ORIGINAL ARTICLES

PROPHYLAXIS WITH IRON AND FOLATE SUPPLEMENTATION IN PREGNANCY; A HEALTH FACILITY-BASED ASSESSMENT OF ITS ROLE FOR PREVENTION OF ANAEMIA AT DELIVERY

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Abstract

Objective: Presumptive Iron and folate supplementation, (IFS), for both healthy and iron-deficient pregnant women in developing countries, is aimed to ameliorate the high prevalence of maternal anaemia.[1] This may be valuable only in selected women.[13] Its role for averting maternal anaemia at delivery is therefore analysed.
Methodology: The hospital-based cross-sectional study enrolled 413 ANC attendant parturients, exposed to IFS prior to delivery. Anaemia in pregnancy was classified by specifications of the Indian Council of Medical Research (ICMR) using maternal pre-delivery haemoglobin concentrations. Maternal haemoglobin concentrations and differential patterns of exposure to IFS were analysed across various maternal and environmental variables with epi info 3.5.4.
Results: Parturients were mostly aged 25-34 years and largely exposed to IFS for ≥ 6 months during pregnancy. Anaemic parturients, (typically defined by lower maternal age), initiated ANC attendance later than non-anaemic parturients. Patterns of maternal anaemia varied insignificantly despite differential patterns of duration of IFS and subjectively assessed degree of compliance. Self-reported full compliance with IFS weakly correlated with higher maternal Hgb concentrations. Mean maternal Hgb concentrations remained consistent with mild anaemia irrespective of duration of IFS.
Conclusion: Despite weak correlates between maternal anaemia and degree of compliance, the capacity of IFS to prevent mild, moderate or severe maternal anaemia remains unclear.
Recommendation: Indiscriminate IFS for all pregnant women, regardless of their Hgb concentrations, should be reviewed while investigation of factors that may underlie maternal non-response to routine IFS should be prioritized.

Key Words: *Iron, folate, supplementation, anaemia, pregnancy, effectiveness*

Introduction

Anaemia in pregnancy, a decrease in total red blood cell or haemoglobin (Hgb) in blood during pregnancy or postpartum, remains highly prevalent globally, conferring increased risk of morbidity and mortality for mother and fetus.[1] Anaemia from iron deficiency during pregnancy significantly predicts low birthweight and increased risk of preterm delivery.[2] Mechanisms causal to these effects are not clearly understood.[2] Prevalence of iron-deficiency anaemia, (the most prevalent nutritional deficiency during pregnancy), varies significantly among pregnant women by Region, country etc. due to varying socioeconomic factors, lifestyles and health-seeking behaviours across different cultures.[2] An estimated 52% of pregnant women in developing countries are anaemic compared with an estimated 23% in the developed world.[2] Maternal iron status in pregnancy significantly impacts the iron status of infants postpartum.[3] Inadequate folate during pregnancy is long associated with maternal anaemia and restricted fetal growth while prevalence of iron-deficiency anaemia in pregnancy lingers high among women in both developing and developed countries.[4, 5, 6, 7] At least, half of the global anaemia in pregnancy burden is assumed to be due to iron deficiency.[8, 9] The policy-prescribed, routine presumptive preventive treatment of anaemia among pregnant women with iron and folate supplementation (IFS) is premised on evidence indicating it significantly reduces risk of anemia.[9] Evidence further suggests that iron supplements increase Hgb and serum ferritin levels during pregnancy and also improve the maternal iron status in the puerperium, even in women who enter pregnancy with adequate iron stores.[9] The necessity of indiscriminate IFS during pregnancy has however been debated in industrialized countries where it is not universally practiced.[10] IFS during pregnancy is deemed a safe strategy for averting maternal anaemia mainly in developing countries, where traditional diets, typically, provide inadequate iron and where malaria

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and other infections, causing increased losses, are endemic.[10]

