Original Article

Anemia in pregnancy in Malaysia: a cross-sectional survey

Jamaiyah Haniff MPH, MD[1], Anita Das MPH, MBBS[1], Lim Teck Onn FRCP, MRCP[1], Chen Won Sun PhD[2], Noraihan Mohd Nordin MRCOG, MD[3], Sanjay Rampal MPH, MBBS[4], Safiah Bahrin MPH, MD[5], Muralitharan Ganeslingam MRCOG, MBBS[6], Kumar Iswaran K. Kularatnam MRCOG, MBBS [6], Zaki Morad Mohamad Zaher FRCP, MRCP[1,7], on behalf of Malaysian Anemia Study Group

[1]Clinical Research Centre, Kuala Lumpur Hospital; [2]Biostat Consult Sdn Bhd; [3]Department of Obstetrics and Gynecology, University Putra Malaysia; [4]Department of Social and Preventive Medicine, Universiti Malaya; [5]Division of Family Health Development, Ministry of Health, Putrajaya; [6]Department of Obstetrics, Kuala Lumpur Hospital; [7]Department of Nephrology, Kuala Lumpur Hospital, Malaysia

Anemia is the most prevalent nutritional deficiency during pregnancy. Except for a study conducted 10 years ago in Kelantan, Malaysia's available statistics are based on isolated small urban maternity hospital studies from the 1980s. There was therefore, a need for a large study at national level to estimate the magnitude of the problem in the country as well as to understand its epidemiology. This multi-center, cross-sectional study was conducted from February to March 2005, to assess the prevalence of anemia. Multistage stratified random sampling technique was used and 59 Ministry of Health (MOH) primary health care clinics were selected. Our final dataset consisted of 1,072 antenatal mothers from 56 clinics. The overall prevalence of anemia in this population was 35 % (SE 0.02) if the cut off level is 11 g/dL and 11 % (SE 0.03) if the cut-off level is 10 g/dL. The majority was of the mild type. The prevalence was higher in the teenage group, Indians followed by Malays and Chinese being the least, grandmultiparas, the third trimester and from urban residence. After multiple linear regression analysis, only gestational age remained significant. These findings are useful for our Maternal Health program planners and implementers to target and evaluate interventions. Work is in progress for outcomes and cost-effectiveness studies to best tackle this problem. In conclusion, the prevalence of anemia is 35% and mostly of the mild type and more prevalent in the Indian and Malays.

Key Words: anemia, pregnancy, prevalence, haemoglobin, grandmultiparity

INTRODUCTION

Anemia in pregnancy constitutes a major public health problem in developing countries. Brabin et al found a strong association of severe anemia (OR 3.51, 95% CI: 2.05–6.00) with maternal mortality.[1] In addition, associated adverse perinatal outcomes have been well documented.[2-7] It is disturbing to find that the prevalence of anemia in pregnancy in developing countries, is still high. Nearly half the pregnant women in the world are estimated to be anemic, i.e 52% compared to 23% in industrialized countries.[8] Recent World Health Organization (WHO) data shows that approximately 10.8 million in African countries, 9.7 million in the Western Pacific and 24.8 million pregnant women in South East Asia are anemic; the highest number being in South East Asia.[8]

Unfortunately, in Malaysia, there is an absence of reliable epidemiological data regarding prevalence and associated demographic risk factors. Most of the studies performed in Malaysia were done more than a decade ago. [9-11] In addition most of them were isolated small-sample size hospital-based studies [9,10,12,13] and were therefore biased towards high-risk pregnancies. In addition, different cut off levels of haemoglobin were used such as 6[9], 10[10] and 11 g/dL[11], which gave rise to varying degrees of prevalence, which made it difficult to make comparisons.

The "at risk groups" in Malaysia, need to be identified for targeted intervention.[14] With the absence of reliable data on prevalence, it has been difficult to systematically evaluate intervention programs and WHO has acknowledged that 90 countries implementing these intervention programs are facing similar problems.[8] Clearly, there is a need for updated epidemiological data on this important health problem in this country. Malaysia's anemia study group therefore conducted this large cross-sectional study with the aim

Corresponding Author: Dr. Jamaiyah Haniff, Head of Clinical Epidemiology Unit, Clinical Research Centre, 3rd Floor, Dermatology Block, Kuala Lumpur Hospital, Jalan Pahang, 50586, Kuala Lumpur, Malaysia
Tel: 6-03-26924249; Fax: 6-03-26911682
Email: jamaiyah@crc.gov.my
Manuscript received 31 January 2006. Initial review completed 26 September 2006. Revision accepted 6 October 2006.

of ascertaining the prevalence, distribution of haemoglobin and the associated socio-demographic characteristics of anemia in pregnancy, among Malaysian women attending Ministry of Health (MOH) primary care facilities. This is to provide epidemiological data and information regarding the extent of the problem since it is still a significant problem in Malaysia.

MATERIALS AND METHODS

This multi-center, cross-sectional observational study was conducted to ascertain the epidemiological data of anemia in pregnancy among Malaysian women where 1,072 mothers were included. The Ministry of Health's Medical and Research Ethics Committee of Malaysia (MREC) approved the study proposal. Consent was obtained from all the subjects included into the study.

Study population and sampling

In Malaysia, the projected 2005 population statistics show that the proportion of women of child bearing age (15-44 years) is 6,118,500 from 12,824,900 women population; which is about 48%.[15] The majority (65%) of pregnant women are seen at government Ministry of Health (MOH) primary health antenatal clinics.[16] The study population consisted of pregnant women attending the Ministry of Health (MOH) antenatal clinics, at primary care settings across the country from February to March 2005. There were no other inclusion criterions.

