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Association Between Prenatal Iron Supplementation and Birth Weight: A Cross-Sectional Analysis of DHS-7 Data

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ABSTRACT

Low birth weight (LBW) continues to be a public health problem and is associated with poor neonatal health outcomes. Iron deficiency in pregnancy is known to have adverse effects on the growth of the fetus, and iron supplementation during pregnancy is commonly recommended to enhance birth outcomes. But the evidence based on information from DHS-7 is limited. **Objectives:** To assess the association between iron supplementation during pregnancy and birth weight, adjusting for maternal age, education, wealth, and use of antenatal care. **Methods:** A cross-sectional study with secondary data was obtained from DHS-7. Data were analyzed for 100 women having full information on iron supplementation during pregnancy and newborn birth weight. The outcome variable was birth weight, and the primary exposure was iron supplementation. The following factors were considered as covariates: maternal age, education, wealth index, and antenatal care visits. Data were analyzed using descriptive statistics, the Mann-Whitney U test, and multiple linear regression with robust standard errors. **Results:** Women who received iron supplementation delivered infants with significantly higher birth weights than those who did not. After adjustment for other factors, iron supplementation remained significantly associated with higher birth weight. Maternal age and antenatal care visits were also positively associated with birth weight, while education and wealth showed no significant effects. **Conclusions:** Iron supplementation during pregnancy was significantly associated with higher birth weight after adjustment for maternal and socioeconomic factors. These findings suggest that iron supplementation and adequate antenatal care may contribute to improved birth outcomes.

INTRODUCTION

LBW is a major public health problem worldwide, particularly in LMIC countries [1]. It has been linked to higher rates of neonatal death, childhood diseases, poor growth and development, and future developmental problems [2]. Several factors such as the mother's nutritional status, her age, the mother's education, socio-economic factors and use of antenatal care services, are all factors that affect birth weight [3]. Iron deficiency in pregnancy is one of the most prevalent nutritional problems of the mother and fetus. It has been linked to negative pregnancy outcomes such as low birth weight and preterm birth. As a result, routine iron supplementation during pregnancy is recommended as part of antenatal care services by the World Health Organization [4]. Maternal iron supplementation can help increase hemoglobin levels, which can help deliver more oxygen to the fetus, and can help the fetus grow and develop normally [5]. Regardless of these recommendations, there has been inconsistent implementation of iron supplementation in various populations, and inequities in access [6]. Women with higher levels of education, higher socioeconomic status, and a higher number of antenatal care visits are

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more likely to consume iron supplements during pregnancy [7]. Thus, variations in birth weight among supplemented and non-supplemented women could be due not just to supplementation but to underlying factors such as those associated with the mother and socioeconomic status [8]. Such factors should be taken into account when assessing the possible association between iron supplementation and birth outcomes [9]. Other factors related to healthcare use, such as when women start care during pregnancy, how often they attend care, and compliance with prenatal iron supplementation, may also affect the relationship between prenatal iron supplementation and birth weight. Early initiation of antenatal care increases the likelihood of women having received regular antenatal care and other recommended maternal care services, which could lead to better fetal growth [10]. Studies of the relationship between iron supplementation and birth weight with an adjustment for important maternal and socioeconomic factors, however, are limited and have been conducted in the context of DHS-7 [11]. Community-level assessments of maternal health practices and birth outcomes can be conducted using large population-based surveys like DHS. The data can support identification of service gaps, inequalities in access to maternal nutrition interventions, and populations that might be less likely to access routine supplementation programs [12]. Results of such analyses can help health planners/policymakers enhance antenatal care services and maternal nutrition programs to reduce the burden of low birth weight and improve neonatal health outcomes [13].

Although previous studies have explored the relationship between iron supplementation and birth weight, limited evidence is available from DHS-7 data using an adjusted analytical approach. Therefore, this study aimed to assess the association between iron supplementation during pregnancy and birth weight while controlling for maternal age, education, wealth status, and antenatal care utilization.

