

Antenatal haemoglobin profile at the Port Moresby General Hospital

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SUMMARY

From 1 November 1995 to 10 April 1996, 1001 consecutive mothers who had attended the Port Moresby General Hospital (PMGH) antenatal clinic and were delivered in the Maternity Unit of the PMGH were surveyed for their antenatal haemoglobin (Hb) levels. One or more Hb results had been noted in the antenatal records of 997 subjects. The mean of the first Hb level for this sample was 10.6 ± 1.72 g/dl. The first Hb level was below 10.0 g/dl in 33% of the 997 subjects. The dates were reliable in 777 subjects. The mean first Hb for this group was the same as for the total sample. A subgroup of 449 subjects with reliable dates and first Hb measurement at ≤ 26 weeks gestation had a first Hb mean of 10.9 ± 1.78 g/dl. Among those with reliable dates, 569 had two or more Hb measurements, the last being at ≥ 34 weeks. In this subgroup, the mean of the last Hb was 11.1 ± 1.60 g/dl. The first Hb was measured at ≤ 26 weeks in 352 subjects in this subgroup. The means for the first and last Hb levels for this subset were 10.9 ± 1.78 and 11.1 ± 1.57 g/dl, respectively; the paired t test did not show any difference between the first and last Hb levels. For subjects in the total sample who had two or more Hb measurements, the mean for the lowest Hb level was 10.0 ± 1.54 ; 45% had levels below 10.0 g/dl at some time during the pregnancy.

Introduction

According to the World Health Organization, evidence from more than 500 studies, worldwide, has shown that anaemia (especially iron deficiency anaemia) is one of the most widespread and most neglected nutritional diseases in the world today. The incidence is particularly severe among pregnant and lactating women in the developing world. In Southern Asia, for example, 75% of pregnant women are anaemic, compared with 17% in Northern America and Europe (1). Although the harmful effects of severe anaemia are well known - increased incidence of maternal morbidity and mortality, low birthweight, and perinatal morbidity and mortality - the haemoglobin (Hb) level below which these effects begin to operate differs from one

community to another. It has recently been pointed out that attempts to increase Hb levels to pre-pregnancy levels in patients who are not anaemic at the beginning of a pregnancy may in fact lead to adverse perinatal outcome. In this group of patients iron supplementation may not necessarily be of much benefit to the mother either. It is important therefore to monitor the haemoglobin and iron status of pregnant patients so that treatment can be offered to those in need (2,3).

In the developing world, anaemia is defined as a Hb level less than 10.0 g/dl. The aetiology is commonly multifactorial: inadequate intake of iron and folic acid, increased demands from many and frequent pregnancies, losses from hookworm infection, and increased destruction and dyserythropoiesis from malaria and the

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haemoglobinopathies. These work together in various combinations to cause anaemia.

The incidence and severity of anaemia in pregnancy may be used as indicators of the general health of women of reproductive age.

Prevention of anaemia by the time of delivery is one of the major objectives of antenatal care. Success or failure in this endeavour is easily measured by repeated Hb estimations at the antenatal clinic. Regular attenders at antenatal clinics should show better Hb levels at term than poor or non attenders.

Over 9000 women are delivered at the Port Moresby General Hospital (PMGH) annually. The incidence of anaemia during pregnancy, defined as Hb less than 10.0 g/dl, is over 30% and severe anaemia, defined as Hb level below 8.0 g/dl, is about 5% (4). This seems to be an improvement over what obtained a decade ago; in 1986, the incidence of Hb <10.0 g/dl was 59% (5). In a study of anaemia in pregnancy at the PMGH in 1987, Sill et al. found multiple causes: iron and folate deficiency, malaria, alpha-thalassaemia and hookworm infection were the major causes (6).

Iron, folic acid and prophylactic antimalarials are routinely prescribed for patients who attend our antenatal clinics in an attempt to raise the Hb of the patients. It was to find out the usefulness of this intervention that the study was undertaken.

Patients and Methods

The objectives of the study were as follows:

1. To determine the incidence of anaemia among antenatal clinic attenders who delivered at the PMGH.
2. To assess the effect of antenatal attendance on the Hb level.
3. To examine the relationship between the Hb level and selected sociodemographic and obstetric characteristics.
4. To compare perinatal outcome in anaemic and non-anaemic subjects.

This was a non-randomized retrospective sequential survey. The study population consisted of all mothers who attended the PMGH and urban antenatal clinics and delivered in the Maternity Unit of the hospital during the study period. Eligible subjects who died at the hospital from severe anaemia were to be included in the study.

The data sources were a standardized pretested questionnaire and the subjects' antenatal, labour and delivery records. The data collection started with administration of the questionnaire by trained research assistants on the patients' admission to the labour ward.