The sampling frame for the clinics was obtained from the "National Medicine Use Survey" (NMUS) of the Ministry of Health.[17] Clinics were stratified by 14 states in Malaysia. For each state, a quota of clinics was selected based on the size of the female population in that state. Figures for the female population were obtained from the National Population and Housing Census of 2000.[15] A total of 59 clinics were selected by simple random sampling. Each clinic was requested to recruit 20 pregnant subjects in a consequential manner on their antenatal clinic day so as to obtain a sample size of 1180 subjects.

Study assessment and definitions

The relevant data was obtained from patients' medical records and through face-to-face interview. The variables studied were socio-demographic factors such as nationality, age, ethnicity, education level, patient's occupation and husband's occupation. Occupation was used as a proxy measure for social class. Both the subject's occupation and her husband's occupation were classified according to the Malaysian Labour Force Survey 10-category occupation classification.[18] The higher of the two was used to assign the patient to a particular occupation. Then the 10 occupation categories were collapsed into 4 social class categories according to perceived salary as stated below.

- Class 1 includes legislators, senior officials, managers, and professionals
- Class 2 includes technicians, associate professionals and clerical workers
- Class 3 includes service workers, shop and market sales workers, skilled agriculture and fishery workers, craft and related trades workers, and plant and machine-operators and assemblers
- Class 4 includes elementary occupations, students, retirees, and people who are self-employed

The urban-rural classification of residence was based on population size of the district where the clinic was located.[15] Information on the obstetric history of the patient was also collected.

Haemoglobin concentration was based on the last routinely collected reading using the haemoglobinometer method (limited to those only using the Hemocue model).[19] This method uses blood samples drawn from either capillary or venous blood. For this study, anemia was defined according to the WHO [8] criteria of haemoglobin (Hb) below 11 g/dL. Anemia was further categorized into 3 levels; mild 9-11 g/dL, moderate 7-9 g/dL and severe <7 g/dL. [13]

It was not possible to obtain data on nutritional status and dietary intake. This data is not routinely collected and therefore was not available in subjects' records.

Statistical analysis

In order to provide sufficiently precise estimates, the sample size calculation had taken into consideration the known prevalence of anemia in pregnancy and the accuracy with the level of confidence, which we were willing to accept. Using prevalence from previous studies, [10, 11, 13,] which ranged from 20%-50%, 95% power and confidence intervals of 17.6 to 22.6% and 46.8 to 53.1% respectively, we estimated a sample size of 1000. Assuming that each clinic would contribute 20 subjects each, 50 clinics were proposed. In addition to that, to cover for non-responders, we over-sampled by 9 clinics.

Continuous variables have been described by summary statistics such as mean, median, and standard deviation and categorical (nominal/ordinal) variables, by the frequencies of each category.

Multiple linear regression was used to estimate the effects of covariates on haemoglobin levels. The model includes nationality, ethnicity, education level, social class, urban-rural residence, gravida, parity and gestational age. The level of significance was set at 0.05.

RESULTS

Out of the 59 clinics sampled 56 responded. Three clinics failed to respond because they were understaffed and as a result they could not contribute data during the study period. These three clinics were not systematically different from the other clinics. Participating clinics enrolled a total of 1,074 out of the expected 1,180 subjects giving a subject response rate of 91%. Two cases were excluded due to missing haemoglobin values. Thus the final sample size was 1,072 subjects and the post hoc power calculation of the study is 99%.

Table 1 shows demographic characteristics of the sample. The majority of the subjects were young mothers, between 20 to 30 years, with an average age of 29 years. The youngest and oldest participants were respectively 16 and 54 years old. About 5% of all pregnancies were among teenagers and about 5% were among women 40 and above. 63% of samples were Malay ethnic origin and about half (48%) were from rural residence. These are to

Table 1. Demographic characteristics

Demographic characteristics	(Total=1072) N	%
Age group (years)	46	4.29
<20	575	53.6
20-<30	406	37.9
30-<40	45	4.2
40		
Nationality	1033	96.4
Malaysia	30	2.8
Indonesia	3	0.28
Philippines	3	0.28
Thailand	3	0.28
Others		
Ethnicity	678	63.3
Malay	109	10.2
Chinese	62	5.78
Indian	223	20.8
Others		
Education level	223	20.8
Lower secondary	656	61.2
Secondary	193	18
Tertiary		
Social Class	244	22.8
Class 1	226	21.1
Class 2	429	40.0
Class 3	173	16.1
Class 4		
Residence		
Rural	514	48.0
Urban	558	52.1

Remark: Class 1 includes legislators, senior officials, managers, and professionals; Class 2 includes technicians, associate professionals and clerical workers; Class 3 includes service workers, shop and market sales workers, skilled agriculture and fishery workers, craft and related trades workers, and plant and machine-operators and assemblers; Class 4 includes elementary occupations, students, retirees, and people who are self-employed

be expected for a sample that is representative of the Malaysian obstetrics population.

Figure 1 shows the distribution of haemoglobin (Hb) concentration for all subjects, which is remarkably normal. The mean Hb was 11.46g/dL (SD 1.31). The range is from 7.6 g/dL to 15.8 g/dL with a median of 11.4 g/dL. Table 2 shows the variation in mean Hb by demographic, obstetric and clinical characteristics of the subjects.

Younger and older mothers, Malays and Indian mothers, those with a lower level of education, mothers from social class 2 and 4, those from urban residence, mothers in their 3rd trimester, grandmultigravidas, grandmultiparas, had lower mean Hb levels. Mean Hb concentrations also declined with gestational age (p<0.001) (Fig 2). The drop in the mean Hb in the third from the first trimester was as much as 1.37 g/dL.

