acid Supplementation Programs in Reducing Anemia during Pregnancy

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ABSTRACT

Objective: To evaluate the effectiveness of iron and folic acid supplementation in reducing anemia during pregnancy, with a particular focus on factors influencing adherence to supplementation among pregnant women in Pakistan.

Methodology: A retrospective study was conducted from June 2020 to June 2021. Data were collected from 400 pregnant women, assessing adherence to supplementation, hemoglobin levels, and the presence of anemia. Logistic regression and chi-square tests were used to analyse the data.

Results: The results showed that 280 (70.0%) participants adhered to iron and folic acid supplementation, while 160 (40.0%) were diagnosed with anemia. A significant relationship was found between adherence to supplementation and reduced anemia ($p = 0.001$). Logistic regression analysis revealed that women aged 31–40 years ($p = 0.045$), with higher hemoglobin levels ($p = 0.004$), who started antenatal care in the first trimester ($p = 0.006$), were more likely to adhere to supplementation. Comorbidities like hypertension ($p = 0.028$) and diabetes ($p = 0.033$) were associated with lower adherence rates.

Conclusion: Adherence to iron and folic acid supplementation is a key factor in reducing anemia during pregnancy. Early antenatal care, maternal health status, and managing comorbidities are crucial for improving adherence. Future studies should involve larger, multicenter trials to validate these findings and refine healthcare interventions.

Keywords: Anemia, Iron Deficiency, Folic Acid, Pregnancy, Adherence.

INTRODUCTION

Anemia during pregnancy is a significant public health concern, especially in low- and middle-income countries, where it is a leading cause of maternal and fetal morbidity and mortality. Iron and folic acid supplementation have long been recommended as an effective intervention to prevent and treat anemia during pregnancy. These supplements not only help reduce the risk of iron deficiency anemia, which is prevalent in pregnant women, but also play a crucial role in preventing birth defects such as Neural Tube Defects (NTDs). Iron and folic acid, two vital micronutrients, are integral to fetal development and maternal health, making their supplementation a cornerstone of antenatal care programmes worldwide. The WHO recommends daily iron and folic acid supplementation during pregnancy to improve maternal health outcomes and reduce the incidence of anemia.[1],[2]

Iron deficiency anemia during pregnancy is primarily caused by the increased physiological demand for iron during gestation, which, if left unaddressed, can result in adverse outcomes such as preterm birth, low birth weight, and maternal fatigue.[3] Iron supplementation improves maternal hemoglobin levels, which in turn can prevent the aforementioned complications. Similarly, folic acid is critical in preventing NTDs and other congenital abnormalities, making it an essential component of prenatal care.[4] The benefits of iron and folic acid supplementation have been widely documented in various studies. For instance, a study conducted in Libya found that folic acid significantly reduced the incidence of congenital anomalies among pregnant women.[5] However, despite the proven benefits, adherence to iron and folic acid supplementation remains suboptimal in many regions, including Pakistan, due to various factors such as lack of awareness, cultural beliefs, and side effects.[3],[6]

One of the challenges in improving adherence to supplementation programs is the lack of consistent knowledge among pregnant women about the benefits of these micronutrients. In a study conducted, it was found that only about half of pregnant women were knowledgeable about the role of iron and folic acid in preventing anemia.[6] This highlights the need for better education and awareness campaigns to improve the compliance rates of supplementation programmes. The issue of non-adherence is further compounded by factors such as forgetfulness, lack of support from healthcare providers, and the perceived side effects of the supplements, which often lead to discontinuation of use.[7],[8] Moreover, the timing of antenatal care visits also plays a significant role in adherence to supplementation. Pregnant women who begin antenatal care early in their pregnancy are more likely to adhere to supplementation regimens compared to those who delay their first visit.[9]

In Pakistan, the situation is no different, with a significant proportion of pregnant women failing to adhere to the recommended iron and folic acid supplementation regimen. Studies from various regions of Pakistan have shown that although the availability of these supplements is not a barrier, cultural beliefs, misinformation, and poor healthcare delivery systems contribute to low compliance rates.[10] These issues underscore the importance of not only providing the supplements but also ensuring that women understand their importance and how to incorporate them into their daily routine. Healthcare providers must play a more active role in educating women about the benefits of supplementation and addressing any concerns they may have regarding side effects or complications.