Variables examined included:

1. **Sociodemographic:** age, residential area (urban/slum/village), school years completed.
2. **Anthropometric measures:** first antenatal weight, last antenatal weight, weight gain.
3. **Past obstetric history:** parity before index pregnancy, last birth-pregnancy interval.
4. **Index pregnancy:** number of antenatal clinic visits, gestational age at first (booking) visit, Hb concentration measurements and gestational age (GA) at which measurements were taken, malaria prophylaxis, clinical (symptomatic) malaria.

Sample size and study period

From 1 November 1995 to 10 April 1996, 1001 subjects were recruited.

Data analysis

The Epi Info version 6 and the SPSS/PC+ softwares were used for the statistical analyses. Differences were taken as significant if the p value was <0.05 and the 95% confidence interval of the odds ratio did not include 1.

Data limitations and definition of terms

Age was as given by the patient. The age was considered reliable if the patient could

give both her age and date of birth, and if the two were in agreement.

Gestational age (GA) was taken as reliable if the patient was sure of her dates and she delivered spontaneously at term; or if the patient had an ultrasound scan-dating before the 26th week.

Last birth-pregnancy interval was calculated as the number of months between the penultimate delivery and the index birth, minus the index birth GA in months.

Results

1001 subjects were recruited; of these 997 had Hb results in their antenatal records.

Number of Hb measurements and first and lowest Hb results

Of the 997 subjects with at least one available Hb measurement, 190 (19%) had one, 648 (65%) had two and 159 (16%) had three or more Hb measurements (Table 1, Panel A). The mean for the first Hb measurements was 10.6±1.72 g/dl. The first Hb level was below 10.0 g/dl in 33% (333/997) of the mothers and below 11.0 g/dl in 58% (Table 1, Panel B). The dates were reliable in 777 subjects. The mean of the first Hb for the reliable-dates group was 10.6±1.72 g/dl, which was the same as for the total sample (Table 1, Panel C). Among subjects who had two or more Hb measurements, the mean of the lowest Hb levels was 10.0±1.54 g/dl; 45% were below 10.0 g/dl and 72% were below 11.0 g/dl (Table 1, Panel D).

TABLE 1

NUMBER OF TIMES HAEMOGLOBIN WAS MEASURED AND FIRST HAEMOGLOBIN RESULTS

Panel A: Number of times Hb was checked in 997 subjects with available Hb results

Number of Hb checks	1	2	3+	Total
Number (%)	190 (19.1)	648 (65.0)	159 (15.9)	997 (100)

Panel B: First Hb results (N=997)

First Hb (g/dl) category	<5.0	5.0-7.9	8.0-9.9	≥10.0
Number (% of 997)	1 (0.1)	64 (6.4)	268 (26.9)	664 (66.6)

Mean Hb 10.6±1.72 g/dl; Median Hb 10.6 g/dl; Hb <11.0 g/dl 58.5% (583/997)
 Percentiles: 5th 7.6 g/dl; 10th 8.4 g/dl; 90th 12.7 g/dl; 95th 13.4 g/dl

Panel C: First Hb results for subjects with reliable dates (N=777)

First Hb (g/dl) category	<5.0	5.0-7.9	8.0-9.9	≥10.0
Number (% of 777)	1 (0.1)	47 (6.0)	203 (26.1)	526 (67.7)

Mean Hb 10.6±1.72 g/dl; Median Hb 10.6 g/dl; Hb <11.0 g/dl 58.2% (452/777)
 Percentiles: 5th 7.6 g/dl; 10th 8.5 g/dl; 90th 12.8 g/dl; 95th 13.4 g/dl

Panel D: Lowest Hb result in subjects with two or more Hb results available (N=793)

First Hb (g/dl) category	<5.0	5.0-7.9	8.0-9.9	≥10.0
Number (% of 793)	3 (0.4)	71 (9.0)	279 (35.2)	440 (55.5)

Mean Hb 10.0±1.54 g/dl; Median Hb 10.1 g/dl; Hb <11.0 g/dl 71.5% (567/793)
 Percentiles: 5th 7.4 g/dl; 10th 8.0 g/dl; 90th 11.9 g/dl; 95th 12.4 g/dl

First Hb results in subjects with reliable dates

The first Hb level measured in the 1st trimester was significantly higher than the first Hb levels measured in the 2nd and 3rd trimesters; and the 2nd trimester first Hb was higher than the first Hb level of those who booked in the 3rd trimester ($p < 0.001$), confirming the known differential effects of GA on the Hb level (Table 2, Panel A). The mean Hb for reliable-dates subjects whose first Hb was at ≤ 26 weeks was 10.9 ± 1.78 g/dl. In this subgroup of 449 subjects, the Hb level was below 10.0 g/dl in 26% and below 11.0 g/dl in 50% (Table 2, Panel B).