Despite evidence of associations between adverse pregnancy outcomes and high Hgb concentrations and increased iron stores, IFS remains preferred for both healthy and iron-deficient pregnant women in many developing countries.[11] Presumed universal benefits of IFS during pregnancy is occasionally debated with contrary positions questioning its importance for women who are iron replete or not anemic.[11] Correction of iron deficiency during pregnancy, even by supplementation with twice the amount of iron given to the iron adequate women, has been defined difficult.[12] Another study suggests that IFS during pregnancy for prevention or correction of maternal anaemia may be valuable *only in selected women*.[13] Routine IFS has also been historically partly linked to the era of economic depression and "welfare foods," which coincided with the development of organized antenatal care (ANC).[13] The need for objective assessment of benefits of old established traditions within an ANC context, in a changing community, is therefore emphasized.[13] The call for objective review is premised on the fact that haemopoiesis constitutes a function of more than minerals and vitamins made into a pill that may not be in an assimilable form as haem iron in the diet.[13] The prevalence of maternal anaemia, (defined as Hgb <11.0 g/dl), one week postpartum, is 14% in *iron-supplemented* women and 24% in *non-supplemented* women.[14] This study analyses the role of IFS for averting maternal anaemia during pregnancy and at delivery among ANC attendants.

Methodology

This hospital-based cross sectional study enrolled 413 consenting parturients (who attended ANC and were therefore on IFS prior to delivery) from the maternity units of the Kade Government Hospital and St. Dominic's Hospital (in Kwaebibirem and Denkyembuor districts respectively). Anaemia in pregnancy was classified by specifications of the Indian Council of Medical Research (ICMR) which defines anaemia in pregnancy (in an *iron-supplemented* population) as follows: Hgb concentration ≤10.9g/dl in the first trimester, ≤10.4g/dl in the second trimester and ≤10.9g/dl in the third trimester.[15] The clinical spectrum of severity is classified as follows: Hgb concentration of 10.9-10g/dl as mild, 9.9-7g/dl as moderate and 6.9-4g/dl as severe. Definition of Hgb concentration of ≤4g/dl as very severe anaemia was not distinctly analysed outside the spectrum of severe anemia.[15] Maternal pre-delivery Hgb concentrations, (checked routinely for all parturients accessing in-patient obstetric care), solely comprised the reference Hgb concentrations for maternal anaemia classification status; post-delivery Hgb concentrations were not preferred to avert possible significant changes resulting from inevitable delivery-associated blood losses. All abstracted information was validated from ANC booklets, personal folders and appropriate obstetric registers. Importantly further, albeit subjectively, *self-assessed* and *self-reported* perceived degree of compliance with IFS during pregnancy was assessed on a scale from *full*, *part to poor compliance*. The study excluded non-ANC attendants as the IFS policy during pregnancy remains a safe motherhood correlate within the confines of an ANC context. Classification of urban or rural community status was in accordance with definitions of the Ghana Statistical Service - communities with estimated populations of ≤ 5000 are rural. Ethical approval was granted by the Ghana Health Service Ethical Review Committee, (GHS-ERC No. 014/02/19). All data were analysed with epi info 3.5.4.

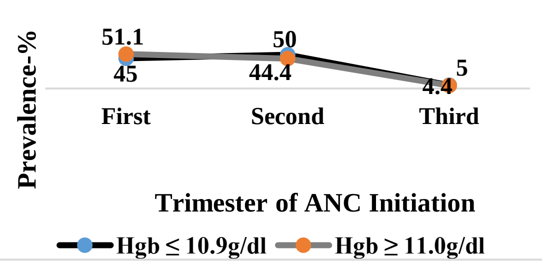
Results

The iron-supplemented population of parturients studied demographically comprised predominantly of women aged 25-34 years, characterized by a marginally higher population of rural residents and a markedly low proportion of women engaged in formal occupations. Parturients, largely married or cohabiting mostly initiated ANC in the first and second trimesters and were largely exposed to IFS for ≥6 months during pregnancy. Majority of parturients, largely of Junior High school educational background, were mostly exposed to IPTp-SP, (prescribed presumptively for the treatment of malaria during pregnancy). [Table 1]

The mean maternal age of 27.5 (±6.6) years, defined by wide standard deviation and variance, was marginally lower among parturients with Hbg ≤ 10.9g/dl. Mean parity and gestational age of initiation of ANC were marginally higher among parturients with Hgb ≤ 10.9g/dl than those of higher Hgb concentrations. [Table 2]

