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Exploring Risk Factors and Assessing the Effectiveness of Intravenous Iron Sucrose versus Oral Ferrous Fumarate for Pregnancy-Related Anemia

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Abstract

Background: Anemia associated to pregnancy, which is defined by low hemoglobin levels or inadequate red blood cells, is a serious worldwide health issue that affects the prognosis of both mothers and fetuses. Due to food habits, healthcare access issues, and socioeconomic differences, anemia during pregnancy is very common in Pakistan.

Objective: The aim of the study was to identify risk variables linked to anemia in expectant mothers and assess the effectiveness of intravenous iron sucrose against oral ferrous fumarate in the management of iron deficient anemia during pregnancy.

Methodology: This prospective cross-sectional study was conducted from November 2022 to October 2023 at the Department of Obstetrics and Gynecology, Liaqat Memorial Hospital, Kohat, Pakistan. The final cohort consisted of 120 pregnant women, equally divided between Group A (oral) and Group B (intravenous). Group B had intravenous iron sucrose therapy, whereas Group A got oral ferrous fumarate. Serum ferritin and hemoglobin levels were assessed during the course of the 4-week follow-up assessments. The statistical analysis was performed using SPSS version 27, which showed continuous variables as mean and standard deviation and categorical data as frequency and percentage. A P value of less than 0.05 was considered noteworthy.

Results: Group A's mean hemoglobin rose from 86.49 g/dL to 102.97 g/dL (T-Value: 4.45, P-Value: 0.017), and serum ferritin increased from 8.19 ng/ml to 56.62 ng/ml (T-Value: 11.05, P-Value: 0.029). Similarly, Group B showed significant improvements, with hemoglobin increasing from 82.87 g/dL to 118.41 g/dL (T-Value: 5.26, P-Value: 0.001) and serum ferritin surging from 9.84 ng/ml to 109.85 ng/ml (T-Value: 7.37, P-Value: 0.001). Significant risk factors identified included poor nutrition (51.67%, n=62), multi-parity (59.17%, n=71), lack of antenatal care (67.50%, n=81), and lower socio-economic status (57.50%, n=69).

Conclusion: Intravenous iron sucrose is more effective than oral ferrous fumarate in increasing maternal iron stores, with a notable advantage in terms of fewer side effects.

Keywords: oral ferrous fumarate, risk factors, intravenous iron sucrose, anemia, pregnancy, iron sucrose, ferrous fumarate, pregnancy complications, maternal healths

Introduction

Anemia associated with pregnancy is a disorder in which a pregnant woman has low hemoglobin levels or inadequate red blood cells, which reduces the blood's ability to deliver oxygen to the body's tissues and organs [1,2]. A woman's blood volume rises throughout pregnancy to meet the expanding requirements of the growing baby. Nevertheless, a rise in blood volume often does not correspond with a corresponding increase in the generation of red blood cells or iron consumption [3]. Anemia during pregnancy is often caused by iron deficiency since iron is essential for the formation of hemoglobin [4,5].

Globally, anemia during pregnancy has substantial hazards that affect the health of the mother and the development of the fetus [6]. The World Health Organization estimates that the incidence of anemia amongst pregnant women in industrialized and

developing countries is 14% in developed countries and 51% in undeveloped countries [7]. Anemia is a global health issue that affects about two thirds of pregnant women in underdeveloped nations [8]. The country of Pakistan already has significant healthcare issues, and the frequency of pregnancy-related anemia is concerningly high in this particular setting [9]. This disproportionate burden is caused by a number of causes, including food habits, restricted access to healthcare, and socioeconomic inequities [10].

Comprehending the risk factors linked to anemia related to pregnancy is crucial in order to develop efficacious preventative measures and therapies [11]. In Pakistan, low consumption of foods high in iron combined with a lack of knowledge about healthy eating during pregnancy stands out as a major risk factor [12]. Pregnancy-related anemia is also significantly influenced by socioeconomic variables, including differences in healthcare usage and access to high-quality healthcare. Deciphering these risk variables will advance our scientific knowledge of anemia and open the door to focused public health initiatives [13]. Furthermore, managing pregnancy-related anemia is significantly hampered by disparities in healthcare access, especially in areas with poor resources [14]. Timely treatments are impeded in Pakistan by delayed or poor prenatal care, which is a result of rural-urban disparities and socioeconomic variables [15]. Choosing the right iron supplements is essential to controlling anemia during pregnancy [16].

