Maternal Determinants of Anaemia in Pregnancy and Haemoglobin Trajectories by Iron Status: A Prospective Population-Based Cohort Study in Southwestern Sweden

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Introduction

- The aetiology of anaemia in pregnancy is complex and multifactorial[1].
- Leading cause: Iron deficiency[2].
- During pregnancy overall iron requirements are significantly higher than pre-pregnancy[3].

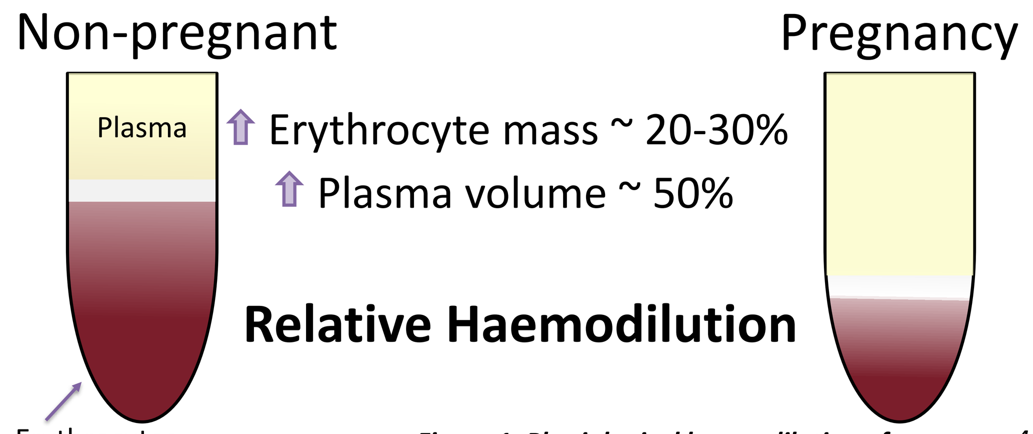

Figure 1: Physiological haemodilution of pregnancy[4].

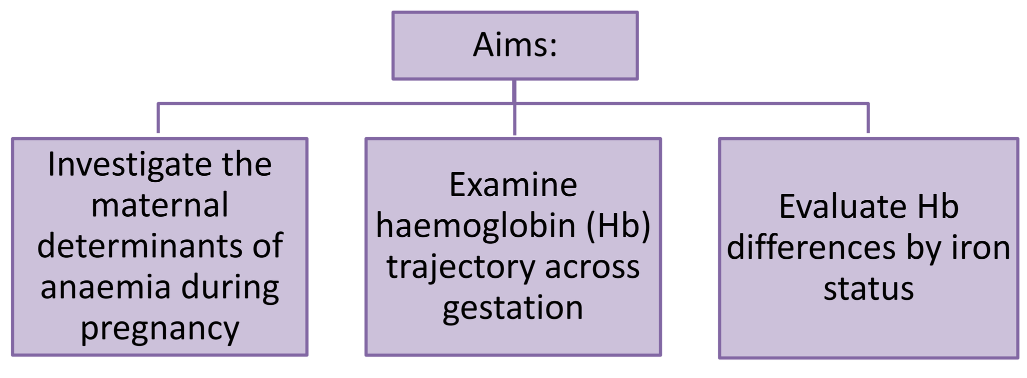

Figure 2: Research project aims.

Methods

- **Study Design**: Secondary analysis of the GraviD cohort, a population-representative pregnancy cohort from the southwestern Sweden.
- 2,122 women were recruited at antenatal care registration in 2013-2014. Trimester 1 (T1) serum ferritin measurements were available for 1,637.
- **Anaemia in pregnancy**: Hb <110g/L in T1 and trimester 3 (T3), and <105g/L in trimester 2 (T2). **Iron deficiency (ID)**: serum ferritin <30µg/L.
- **T1**: Pregnancy registration, primarily weeks 8–12. **T2**: Weeks 23-27. **T3**: Weeks 35-40.

Results

- Multiparous women had higher odds of anaemia compared to nulliparous women.
- Women from Africa and Asia had higher odds of anaemia than those from Northern Europe.
- Mean Hb concentrations decreased from T1 to T2 and increased in T3, showing a significant change in Hb concentrations across pregnancy.
- Mean Hb concentrations were lower among participants with ID at T1 and T2.
- ID in T1 was associated with higher anaemia prevalence across all trimesters.

Table 1: Maternal characteristics in trimester 1 of pregnancy (n = 2,122).