A significant proportion of parturients who initiated ANC attendance in the first trimester were anaemic at delivery. The highest prevalence of anaemia at delivery was observed among parturients who initiated ANC attendance in the second trimester. [Graph 1]

Graph 1. Prevalence of anaemia at delivery assessed by trimester of initiation of ANC attendance



Assessment of the prevalence of maternal anaemia at delivery, stratified by maternal age, area of residence, maternal occupation etc., showed variations as indicated in the table below. Analyses of the clinical spectrum of severity showed that mild and severe anaemia at delivery increased inversely with decreasing maternal age. Mild anaemia at delivery was significantly higher among women engaged in formal occupations. The prevalence of moderate anaemia at delivery was markedly high among women who did not use bed nets during pregnancy. Notably, however, the prevalence of anaemia at delivery did not significantly vary among parturients despite their differential patterns of ANC attendance, duration of IFS and subjectively assessed degree of compliance with IFS during pregnancy. Parturients reporting poor compliance with IFS also recorded a notably high mild anaemia case burden. [Table 3]

Mean Hgb concentrations of parturients with Hgb ≤10.9g/dl remained comparatively low while that of parturients with Hgb ≥11.0g/dl also remained comparatively high irrespective of their differential durations IFS. [Table 4]

Assessment of the self-reported degree of compliance with IFS during pregnancy showed that parturients with maternal Hgb ≤10.9g/dl recorded a comparatively lower proportion of respondents who reported full compliance with IFS. This sub group further recorded higher proportions of parturients reporting self-assessed partial and poor compliance with IFS during pregnancy. Parturients with Hgb concentrations ≥11.0g/dl contrarily recorded significantly lower proportions of reports of partial compliance with IFS and notably no report of self-assessed poor compliance. [Table 5]

The severity of maternal anaemia, (among parturients with Hgb ≤10.9g/dl stratified by parturients' self-reported degree of compliance), largely varied insignificantly. The prevalence of maternal anaemia at delivery was however notably high among parturients engaged in formal occupations who also reported full compliance with IFS. [Table 6]

Mean maternal Hgb concentration, analysed by duration of IFS, generally remained consistent with mild anaemia irrespective of duration of exposure. Mean maternal Hgb concentrations among parturients aged ≤20 years however notably, though marginally, increased commensurately with increasing duration of IFS. [Table 7]

Table 1. Baseline demographic characteristics of the iron-supplemented population parturients

Characteristic	Frequency (n=413)	Percent - %
Age group in years		
≤ 24 years	157	38
25-34 years	173	41.9
35-44 years	81	19.6
≥ 44 years	2	0.5
Residence		
Urban	205	49.8
Rural	207	50.2
Occupation type		
Formal	56	16.2
Informal	290	83.8
Marital status		
Married/cohabiting	279	67.6
Single	134	32.4
Trimester of ANC commencement		
First trimester	189	46.3
Second trimester	199	48.8
Third trimester	20	20.0
Duration of IFS		
1-3 months	95	29.7
4-6 months	191	23.3
> 6 months	121	46.9
Maternal educational background		
≤ Junior High	282	68.4
≥ Senior High	130	31.6
IPTp-SP status		
Yes	362	87.9
No	50	12.1
Malaria in pregnancy		
Yes	127	30.8
No	285	69.2
Trimester of malaria in pregnancy		
First trimester	17	13.7
Second trimester	53	42.7
Third trimester	54	43.5
Used bed net		
Yes	286	70.8
No	114	29.2
Anaemia at term		
Yes	322	78.2
No	90	21.8
Anaemia severity at term		
Mild	149	46.3
Moderate	170	52.8
Severe	3	0.9
Parity		
≤ Para 2	213	52.1
Para 3-4	142	34.7
≥ Para 5	54	13.2

Table 2. Baseline characteristics of parturients analysed by maternal anaemia status

Characteristic	Parturients with Hgb ≤ 10.9g/dl			Parturients with Hgb ≥ 11.0g/dl		
	Mean Hgb	Std. Dev	Variance	Mean Hgb	Std. Dev	Variance
Maternal Age	27.5	6.6	44.5	28.1	7.2	52.0
Parity	2.7	1.6	2.8	2.5	1.7	2.9
ANC initiation (weeks)	15.2	5.8	33.6	14.8	6.1	38.2
Haemoglobin	9.6	0.9	0.9	11.6	0.6	0.4