Objective

The aim of the study was to identify risk variables linked to anemia in expectant mothers and assess the effectiveness of intravenous iron sucrose against oral ferrous fumarate in the management of iron deficient anemia throughout pregnancy.

Materials and methods

Study Design and Setting

Over the course of 12 months, from November 2022 to October 2023, a prospective cross-sectional research was carried out at the Department of Obstetrics and Gynecology, Liaqat Memorial Hospital, Kohat, Pakistan.

Inclusion and Exclusion Criteria

Pregnant women between the ages of 18 and 36 who are between the gestational ages of 10 and 34 weeks, with hemoglobin concentrations within 70 and 99 g/L and serum ferritin levels below fifteen ng/ml. Participants were not permitted to have previous experiences of allergy to iron injections. Pregnant women who weren't between the ages of 18 and 36, whose gestational age was less than ten weeks or exceeded than 34 weeks, or who had recently used iron supplements were eliminated from the research. To preserve homogeneity in the research group, pregnant women bearing multiple fetuses (e.g., twins) are eliminated as well.

Data Collection

Structured interviews and questionnaires was conducted to gather information on socio-economic status, dietary habits, and healthcare access. Relevant obstetric and medical history was examined in the medical records. 178 pregnant participants were initially enrolled in the study; however, 58 of them were removed after stringent criteria were applied. These excluded patients included 14 individuals whose ages fell outside the range of 18 to 36, 12 patients whose gestational ages were between 10 and 34 weeks, 8 patients with allergy concerns, 7 patients with multiple gestations, and 17 patients whose last three months' worth of iron supplementation occurred. Group A (Oral) and Group B (IV) of the final research cohort, comprising 120 pregnant women, were equally divided into two groups of 60 participants each to enable a fair comparison of the safety and effectiveness of oral ferrous fumarate vs intravenous iron sucrose in treating inadequate iron levels anemia in gestation (figure 1).

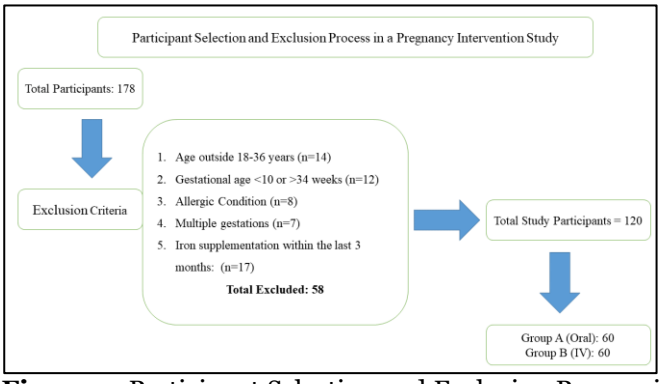

Figure 1: Participant Selection and Exclusion Process in a Pregnancy Intervention Study

Treatment Protocols for Iron Supplementation

Oral Group (Group A): Throughout a 4-week period, each of the two ferrous fumarate pills administered to the patients included 100 mg of elemental iron daily. An additional 5 mg of folic acid daily was given.

Intravenous Group (Group B): The total dosage necessary for iron sucrose is calculated using a particular formula: weight in kilos multiplied by the difference between goal and actual hemoglobin levels, then multiplied by 0.24 and added 500 mg. Next, the result is rounded to the closest multiple of 100 milligrams [17]. This estimated dosage was administered three times a week as an intravenous infusion of 200 mg over 30 minutes in 100 ml of 0.9% normal saline (NS). The weekly maximum dosage that was administered was 600 mg (maximum allowable dose). In addition, for four weeks, participants take five milligrams of oral folic acid every day.

Follow-up of patient

The levels of serum ferritin and hemoglobin were measured on day thirty after a period of four weeks of treatment.

Statistical Analysis

Data was entered into SPSS version 27 for analysis. The mean and standard deviation were used for representing the continuous variables. All of the categorical data was given as percentages and frequencies. The statistical significance of the variations among oral and intravenous

treatment modalities for every variable was assessed using the Student T test. P values less than 0.05 were deemed significant.

Ethical Approval

The ethical approval was obtained from the ASRB KUST (324/2022). Every participant gave written, informed permission to participate in the research.