Age, years	31.4 ± 4.9
Body Mass Index, kg/m²	24.5 ± 4.3
Parity	
Nulliparous	904 (42.6)
Primiparous	817 (38.5)
Multiparous	401 (18.9)
Birth region	
Northern Europe	1599 (75.5)
Other Europe	148 (7)
Asia	214 (10.1)
Africa	117 (5.5)
America	41 (1.9)
Education	
College or University level	1244 (59.3)
Haemoglobin, g/L	126.5 ± 9.9
Anaemia[1]	76 (3.6)
Ferritin, µg/L	42.5 [40.9]
Iron deficiency[2]	527 (24.8)

Note: Continuous variables are presented as mean ± standard deviation (SD) if normally distributed and median [Interquartile range, IQR] for non-normally distributed variables. Categorical variables are reported as n (%). [1]Anaemia: haemoglobin (Hb) <110 g/L. [2]Iron deficiency; serum ferritin <30 µg/L; prevalence based on total cohort.

Table 2: Maternal determinants of anaemia[1] in trimester 1 of pregnancy: unadjusted logistic regression analysis.

	OR (95% CI)	p-value
Parity		
Nulliparous	Ref	
Primiparous	0.8 (0.5-1.5)	0.497
Multiparous	**2.6 (1.5-4.4)**	**<0.001**
Birth region		
Northern Europe	Ref	
Other Europe	1.2 (0.4-3.4)	0.730
America	0 (0)	0.998
Asia	**4.2 (2.4-7.6)**	**<0.001**
Africa	**7.3 (4.0-13.5)**	**<0.001**

Note: Unadjusted logistic regression models were fitted separately for each variable. Reference categories are indicated by Ref. Statistically significant p-values (p < 0.05) are presented in bold. Parity: n = 2090; Birth region: n = 2086. [1]Anaemia is defined as haemoglobin (Hb) <110 g/L. Anaemia was categorised as non-anaemic (Hb ≥110 g/L, coded as 0) and anaemia (Hb <110 g/L, coded as 1).

BMI category and education status were not significantly associated with anaemia at trimester 1 of pregnancy across all categories.

Note: Using normal weight (BMI 18.5 – 24.9kg/m²) and primary education as reference categories.

*Figure 3: Mean haemoglobin concentrations across the three trimesters of pregnancy (n = 1556). Error bars represent standard error of the mean. Asterisks indicate statistically significant differences between groups, based on Bonferroni corrected repeated measures ANOVA (**p<0.001).*

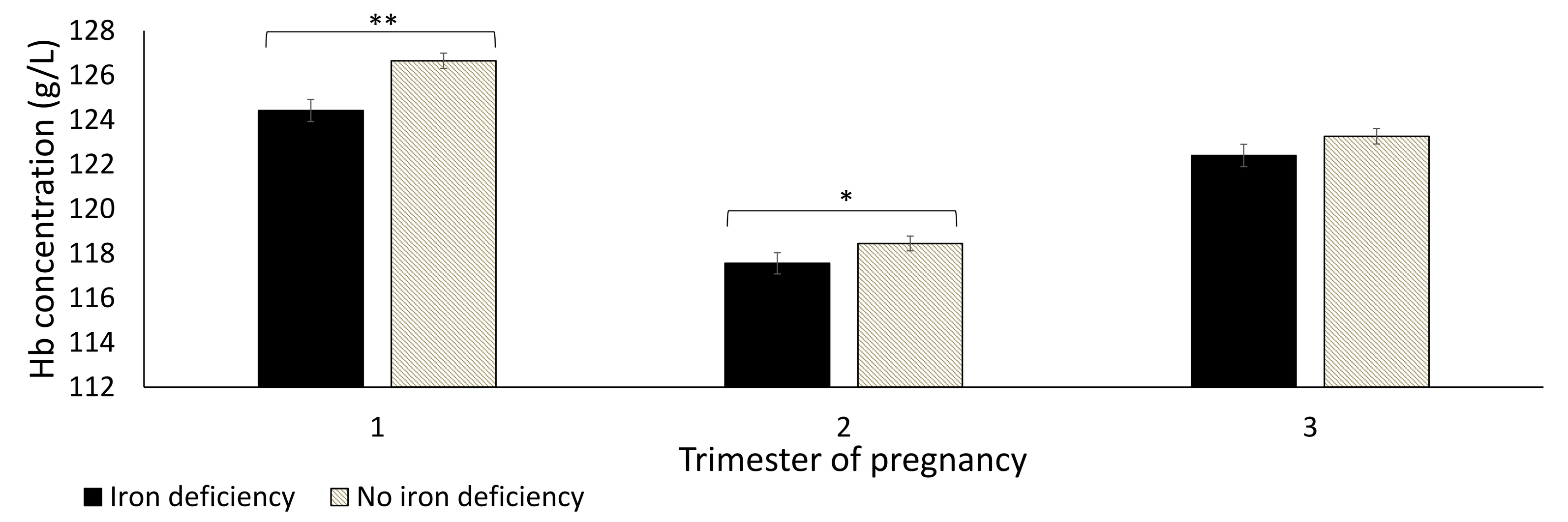

*Figure 4: Mean haemoglobin concentrations across pregnancy according to iron deficiency status at trimester 1 (n = 1213). Error bars represent standard error of the mean. Asterisks indicate statistically significant differences between groups, based on independent samples t-tests (*p< 0.05, **p<0.001).*