Table 3. Prevalence of maternal anaemia analysed by maternal and environmental indicators

Characteristic	Severity of maternal anaemia - %		
	Mild	Moderate	Severe
Maternal age			
≤ 24 Years	40.30	36.50	66.70
25-34 Years	38.90	46.50	33.30
35-44 Years	20.10	17.10	0.00
≥ 44 Years	0.70	0.00	0.00
Residence			
Urban	47.8	50.5	1.90
Rural	45.1	54.9	0.00
Occupation type			
Formal	64.4	35.6	0.00
Informal	42.5	56.6	0.90
Marital status			
Married/cohabiting	45.1	54,5	0.50
Single	48.6	49.5	1.80
Parity			
≤ Para 2	49.4	49.4	1.30
Multipara (3-4)	39.7	59.5	0.90
Grand multipara (≥ 5)	55.8	44.2	0.00
ANC Initiation			
First trimester	49.7	49.0	1.40
Second trimester	43.4	56.0	0.60
Third trimester	56.3	43.8	0.00
Maternal education			
≤ JHS	44.7	53.9	1.30
≥ SHS	50.0	50.0	0.00
Exposed to IPTp-SP			
Yes	47.2	52.1	0.70
No	39.5	57.9	2.60
Sleep under net			
Yes	50.0	49.5	0.50
No	37.0	60.9	2.20
Duration of IFS			
≤ 3 months	46.1	53.9	0.0
4-6 months	46.6	52.0	1.4
> 6months	47.3	51.6	1.1
Degree of compliance			
Full	50.0	48.9	1.1
Part	40.2	59.0	0.8
Poor	83.3	16.7	0.0

Table 4. Assessment of mean Haemoglobin concentrations of parturients by estimated duration of exposure to Iron and Folate Supplementation during pregnancy

Characteristic	Parturients with Hgb ≤10.9g/dl			Parturients with Hgb ≥10.9g/dl		
	Mean Hgb	Std. Dev	Variance	Mean Hgb	Std. Dev	Variance
IFS ≤ 3 months	9.7	0.7	0.6	11.5	0.5	0.2
IFS 4-6 months	9.6	1.1	1.2	11.6	0.6	0.4
IFS > 6 months	9.6	0.8	0.7	11.5	0.7	0.5

Table 5. Prevalence of Anaemia at delivery analysed by self-reported maternal self-assessed degree of compliance with Iron and Folate Supplementation during pregnancy

Characteristic	Self-reported compliance (Hb≤10.9g/dl) - %			Self-reported compliance (Hb≥11.0g/dl) - %		
	Full	Part	Poor	Full	Part	Poor
Residence						
Urban	64.3	33.1	2.5	78.7	21.3	0.0
Rural	55.1	43.7	1.3	60.5	39.5	0.0
Mat. Occupation						
Formal	62.8	30.2	7.0	90.9	9.1	0.0
Informal	57.4	41.3	1.3	71.4	28.6	0.0
Partner Occupation						
Formal	60.4	32.1	7.5	75.0	25.0	0.0
Informal	59.7	39.5	0.8	69.2	30.8	0.0
Marital status						
Married/cohabit	58.7	39.4	1.9	69.2	30.8	0.0
Single	61.1	37.0	1.9	72.0	28.0	0.0
Parity						
Para 1	59.8	37.9	2.3	78.1	21.9	0.0
Para 2	60.6	36.6	2.8	66.7	33.3	0.0
Multipara	59.6	38.6	1.8	73.1	26.9	0.0
Grand multipara	57.1	42.9	0.0	45.5	54.5	0.0
Trimester of ANC initiation						
First trimester	72.0	27.3	0.7	71.7	28.3	0.0
Second trimester	49.4	48.1	2.6	70.0	30.0	0.0
Third trimester	50.0	50.0	0.0	50.0	50.0	0.0
Duration of Iron and Folate Supplementation						
≤ 3 months	48.6	50.0	1.4	57.9	42.1	0.0
4-6 months	56.6	41.4	2.1	72.1	27.9	0.0
> 6 months	74.2	24.7	1.1	75	25	0.0
Maternal educational background						
≤ Junior High	57.8	40.8	1.3	68.5	31.5	0.0
≥ Senior High	63.4	33.3	3.2	72.2	27.8	0.0
IPTp-SP exposure						
Exposed	60.0	38.2	1.8	71.8	28.2	0.0
Unexposed	55.6	41.7	2.8	71.8	28.2	0.0
Use bed net during pregnancy						
Used bed net	65.5	33.5	0.9	65.6	34.4	0.0
Not use bed net	47.3	48.4	4.4	80.8	90.2	0.0