Results

In this study, a cohort of 120 pregnant women was examined to investigate pregnancy-related anemia in Pakistan. The participants were categorized across several key demographic factors. Age distribution revealed 31.67% (n= 38) were in the 18-24 range, 49.16% (n= 59) in the 25-30 range, and 19.17% (n= 23) in the 31-36 range. Educational backgrounds varied, with 48.33% (n= 58) classified as illiterate, 22.50% (n= 27) having completed school, 17.50% (n= 21) holding a college degree, and 11.67% (n= 14) with a university education. In terms of parity, 40.83% (n=49) were experiencing their first pregnancy, while 59.17% (n=71) had previously given birth to multiple children. Socioeconomic status exhibited diversity, as 57.50% (n= 69) belonged to the lower class, 30.83% (n= 37) to the middle class, and 11.67% (n= 14) to the upper class. Gestational age distribution showed 11.67% (n= 14) in the first trimester, 34.17% (n= 41) in the second trimester, and 54.17% (n= 65) in the third trimester. Employment status demonstrated that 34.16% (n= 41) of participants were employed, while 65.84% (n= 79) were unemployed (table 1).

Table 1: Demographic Characteristics of Participants in a Study on Pregnancy-Related Anemia in Pakistan

Variables		No. of patients (n)	Percentage (%)
Age	18-24	38	31.67
	25-30	59	49.16
	31-36	23	19.17
Level of Education	Illiterate	58	48.33
	School	27	22.50
	College	21	17.50
	University	14	11.67
Parity	Primary	49	40.83
	Multi	71	59.17
Socioeconomic Status	Lower class	69	57.50
	Middle class	37	30.83
	Upper class	14	11.67
Gestational Age	1st trimester	14	11.67
	2nd trimester	41	34.17
	3rd trimester	65	54.17
Employment Status	Employed	41	34.16
	Unemployed	79	65.84

This study identifies several significant risk factors for anemia in pregnancy. Among them are poor nutrition (51.67%, n=62), potentially leading to inadequate iron intake. Multi-parity (59.17%, n=71) indicates an increased risk due to the cumulative demands of multiple pregnancies. Acute blood loss (22.50%, n=27) and chronic blood loss (15.83%, n=19) are direct contributors to lowered iron levels. Worm infestation (10.83%, n=13) can interfere with nutrient absorption, potentially causing anemia. Lack of antenatal care (67.50%, n=81) highlights gaps in proactive health monitoring, and lower socioeconomic status (57.50%, n=69) suggests broader systemic challenges impacting maternal well-being (figure 2).

