

## Iron Intake and Iron Deficiency Anaemia among Young Women in Kuala Lumpur

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### ABSTRACT

**Objective:** To assess the prevalence of iron deficiency, anaemia and iron deficiency anaemia (IDA) in women aged 20–40 years and its association with iron intake. **Methods:** A total of 388 women were recruited from universities and work sites in Kuala Lumpur and its suburbs. The subjects comprised 135 Malays, 130 Chinese and 123 Indians. Dietary intake was estimated using a single 24-hour food recall and a semi-quantitative food frequency questionnaire. Haemoglobin (Hb), haematocrit (hct), mean corpuscular volume (MCV) and serum ferritin were determined. **Results:** The prevalence of anaemia (Hb <12g/dL) was 20.9%, being highest among the Indians (26.4%) and lowest among the Malays (16.4%). About 10.3% of the women showed iron deficiency anaemia (IDA) (Hb <12g/dL + serum ferritin <15µg/L + MCV <80fl). The prevalence of IDA was highest in Indians (18.0%) followed by Chinese (9.9%) and Malays (4.3%). The mean (95%CI) intake of total iron was at 14.4 mg/day (95% CI 13.4, 15.5), amounting to 49.7% of the Malaysian recommended nutrient intake (RNI). Intake of iron was the highest for the Indians (16.0 mg/d) and the lowest for the Chinese (11.3 mg/d). **Conclusions:** The overall prevalence of IDA was lower compared to prevalence of anaemia. Nonetheless, the markedly higher prevalence of IDA among the Indians, despite relatively higher intake levels of iron-rich foods warrants further investigations, including the bioavailability of iron in the context of cultural practices that may influence food preferences and meal preparation.

**Keywords:** Anaemia, iron deficiency anaemia, iron intake, women

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### INTRODUCTION

The World Health Organization<sup>[1]</sup> estimated that about 40% of the world's population (more than 2 billion individuals) suffers from anaemia. The prevalence of iron deficiency (ID), which is usually detected by low serum ferritin concentrations, is estimated to be from 2.0 to 2.5 times the prevalence of anaemia.<sup>[2]</sup> Iron deficiency anaemia (IDA) occurs when ID is sufficiently severe to diminish the production of haemoglobin. Health consequences of IDA have been observed in infants and children,<sup>[3, 4]</sup> adolescents<sup>[5]</sup> and pregnant women<sup>[6,7]</sup>. In the latter, IDA consequences include premature birth, low birth weight and small for gestational age of the newborn.<sup>[8]</sup>

Whilst there are many studies on anaemia in Malaysia, there is a relative dearth of studies on ID.<sup>[9, 10]</sup> Inadequate iron intake is a key factor in the development of iron deficiency and IDA. The Malaysian Adult Nutrition Survey (MANS) estimated iron intake

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of women at about 9.5mg/d, compared to 20mg/d recommended for women aged 19 to 50 years.<sup>[11]</sup>

This study was undertaken to assess the prevalence of ID, anaemia and IDA in women aged 20-40 years in Kuala Lumpur suburbs and its association with iron intake.

## METHODS

### *Subjects*

Women aged 18-40 years were recruited from universities and other work sites located in the suburbs of Kuala Lumpur through convenient sampling. The inclusion criteria included being not pregnant or breastfeeding, not taking supplements regularly, not consuming alcohol habitually, not a habitual smoker and without a history of diabetes, hypertension, liver, heart or gastrointestinal problems. Those who qualified, they were given a two-page information sheet about the study. If they agree to participate, they were asked to sign a consent form. The study protocol was reviewed and approved by the Medical Research Ethics Committee of the Faculty of Medicine and Health Sciences, Universiti Putra Malaysia.

### *Dietary Intake*

Dietary intake was determined using a single 24-hour recall and a semi-quantified food frequency questionnaire (FFQ). The interviews were conducted by trained interviewers. The dietary data was analysed using Nutritionist Pro, version 2.5 (First Databank, California, USA). The FFQ listed a total of 30 food items including those high in iron and frequently eaten by all ethnic groups. For each food item, the following information was recorded: (a) frequency of consumption as number of times per day, per week, per month or never and (b) number of portions usually consumed (slices, units or standard servings).