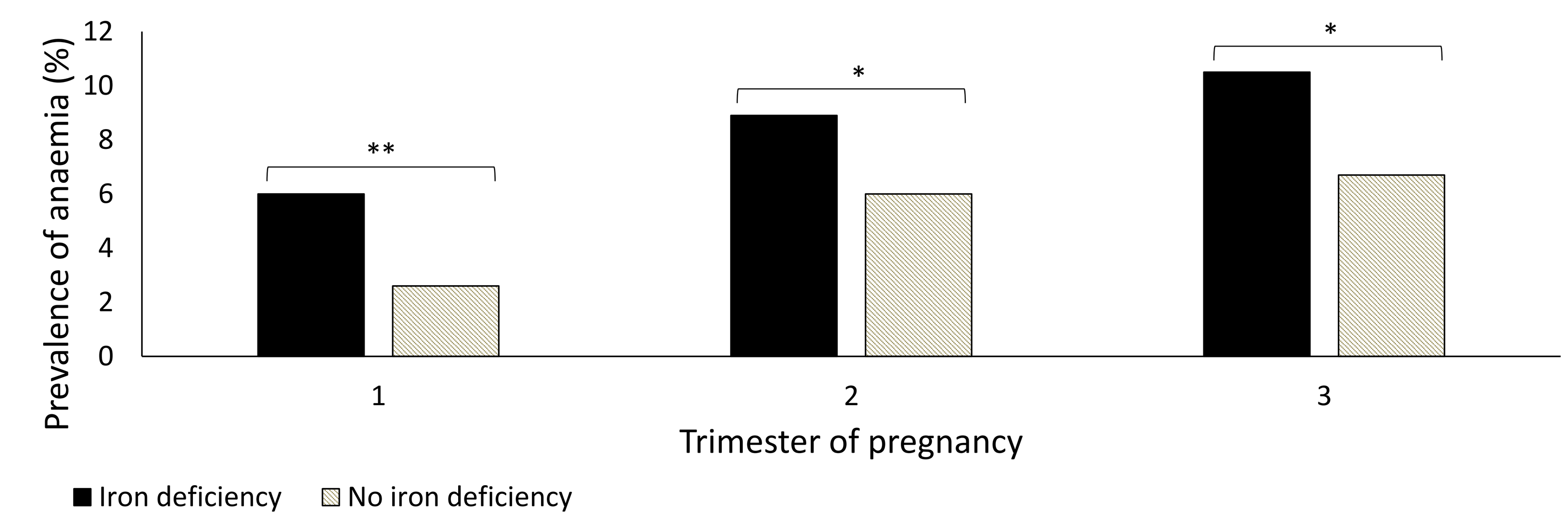

*Figure 5: : Prevalence of anaemia across pregnancy in participants with and without iron deficiency (ID) in the first trimester. Asterisks indicate statistically significant differences between groups, based on chi-square tests (*p< 0.05, **p<0.001).*

Conclusion

- Multiparity, and African and Asian origins were potential maternal determinants of anaemia in early pregnancy.
- Variation in mean Hb concentrations across T1 and T2 appeared to be influenced by baseline iron status.
- Assessment of pre-pregnancy dietary data and adherence to recommended supplementation, represents an important direction for future research, allowing for better consideration of nutritional influences.

References:

1. Agarwal AM, Rets A. Laboratory approach to investigation of anemia in pregnancy. Int J Lab Hematol. 2021 Jul 20;43(S1):65–70. doi:10.1111/ijlh.13551
2. Obianeli C, Afifi K, Stanworth S, Churchill D. Iron Deficiency Anaemia in Pregnancy: A Narrative Review from a Clinical Perspective. Diagnostics. Multidisciplinary Digital Publishing Institute (MDPI); 2024. doi:10.3390/diagnostics14202306
3. Bothwell TH. Iron requirements in pregnancy and strategies to meet them. Am J Clin Nutr. 2000 Jul;72(1):257S-264S. doi:10.1093/ajcn/72.1.257S
4. Fisher AL, Nemeth E. Iron homeostasis during pregnancy. Am J Clin Nutr. 2017 Dec;106:1567S-1574S. doi:10.3945/ajcn.117.155812