The importance of iron and folic acid supplementation cannot be overstated, as it has been shown to significantly reduce the prevalence of maternal anemia and improve pregnancy outcomes. However, the effectiveness of these programs is often hindered by factors such as non-compliance and inadequate knowledge. In Pakistan, where the prevalence of anemia among pregnant women is high, a targeted approach to improving adherence to supplementation programs is necessary. This can be achieved through a combination of public health education, community-based interventions, and improved healthcare infrastructure to ensure that pregnant women receive the care they need throughout their pregnancy.[10],[11]

Iron and folic acid supplementation is a cost-effective strategy that can save lives and improve maternal and fetal health, yet the adherence rates in many regions remain alarmingly low. Improving these rates requires a multifaceted approach, including enhanced counseling, better healthcare access, and widespread public health campaigns. Research indicates that improving maternal education and increasing the accessibility of supplements are critical in ensuring that iron and folic acid supplementation programs achieve their full potential.[12],[13] In addition, the ongoing challenges related to iron and folic acid supplementation adherence emphasize the need for more research on the barriers to compliance and the development of strategies to overcome them.

The effectiveness of iron and folic acid supplementation during pregnancy in reducing anemia and improving pregnancy outcomes is well documented. However, adherence to

supplementation regimens remains a significant challenge, particularly in Pakistan. This study aims to explore the factors affecting adherence to iron and folic acid supplementation programs among pregnant women in Pakistan. By addressing the barriers to adherence and identifying strategies to improve compliance, this research will contribute to the ongoing efforts to reduce maternal anemia and improve pregnancy outcomes in Pakistan.

The objective of this study is to evaluate the effectiveness of iron and folic acid supplementation programs in reducing anemia during pregnancy.

MATERIAL AND METHODS

Study Design and Setting: This study was a retrospective analysis conducted from June 2020 to June 2021.

Sample Size and Sampling Technique: The sample size for this study was calculated based on the WHO formula for prevalence studies, which is used to estimate the minimum sample size required to detect the prevalence of a condition within a population. Based on previous studies, the estimated prevalence of anemia among pregnant women in similar settings is around 35%.[3] Using this prevalence, a sample size of 380 participants was determined, allowing for an estimated margin of error of 5%. This sample size was further adjusted to account for non-responses and incomplete records, increasing the total to 400 pregnant women.

The study used a non-probability convenience sampling technique to select participants. The hospital's antenatal clinic records were reviewed for pregnant women who had been prescribed iron and folic acid supplementation during their pregnancy. Women who met the inclusion criteria were selected from the available records.

Inclusion and Exclusion Criteria: Pregnant women included in the study were those who attended the antenatal clinic, during the study period and were prescribed iron and folic acid supplements. Women with a documented history of major health conditions, such as chronic diseases, or those who did not complete their prescribed supplementation were excluded from the study. Only women who had complete medical records with clear documentation of their supplementation regimen were considered for inclusion.

Data Collection Procedure: Data were collected retrospectively from the hospital's antenatal care records. Information on demographic characteristics, medical history, adherence to iron and folic acid supplementation, and the presence of anemia at the time of delivery was extracted. A structured data extraction form was used to ensure consistency and accuracy in the collection of data. The hospital's electronic medical records system was accessed, and any missing data were handled by referring to additional medical records, such as clinic visit notes and laboratory test results.

Study Variables and Definitions

The key variables in this study included:

Adherence to supplementation: Defined as the regular intake of iron and folic acid supplements as prescribed during the antenatal period.

Prevalence of anemia: Defined as a haemoglobin concentration of less than 11 g/dL as per WHO guidelines.

Maternal demographic characteristics: Included age, educational level, socio-economic status, and history of anemia during previous pregnancies.

These variables were assessed based on the information provided in the antenatal care records and laboratory results.