### *Biochemical Measurements*

A total of 10 ml blood (non-fasting) was taken from each subject, for haemoglobin (Hb), haematocrit (hct), mean cell volume (MCV), and serum ferritin. Hb, Hct and MCV were measured the same day with a haematology analyser (ABX micros-60, Horiba-ABX, France). Serum samples were stored at  $-20^{\circ}\text{C}$  until sent to University of Otago, New Zealand for the determination of serum ferritin using an AxSYM analyser and AxSYM Ferritin assay (Abbott Laboratories)

### *Statistical Analysis*

The data were analysed using SPSS for Windows version 13.0 (SPSS, Chicago, IL, USA). Characteristics of the women were described using frequencies, percentages, means, standard deviations, median and percentiles (5-95<sup>th</sup>). Anaemia was defined as a hemoglobin level less than 12g/dL, depleted iron store as serum ferritin less than 15 $\mu\text{g/L}$ , and iron deficiency anaemia as Hb less than 12g/dL, MCV less than 80fl and serum ferritin less than 15 $\mu\text{g/L}$ . Analysis of variance with a Duncan test for multiple comparisons was used to determine differences among groups and a *p* value of less than 0.05 was considered to indicate statistical significance.

**Table 1.** General characteristics of the study sample (N=388)

Characteristics	Malay	Chinese	Indian	All
	N= 135	N= 130	N= 123	N= 388
	N (%)			
Age (yr)				
≤ 20	11 (8.2)	13 (10.0)	6 (4.9)	30 (7.7)
21-30	96 (71.1)	108 (83.1)	85 (69.1)	289 (74.5)
> 30	28 (20.7)	9 (6.9)	32 (26.0)	69 (17.8)
Median (years)	25	22	24	23
5-95 <sup>th</sup> percentiles (years)	20-38	20-33	20-39	20-38
Marital status				
Single	83 (61.9)	124 (96.1)	86 (69.4)	293(75.7)
Married	48 (35.8)	5 (3.9)	36 (29.0)	89 (23.0)
Divorced/widowed	3 (2.2)	-	2 (1.6)	5 (1.3)
Education				
Primary	3 (2.2)	-	7 (5.7)	10 (2.6)
Secondary	35 (25.9)	3 (2.3)	24 9 (9.5)	62 (16.0)
Form 6/matriculation	23 (17.0)	15 (11.6)	14 (11.4)	52 (13.4)
College/University	74 (54.8)	111 (86.0)	78 (63.4)	263 (68.0)
Median (yrs)	16	16	16	16
5-95 <sup>th</sup> percentiles (yrs)	11-16	13-16	7-16	11-16
Occupation				
Working	77 (58.8)	12 (9.4)	37 (30.6)	126 (33.2)
Students	50 (38.2)	116 (90.6)	75 (62.0)	241 (63.4)
Housewives	4 (3.1)	-	9(7.4)	13 (3.4)
BMI (kg/m <sup>2</sup> )				
Mean ± SD	24.1 ± 4.7a	21.2 ± 3.5b	22.3 ± 4.8c	22.6 ± 4.5
Underweight (< 18.5)	10 (7.4)	29 (22.7)	24 (22.5)	63 (17.1)
Normal (18.5-24.9)	81 (60.0)	88 (22.7)	63 (53.9)	232 (63.1)
Overweight (25.0 –29.9)	27 (20.0)	6 (4.7)	7 (14.6)	40 (10.9)
Obese (≥30.0)	17 (12.6)	5 (3.9)	11 (9.0)	33 (8.9)

## RESULTS

Completed questionnaires and biochemical data were obtained from 388 (135 Malay, 130 Chinese and 123 Indians) of the 399 women who were enrolled. Table 1 summarises the characteristics of these 388 subjects who were included in all subsequent analyses. The median age of the subjects was 23 years and 74.5% were in the 21-30 years age category. Two hundred and ninety-three (75.7%) of them were single and education attainment was quite high (16 years or at about Form Five level). This is due to the inclusion of a high proportion of university students as subjects, (60.3%). The working women were employed in a variety of positions including clerks, bank executives, factory operators, laboratory