The overall prevalence of anemia in this population using a cutoff level of 11 g/dL was 35 % (SE 0.02) and 11% (SE 0.03) when the cutoff level of 10 g/dL was used (Table 3). Table 3 shows that if the cut off point of 10 g/dL is used compared to 11 g/dL the differences in prevalence estimates ranged from 10 % (SE 0.09) to as high as 33% (SE 0.12). With the 10 g/dL cutoff level, a decreasing trend in prevalence was elicited across increased education levels, and increasing trends were seen with gravida, parity and gestational age.

At a cutoff point of 11 g/dL, young mothers less than 20 years had a prevalence of 46%, grandmultigravidas 39%, grandmultiparas 45% and mothers in third trimester of pregnancy 43%.

Table 4 shows that the majority of mothers with anemia were categorized as mild. There were no severe anemic cases in the sample since the lowest haemoglobin level reported was 7.6g/dL.

Table 5 shows the results of modeling haemoglobin as a function of age, nationality, ethnicity, education level, social class, urban-rural residence, gravida, parity and gestational age. Clearly the effect of gestational age

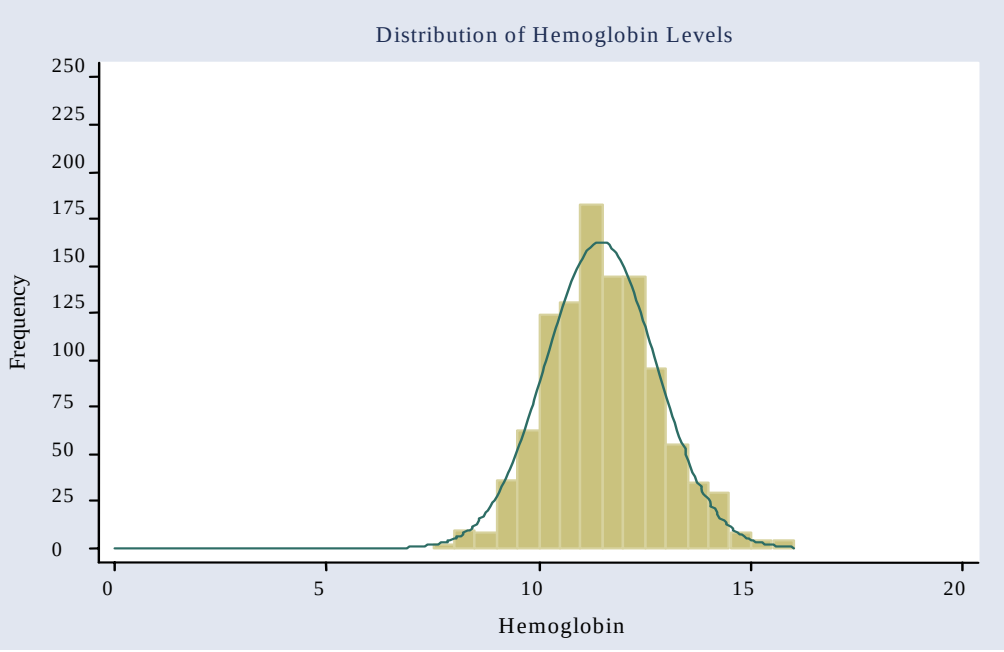


Figure 1. Distribution of haemoglobin levels

(p<0.001) stood out among all other factors. There is a significant difference between Chinese and Malays (Table 5, p=0.033) where the mean haemoglobin of the Chinese is higher and Indians are lower (Table 2). There was no correlation between mother's age and haemoglobin level (Spearmen correlation r = 0) and other factors ceased to be significant.

DISCUSSION

Subjects in our study population were mainly young mothers between 20 to 30 years, with an average age of 29 years. About 5% of all pregnancies were among teenagers and about 5% were among women 40 and above. 63% of samples were of Malay ethnic origin and about half (48%) were from rural clinics. These are to be expected for a sample that is representative of the Malaysian obstetrics population. The results of the Hb distribution also showed a normal distribution. These factors showed that the results of this study can reflect that of the national population.

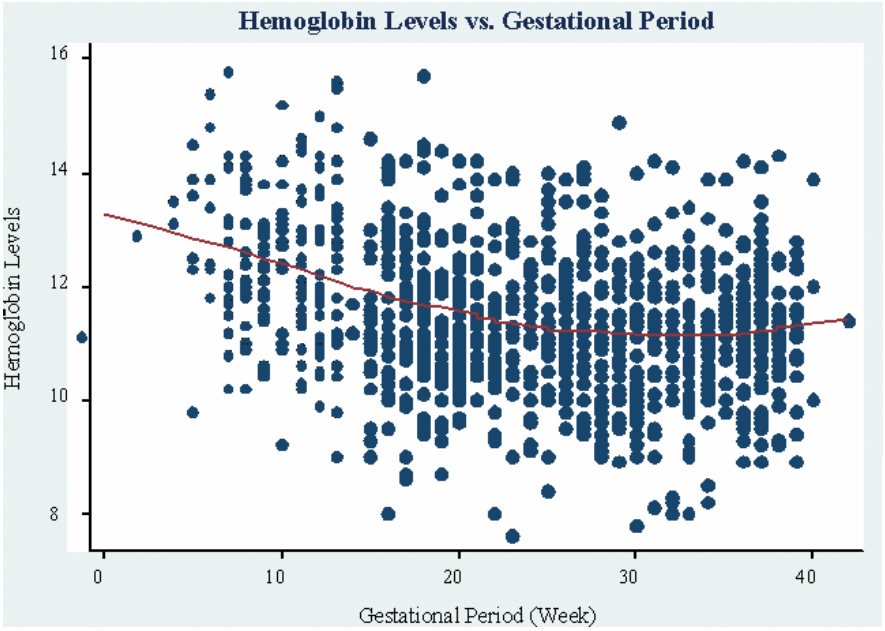
Prevalence of anemia

The overall prevalence of anemia in this study population was 35 % (SE 0.02). It is lower than reported in previous

