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Low compliance with an iron-supplementation program: a study among pregnant women in Jakarta, Indonesia¹⁻³

Werner Schultink, Marianne van der Ree, Paul Matulesi, and Rainer Gross

ABSTRACT The efficiency of an established iron-supplementation program for pregnant women in Jakarta, Indonesia was investigated. Hemoglobin, serum ferritin, and packed cell volume (PCV) were measured at the start of the study and after 2 mo supplementation with 300 mg ferrous sulphate/d. The women ($n = 45$) were questioned about compliance and stool samples were checked for iron content to control for tablet intake. Twelve women dropped out. Prevalence of anemia (42%) did not decrease during the study period. Of the remaining 33 women, 64% ($n = 21$) claimed to have taken all iron tablets. This was only confirmed by positive stool tests in 12 women. Serum ferritin and PCV increased in women with positive stool tests ($P < 0.05$ and $P < 0.01$, respectively) after supplementation. It is concluded that compliance was low and that the iron dose needs to be increased. Supplementation programs need reliable monitoring and evaluation systems. *Am J Clin Nutr* 1993;57:135-9.

KEY WORDS Iron supplementation, compliance, pregnancy, anemia

Introduction

Pregnant women in developing countries suffer frequently from nutritional anemia, particularly iron-deficiency anemia. In South Asia prevalence of anemia among pregnant women is as high as 65% (1). In Indonesia estimated prevalence of nutritional anemia among pregnant women, based on scattered surveys, is between 50% and 70% (2, 3). It has been demonstrated in controlled field trials that iron-deficiency anemia can be prevented and treated by iron-supplement distribution through a primary health care system (4-7).

Therefore, the Indonesian government started implementing an iron-supplementation program ≈ 10 y ago to reduce the high anemia rate. The United Nations Children's Fund (UNICEF) supports the Indonesian supplementation program with $\approx \$500,000$ (US) per year. This program is based on the expectation that all pregnant women regularly visit either a community health center (Puskesmas) or an integrated health service post (Posyandu) during pregnancy. Health care staff are instructed to distribute iron and folate tablets to each women throughout the third trimester of pregnancy free of charge.

However, iron-supplementation programs without supervised or controlled consumption of tablets may lose effectiveness through factors such as irregular tablet distribution and poor compliance (7-9). Data on the efficiency of established iron-

supplementation programs are limited, and little information was available on the Indonesian program. The present study aimed to describe compliance of program participants and the effectiveness of the ongoing iron-supplementation program in Jakarta, Indonesia.

Subjects and methods

The study took place at an established community health center in central Jakarta, Indonesia from September to November 1991. The health center serves an area with 248 500 inhabitants and ≈ 1000 pregnant women attend the center yearly. Subjects were 45 women in the second trimester of pregnancy. They were selected at random from pregnant women who attended the normal pregnancy care program at the health center. As part of the program the women normally received once a month 30 iron tablets containing 300 mg ferrous sulphate (PT Kimia Farma, Bandung, Indonesia; one tablet is equivalent to 60 mg elemental iron). The usual iron tablet-distribution procedure was not changed for this program. Tablets were distributed in three small plastic bags, each bag containing 10 tablets. Health care staff told pregnant women to take one tablet per day (without special instructions on time of ingestion) and to return to the health center when the tablets were finished. The color of the tablets was red and they were the same in content and appearance as the tablets normally distributed by the health center.

Hemoglobin concentration, packed cell volume (PCV), serum ferritin, body weight, and height of the subjects were measured at the beginning of the study and after 2 mo. Blood was obtained by skin puncture of the left-hand ring finger by using an automatic skin puncture device (Autoclix-Lancet Boehringer Mannheim, Mannheim, Germany). Hemoglobin concentration was determined in duplicate by the cyanomethemoglobin method

¹ From South East Asian Ministries of Education Organization-Tropical Medicine (SEAMEO-TROPED) Center, Indonesia, at the University of Indonesia, Jakarta, Indonesia; the Division of Health, Population and Nutrition of the German Cooperation for Technical Collaboration (GTZ) Eschborn, Germany; the Department of Human Nutrition, Wageningen Agricultural University, Wageningen, The Netherlands.

² Address correspondence to JW Schultink, SEAMEO/GTZ, PO Box 3852, 10038 Jakarta, Indonesia.

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TABLE 1
Selected characteristics of the women at the start of the study*

Age (y)	24.5 ± 4.6
Gestation time (wk)	20.8 ± 3.5
Weight (kg)	51.4 ± 7.1
Height (cm)	152.6 ± 7.0
Parity	0.6 ± 1.0
Time since last pregnancy (mo)	46.4 ± 29.7†

* $\bar{x} \pm SD$; $n = 33$.

† For 12 women, 21 women were pregnant for first time.