**Table 2.** Mean energy and nutrient intake of subjects (N= 388)

Variable	RNI	Mean (95 % CI)			
		Malay N= 135	Chinese N= 130	Indian N= 123	All N= 388
Energy (kcal)	2000	1443 (1355, 1532) <sup>a</sup>	1251 (1177, 1324) <sup>b</sup>	1505 (1404, 1607) <sup>a</sup>	1402 (1350, 1453)
Protein (g)	55	57 (53, 61) <sup>a</sup>	50 (46, 54) <sup>b</sup>	57 (52, 62) <sup>a</sup>	55 (52, 57)
Fat (g)	46-70	46 (42, 50) <sup>a</sup>	42 (36, 48) <sup>a</sup>	46 (41, 51) <sup>a</sup>	45 (42, 48)
Iron (mg)	20-29	15.8 (13.9, 17.7) <sup>a</sup>	11.3 (9.8, 12.7) <sup>b</sup>	16.0 (14.0, 18.1) <sup>a</sup>	14.4 (13.4, 15.5)
Vitamin C	70	60 (48, 73) <sup>a</sup>	53 (42, 63) <sup>a</sup>	56 (45, 66) <sup>a</sup>	56 (50, 63)

ANOVA post-hoc test (Duncan): mean values with different superscripts are significantly different at  $P < 0.05$  level

technologists and nurses. The mean BMI was 22.6kg/m<sup>2</sup> and the majority were in the normal category (63.1%).

The mean intake and the corresponding 95% confidence intervals of energy, iron and vitamin C intakes are presented in Table 2. Iron intake was similar in Malay and Indian subjects but was significantly lower among the Chinese subjects. Mean iron intake of Malay and Indian subjects were 15.8 (13.9, 17.7)mg and 16.0 (14.0, 18.1)mg respectively, while that of the Chinese was 11.3 (9.8, 12.7)mg. The main foods providing heme iron for all three ethnic groups are chicken and eggs. Pork is the additional heme iron source for the Chinese.

When the mean intake of iron of the subjects was compared to the Malaysian Recommended Nutrient Intake (RNI,) assuming 10% iron bioavailability,<sup>[12]</sup> it is seen that 15.5% met the RNI level for iron. About 76.5% of the subjects did not meet 2/3 of the RNI for iron. In this respect, a higher percentage of Chinese subjects (88.3%) had inadequate iron intake compared to the Malays (68.1%) and Indians (74.4%).

The levels of Hb, hematocrit, MCV and ferritin (mean  $\pm$  SD) of the subjects were 12.7  $\pm$  1.5g/dl, 34.8  $\pm$  3.3%, 76.1  $\pm$  7.6fl and 29.3  $\pm$  27.8 $\mu$ g/L respectively (Table 3). Overall, the Indian subjects had significantly lower Hb and serum ferritin levels compared to the Malay and Chinese subjects. Depleted iron stores were found in 33% of the subjects with the Indians having the highest percentage (53.9%) followed by the Chinese (25.2%) and Malay (22.9%) (Table 4). Overall prevalence of anaemia was 20.9%, while the combination of anaemia and depleted iron stores was found in 11.6 % of the subjects. The majority of the women with depleted iron stores (64.1%) were not anaemic. Severe anaemia (<7g/dL) was found in only three subjects; thus most of the women could be considered as having mild

**Table 3.** Iron status of subjects

	Malay N= 135	Chinese N= 130	Indian N= 123	All N= 388
Hemoglobin (g/dL)	12.8 ± 1.6 <sup>a</sup>	12.8 ± 1.2 <sup>a</sup>	12.4 ± 1.6 <sup>b</sup>	12.7 ± 1.5
Hematocrit (%)	35.1 ± 2.9 <sup>a</sup>	34.4 ± 3.0 <sup>a</sup>	34.7 ± 3.9 <sup>a</sup>	34.8 ± 3.3
Mean cell volume (fl)	76.4 ± 6.2 <sup>a</sup>	76.5 ± 7.5 <sup>a</sup>	75.1 ± 8.9 <sup>a</sup>	76.1 ± 7.6
Ferritin (µg/L)	35.0 ± 31.9 <sup>a</sup>	32.4 ± 27.7 <sup>a</sup>	20.1 ± 20.2 <sup>b</sup>	29.3 ± 27.8

ANOVA post hoc test (Duncan): mean values with different superscript are significantly different at  $P < 0.05$  level

**Table 4.** Prevalence of anaemia, depleted iron stores and IDA

Classification based on WHO (2001) <sup>[15]</sup>	Malay N= 135	Chinese N= 130	Indian N= 123	All N= 388
Anaemia (Hb <12 g/dL)	16.4	20.6	26.4	20.9
Depleted iron store (ferritin <15 µg/L)	22.9	25.2	53.9	33.0
Iron deficiency anaemia (Hb < 12 g/dL + ferritin < 15 µg/L + MCV < 80fl)	4.3	9.9	18.0	10.3