Table 2. Distribution of haemoglobin levels in relation to demographic, obstetric and clinical characteristics

	(Total=1072) N	Haemoglobin Levels Mean (SD)
I Demographic characteristics		
Age group (years)		
• <20	46	11.3 (1.26)
• 20-<30	575	11.5 (1.36)
• 30-<40	406	11.4 (1.25)
• ≥40	45	11.3 (1.36)
Ethnic group		
• Malay	678	11.4 (1.27)
• Chinese	109	11.7 (1.27)
• Indian	62	11.4 (1.43)
• Others	223	11.6 (1.42)
Education level		
• Lower secondary	223	11.4 (1.31)
• Secondary	656	11.5 (1.34)
• Tertiary	193	11.5 (1.22)
Social class		
• Class 1	244	11.6 (1.27)
• Class 2	226	11.3 (1.24)
• Class 3	429	11.5 (1.37)
• Class 4	173	11.4 (1.31)
Residence		
• Rural	514	11.5 (1.31)
• Urban	558	11.4 (1.32)
II Pregnancy and Obstetric characteristics		
Gestational age (Trimester)		
• Trimester 1: <12 weeks	101	12.5 (1.26)
• Trimester 2: 12-<28 weeks	553	11.6 (1.29)
• Trimester 3: ≥28 weeks	418	11.1 (1.20)
III Clinical characteristics		
Gravida		
• Primigravida: 1	294	11.5 (1.35)
• Multigravida: 2-5	673	11.5 (1.29)
• Grand multigravida: ≥6	105	11.2 (1.35)
Parity		
• Primipara: 0	299	11.5 (1.36)
• Multipara: 1-4	699	11.5 (1.28)
• Grand multipara: ≥4	74	11.2 (1.42)
Type of blood drawn		
• Venous	295	11.6 (1.48)
• Capillary	777	11.4 (1.24)
History of blood transfusion in the past 3 months		
• Yes	3	9.93 (0.31)
• No	1069	11.5 (1.31)

Remark: Class 1 includes legislators, senior officials, managers, and professionals; Class 2 includes technicians, associate professionals and clerical workers; Class 3 includes service workers, shop and market sales workers, skilled agriculture and fishery workers, craft and related trades workers, and plant and machine-operators and assemblers; Class 4 includes elementary occupations, students, retirees, and people who are self-employed.



p-value<0.001 (This value is obtained from nonparametric trend test developed by Cuzick, which is an extension of the Wilcoxon rank-sum test.)

Figure 2. Distribution of haemoglobin levels in relation to gestation age (Weeks).

Malaysian studies.[10, 11, 13] The only comparable population-based study conducted in Malaysia, which used the same definition, found a prevalence of 47.5 %. [11] This difference could possibly be due to the rural setting where that study was conducted, whereas our study had a wider representative sample, which included mothers from urban residence. Another Malaysian study in 1982 estimated a prevalence of anemia (defined as haemoglobin [Hb] below 10.5 g/dL) at 18.7%; this however was an urban hospital-based study on a sample of only 190 subjects.[12] A study in 1984 of 309 pregnant women in their 3rd trimester from a Maternity Hospital reported a prevalence of 30-40%.[10] A report by MOH quoted that anemia in late pregnancy for women with Hb of 9-11g/dL for the year 2000 was 30.3%, in 1999 was 37.7% and in 1998 was 52.9%, while anemia with Hb <9g/dL for year 2000 was 3.1%, in 1999 was 3.6% and in 1998 was 4.6%.[20]

When compared with neighboring countries, our study showed a prevalence rate that seemed higher than that of Singapore (15%),[21] but remained comparable with that of Indonesia (37.1% to 46.2%).[22, 23] The rate is lower than in most developing countries such as South India 69.5 % [24] and most African countries including Eastern Africa and Western Africa.[8] When compared to most developed countries such as United Kingdom, France and Germany [2], our study reported a higher prevalence.

It is difficult to compare prevalence rates as the definition of anemia differs. The 10 g/dL cut-off level was used in most Malaysian studies, probably due to its common use in clinical practice despite the Ministry of Health's recommended cut-off level of 11g/dL. [20] At the cut-off level of 10 g/dL, the prevalence would be lower than if the higher cut-off of 11 g/dL (recommended by WHO) were used. The overall prevalence of anemia in our study population using a cutoff level of 11 g/dL was 35 % (SE 0.02) and 11% (SE 0.03) when the cutoff level of 10 g/dL was used (Table 3). Common use of the lower cut off level (10 g/dL) in clinical practice here could probably be due to the cost factor. In Malaysia, all pregnant women are prescribed prophylactic oral iron and folate supplements and if the haemoglobin level is between 10-11 g/dL oral treatment is indicated anyway. If a higher cutoff level was used (11 g/dL), a higher percentage of pregnant women with anemia would be reported and this would incur added investigation costs.

There is not much published data on the attributable risks on perinatal or maternal outcomes to support the cut-off point used by the WHO or the MOH. All of this point to the validity of the current definition of anemia in pregnancy and it therefore remains a debatable issue.