METHODS

The research design adopted in this study was a retrospective cross-sectional design with secondary data from the Pakistan Demographic and Health Survey (PDHS) 2017-18. The study duration was from July 2025 to December 2025. The DHSP employs a multi-stage stratified cluster sampling design with enumeration areas selected by probability proportional to size, followed by random household selection. For this analysis, 100 women with complete data on birth weight, iron supplementation, and covariates were included. Written informed consent was taken. Sampling weights, clusters, and strata were not applied, as the objective was to explore associations within the complete-case subset rather than generate nationally representative estimates; consequently, findings require validation using design-based weighted analyses. Data were accessed following standard DHSP protocols. The final analytical sample of 100 women was derived from the DHSP-7 dataset by applying strict inclusion criteria requiring complete data on birth weight, iron supplementation, and all covariates of interest. This complete-case subset is not intended to represent the national population but rather to examine adjusted associations within a cohort of women with full data availability. The high proportion of missing birth weight data in DHSP-7 necessitated this complete-case approach to maintain internal validity for multivariable regression analysis. No sampling weights or survey design variables were applied, as the objective was exploratory and hypothesis-generating rather than producing nationally representative estimates. The outcome variable was the weight of the newborn baby (kg), which was treated as a continuous variable. Iron supplementation during pregnancy (yes or no) was the primary exposure factor. Other variables were maternal age (years), education (no education, primary, secondary, and higher), wealth index (poorest to richest quintiles), and the number of antenatal care visits. However, several important confounders were not available in the DHSP-7 dataset used or could not be included due to the study's analytical scope, including maternal anemia status, pre-pregnancy BMI, parity, birth order, multiple pregnancy (twins/triplets), child sex, maternal smoking, and maternal chronic diseases (e.g., hypertension, diabetes). Gestational age at delivery and preterm birth status were not available in the DHSP-7 dataset used for this analysis and therefore could not be included as covariates. Birth weight data in DHSP are commonly affected by missingness, recall bias, and rounding (e.g., recorded in 500g increments). To address these issues, the following steps were taken: (1) only records with non-missing birth weight values were retained; (2) birth weight values were examined for unusual or implausible entries (e.g., <500g or >6000g) and none were identified; (3) no imputation or rounding adjustment was applied, as the analysis was restricted to complete cases; and (4) the use of birth weight as a continuous variable, while acknowledging the potential for rounding, was maintained to preserve variability. However, it is recognized that these data limitations may introduce measurement error and bias. Future studies should consider using heaping correction methods or validating birth weight data against health facility records, thereby ensuring that the data used for analysis is reliable and appropriate for further statistical analysis. Ethical issues were also included in the analysis of the secondary data. Data were anonymized and made available to the public by DHS, thereby ensuring that no personal identifiers were used during analysis and maintaining the complete

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confidentiality of participants. DHS data usage guidelines were followed to obtain permission to use the dataset. The study was carried out academically and scientifically, and all the results and findings were presented in a summarized manner, preventing the identification of any participant. It should also be recognized that, as the data were gathered at a single time point, it cannot be concluded that there are cause-and-effect relationships between iron supplementation and birth weight. Causality is difficult to establish for the timing of exposure and outcome. Despite this, the analysis provides useful information on the relationship between iron supplementation and birth weight among the study population and may support additional research studies and future maternal health interventions.

Data were analyzed using appropriate statistical methods. Descriptive statistics were used to summarize maternal and newborn characteristics. Continuous variables were expressed as mean with standard deviation or median with interquartile range (IQR), depending on their distribution, while categorical variables were presented as frequencies and percentages. The Shapiro-Wilk test was used to assess the normality of continuous variables. Differences in birth weight between iron-supplemented and non-supplemented groups were examined using the Mann-Whitney U test. Multiple linear regression with robust standard errors was used to assess the association between iron supplementation and birth weight, adjusting for maternal age, education, wealth index, and antenatal care visits. However, DHS sampling weights, clusters, and strata were not incorporated into this analysis. Failure to account for the complex survey design may lead to underestimated standard errors and unreliable p-values/confidence intervals for population inference. Therefore, findings are exploratory, limited to the complete-case sample, and require validation using weighted, design-based survey procedures in future studies. A p-value of less than 0.005 was considered statistically significant.

RESULTS

Infants of women who were iron-supplemented had significantly heavier mean birth weight (3.21 kg vs. 2.65 kg). They were also older, with more antenatal visits with their healthcare provider, higher education levels, and higher wealth than the non-iron group. It is also striking to note that half of the non-iron group had no education and were in the poorest wealth quintile, while the majority of the iron group had secondary education and middle to richer wealth (Table 1).