Table 6. Prevalence of anaemia at delivery analysed by severity and self-reported degree of compliance with Iron and Folate Supplementation during pregnancy

Characteristic	Self-reported degree of compliance	Severity of maternal anaemia - %		
		Mild (10.9-10.0g/dl)	Moderate (9.9-7.0g/dl)	Severe (≤ 6.9g/dl)
Residence				
Urban	Full	49.5	48.5	2.0
	Part	40.4	57.7	1.9
	Poor	100	0.0	0.0
Rural	Full	50.6	49.4	0.0
	Part	40.6	59.4	0.0
	Poor	50.0	50.0	0.0
Maternal occupation				
Formal	Full	74.1	25.9	0.0
	Part	46.2	53.8	0.0
	Poor	66.7	33.3	0.0
Informal	Full	45.3	53.1	1.6
	Part	38.0	62.0	0.0
	Poor	100	0.0	0.0
Marital status				
Married/cohabit	Full	48.4	50.8	0.0
	Part	40.2	59.8	0.0
	Poor	100	0.0	0.0
Single	Full	53.0	45.5	1.5
	Part	40.0	57.5	2.5
	Poor	50.0	50.0	0.0
Parity				
≤ Para 2	Full	49.5	49.5	1.1
	Part	49.2	49.2	1.7
	Poor	75.0	25.0	0.0
≥ para 3	Full	51.1	47.8	1.1
	Part	32.3	67.7	0.0
	Poor	100	0.0	0.0
Duration of IFAS				
≤ 4 months	Full	50.8	48.3	0.0
	Part	40.2	58.8	1.0
	Poor	100	0.0	0.0
≥ 5 months	Full	49.3	49.3	1.4
	Part	39.1	60.9	0.0
	Poor	100	0.0	0.0
Maternal educational background				
≤ Junior High	Full	47.3	51.2	1.6
	Part	40.7	58.2	1.1
	Poor	100	0.0	0.0
≥ Senior High	Full	55.9	44.1	0.0
	Part	38.7	61.3	0.0
	Poor	66.7	33.3	0.0

Table 7. Mean maternal Haemoglobin concentration analysed by duration of exposure to Iron and Folate Supplementation across maternal and environmental factors

Characteristic	Mean maternal Hb concentration		
	IFS ≤ 3 months	IFS 4-6 months	IFS > 6 months
Maternal age			
≤ 20 years	9.8	9.9	10.1
21-30 years	10.1	10.0	10.1
31-40 years	10.2	10.2	10.2
41-50 years	9.8	10.7	8.8
< 35 years	10.0	10.0	10.1
≥ 35 years	10.4	10.5	10
Residence			
Urban	10.0	9.9	10.2
Rural	10.1	10.2	9.9
Marital status			
Married	10.1	10.2	10.2
Single	10.0	9.8	9.9
Parity group			
Para 1	10.3	10.2	10.1
Para 2	10.0	10.3	10.4
Multipara	9.9	10.0	9.8
Grand multipara	10.1	10.1	10.4
Trimester of ANC start			
First trimester	10.0	10.2	10.1
Second trimester	10.1	10.0	9.6
Third trimester	10.0	10.1	10.8

Discussion

An estimated ≥40% of pregnant women globally have Hgb concentrations consistent with various degrees of the clinical spectrum of anemia.[9] About half of this case burden is attributed to the micronutrient deficiency of iron.[9] During pregnancy, additional iron and folate is required to meet pregnant women's nutritional needs as well as those of the developing fetus.[9] All pregnant women in Ghana are expected to have their Hgb concentrations measured at initiation of ANC attendance, at 28 weeks gestation and at 36 weeks gestation to identify and manage anemia.[16] WHO recommends daily oral iron and folic acid supplementation with 30 mg to 60 mg of elemental iron and 400 µg (0.4 mg) folic acid for pregnant women to prevent maternal anaemia, puerperal sepsis, low birth weight, and preterm birth.[9] Benefits of this presumptive policy has been occasionally refuted with the argument that it may be valuable in selected women.[13] This study therefore analyses the role of IFS in eliminating maternal anaemia at delivery.