Perhaps at this juncture, it is more important to direct further efforts towards defining a cut off level where pregnant women are exposed to health risks associated with anemia. Malaysian women should not have to contend with lower haemoglobin (Hb) levels and associated risks during pregnancy.[13] Those with anemia cannot tolerate blood loss as well as patients with a higher Hb level. It was found that the relative risk of maternal mortality associated with moderate anemia was 1.35 (95% CI; 0.92-2.00) and for severe anemia, was 3.51 (95% CI; 2.05-6.00).[25] The leading cause of maternal mortality in Malaysia is post partum hemorrhage [26] and therefore it is imperative that all cases of anemia be identified and treated to ensure adequate Hb levels before labour. [13]

Zulkifli *et al* found that only 50 % of those mothers who were anemic at booking, had improved haemoglobin (Hb) levels by their last visit in spite of routine prophylactic oral iron supplementation for all pregnant women[11], which is similar to our study that found that there is an increasing trend in the prevalence of anemia with ongoing pregnancy. Reasons could be due to poor compliance with oral supplements, [13] booking at late gestation period [10] or also due to other causes of anemia such as the haemoglobinopathies.[13]

Table 3. Prevalence of anemia with various cut off points in relation to demographic, obstetric, and clinical characteristics

	Haemoglobin level of < 10 g/dL			Haemoglobin level of 10 - < 11 g/dL			Haemoglobin level of < 11 g/dL		
	N	% (SE)	95% Confidence Interval	N	% (SE)	95% Confidence Interval	N	% (SE)	95% Confidence Interval
Overall prevalence	117	11 (0.03)	(8, 14)	254	24 (0.03)		371	35 (0.02)	(31, 4)
Age group (years)									
• <20	6	13 (0.14)	(0, 27)	15	33 (0.12)	(11, 5)	21	46 (0.11)	(24, 7)
• 20-<30	61	11 (0.04)	(7, 15)	136	24 (0.04)	(20, 3)	197	34 (0.03)	(28, 4)
• 30-<40	45	11 (0.05)	(6, 16)	92	23 (0.04)	(19, 3)	137	34 (0.04)	(26, 4)
• ≥40	5	11 (0.14)	(0, 25)	11	24 (0.13)	(11, 4)	16	36 (0.12)	(12, 6)
Ethnic group									
• Malay	72	11 (0.04)	(7, 15)	171	25 (0.03)	(22, 3)	243	36 (0.03)	(30, 4)
• Chinese	8	7 (0.09)	(0, 16)	23	21 (0.08)	(13, 3)	31	29 (0.08)	(13, 5)
• Indian	10	16 (0.12)	(4, 28)	13	21 (0.11)	(10, 3)	23	37 (0.10)	(17, 6)
• Others	27	12 (0.06)	(6, 18)	47	21 (0.06)	(15, 3)	74	33 (0.05)	(23, 4)
Education level									
• Lower secondary	32	14 (0.06)	(8, 20)	44	20 (0.06)	(14, 3)	76	34 (0.05)	(24, 4)
• Secondary	67	10 (0.04)	(6, 14)	169	26 (0.03)	(23, 3)	236	36 (0.03)	(30, 4)
• Tertiary	18	9 (0.07)	(2, 16)	41	21 (0.06)	(15, 3)	59	31 (0.06)	(19, 4)
Social Class									
• Class 1	21	9 (0.06)	(3, 15)	53	22 (0.06)	(16, 3)	74	30 (0.05)	(20, 4)
• Class 2	26	12 (0.06)	(6, 18)	56	25 (0.06)	(19, 3)	82	36 (0.05)	(26, 5)
• Class 3	45	10 (0.04)	(6, 14)	106	25 (0.04)	(21, 3)	151	35 (0.04)	(27, 4)
• Class 4	25	14 (0.07)	(7, 21)	39	23 (0.07)	(16, 3)	64	37 (0.06)	(25, 5)
Residence									
• Rural	50	10 (0.04)	(6, 14)	109	21 (0.04)	(17, 3)	159	31 (0.04)	(23, 4)
• Urban	67	12 (0.04)	(8, 16)	145	26 (0.04)	(22, 3)	212	38 (0.03)	(32, 4)
Gravida									
• Primigravida: 1	27	9 (0.06)	(3, 15)	78	27 (0.05)	(22, 3)	105	36 (0.05)	(26, 5)
• Multigravida: 2-5	73	11 (0.04)	(7, 15)	152	23 (0.03)	(20, 3)	225	33 (0.03)	(27, 4)
• Grand multigravida: ≥6	17	16 (0.09)	(7, 25)	24	23 (0.09)	(14, 3)	41	39 (0.08)	(23, 6)
Parity									
• Primipara: 0	27	9 (0.06)	(3, 15)	76	25 (0.05)	(20, 3)	103	34 (0.05)	(24, 4)
• Multipara: 1-4	78	11 (0.04)	(7, 15)	157	22 (0.03)	(19, 3)	235	34 (0.03)	(28, 4)
• Grand multipara: ≥4	12	16 (0.11)	(5, 27)	21	28 (0.10)	(18, 4)	33	45 (0.09)	(27, 6)
Gestational Age									
• Trimester 1: <12 weeks	2	2 (0.10)	(0, 12)	10	10 (0.09)	(1, 20)	12	12 (0.09)	(0, 30)
• Trimester 2: 12-<28 weeks	49	9 (0.04)	(5, 13)	129	23 (0.04)	(19, 3)	178	32 (0.03)	(26, 4)
• Trimester 3: ≥28 weeks	66	16 (0.05)	(11, 21)	115	28 (0.04)	(24, 3)	181	43 (0.04)	(35, 5)

Remark: Class 1 includes legislators, senior officials, managers, and professionals; Class 2 includes technicians, associate professionals and clerical workers; Class 3 includes service workers, shop and market sales workers, skilled agriculture and fishery workers, craft and related trades workers, and plant and machine-operators and assemblers; Class 4 includes elementary occupations, students, retirees, and people who are self-employed.