First and last Hb levels in patients with reliable dates and two or more Hb measurements

In the reliable-dates group, 569 subjects had

two or more Hb measurements, the last being at ≥ 34 weeks. In this subgroup, the mean of the last Hb was 11.1 ± 1.60 g/dl (Table 3, Panel A). The first Hb was measured at ≤ 26 weeks and the last Hb at ≥ 34 weeks in 352 of the reliable-dates group. The means for the first and last Hb levels for this subset were 10.9 ± 1.78 and 11.1 ± 1.57 g/dl, respectively (Table 3, Panel B). The paired t test did not show any significant difference between the first and last Hb levels (Table 3, Panel C).

Anaemia by selected subject characteristics

A lowest Hb below 10.0 g/dl at any time during the pregnancy did not show a significant association with any of the selected sociodemographic and reproductive characteristics examined. However, lowest Hb level below 8.0 g/dl was found to have a significant association with symptomatic malaria in the index pregnancy (Table 4, Panel A).

TABLE 2

FIRST HAEMOGLOBIN RESULTS BY TRIMESTER IN SUBJECTS WITH RELIABLE DATES

Panel A: First Hb result by trimester in subjects with reliable dates (N=775)

GA category (weeks)	≤ 13	14-26	≥ 27	N	p
Number (% of 775)	33 (4.3)	414 (53.4)	328 (42.3)	775	
Mean Hb g/dl	11.7 ± 1.47	10.8 ± 1.79	10.3 ± 1.60		$< 0.000^*$
Median Hb	11.8	10.8	10.3		
Hb < 8.0 : number (% of 48)	0 (0)	25 (52.1)	23 (47.9)	48	
Hb < 10.0 : number (% of 250)	5 (2)	112 (44.8)	133 (53.2)	250	
Hb < 11.0 : number (% of 451)	11 (2.4)	211 (46.8)	229 (50.8)	451	

Panel B: First Hb results for subjects with first Hb at ≤ 26 weeks GA

First Hb (g/dl) category	< 5.0	5.0-7.9	8.0-9.9	≥ 10.0	N
Number (%)	0 (0.0)	25 (5.6)	93 (20.7)	331 (73.7)	449
Mean Hb 10.9 ± 1.78 g/dl; Median Hb 11.0 g/dl; Hb < 11.0 g/dl 49.7% (223/449)					
Percentiles: 5th 7.6 g/dl; 10th 8.6 g/dl; 90th 13.1 g/dl; 95th 13.8 g/dl					

GA = gestational age

* Kruskal-Wallis H p value significant

TABLE 3

HAEMOGLOBIN RESULTS IN RELIABLE-DATES SUBJECTS WITH TWO OR MORE HAEMOGLOBIN MEASUREMENTS

Panel A: Last Hb results for subjects with reliable dates and last Hb at ≥34 weeks GA

Last Hb (g/dl) category	<5.0	5.0-7.9	8.0-9.9	≥10.0	N
Number (% of 569)	0 (0.0)	13 (2.3)	117 (20.6)	439 (77.2)	569

Mean Hb 11.1±1.60 g/dl; Median Hb 11.2 g/dl; Hb <11.0 g/dl 42.9% (244/569)

Percentiles: 5th 8.4 g/dl; 10th 9.1 g/dl; 90th 13.1 g/dl; 95th 13.5 g/dl

Panel B: First and last Hb results in subjects with first Hb at ≤26 and last Hb at ≥34 weeks

	Mean±SD	Hb<10.0 g/dl	Percentiles			
			5th	10th	90th	95th
First Hb g/dl	10.9±1.78	27.3% (96/352)	7.6	8.6	13.1	13.6
Last Hb g/dl	11.1±1.57	23.3% (82/352)	8.2	9.1	13.1	13.5

Panel C: Paired t test

	Mean±SD	SEM	t value	df	2-tailed p
Last Hb	11.074±1.575	0.084	1.94	351	0.053*
First Hb	10.875±1.783	0.095			

Paired differences: N=352; Mean±SD 0.198±1.913; SEM 0.102

GA = gestational age

SD = standard deviation

SEM = standard error of the mean

df = degrees of freedom

* Not significant

TABLE 4

ANAEMIA, MALARIA AND BIRTHWEIGHT

Panel A: Anaemia and symptomatic malaria

	Lowest Hb level <8.0 g/dl		M-H p
	Yes	No	
Symptomatic malaria	18.5% (15/81)	8.6% (77/897)	0.004

Panel B: Last Hb level <10.0 g/dl and birthweight

Last Hb <10.0 g/dl	Last Hb ≥10.0 g/dl	K-W p	OR (95% CL)
Mean birthweight (g)	Mean birthweight (g)		
±SD	±SD		
3273.7±428.10	3141.9±460.45	0.009	0.41 (0.22, 0.80)
N=130	N=439		