The study findings showed that the iron-supplemented population of women studied who had Hgb ≤10.9g/dl at delivery were marginally younger than women with Hgb ≥11.0g/dl. Majority of parturients were aged 25-34 years and were mainly married. These findings were fairly consistent with findings of a study that indicated that mean maternal age was 28.3 (±6.6) years;[16, 17] the mean maternal age in this study was however defined by a wider standard deviation and variance. Anaemia, defined by Hgb ≤10.9g/d, globally affects an estimated 29% of non-pregnant women and about 40% of pregnant women aged 15-49 years.[16] While the overall mean Hgb concentration of parturients in this study remained consistent with mild anaemia, (i.e. 10.1g/dl [±1.2]), the mean maternal Hgb of parturients with Hgb ≤10.9g/dl was 9 (±0.9); the mean Hgb concentration of women with Hgb ≥11.0g/dl was significantly higher at 11.6g/dl (±0.6). The mean maternal Hgb concentration assessed by the estimated duration of IFS showed no significant variations. While the overall mean Hgb concentration was 10.1g/dl (±1.2), mean Hgb concentration of parturients with Hgb ≤10.09g/dl varied insignificantly irrespective of the duration of exposure to IFS. Mean maternal Hgb concentration for parturients of Hgb ≥11.0g/dl equally remained high, unfettered by duration of IFS.

A higher overall prevalence of maternal anaemia in this study, (i.e. 71.2%), was measured than reported for pregnant women in Ghana at 45% in the latest Demographic and Health Survey.[16] This prevalence is sufficiently high for the classification of maternal anaemia as a public health problem.[16] This study's estimates however compares with the prevalence of 70% reported in 25 communities in the Northern Region of Ghana.[16] The national prevalence varies by geographical area i.e. 57.1% in Sekyere West to the south of Ghana and 34.4% in Secondi-Takoradi in Western Ghana.[16] This study's estimates further exceed estimates of some countries e.g. 58% in South Eastern Nigeria, 51.9% in Southern Ethiopia, 63.1% in Kiboga, Uganda, 54.6% in Derna, Libya and Niger Delta and 69.6% in Nigeria among iron-supplemented populations of pregnant women.[16] Significantly lower estimates include 23.5% in South West Ethiopia, 25.2% in North West Ethiopia and Mpigi, 32.5% in Uganda.[16] Variations in estimates are attributed to differences in socio-economic circumstances, cultural practices, dietary patterns, preventive health practices and diagnostic tests.[16] Despite the variations, the prevalence of anaemia in pregnancy remains globally high.[18]

Mean parity was 2.7 (±); the demographic and health survey estimate Ghana's fertility at 4.4 per woman, (among the lowest in Sub Saharan Africa).[18] This study did not estimate mean fertility as data were not representative of the end of parturients' reproductive life. The mean gestational age of initiation of ANC was 15.1 (±5.8) weeks of gestation i.e. within the second trimester. Parturients with anaemia at delivery initiated ANC marginally later than women with Hgb concentrations not consistent with anaemia. The WHO recommends at least, eight ANC visits with the first visit during the first trimester.[19] Late initiation of ANC may lead to late detection of complications that may be detrimental to maternal and fetal health.[19] ANC forms the basis of all maternal health care services in Ghana, and encompasses the evaluation of the general health of pregnant women with aims to detect and prevent adverse maternal and neonatal outcomes.[19] The 2014 Ghana Demographic and Health Survey, (GDHS), showed that 97% of females who gave birth in the 5 years preceding the survey attended ANC at least once for their last childbirth and approximately nine in ten women had four or more ANC visits.[19] Studies on factors influencing timing of ANC initiation in Ghana remains pauce.[19] A study reported that an estimated 57% of pregnant women in Ghana initiate ANC attendance within the first trimester; this compares with the estimated 46.3% in this study who initiated ANC attendance in the first trimester further inextricably suggesting ample exposure to IFS.[19]