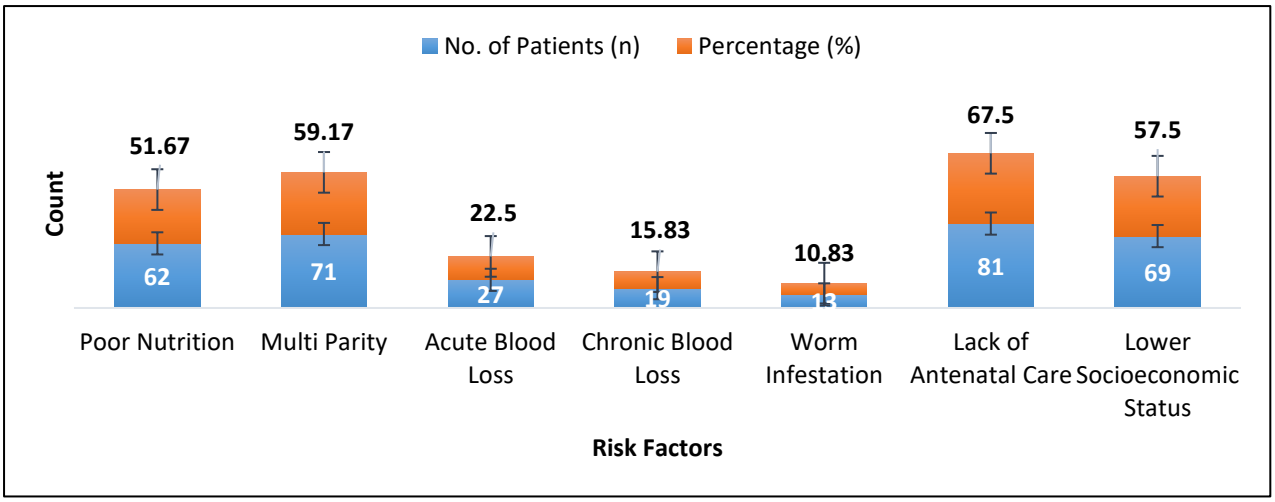

Figure 2: Associated Risk Factors for Anemia in Pregnancy

The table 2 summarizes the hemoglobin levels before and after treatment in two groups, A and B. Group A received oral treatment, while Group B received intravenous iron. Prior to treatment, Group A had a mean hemoglobin level of 86.49 g/dL (SD: 11.81), which increased to 102.97 g/dL (SD: 10.71) post-treatment, with a T-Value of 4.45 and statistically significant P-Value (0.017). Similarly, Group B exhibited a pre-treatment mean hemoglobin of 82.87 g/dL (SD: 10.75), rising to 118.41 g/dL (SD: 13.52) post-treatment, with a T-Value of 5.26 and a highly significant P-Value (0.001).

Table 2: Pre and Post-Treatment Hemoglobin Levels: A Comparative Analysis between Group A (Oral Treatment) and Group B (Intravenous Iron) after 4 Weeks

Hemoglobin Levels	Before the treatment		After treatment		T-Value	P-Value
	Mean	SD	Mean	SD		
Group A	86.49	11.81	102.97	10.71	4.45	0.017
Group B	82.87	10.75	118.41	13.52	5.26	0.001

The table 3 outlines the changes in serum ferritin levels before and after treatment in Groups A and B. Group A, treated orally, had a pre-treatment mean serum ferritin level of 8.19 ng/ml (SD: 3.42), which significantly increased to 56.62 ng/ml (SD: 9.88) post-treatment. The T-Value was 11.05, and a statistically significant P-Value of 0.029. In Group B, receiving intravenous iron, the pre-treatment mean serum ferritin level was 9.84 ng/ml (SD: 3.47), rising substantially to 109.85 ng/ml (SD: 18.91) post-treatment. The T-Value was 7.37, and a highly significant P-Value of 0.001, emphasizing the efficacy of the treatment.

Table 3: Comparative Evaluation of Serum Ferritin Concentration in Groups A and B prior to and following 4 Weeks of Therapy

Serum ferritin level	Before treatment		After treatment		T-Value	P-Value
	Mean	SD	Mean	SD		
Group A	8.19	3.42	56.62	9.88	11.05	0.029
Group B	9.84	3.47	109.85	18.91	7.37	0.001

In a comparative analysis between Intravenous Iron Sucrose and Oral Ferrous Fumarate, involving 60 patients for each treatment, the occurrence of side effects was examined. In the Oral Ferrous Fumarate group, four patients (6.67%) experienced dyspepsia, and two patients (3.33%) reported vomiting and 8 patients (13.33%) reported constipation and 1 patient reported nausea. In intravenous iron sucrose group 1 patient reported dyspepsia (1.67%) and two patients reported constipation (3.33%). The absence of myalgia, pruritus and diarrhea was noted in both groups (Table 4).

Table 4: Comparison of Side Effects between Intravenous Iron Sucrose and Oral Ferrous Fumarate in a Study with 60 Patients for Each Treatment

Side Effects	Intravenous Iron Sucrose (n=60)		Oral Ferrous Fumarate (n=60)	
	No of Patients (n)	Percentage (%)	No of Patients (n)	Percentage (%)
Nausea	0	0	1	1.67
Vomiting	0	0	2	3.33
Dyspepsia	1	1.67	4	6.67
Constipation	2	3.33	8	13.33
Diarrhea	0	0	0	0
Myalgia	0	0	0	0
Pruritus	0	0	0	0
Total	3		15	

Discussion

The present study aimed to explore risk factors associated with pregnancy-related anemia in Pakistan and assess the effectiveness of intravenous iron sucrose compared to oral ferrous fumarate in treating iron deficiency anemia during pregnancy. Pregnancy-related anemia is a global health concern, with global prevalence rates estimated by the World Health Organization (WHO) at 14% in developed countries and 51% in developing nations [7], the burden of anemia during pregnancy is particularly noteworthy in Pakistan [9]. The disproportionate burden in Pakistan is attributed to socio-economic disparities, limited healthcare access, and inadequate nutrition during pregnancy [15]. In a comparative analysis between Intravenous Iron Sucrose and Oral Ferrous Fumarate, involving 60 patients for each treatment, the occurrence of side effects was examined.

In the Oral Ferrous Fumarate group, four patients (6.67%) experienced dyspepsia, and two patients (3.33%) reported vomiting and 8 patients (13.33%) reported constipation and 1 patient reported nausea. In intravenous iron sucrose group 1 patient reported dyspepsia (1.67%) and two patients reported constipation (3.33%). The absence of myalgia, pruritus and diarrhea was noted in both groups.