Table 1: Comparison of Characteristics by Iron Supplementation Status

Characteristics	Iron = No (n=28), n (%)	Iron = Yes (n=72), n (%)
Birth Weight (kg)	2.65 (0.17%)	3.21 (0.27%)
Maternal Age (years)	22.6 (3.5%)	28.0 (4.6%)
Antenatal Visits (n)	3.4 (1.2%)	5.5 (1.7%)
Education Level		
No Education	14 (50.0%)	5 (6.9%)
Primary	10 (35.7%)	20 (27.8%)
Secondary	4 (14.3%)	37 (51.4%)
Higher	0 (0.0%)	10 (13.9%)
Wealth Index		
Poorest	14 (50.0%)	5 (6.9%)
Poorer	9 (32.1%)	16 (22.2%)
Middle	3 (10.7%)	23 (31.9%)
Richer	2 (7.1%)	18 (25.0%)
Richest	0 (0.0%)	10 (13.9%)

The overall distribution of birth weight was not normal (p=0.011), but the distribution within each group (non-iron and iron) was normal (p=0.090, p=0.120, respectively). However, as a non-parametric test was pre-specified in the methods, the Mann-Whitney U test was used for comparing birth weight between groups, and parametric tests were not employed. Thus, the parametric tests between the two groups for the comparison of birth weight are valid. Maternal age and the number of antenatal visits were found to be non-normal (p<0.01) and hence medians and interquartile ranges will be used when summarizing the data(Table 2).

Table 2: Normality Test Results(Shapiro-Wilk)

Variables / Group	W statistic	p-value	Interpretation
Birth weight (overall)	0.966	0.011	Not normally Distributed (p<0.005)
Birth weight – Iron = No	0.936	0.089	Approximately Normal (p>0.005)
Birth weight – Iron = Yes	0.973	0.120	Approximately Normal (p>0.005)
Maternal age (years)	0.957	0.002	Not normally Distributed (p<0.005)
Antenatal visits (n)	0.951	0.001	Not normally Distributed (p<0.005)

A Mann-Whitney U test showed that women who received iron supplementation had a significantly higher median birth weight (W = 83, p<0.001) at 3.20 kg (IQR=0.40) compared to women who were not supplemented at 2.65 kg (IQR=0.30)(Table 3).

Table 3: Mann-Whitney U Test Results: Birth Weight by Iron Supplementation Status

Iron Supplementation	n	Median Birth Weight (kg)	IQR (kg)	Test Statistic (W)	p-value
No	28	2.65	0.30	83	<0.001
Yes	72	3.20	0.40		

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The multiple linear regression model of birth weight as the outcome and predictors of iron supplementation (yes/no), maternal age (years), education level (0–3), wealth index (1–5), and number of antenatal visits. Standard errors were robust (Huber-White) to correct for non-normal and heteroscedastic errors. The independent effects of iron supplementation were observed to be associated with a 0.226 kg higher birth weight (95% CI: 0.188–0.264, p<0.001). While this effect size is large and highly statistically significant despite the small sample size, this finding should be interpreted with considerable caution. The large coefficient may indicate residual confounding due to unmeasured variables (such as gestational age, maternal anemia, or pre-pregnancy BMI) or potential model overfitting, given the limited number of complete cases (n=100). The small sample size and the absence of key confounders mean that the observed effect size may be inflated and may not reflect the true population-level association. Antenatal visits also showed a strong positive association (β=0.101 kg per visit, 95% CI: 0.079–0.123, p<0.001). Maternal age (kg per year) had a small but significant effect (β=0.010 kg per year, p<0.001). There were no statistically significant factors for education level (p=0.719) or wealth index (p=0.056) in the adjusted model. The normal distribution plot of the model residuals was close to normal (Shapiro–Wilk p=0.109). The wealth index result approached but did not reach statistical significance (p=0.056), and given the borderline nature of this finding, it should not be interpreted as meaningful or evidence of an effect. This is particularly important given the small sample size and the lack of adjustment for survey design, which may have inflated the precision of estimates (Table 4).

Table 4: Multiple Linear Regression Analysis of Factors Associated with Birth Weight (kg) among Women in a DHS-7-Based Sample (n=100)

Predictors	Coefficient (kg)	Robust SE	95% CI	t value	p-value
(Intercept)	2.004	0.049	(1.909, 2.099)	41.29	<0.001
Iron Supplementation (Yes vs. No)	0.226	0.019	(0.188, 0.264)	11.74	<0.001
Maternal Age (per year)	0.010	0.003	(0.005, 0.016)	3.82	<0.001
Education Level (per category)	0.010	0.029	(-0.046, 0.066)	0.36	0.719
Wealth Index (per quintile)	0.036	0.019	(0.000, 0.073)	1.93	0.056
Antenatal Visits (per visit)	0.101	0.011	(0.079, 0.123)	9.19	<0.001