Table 4. Prevalence by severity of anemia

	N	Prevalence of severity of anemia % (SE)		
		Mild (N=352)	Moderate (N=19)	Severe (N=0)
Overall prevalence	1072	33 (0.01)	2 (0.004)	0 (0)

Remark: Mild anemia is defined as having a haemoglobin level of 9-<11 g/dL; Moderate anemia is defined as having a haemoglobin level of 7-<9 g/dL; Severe anemia is defined as having a haemoglobin level of <7 g/dL; Note: Since the lowest haemoglobin level is 7.6 g/dL, therefore, there were no severe anemic subjects

Table 5. Multiple linear regression of haemoglobin levels in relation to demographic, obstetric, and clinical characteristics

Variables	N (%)	Coefficient (SE)	95% Confidence Interval	*p*-value
Age (years)	1072 (100)	0.01 (0.01)	(-0.01, 0.02)	0.53
Nationality				
• Malaysia[Ref]	1033 (96.4)	-	-	-
• Indonesia	30 (2.80)	0.13 (0.24)	(-0.35, 0.60)	0.60
• Philippines	3 (0.28)	-0.55 (0.73)	(-1.98, 0.88)	0.45
• Thailand	3 (0.28)	1.09 (0.73)	(-0.35, 2.53)	0.14
• Others	3 (0.28)	-1.46 (0.73)	(-2.88, -0.03)	0.05
Ethnicity				
• Malay[Ref]	678 (63.3)	-	-	-
• Chinese	109 (10.2)	0.28 (0.13)	(0.02, 0.54)	0.03
• Indian	62 (5.78)	0.01 (0.17)	(-0.33, 0.33)	0.99
• Others	223 (20.8)	0.21 (0.11)	(-0.01, 0.42)	0.05
Education level				
• Lower secondary	223 (20.8)	-0.17 (0.15)	(-0.46, 0.13)	0.27
• Secondary	656 (61.2)	-0.05 (0.11)	(-0.27, 0.18)	0.67
• Tertiary[Ref]	193 (18.0)	-	-	-
Social Class				
• Class 1[Ref]	244 (22.8)	-	-	-
• Class 2	226 (21.1)	-0.22 (0.12)	(-0.45, 0.02)	0.07
• Class 3	429 (40.0)	0.01 (0.11)	(-0.21, 0.23)	0.94
• Class 4	173 (16.1)	-0.13 (0.14)	(-0.41, 0.14)	0.35
Residence				
• Rural	514 (48.0)	0.15 (0.08)	(-0.01, 0.31)	0.07
• Urban[Ref]	558 (52.1)	-	-	-
Gravida				
• Primigravida: 1[Ref]	294 (27.4)	-	-	-
• Multigravida: 2-5	673 (62.8)	0.14 (0.19)	(-0.23, 0.50)	0.47
• Grand multigravida: ≥6	105 (9.79)	-0.04 (0.27)	(-0.57, 0.50)	0.90
Parity				
• Primipara: 0[Ref]	299 (27.9)	-	-	-
• Multipara: 1-4	699 (65.2)	-0.11 (0.18)	(-0.47, 0.25)	0.55
• Grand multipara: ≥4	74 (6.90)	-0.09 (0.29)	(-0.67, 0.48)	0.75
Gestational Age				
• Trimester 1: <12 weeks[Ref]	101 (9.42)	-	-	-
• Trimester 2: 12-<28 weeks	553 (51.6)	-0.93 (0.14)	(-1.19, -0.66)	<0.01
• Trimester 3: ³28 weeks	418 (39.0)	-1.41 (0.14)	(-1.69, -1.14)	<0.01
R^2=0.0691				

Remark: [Ref]=Reference group; Class 1 includes legislators, senior officials, managers, and professionals; Class 2 includes technicians, associate professionals and clerical workers; Class 3 includes service workers, shop and market sales workers, skilled agriculture and fishery workers, craft and related trades workers, and plant and machine-operators and assemblers; Class 4 includes elementary occupations, students, retirees, and people who are self-employed

Managing anemia in late pregnancy poses a big challenge as it takes some time to increase the Hb levels using oral or parenteral iron. It takes about as long as two weeks to increase the Hb level by 1g/dL.[13] Furthermore the use of parenteral iron is associated with increased risk of allergies and anaphylactic reactions. Blood transfusion can increase Hb level within a short duration but there is an increased risk of transmitting blood borne diseases such as HIV and hepatitis. It is therefore, of utmost importance to identify such anemic patients early in order to treat them adequately. Therefore more information related to anemia in pregnancy is needed.

Mean haemoglobin level

The overall mean haemoglobin (Hb) was 11.46g/dL (SD 1.31). The mean for each of the first, second and third trimesters were 12.47 g/dL (SD 1.26), 11.55 g/dL (SD 1.29) and 11.10 g/dL (SD 1.20) respectively. These differences were statistically significant. When compared with an earlier study [27] which reported means of 12.95, 11.4 and 10.9, it showed a similar trend. This may well be explained by the physiological expansion of maternal plasma volume by 25-40% causing a drop in the haemoglobin levels. [28]

Table 2 shows the variation in mean Hb by demographic, obstetric and clinical characteristics of the subjects. It would seem that age, ethnicity, education, social class, urban rural residence, gestational age, gravida and parity are also associated with anemia in pregnancy. However with multiple linear regression, the observed effect of gestational age and ethnicity persisted after adjustment for other covariates. The reasons why gestational age was associated with anemia has been explained above.