Consistently with extant evidence suggesting that less than 50% of pregnant women in Ghana initiate ANC attendance after first trimester of pregnancy, about 48.8% in this study initiated ANC attendance in the second trimester.[19] Parturients with Hgb ≥11.0g/dl had a marginally lower mean gestational age of initiation of ANC attendance (i.e. 14.8 [±6.1]) which was however still suggestive of a sustained preference for second trimester ANC initiation. This study suggests that mean Hgb concentrations of pregnant women at delivery varied insignificantly for both women with Hgb ≤10.9g/dl and women with Hgb ≥11.0g/dl irrespective of the duration of IFS during pregnancy. A study showed that most anaemic pregnant women were anaemic antecedent to conception and further posited that clinical benefits and risks of IFS remain unclear despite wide acceptance and WHO recommendation.[20] This study further reports the highest prevalence of severe anaemia at delivery among parturients aged ≤24 years while second in this series were parturients aged 25-34 years. Along the clinical spectrum of severity, the estimates of anaemia in pregnancy in Northern Ghana show that that about 61.2% have mild anaemia, 37.2% have moderate anaemia while 1.6% have severe anemia.[16] These estimates varied with those of this study as follows: 46.3% had mild anaemia, 52.8% had moderate anaemia while the prevalence of severe anaemia at delivery remained insignificant.

The estimated duration of IFS during pregnancy observably did not impact maternal Hgb concentrations at delivery, a particularly notable observation among parturients with maternal Hgb ≤10.9g/dl. A study indicates that iron requirements during pregnancy is approximately 1,000mg.[23] Hallberg posits that an estimated 350mg of iron is lost to the foetus and the placenta and 250mg is lost at delivery.[21] The large increase in maternal red blood cell mass additionally calls for an estimated 450mg while basal losses from the body, (amounting to 240mg), continue during pregnancy.[22] Total iron requirements during pregnancy, (outside delivery-associated losses), constitutes an estimated 1,040mg.[22] Permanent iron losses of about 840mg continue to the foetus and placenta, at delivery, and basal losses.[22] The total iron needs of ≥1,000mg, (equivalent to about 6mg of iron absorbed per day in a woman who starts pregnancy with absent or minimal storage iron), are concentrated in the last two trimesters of pregnancy.[23] This constitutes large amounts of iron to accumulate over a 6-month period, especially when compared with the average total body iron content of 2,200mg and the 1.3mg of iron absorbed per day by non-pregnant women.[23] Initiation of IFS is defined appropriate at about 12 weeks of gestation, (the beginning of the second trimester), when the iron requirements begin to increase at a dose of 30 mg per day.[23] Despite first and second trimester initiation of ANC attendance, (inextricably linked to IFS initiation after about 12 weeks per recommendations), prevalence of maternal anaemia at delivery in this study remained generally high. Fairly early initiation of IFS was not a correlate for enhanced Hgb concentrations at delivery.

Findings further showed that self-reported, (self-assessed), full and partial compliance with IFS during pregnancy were recorded in higher proportions among parturients with maternal Hb≥11.0g/dl. This group, notably, recorded no report of poor compliance. This lends credence to studies that reported that maternal Hgb concentrations significantly improved only among strictly compliant pregnant women by 0.3 g/dl, decreased among partially compliant women by, 0.36 g/dl and significantly decreased among the non-compliant by -1.4 g/dl.[24, 25, 26] Women engaged in formal occupations in this study recorded the highest prevalence of self-reported full compliance and also the highest prevalence of mild maternal anaemia at delivery. Findings further supported a study that reported associations between maternal anaemia and non-compliance with IFS and a study that also suggested that maternal Hgb concentrations improved with community-based approaches to improving IFS compliance.[27, 28]