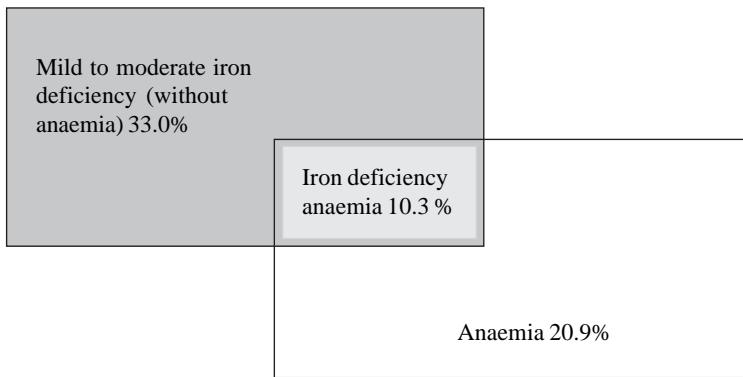
(10-11.9 g/dL) to moderate levels (7-9.9 g/dL) of anaemia. Based on the WHO definition,<sup>[13]</sup> the prevalence of IDA was 10.3% with the Indians having the highest percentage (18.0%) followed by the Chinese (9.9%) and Malays (4.3%) (Figure 1).

## DISCUSSION

The overall prevalence of anaemia in this study was 20.9%, while iron deficiency anaemia was at 10.3%, indicating that about half of the anaemia was due to iron deficiency. Other causes of anaemia in young women include heavy menstruation for longer than five days, abnormal uterine bleeding, (such as from fibroids)<sup>[14]</sup> and pregnancy.<sup>[15]</sup>

The prevalence of anaemia found in young non-pregnant women (20.9%) appears higher than the WHO estimate for non-pregnant women in Thailand at 18%.<sup>[16]</sup> However, there is a lower prevalence of iron deficiency anaemia compared to young adolescent girls from Indonesia (21.8%)<sup>[17]</sup>. Similarly, women of reproductive age in northwest Vietnam reported a higher prevalence of anaemia (37.5%).<sup>[18]</sup>

Serum ferritin is normally used as a marker of iron stores. The prevalence of iron depletion in women studied was 33%. Low iron stores without anaemia, is a commonly observed situation, especially in menstruating women. One reason for this is that the usual



**Figure 1.** Prevalence of anaemia, iron deficiency and IDA in Malaysian women

diets in the population may not meet the high iron requirements of the menstruating women. Some other factors, such as type of contraception in women, blood donation or minor pathological blood loss (hemorrhoids, gynecological bleeding), may increase the difficulty of covering iron needs. Moreover, women, especially those consuming low-energy diets, vegetarians and vegans are at particularly high risk of iron deficiency.<sup>[19]</sup>

In developing countries including Malaysia, dietary iron is derived mainly from meat and legumes. Overall, the intake of iron in this study was slightly higher than those reported by the MANS study,<sup>[11]</sup> and was similar to levels reported in adults in Manila,<sup>[20]</sup> and Hong Kong.<sup>[21]</sup> The Indian subjects had the highest prevalence of anaemia and IDA, despite having a higher mean daily iron intake (16.0mg/d) than that of the Chinese (11.3 mg/d) and Malay (15.8 mg/d). This may be due to low bioavailability of iron from dhal and other legumes that are frequently consumed by Indians generally. Iron from these vegetable sources has less than 5% bioavailability due to the presence of inhibitors of iron absorption including phytate.<sup>[22]</sup> Food items taken that could enhance iron absorption in this sample of subjects are mainly cabbage and orange owing to their vitamin C content.

## CONCLUSIONS

The prevalence of anaemia and IDA among urban Malaysian women were 20.9% and 10.3%, respectively, and marked differences were found among the ethnic groups. Intervention strategies for the reduction of anaemia and iron deficiency should be sensitive to cultural practices including food preferences and preparation. Pre-pregnancy evaluation provides important information for effective intervention strategies and may play a crucial role in preventing development of IDA during pregnancy.