(10) by using a Compur Minilab (Bayer Diagnostic GmbH, München, Germany). Variation based on duplicate measurements was 2%. PCV was measured by the microhematocrit method (10). Serum ferritin was determined by enzyme immunoassay procedure (10) by using a commercial kit (Ramco Laboratories, Houston, TX). Body weight was measured to the nearest 0.1 kg on an electronic weighing scale (770 alpha; SECA, Hamburg, Germany). A correction of 0.5 kg was made for clothing. Body height was measured to the nearest 0.1 cm using a Microtoise (CMS Weighing Equipment, Ltd, London). When the subjects returned to the health center after 1 mo to receive new iron tablets they were asked to bring a stool sample. The subjects were asked to bring a second stool sample after 2 mo. These stool samples were checked for elemental iron to determine whether the women took their iron tablets. Presence of elemental iron in stool was tested by using the coloring reaction described by Afifi et al (9). Stool samples were also checked for the presence of hookworm parasites by microscopic examination. None of the subjects had hookworm. No explanation was given as to why they had to bring stool samples.

After 2 mo the women were interviewed about their compliance with the supplementation program and about factors influencing compliance. This interview at the end of the study took place in subject's homes without the presence of health center staff. Women were asked how many tablets they had received from health center staff; whether they had taken all their tablets; about possible side effects they experienced like nausea, vomiting, constipation; and whether they knew the purpose of taking the tablets.

Changes in blood values within subjects between the start and the end of the study were tested with paired *t* tests. Differences between subgroups of subjects were tested with unpaired *t* tests. Where values were not normally distributed, as with serum ferritin, differences were tested by using Wilcoxon's matched-pairs signed-ranks test (11). The study protocol was approved by the ethical review committee of the SEAMEO-TROPED Center at the University of Indonesia, Jakarta.

Of the initial group of 45 women, a blood sample was obtained from 33 women after 2 mo. Twelve women could not be surveyed at the end of the study for reasons such as moving, premature delivery, and illness. Data will be presented for the 33 women from whom blood samples were obtained at the start and at the end of the study. Average income of the women's households was ≈\$80/mo (US). Two women of 33 were illiterate; all women were Muslim. Selected characteristics of the 33 women are presented in Table 1.

Results

Prevalence of anemia, defined as hemoglobin concentration < 110 g/L, was 42% ($n = 14$) at the start of the study. At the end of the study, after 2-mo supplementation program, the prevalence of anemia was also 42%. Of the 14 women who were anemic at the start of the study, 11 still had low hemoglobin concentrations after 2 mo. Among the initial group of 45 women 41% of the women were anemic. Hemoglobin concentration, PCV, serum ferritin, and weight of the subjects at the start and at the end of the study are presented in Table 2. There was no significant change in hemoglobin value. PCV at the end of the study was 1.8 ± 3.1 L/L higher ($P < 0.05$) than at the start of the study. Serum ferritin increased by 11.8 ± 28.2 μg/L ($P = 0.05$).

When asked during the interview at the end of the study if they had taken the iron tablets given to them by health center staff, 21 women responded positively; 16 of them claimed to have taken 30 tablets per month, 4 claimed to have taken 20 tablets per month, and 1 woman said that she took 10 tablets per month. The five women who took ≤ 20 tablets stated that they had not received more tablets at the health center. Fifteen of the 21 women who claimed to have taken the tablets stated that they knew the purpose of taking the tablets: 13 said that it served to increase the amount of blood, one woman said that it would improve the condition of the fetus, one thought the tablets contained vitamins. Six women who said that they had taken the tablets did not know the purpose. Of the 12 women who said that they had not taken the iron tablets only two complained about side effects like nausea and vomiting. The most important reason for not taking the tablets was that they just forgot, without further explanation. Four of these 12 women knew the purpose of taking iron tablets.

The women were asked to bring stool samples after 1 and 2 mo. One-month samples were obtained from 23 women. Five of these samples contained iron, indicating recent intake of iron tablets. After 2 mo samples were obtained from 33 women and eight of these samples contained iron. A total of 13 positive samples came from 12 different women, hence the stool of only one woman contained iron at both times of stool collection. The two illiterate women had negative stool tests. The relationship between iron-tablet intake as claimed during the interview and positive stool samples in the second month is shown in Table 3. Sensitivity and specificity of the interview method compared

TABLE 2
Hemoglobin concentration, packed cell volume (PCV), serum ferritin, and body weight at the start of the study and after 2-mo supplementation*

	Start of study	After 2 mo
Hemoglobin (g/L)	111 ± 10	112 ± 11
PCV (L/L)	31.2 ± 2.9	33.0 ± 3.1†
Serum ferritin (μg/L)	15.4 ± 12.7	27.3 ± 26.1‡
Weight (kg)	51.4 ± 7.1	55.4 ± 7.4†

* $\bar{x} \pm SD$; $n = 33$ unless otherwise noted.

† Significantly greater than value at the start of the study, $P < 0.01$.

‡ Significantly greater than value at the start of the study, $P = 0.05$; $n = 26$.

TABLE 3
Relationship between positive stool test and woman's claim to have taken all tablets

	Iron in stool sample		
	Yes	No	Total
Woman's claim			
Yes	7	14	21
No	1	11	12
Total	8	25	33

with the check of stool samples is 0.88 (7/8) and 0.44 (11/25), respectively.