M-H p = Mantel-Haenszel chi squared p value

K-W p = Kruskal-Wallis H p value

OR (95% CL) = odds ratio and 95% confidence limits of odds ratio

SD = standard deviation

Hb levels below 10.0 g/dl by perinatal outcome

As there were only 9 perinatal deaths in this study, any relationship between perinatal death and anaemia could not be investigated. Subjects whose first, lowest or last Hb levels were <10.0 g/dl had slightly heavier babies than those whose Hb levels were ≥ 10 g/dl. However, only the last Hb level showed a significant difference in birthweight between the Hb <10.0 g/dl and Hb ≥ 10.0 g/dl subjects (Table 4, Panel B). Examination of Hb <8.0 g/dl did not show any difference.

Discussion

Over 80% of the patients had two or more Hb measurements and nearly 60% had the first Hb before 27 weeks. The first Hb level measured in the first trimester was significantly higher than the measurements in the second and last trimesters. As it was unlikely that before their first clinic visit these patients had been on iron-folate supplementation and malaria prophylaxis, this difference in Hb level between patients who booked in the first trimester and those who booked later could be taken as the normal trend in our population. This would be in consonance with what is normally observed. There is a well-known progressive increase in the plasma volume of some 50% above the non-pregnant values from the 6th to the 32nd week. Even though there is an increase in the red cell mass of about 25%, this increase starts later, at the 16th week, but goes on to the end of pregnancy. The differential rise between the red cell mass and plasma volume causes haemodilution resulting in a decrease in the Hb level with advancing pregnancy, reaching a nadir at about 34 weeks maturity (7,8). The increase in the red cell mass demands iron. This increase is unlikely to reach its maximum in the absence of iron stores or without iron supplementation. It has been shown that without supplementation, women who are not anaemic at the start of pregnancy show a significant drop in their Hb concentration, serum iron and serum ferritin levels by term. Women who are on iron supplementation do not show a fall in these indices (9,10). This observed fall in the haematological indices is normal and any further supplementation of iron and folate for

this category of patients may in fact prove to be detrimental to the perinatal outcome and might not be of much benefit to the mother either (2,11). To explain the adverse effects of high Hb levels on perinatal outcome, it could be hypothesized that above a certain level high haematocrits cause increased viscosity and thereby interfere with blood flow in the placental bed. Interestingly, our subjects whose last Hb levels were below 10.0 g/dl delivered significantly heavier babies than the mothers whose last Hb levels were ≥ 10.0 g/dl. This association was not found with last Hb <8.0 g/dl. However, many of our women and women elsewhere in the underdeveloped world start pregnancy with depleted iron stores and therefore need supplementation.

The first Hb showed over a third of the subjects to be anaemic, ie, with Hb below 10.0 g/dl. Over 40% had Hb less than 10.0 g/dl at some stage during the pregnancy; and 8% had levels below 8.0 g/dl. In spite of the prescribed iron and folate supplementation and malaria chemoprophylaxis, at ≥ 34 weeks gestation the Hb level was below 10.0 g/dl in 23%. The mean and 5th percentile values for the Hb at ≥ 34 weeks were 11.1 and 8.2 g/dl, respectively (Table 3, Panel B). These figures are much lower than the 12.5 and 11.4 g/dl in the USA but show an improvement over the figures obtained in this institution a decade ago (5,8). The patients who were on iron-folate supplementation and malaria chemoprophylaxis did not show a significant fall in Hb between the first and last Hb values. This would indicate that supplementation is of value in our community.

Those of our patients who had malaria were more likely to have severe anaemia (Hb <8.0 g/dl). This observation is in agreement with clinical experience. When regular antenatal clinic attenders develop severe anaemia, this is usually due to a malarial attack. Severe anaemia was not significantly associated with any other variable examined. This in itself is not surprising since the proportion of patients with Hb <8.0 g/dl was small.

There is no doubt that in comparison with the more advanced countries, severe anaemia is a problem in our community. Its adverse effects on perinatal outcome were not seen in this

study because of small numbers; which, in turn, might be attributed to the care offered by a tertiary institution. The perinatal results may be different in other parts of the country, especially in areas where women may not have ready access to good obstetric services. It has been shown in other developing countries that irrespective of social status or maternal age, pregnant women need iron supplementation (3). Our results seem to agree with this. We are still using data from the 1987 survey (6) to guide us in the management of our antenatal patients. We need to conduct another survey to determine whether the causes of anaemia have changed. Armed with these results, we would be in a position to advise administrative officials as to ways to improve the haemoglobin status and health of our women.

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