The research study identifies several significant risk factors for anemia in pregnancy, shedding light on

potential contributors to this health concern. Poor nutrition, reflected in 51.67% (n= 62) of cases, highlights the importance of addressing dietary deficiencies, particularly in terms of inadequate iron intake. Multi-parity, representing 59.17% (n= 71) of cases, emphasizes the cumulative demands of multiple pregnancies as a substantial risk factor. Lack of antenatal care (n=81; 67.50%) and lower socioeconomic status (n=69; 57.50%) further accentuate broader systemic challenges affecting maternal well-being. The findings of the current research study align with existing literatures on anemia in pregnancy, substantiating the well-established links between poor nutrition, multi-parity, lack of care, and lower socioeconomic status as significant risk factors [18,19].

In the study, Group A received oral treatment, and Group B received intravenous iron for managing anemia in pregnancy. After 30 days, Group A's mean hemoglobin increased from 86.49 g/dL to 102.97 g/dL post-treatment (T-Value: 4.45, P-Value: 0.017). Similarly, Group B increased from 82.87 g/dL to 118.41 g/dL (T-Value: 5.26, P-Value: 0.001). Moreover, Group A, mean serum ferritin rose from 8.19 ng/ml to 56.62 ng/ml (T-Value: 11.05, P-Value: 0.029), while Group B, receiving intravenous iron, increased from 9.84 ng/ml to 109.85 ng/ml (T-Value: 7.37, P-Value: 0.001). These findings align with earlier research studies that have explored the efficacy of different iron supplementation methods, emphasizing the positive impact of both oral and intravenous iron treatments in elevating hemoglobin levels and serum ferritin levels in pregnant women with anemia [20,21]

A comparative analysis of side effects between intravenous iron sucrose and oral ferrous fumarate revealed notable differences. Patients receiving intravenous iron sucrose reported no nausea, vomiting, or diarrhea, whereas the oral ferrous fumarate group exhibited higher incidences of dyspepsia, vomiting, and constipation. Statistical analysis confirmed significant differences in the occurrence of nausea (p=0.045), dyspepsia (p=0.014), and metallic taste (p=0.025), favoring intravenous iron sucrose with a lower incidence of these side effects. These findings contribute valuable insights for healthcare professionals in choosing the most suitable iron supplementation method for pregnant women with anemia. These findings align with and extend existing research, providing healthcare professionals with valuable insights to make informed decisions regarding the most suitable iron supplementation method for pregnant women with anemia [22].

Study Limitations

The study on risk factors and treatments for pregnancy-related anemia in Pakistan provides crucial insights despite certain limitations. There are a few limitations to the research, despite the fact that it thoroughly compared the benefits of intravenous iron sucrose vs oral ferrous fumarate in raising hemoglobin and serum ferritin levels in expectant mothers. First off, while 120 individuals in the study is an acceptable sample size for statistical analysis, it may restrict the applicability of the results to larger populations. Furthermore, Liaqat Memorial Hospital in Kohat, Pakistan is a single-center setting that may create regional biases and limit the application of results to other healthcare contexts. Moreover, the study's 12-month duration may have limited its ability to capture long-term impacts and differences in treatment outcomes throughout trimesters of pregnancy. Notwithstanding these limitations, the study highlights important progress in the diagnosis and treatment of pregnancy-related anemia and emphasizes the need for additional multicenter studies with bigger and more diverse cohorts to confirm and generalize these findings to different populations and environments.

Conclusion

This study sheds light on the significant risk factors associated with pregnancy-related anemia in Pakistan, emphasizing the critical role of poor nutrition, multi-parity, and socio-economic challenges. The research contributes valuable insights into the efficacy of intravenous iron sucrose versus oral ferrous fumarate in treating iron deficiency anemia during pregnancy. Both treatment modalities demonstrated a substantial improvement in hemoglobin and serum ferritin levels, with intravenous iron sucrose showing a notable advantage in terms of fewer side effects. These findings underscore the importance of addressing risk factors and tailoring interventions to the specific needs of pregnant women in Pakistan, guiding healthcare professionals towards informed decisions in managing anemia during pregnancy.

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: RAR
Acquisition, analysis, or interpretation of data: HT, AA
Drafting of the manuscript: RAR, MY
Critical review of the manuscript for important intellectual content: HT, AA
Supervision: MY

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