As for ethnicity, the two major races that seemed equally affected by anemia were the Malay mothers (36%) and Indian mothers (37%) although not exceptionally higher than the overall average prevalence. Our study found that the Chinese had a lower prevalence of anemia. This is not surprising as Goh *et al*, 1986 found that Chinese women had higher haemoglobin and serum ferritin levels compared to the Malays and Indians.[29] Possible explanations are dietary habits, lower parity and higher social class. In Singapore [30] where the racial makeup is somewhat similar to that of Malaysia, Indian mothers were found having the lowest prevalence and the highest prevalence was seen among the Malays. Noraihan MN *et al* also found a majority of Malay mothers and mothers from the lower socioeconomic background with monthly income of less than Ringgit Malaysia 1,000 were anemic. [13]

Even though subjects below 20 years had a prevalence of 46%, further analyses showed no significant difference in the age group distribution. This differs with findings from Zulkifli *et al* 1997 where anemia was found to be associated with women above 40 years. [11] Further analyses also showed that grandmultiparity was not associated with anemia, differing as well with findings from most Malaysian studies. [10, 11]

LIMITATION OF STUDY

One of the limitations of this study was the bias due to various methods of blood taking. Some clinics used venous blood samples while others used capillary blood samples. It is known that these methods can give rise to differences in readings.[31,32] Because the capillary blood vessel is small, the red cell volume of capillary blood is 1–3% lower than that of venous blood, and therefore its haemoglobin concentration is lower.[31] However when the HemoCue was used, the results were the same as it cannot detect such a small difference.[32] Sari et al recommended that the method of choice for evaluating anaemia in remote areas would be the HemoCue using venous blood and the second choice would be the HemoCue assessment of capillary blood.[32]

Neufeld et al however found the reverse, where the capillary blood had higher Hb (+0.5g/dL) than venous blood in adults and children.[33]

Information on clinical risk indicators was not obtained during the study. This would have been extremely important information, specifically clinical risk indicators among subjects who had haemoglobin levels between 10 and 11 g/dL. It would have been helpful in the development of further policy especially since the majority of study patients had mild anemia.

Other limitations are those that pertain to the nature of the study design being a cross sectional study. In addition, due to constraints of time, resources and logistics, some potentially important variables such as haemoglobin level at time of booking and gestation age at time of booking were not included in this study. Further research is needed in this area to ascertain the cause, predisposing factors and cost effectiveness of prophylaxis of iron and folate supplementation in the Malaysian context.

CONCLUSION

The overall prevalence of anemia in pregnancy is 35% and the majority of them were of the mild type (9-11 g/dL). At a cutoff point of 11 g/dL, young mothers less than 20 years had a prevalence of 46%, grandmultigravidas 39%, grandmultiparas 45% and mothers in third trimester of pregnancy 43%. After adjusting for all the possible covariates in the multiple linear regression model, there seems to be no significant association between Hb levels and age group, education level, social class, urban-rural residence, gravida and parity. Only two factors remained positively associated with anemia i.e gestational age and ethnicity. A study is in progress to ascertain the outcome of anemia in pregnancy in the Malaysian context. Future studies are needed to look into the cutoff levels of Hb associated with the attributable risks.

ACKNOWLEDGEMENTS

We would like to thank the Director General of Health, Ministry of Health, Malaysia for permission to publish this paper. We are indebted to Sithy Harjieah Ibrahim, Nur Akmal Hayati and Lina Hashim and other staff of the Clinical Research Centre who provided the project management for this study.

REFERENCES

1. Brabin BJ, Hakimi M, Pelletier D. An analysis of anemia and pregnancy-related maternal mortality. J Nutr. 2001; 131(2S-2):604S-615S.
2. World Health Organization. The prevalence of anemia in women: a tabulation of available information. Geneva: WHO, 1992. WHO/MCH/MSM/92.2
3. Scholl TO, Reilly T. Anemia, iron and pregnancy outcome. J Nutr. 2000;130(2S Suppl):443S-447S.
4. Rush D. Nutrition and maternal mortality in the developing world. Am J Clin Nutr. 2000; 72(1 Suppl):212S-240S.
5. Ronnerberg AG, Wood RJ, Wang X, Xing H, Chen C, Chen D, Guang W, Huang A, Xu X. Proconception haemoglobin and ferritin concentrations are associated with pregnancy outcome in a prospective cohort of Chinese women. J Nutr. 2004;134(10):2586-2591.
6. Rasmussen KM. Is there a causal relationship between iron deficiency or iron deficiency anemia and weight birth, length of gestation and perinatal mortality. J Nutr. 2001;131(2S-2):590S-603S.
7. Allen LH. Anemia and iron deficiency: effects on pregnancy outcomes. Am J Clin Nutr. 2000;71(5 suppl): 1280S-1284S.
8. World Health Organization, United Nations Children's Fund, United Nation University. Iron deficiency anemia: a assessment, prevention and control. A guide for programme managers. Geneva: WHO, 2001.WHO/NHD /01.3.
9. Llwellyn-Jones D. Severe anemia in pregnancy (as seen in Kuala Lumpur, Malaysia). Aust N Z J Obstet Gynaecol. 1965;5(4):191-197.