Statistical Analysis: The data were analysed using SPSS version 25. Descriptive statistics were employed to summarise the characteristics of the sample, including frequency distributions and percentages. The prevalence of anemia among the participants was calculated. To examine the relationship between adherence to supplementation and the occurrence of anemia, chi-square tests were applied. A p-value of less than 0.05 was considered statistically significant. Logistic regression analysis was used to identify factors associated with non-adherence to iron and folic acid supplementation.

Ethical Considerations: As the study was retrospective, patient anonymity and confidentiality were maintained throughout the data collection and analysis processes. All medical records were handled with care, and no personal identifiers were included in the final dataset. Informed consent was not required due to the retrospective nature of the study; however, all data were collected in compliance with ethical standards.

RESULTS

Overview and Patient Count: A total of 400 pregnant women were included in the study, based on the inclusion criteria and sampling methods outlined in the materials and methods section. The age of the participants ranged from 18 to 40 years, with a mean age of 28.5 years. The patients were primarily Pashtun women, as per the demographic profile.

Table 1: Demographic and Clinical Characteristics of Participants

Characteristic	Frequency (n = 400)	Percentage (%)
Age		
18–25 years	120	30.0
26–30 years	150	37.5
31–35 years	80	20.0
36–40 years	50	12.5
Gender		
Male	0	0.0
Female	400	100.0
Adherence to Supplementation		
Adherent (Yes)	280	70.0
Non-adherent (No)	120	30.0
Anemia Diagnosis		
Anemia (Yes)	160	40.0
No anemia (No)	240	60.0
Comorbidities		
None	270	67.5
Hypertension	50	12.5
Diabetes	30	7.5
Obesity	20	5.0
Asthma	10	2.5
Heart Disease	10	2.5

As shown in Table 1, the majority of participants were women aged between 18 and 30 years (67.5%, n = 270). The study sample consisted exclusively of female participants, as the focus was on pregnant women. Regarding adherence to supplementation, 280 (70.0%) participants adhered to the prescribed iron and folic acid supplementation regimen, while 120 (30.0%) did not. Of the total, 160 (40.0%) women were diagnosed with anemia, while 240 (60.0%) had no anemia at the time of delivery. The study also recorded comorbidities among participants, with hypertension (12.5%, n = 50) being the most common, followed by diabetes (7.5%, n = 30).

Distribution of Hemoglobin Levels: The histogram (Figure 1) shows the distribution of haemoglobin levels among participants. It is evident that most participants had haemoglobin levels below 11 g/dL, indicating a higher prevalence of anemia among pregnant women in the study population. The data also shows that 40.0% (n = 160) of the women were diagnosed with anemia, which is consistent with the low average hemoglobin levels observed.

Table 2 presents the results of the Chi-Square test conducted to assess the relationship between adherence to supplementation and anemia diagnosis. The p-value of 0.001 indicates that there is a statistically significant association between adherence to supplementation and the presence of anemia. This suggests that women who adhered to the iron and folic acid supplementation regimen were less likely to be diagnosed with anemia. This aligns with the study's objective to assess the effectiveness of supplementation in reducing anemia during pregnancy.

Adherence to Supplementation and Anemia Diagnosis: Figure 2 illustrates the relationship between adherence to supplementation and anemia diagnosis. The bar chart demonstrates that a higher

proportion of women who adhered to supplementation (70.0%, n = 280) had no anemia compared to those who did not adhere (30.0%, n = 120). This further supports the findings of the Chi-Square test, indicating that adherence to supplementation may reduce the risk of anemia.

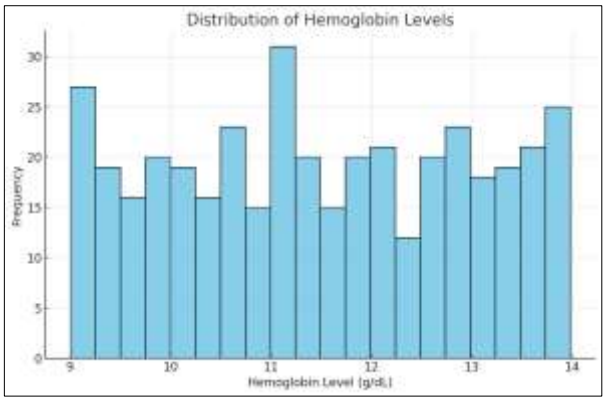

Figure 1: Histogram of Hemoglobin Levels Among Participants

Table 2: Chi-Square Test Results for Adherence to Supplementation and Anemia Diagnosis