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### REFERENCES

- [1] World Health Organization. *Malnutrition, the Global Picture*. Geneva:WHO, 2000.
- [2] Aleen LH, Gillespie SR. What works? A review of the efficacy and effectiveness of nutrition intervention. ACC/SCN: Geneva in collaboration with the Asian Development Bank, Manila, 2001.
- [3] Walter T. Effect of iron-deficiency anaemia on cognitive skills and neuromaturation in infancy and childhood. *Food Nutr Bull* 2003; 24(4 Suppl): S104–10.
- [4] Lozoff B, Beard J, Connor J, Barbara F, Georgieff M, Schallert T. Long-lasting neural and behavioral effects of iron deficiency in infancy. *Nutr Rev* 2006; 64(5 Pt 2): S34–43.
- [5] Bruner AB, Joffe A, Duggan AK, Casella JF, Brandt J. Randomised study of cognitive effects of iron supplementation in non-anaemic iron-deficient adolescent girls. *Lancet* 1996; 348(9033): 992–6.
- [6] Scholl TO. Iron status during pregnancy: setting the stage for mother and infant. *Am J Clin Nutr* 2005; 81(5): 1218S–1222S.
- [7] Golub MS, Hogrefe CE, Tarantal AF, Germann SL, Beard JL, Georgieff MK, Calatroni A, Lozoff B. Diet-induced iron deficiency anaemia and pregnancy outcome in rhesus monkeys. *Am J Clin Nutr* 2006; 83(3): 647–56.
- [8] Milman N. Prepartum anaemia: prevention and treatment. *Ann Hemato* 2008; 87(12): 949–59.
- [9] Hassan R, Abdullah WZ, Nik Hussain NH. Anaemia and iron status of Malay women attending an antenatal clinic in Kubang Kerian, Kelantan, Malaysia. *Southeast Asian J Trop Med Public Health* 2005; 36(5):1304–7.
- [10] Sagin DD, Ismail G, Mohamad M, Pang EK, Sya OT. Anaemia in remote interior communities in Sarawak, Malaysia. *Southeast Asian J Trop Med Public Health* 2002; 33(2): 373–7.
- [11] Kandiah M, Mohd Shariff Z, Mohd Yusof S, Aris T, Mohd Din SH, Din SR, Mohd Yusop KZ, Saihun MH, Haron N. Energy and Nutrient Intakes of Malaysian Adults: Findings from The Malaysian Adult Nutrition Survey (MANS). *Mal J Nutr* 2008; 14 (1): 1–24.
- [12] National Coordinating Committee on Food and Nutrition (NCCFN), Ministry of Health Malaysia. *Recommended Nutrient Intakes for Malaysia*. Putrajaya, Ministry of Health Malaysia, 2005.
- [13] WHO. *Iron deficiency anaemia: Assessment, Prevention and Control. A guide for programme managers*. World Health Organization; 2001.

- [14] Gupta S, Jose J, Manyonda I. Clinical presentation of fibroids. *Best practice & research. Clin Obstet & Gynaecol* 2008; 22(4): 615–626.
- [15] American College of Obstetricians and Gynecologists. ACOG Practice Bulletin No. 95: anaemia in pregnancy. *Obstet Gynecol* 2008; 112(1): 201–7.
- [16] WHO. Nutrition in South-East Asia. World Health Organization, Regional Office for South-East Asia: New Delhi, 2000.
- [17] Kurniawan YA, Muslimatun S, Achadi EL, Sastroamidjojo S. Anaemia and iron deficiency anaemia among young adolescent girls from the peri urban coastal area of Indonesia. *Asia Pac J Clin Nutr* 2006; 15(3): 350–6.
- [18] Pasricha SR, Caruana SR, Phuc TQ, Casey GJ, Jolley D, Kingsland S, Tien NT, MacGregor L, Montresor A, Biggs BA. Anaemia, iron deficiency, meat consumption, and hookworm infection in women of reproductive age in northwest Vietnam. *Am J Trop Med Hyg* 2008; 78(3): 375–81.
- [19] Hallberg L, Hulthen L, Garby L. Iron stores and haemoglobin iron deficits in menstruating women. Calculations based on variations in iron requirements and bioavailability of dietary iron. *Eur J Clin Nutr* (2000); 54(8): 650–657.
- [20] Nakatsuka H, Zhang ZW, Agetano MG, Subida RD, Inouguchi N, Watanabe T, Shimbo S, Higashikawa K, Ikeda M. Total food duplicate study on nutrient intake of working women in Manila, the Philippines. *Tohoku J Exp Med* 1998; 184(3): 189–205.
- [21] Woo J, Leung SSF, Ho SC, Lam TH, Janus ED. Dietary intake and practices in the Hong Kong Chinese population. *J Epidemiol Community Health* 1998; 52: 631–637.
- [22] Hurrell RF. Influence of vegetable protein sources on trace element and mineral bioavailability. *J Nutr* 2003; 133(9):2973S–7S.