10. Siong TE, Kandiah M, Ali J, Kandiah V, Zahari MR, Kuladevan R, Hamzah Z. Nutritional anemia in pregnancy: a study at the maternity hospital, Kuala Lumpur. Malays J Reprod Health. 1984;2(1):32-50.
11. Zulkifli Ahmad, Rogayah Jaafar, M Hashim Mohd Hassan, Mohd Shukri Othman, Azmi Hashim. Anemia during pregnancy in rural Kelantan. Mal J Nutr. 1997;3:83-90.
12. Ali J, Hassan K, Arshat H. Maternal and cord folate and vit B12 levels in Malaysian at parturition. Med J Malaysia. 1982;37(2):160-164.
13. Noraihan MN, Fauzi FA, Kairon N, EM Symonds. Anemia in late pregnancy and compliance to oral supplements. Malays J Obstet Gynaecol. 2004;8(7):31-34.
14. Van den Broek NR, Rogerson SJ, Mhango CG, Kambala B, White SA, Molyneux ME. Anaemia in pregnancy in southern Malawi: prevalence and risk factors. BJOG. 2000;107(4):445-51.
15. Jabatan Perangkaan Malaysia. Indeks Lokaliti Banci Penduduk dan Perumahan 2000.
16. Planning & Development Division. Ministry of Health Malaysia. 2005 Family Health 2004 Subsystem – Health management and Information System.
17. National Medicine Use Survey. Database on listing of Ministry of Health Clinics. Clinical Research Centre. Hospital Kuala Lumpur, Ministry of Health. 4th January 2005
18. Jabatan Perangkaan Malaysia. Malaysian Standard Classification of Occupations (MASCO) 1998. Banci Penduduk dan Perumahan Malaysia 2000. MP 14B Kuala Lumpur.
19. HemoCue B-Glucose Operating Manual 1st edi. Sweden. 1991.www.hemocue.com
20. Ministry of Health Malaysia. Family Health Department Directory Annual Report Year 2000.
21. Singh K, Fong YF, Arulkumaran S. The role of prophylactic iron supplementation in pregnancy. Int J Food Sci Nutr. 1998;49(5):383-389.
22. Nurdia DS, Sumarni S, Suyoko, Hakim M, Winkvist A. Impact of intestinal helminth infection on anemia and iron status during pregnancy: a community based study in Indonesia. Southeast Asian J Trop Med Public Health 2001;32(1):14-22.
23. Suega K, Dharmayuda TG, Sutarga IM, Bakta IM. Iron deficiency anemia in pregnant women in Bali, Indonesia: a profile of risk factors and epidemiology. Southeast Asian J Trop Med Public Health. 2002;33(3):604-607.
24. Abel R, Rajaratnam J, Gnanasekaran VJ, Jayaranam P. Prevalence of anemia and iron deficiency in three trimesters in rural Vellore district, South India. Trop Doct. 2001; 31(2):86-89.
25. Brabin B, Prinsen-Geerligs P, Verhoeff F, Kazembe P. Anemia prevention for reduction of mortality in mothers and children. Trans R Soc Trop Med Hyg. 2003;97(1): 36-38.
26. Ministry of Health Malaysia. Confidential Enquiries on Maternal Death in Malaysia 1997-2000.
27. George E, Adeeb N, Ahmad J. Iron stores in pregnancy. Med J Malaysia. 1980;35(2):129-130.
28. Marieb EN. Human anatomy and physiology.3rd edition. California: Benjamin/Cummings Publishing Company, 1995.
29. Goh Th, Hariharan M. Iron deficiency anemia and serum ferritin levels in Malaysia women. Med J Malaysia. 1986; 41(4):300-304.
30. Singh K, Fong YF, Arulkumaran S. Anaemia in pregnancy- a cross-sectional study in Singapore. European Journal of Clinical Nutrition. 1998;52(1):65-70.
31. Anemia detection in health services: guidelines for program managers. Seattle, WA, Program for Appropriate Technology in Health, 1996.
32. Sari M, de Pee S, Martini E, Herman S, Sugiatmi, Bloem MW, Yip R. Estimating the prevalence of anaemia: a comparison of three methods. Bulletin of the World Health Organization. 2001;79(6):506-11.
33. Neufeld L, García-Guerra A, Sánchez-Francia D, Newton-Sánchez O, Ramírez-Villalobos MD, Rivera-Dommarco J. Haemoglobin measured by Hemocue and a reference method in venous and capillary blood: A validation study. Salud Publica Mex. 2002;44(3):219-227.

Original Article

Anemia in pregnancy in Malaysia: a cross-sectional survey

Jamaiyah Haniff MPH, MD[1], Anita Das MPH, MBBS[1], Lim Teck Onn FRCP, MRCP[1], Chen Won Sun PhD[2], Noraihan Mohd Nordin MRCOG, MD[3], Sanjay Rampal MPH, MBBS[4], Safiah Bahrin MPH, MD[5], Muralitharan Ganeslingam MRCOG, MBBS[6], Kumar Iswaran K. Kularatnam MRCOG, MBBS [6], Zaki Morad Mohamad Zaher FRCP, MRCP[1,7], on behalf of Malaysian Anemia Study Group

[1]Clinical Research Centre, Kuala Lumpur Hospital; [2]Biostat Consult Sdn Bhd; [3]Department of Obstetrics and Gynecology, University Putra Malaysia; [4]Department of Social and Preventive Medicine, Universiti Malaya; [5]Division of Family Health Development, Ministry of Health, Putrajaya; [6]Department of Obstetrics, Kuala Lumpur Hospital; [7]Department of Nephrology, Kuala Lumpur Hospital, Malaysia

馬來西亞婦女懷孕時期貧血之橫斷性研究

貧血是懷孕期間最常見的營養缺乏症。除了 10 年前在 Kelantan 進行的研究之外，馬來西亞現有的統計根據是 80 年代幾個小型的城市中的產科醫院的研究。因此，需要一項全國性大型研究來評估問題的大小並瞭解它的流行病學。為估計貧血症的盛行率，從 2005 年 2 月到 3 月於多中心進行橫斷性研究。以多步驟分層隨機抽樣法，選取了 59 個衛生部(MOH)基層健康照護診所。我們最後的資料包含 56 個診所的 1,072 個產前孕婦。這個族群整體的貧血盛行率若以 11 g/dL 為切點是 35 % (SE 0.02)；若以 10 g/dL 為切點則為 11 % (SE 0.03)。多數為輕微型。盛行率較高的是青少年組；印度人隨後為馬來人，華人最低；多胎次，懷孕第三期和居住於都市者。以線性複迴歸分析之後，只剩懷孕年齡依然顯著。這些發現有助於我們的孕產婦健康計畫的計劃者及執行者來訂定介入目標及評估。為了最好應付這個問題，結果及成本效益的研究工作正在進展中。總而言之，貧血症的盛行率為 35%，多數為輕微型，印度人和馬來人盛行率較高。

關鍵字：貧血、懷孕、盛行率、血紅素、多胎次。