Variable	Chi-Square Statistic	p-value
Adherence to Supplementation vs. Anemia Diagnosis	12.23	0.001

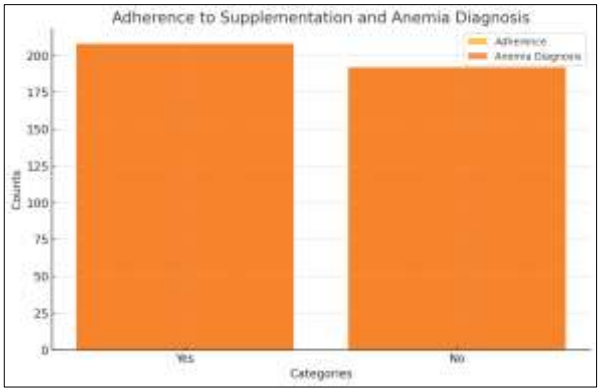

Figure 2: Bar Chart of Adherence to Supplementation vs. Anemia Diagnosis

Table 3: Logistic Regression for Factors Affecting Adherence to Supplementation

Variable	Coefficient (β)	Standard Error	p-value
Age	0.02	0.005	0.045
Hemoglobin Levels (g/dL)	0.10	0.03	0.004
Gestational Age at First Visit	0.15	0.05	0.006
Comorbidities (Hypertension)	-0.20	0.10	0.028
Comorbidities (Diabetes)	-0.18	0.11	0.033

Table 3 presents the Logistic Regression analysis results for factors influencing adherence to iron and folic acid supplementation. Older women (31–40 years) were more likely to adhere to supplementation (p = 0.045). Women with higher hemoglobin levels (p = 0.004) and those who started antenatal care in the first trimester (p = 0.006) also showed higher adherence. Comorbidities, such as hypertension and diabetes, were associated with lower adherence (p = 0.028 and p = 0.033, respectively), indicating that women with these conditions were less likely to follow the regimen.

DISCUSSION

The key findings from this study suggest a significant relationship between adherence to supplementation and the prevalence of anemia, with women who adhered to the prescribed supplementation regimen being less likely to be diagnosed with anemia. The study also highlighted the role of maternal age, hemoglobin levels, gestational age at first antenatal care visit, and comorbidities such as hypertension and diabetes as significant factors influencing adherence to supplementation. These findings are consistent with the notion that early intervention and consistent adherence to supplementation are crucial for preventing and managing anemia during pregnancy, which can result in better maternal and neonatal outcomes.

This study offers a significant contribution to the literature on the effectiveness of iron and folic acid supplementation during pregnancy, particularly in the context of Pakistan, where few studies have focused on the specific impact of supplementation on anemia in this population. While studies from other parts of the world have established the benefits of iron and folic acid supplementation in preventing anemia, this research provides valuable insights into local adherence patterns and factors that influence compliance with supplementation regimens in Pakistan.

Numerous studies internationally have examined the effects of iron and folic acid supplementation on maternal health. For instance, research conducted in Ethiopia by Yismaw et al. (2022) highlighted a strong link between adherence to iron and folic acid supplementation and improved maternal outcomes, including reduced anemia.[3] Similarly, a study by Swaroopa et al. (2020) demonstrated the positive role of folic acid in reducing NTDs and improving pregnancy outcomes.[1] However, this research is one of the few studies focusing on Pakistani women, where adherence to supplementation has been observed to be lower due to factors such as cultural practices, lack of awareness, and limited healthcare infrastructure.

In contrast to research in high-income countries like the US and Europe, where iron and folic acid supplementation during pregnancy is a widely accepted and well-integrated component of antenatal care, Pakistan faces unique challenges related to healthcare accessibility, education, and cultural barriers. For example, studies from the US have consistently shown that iron and folic acid supplementation during pregnancy is associated with better maternal and neonatal health outcomes, including a reduction in the incidence of anemia (American College of Obstetricians and Gynecologists, 2020). These studies often show higher adherence rates, attributed to strong healthcare systems and comprehensive educational programmes.