Mean maternal Hgb concentrations remained consistent with anaemia irrespective of duration of IFS and maternal or environmental factors by which it was stratified. These findings weakly support a study that refuted the importance of IFS for pregnant women irrespective of their Hgb concentrations.[30] Alizadeh *et al* posit that not using IFS during pregnancy did not impact the pregnant women with normal Hgb concentrations.[30] A study also importantly investigated factors predicting maternal non-response to oral iron replacement to inform decisions on transitioning to intravenous therapy in patients unlikely to benefit from oral iron.[31]

As IFS during pregnancy is not a global practice, research to establish its benefits for all women should be prioritized. Hibbard's dissenting views to IFS attributes its origins, in the United Kingdom, to the era of economic depression and "welfare foods," which coincided with the development of organized ANC.[13] Hibbard particularly recommends objective assessment of the benefits of all old established ANC traditions in a changing community.[13] This position maintains that haemopoiesis is dependent on more than the minerals and vitamins that can be conveniently made into a pill but may not be in an assimilable form, as haem iron in the diet.[13] Needed micronutrients may be provided only by a good mixed diet, typically available to the majority reasonably affluent Western societies, though women may not choose the right foods because of ignorance, inertia, or a lifetime of bad habits.[13] Hibbard also strongly posits that evidence supporting need for wholesale prophylactic IFS are flawed; firstly because assumptions that the physiological norms for non-pregnant women are applicable to pregnancy and that depletion equates with deficiency.[13] Secondly, studies based of selected populations may not be nationally applicable.[13] Also, assumptions that compliance with prescribed treatment will be full remain a remote probability.[13] Hibbard again further strongly indicates that the need for deprecation of blind uncritical prescription of any drug is usually disregarded for IFS during pregnancy on the basis that dietary intake is precarious in relation to needs.[13] Further investigation of benefits of IFS during pregnancy should importantly take cognizance of distinctions between iron deficiency and iron deficiency anaemia; failure of distinction renders many studies difficult to interpret.[32] Iron deficiency or sideropaenia is defined by qualitatively insufficient iron to supply its eventual needs.[33] Iron-deficiency anaemia, on the contrary, is characterized by decrease in the number of red blood cells or Hgb concentration i.e. anaemia caused by lack of iron.[34] If an estimated 50% of anaemia in pregnancy is assumed to be due to iron deficiency, justification for indiscriminate IFS of entire populations of pregnant women, (many of whom remain anaemic at delivery), needs further clarification.[8, 9]

Conclusion

The iron-supplemented parturients demographically comprised predominantly of women aged 25-34 years, largely exposed to IFS for ≥4 months during pregnancy. Parturients with Hgb ≤10.9gdl had a marginally lower mean maternal age than those with Hgb ≥11.0g/dl. Non-anaemic parturients largely initiated ANC attendance earlier than anaemic parturients. Initiation of ANC attendance in the first and second trimesters was not correlated with reduced maternal anaemia at delivery. Mild and severe anaemia at delivery increased inversely with decreasing maternal age while moderate anaemia at delivery was markedly high among women who did not use bed nets during pregnancy. Prevalence and patterns of maternal anaemia varied insignificantly despite differential patterns of ANC attendance, duration of IFS and subjectively assessed degree of compliance with IFS. Self-reported poor compliance with IFS weakly correlated with a higher burden of mild anaemia. Mean maternal Hgb, (for both anaemic and non-anaemic parturients), was not amenable to duration of IFS. Self-reported full compliance with IFS mildly correlated with higher maternal Hgb concentrations, though marginal. Mean maternal Hgb concentrations remained consistent with mild anaemia irrespective of duration of IFS. The role of IFS for prevention of mild, moderate or severe maternal anaemia remains unclear. The very low prevalence of severe anaemia is likely attributable to ameliorative interventions initiated immediately it is detected and not necessarily to the IFS impact.

Recommendation

While maternal anaemia is largely attributed to the micronutrient deficiency of iron, increasing access to clinical investigations that may help to establish all underlying causes, (and not only iron-deficiency), should be prioritized. Further research should seek to investigate factors that may underlie maternal response or non-response to IFS during pregnancy. Policy directives indiscriminately subjecting entire populations of pregnant women to IFS, irrespective of their Hgb concentrations, should be reviewed. Maternal compliance with IFS should be prioritized for review to guide future approaches and preferences for prescription.

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