DISCUSSION

The findings of this study demonstrate a significant positive association between iron supplementation during pregnancy and birth weight. Infants born to mothers who received iron supplementation had higher birth weight compared to those who did not, and this association remained significant after adjusting for maternal age, education, wealth index, and antenatal care visits. These results are consistent with findings reported by Díaz-Torres *et al.* who conducted a systematic review and found that daily iron supplementation during pregnancy was associated with increased birth weight and reduced risk of low birth weight, particularly in populations with a high prevalence of anemia [14]. Similarly, a study by Mwangi *et al.* in sub-Saharan Africa reported that maternal iron supplementation and improved hemoglobin status were significantly linked to higher mean birth weight and reduced incidence of small-for-gestational-age births [15]. The authors highlighted that the early commencement of iron supplementation during pregnancy and the high iron supplementation effect in the present study are associated with good utilization of antenatal care. Moreover, according to Arega *et al.* women who were adherent to the use of iron-folic acid had significantly lower low birth weight rates than women with poor adherence in a population from South Asia. Their study also found that there was a relationship between socioeconomic difference and uptake of supplements, in a similar way to the current findings, with women in the iron-supplement group having higher education and wealth status [16]. The relationship between antenatal care visits and birth weight in this study reinforces the findings of previous studies that antenatal care is a good platform for providing nutrition interventions and monitoring maternal health [17]. The lack of a significant independent effect of education and wealth in the adjusted model indicates that their effect might be mediated by access to health services and supplementation. To determine the independent association of iron supplementation with birth weight, a multivariable regression analysis was carried out, and the results agreed with the previous analysis. Further analysis by multivariable regression also revealed a significant independent association between iron supplementation and birth weight [18]. Furthermore, antenatal care attendance was found to be strongly positively associated with birth weight, underscoring the need to maximize maternal health service use during pregnancy [19]. Maternal age had a weak but significant association, while education and wealth index had no significant association after adjustment [20]. The findings showed that socioeconomic and maternal factors could be one of the channels through which utilization of health services influences the outcome of birth, and increased access to antenatal care providers for all mothers is needed. It can be concluded that the findings of the present analysis indicate the importance of making iron supplementation part of the general services of antenatal care, particularly in parts of

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the country where maternal undernutrition and anemia remain high. The findings also highlight the need to have increased coverage, but also early uptake, continued uptake, and regular monitoring during pregnancy. Maximizing counselling of women during prenatal visits, ensuring access to supplements, and addressing access and adherence issues can further boost supplement uptake among women. It is expected that such synergies will affect fetal growth positively and will reduce the percentage of low birth weight at the population level. There was a weak (p=0.056) but non-conventional statistical significance between the wealth index and the rest of the factors. This finding should not be interpreted as definitive; the p-value is near the cutoff point and could be due to a lack of power in the study, or simply represent a chance association. This result is preliminary and needs to be replicated in larger studies before definitive conclusions can be drawn, as this is an exploratory analysis.

There are some limitations to this study: birth weight information is missing in DHS, recall bias may be an issue, and gestational age and other important confounder variables (maternal anemia, BMI, parity, birth order, multiple pregnancy, child sex, smoking, maternal disease) were not adjusted, which may cause residual confounding that could lead to overestimation of associations. The small complete case sample (n=100) restricts generalizability, and the cross-sectional design does not allow for any causal inferences. Findings need to be confirmed in larger and more extensive datasets with weighted design-based analysis. The findings, however, reiterate the importance of iron supplementation in the routine care of women of childbearing potential and the need to enhance equitable access to maternal nutrition interventions to decrease the burden of low birth weight.

CONCLUSIONS

This study definitely indicates that iron supplementation in pregnancy is linked with increased birth weight of infants, even when taking into account the major factors like maternal age, educational level, wealth status, and number of antenatal care visits. Overall, the results suggest that there is a strong and consistent effect on birth weight of iron supplementation for mothers. The antenatal care visits and maternal age were also positively associated with birth weight, but education and wealth status were not. In general, the results point to the importance of iron supplementation to pregnant women as an effective intervention to improve birth outcomes. Improving iron supplementation and regular attendance at antenatal visits could help to lower the risk of low birth weight and improve maternal and neonatal health outcomes.

Authors' Contribution

Conceptualization: MI
Methodology: MNA
Formal analysis: MI
Writing and Drafting: MNA, SAK, SK
Review and Editing: MNA, SAK, MI, SK

All authors approved the final manuscript and take responsibility for the integrity of the work

Conflicts of Interest

The authors declare no conflict of interest.

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