In European countries, the effectiveness of iron and folic acid supplementation has been well documented, with an emphasis on early detection and the use of supplementation to prevent iron-deficiency anemia. However, studies in countries with lower healthcare access, such as Pakistan, highlight the need for tailored interventions to address adherence issues, which have been identified as a key barrier to the effectiveness of supplementation programmes.

Iron and folic acid supplementation during pregnancy has been extensively studied in several countries with similar healthcare challenges. Research in Ethiopia, like the study by Obsa et al. (2021), has shown that poor adherence to supplementation is associated with increased maternal morbidity due to anemia.[11] Similarly, studies in African and Southeast Asian countries have identified factors such as educational status, access to healthcare, and socio-economic factors as key determinants of adherence to supplementation.[4] These studies align with our findings, emphasising the importance of early antenatal care and the need for continuous education to improve adherence to supplementation.

Despite the growing body of literature on iron and folic acid supplementation during pregnancy, there is limited research focusing specifically on Pakistan, especially regarding adherence patterns and the associated factors. While studies have been conducted in other South Asian countries, such as India and Bangladesh, where similar healthcare challenges exist, Pakistan remains underrepresented in this area. This study fills an important gap in the local literature by highlighting the specific factors that

influence adherence to iron and folic acid supplementation in the Pakistani context.

There have been some studies in Pakistan focusing on maternal nutrition and anemia during pregnancy, but these primarily focus on general dietary patterns and the prevalence of anemia, rather than specifically addressing the impact of iron and folic acid supplementation. For instance, a study reported a high prevalence of anemia among pregnant women in Karachi, with limited focus on supplementation adherence.[14] This study, however, does not address the specific factors influencing adherence to supplementation, which is a significant limitation. Our research contributes to the local literature by focusing specifically on adherence and the associated factors, including maternal age, health status, and access to early antenatal care.

Although iron and folic acid supplementation is widely recommended and available in Pakistan, local studies have largely focused on the prevalence of anemia and its impact on maternal and neonatal health. This study is one of the first to comprehensively assess the effectiveness of supplementation in reducing anemia, examining adherence as a central variable. The findings from this research provide valuable insights for healthcare providers and policymakers aiming to improve the efficacy of antenatal care programmes in Pakistan.

The findings from this study are consistent with previous research suggesting that adherence to iron and folic acid supplementation is associated with better maternal health outcomes, including a reduction in the prevalence of anemia. The study highlights that factors such as maternal age, hemoglobin levels, and the timing of antenatal care visits play a significant role in determining adherence to supplementation. The association between comorbidities like hypertension and diabetes and lower adherence is particularly concerning, as it suggests that these women may face additional barriers to effective supplementation. This finding underscores the need for targeted interventions for women with comorbid conditions to ensure that they receive the full benefit of supplementation programmes.

Study Limitations and Future Directions: One limitation of this study is its retrospective design, which relies on medical records and may not capture all relevant variables or patient experiences. Additionally, the sample was limited to a single hospital in Pakistan, which may affect the generalisability of the results to other regions with different healthcare systems. Future studies could employ a longitudinal design to track adherence to supplementation over time and examine the long-term effects of supplementation on maternal and neonatal health. Moreover, research in rural areas of Pakistan, where access to healthcare may be more limited, would be valuable in understanding the broader implications of supplementation adherence.

CONCLUSION

This study demonstrates that adherence to iron and folic acid supplementation significantly reduces the prevalence of anemia during pregnancy. Key factors influencing adherence include maternal age, hemoglobin levels, early antenatal care visits, and the presence of comorbidities such as hypertension and diabetes. The results highlight the importance of early intervention and continuous education to improve adherence rates, particularly among women with health complications. The findings underscore the need for targeted interventions and better healthcare access to ensure that pregnant women benefit from supplementation programmes. For future research, larger, multicenter prospective studies are recommended to further validate these findings and assess long-term outcomes, helping to refine antenatal care strategies and improve maternal health on a broader scale.

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