Changes in blood measurements and body weight for women with at least one positive stool test compared with women with a negative stool test are given in Table 4. Hemoglobin concentration and serum ferritin of women with a positive stool test increased by 4 ± 9 g/L ($P = 0.16$) and 17.0 ± 23.5 μ g/L ($P = 0.05$), respectively, between the start and the end of the study. Serum ferritin of the women with a negative stool test increased by 8.6 ± 31.1 μ g/L ($P = 0.43$), whereas hemoglobin stayed at the same concentration. In Figure 1 the relationship between the initial hemoglobin concentration and the change in hemoglobin concentration is depicted. A significant correlation existed ($r = 0.81$; $P < 0.01$) between initial hemoglobin concentration and the change in hemoglobin between start and end of the study for women with at least one positive stool test ($n = 12$). For the whole group of women no significant correlation existed between initial hemoglobin concentration and the change in hemoglobin concentration.

Discussion

The present study took place in a health center situated in a lower-socioeconomic-class area of Jakarta. Prevalence of anemia (hemoglobin concentration < 110 g/L) among the pregnant women was 42%, which is slightly lower than the reported 49% prevalence among pregnant Javanese women in Bogor District (3). Anemia prevalence among poor rural nonpregnant women in East Java was 25% (12). Reported prevalence rates among pregnant women in other parts of the Southeast Asian region such as northeastern Thailand and Burma are even higher, at 70% and 58–80%, respectively (7). Prevalence of anemia among the Jakarta women after joining the established supplementation program for 2 mo was at the same level as at the start of the study. The results of the present study differ from a similar study among pregnant women from Thailand (7). The Thai women participated in a 10-wk iron-supplementation program at 18–22 wk gestation and prevalence of anemia decreased markedly.

Three factors may explain why prevalence of anemia did not decline. The first is that the pregnant women did not take their tablets. It can be concluded that compliance rate was low because about one-third of the women admitted that they had not taken all the tablets given to them. In addition, although 64% of the women claimed to have taken all iron tablets, this could only be confirmed in 36% of the group with at least one positive stool test. The stool test has proven to be fairly reliable in detecting

recent intake of iron supplements in several other studies. Under controlled conditions the test gave positive results in 98% (9), 92% (13), and 77% (14) of subjects who had taken iron supplements. The reliability of the stool tests is also suggested by the fact that hemoglobin concentration showed a positive trend and serum ferritin concentration increased significantly in women with a positive stool test whereas no similar increases occurred in women with negative stool tests. Hemoglobin concentration of 7 of 21 women who had negative stool tests did increase (Fig 1). These seven women may have taken at least some of the tablets (but not on the days before stool sampling) or they may have increased intake of iron-rich foodstuffs. Although 64% of the women claimed to have taken all iron tablets, the actual percentage of women who took all tablets is most probably much lower. Studies among pregnant English women whose iron-tablet intake was checked with stool samples reported that $\approx 70\%$ of the women were taking the tablets after 2 mo (8, 9). Noncompliance rate among these pregnant women of Jakarta was almost twice as high.

The second factor that may have reduced improvements in the iron status of the pregnant women is that the daily amount of iron provided by the supplements is not enough. The World Health Organization (WHO) (4) recommends a daily iron intake of 120 mg for pregnant women, which is twice as high as the dose provided by the health centers in Jakarta. Efficiency of iron absorption increases if hemoglobin concentration is low. Of the women with a positive stool test only women who were anemic (hemoglobin concentration < 110 g/L) at the start of the study showed a marked increase in hemoglobin concentration. This may indicate that the dose that the women received was not high enough to increase hemoglobin if the initial hemoglobin concentration was > 110 g/L. The dose was, however, high enough to increase serum ferritin concentration. Additionally, inhibitors of iron absorption in food may have played a role. Efficiency of iron absorption decreases when tablets are taken

TABLE 4
Hemoglobin concentration, packed cell volume (PCV), serum ferritin, and body weight of women according to stool test at the start and at the end of the study (2 mo)*

	Start of study	After 2 mo
At least one positive stool test ($n = 12$)		
Hemoglobin (g/L)	110 ± 12	114 ± 7
PCV (L/L)	31.0 ± 3.5	$33.7 \pm 2.2^\dagger$
Serum ferritin (μ g/L)	11.3 ± 7.6	$28.3 \pm 21.5^\ddagger$
Weight (kg)	52.1 ± 4.4	$56.3 \pm 5.4^\ddagger$
No positive stool test ($n = 21$)		
Hemoglobin (g/L)	111 ± 8	111 ± 13
PCV (L/L)	31.2 ± 2.6	32.6 ± 3.5
Serum ferritin (μ g/L) \S	18.0 ± 15.1	26.6 ± 29.2
Weight (kg)	51.0 ± 8.3	$54.9 \pm 8.4^\ddagger$

* $\bar{x} \pm$ SD; $n = 33$.

† Significantly greater than value at the start of the study, $P < 0.01$.

‡ Significantly greater than value at the start of the study, $P < 0.05$; $n = 10$.

\S $n = 16$.

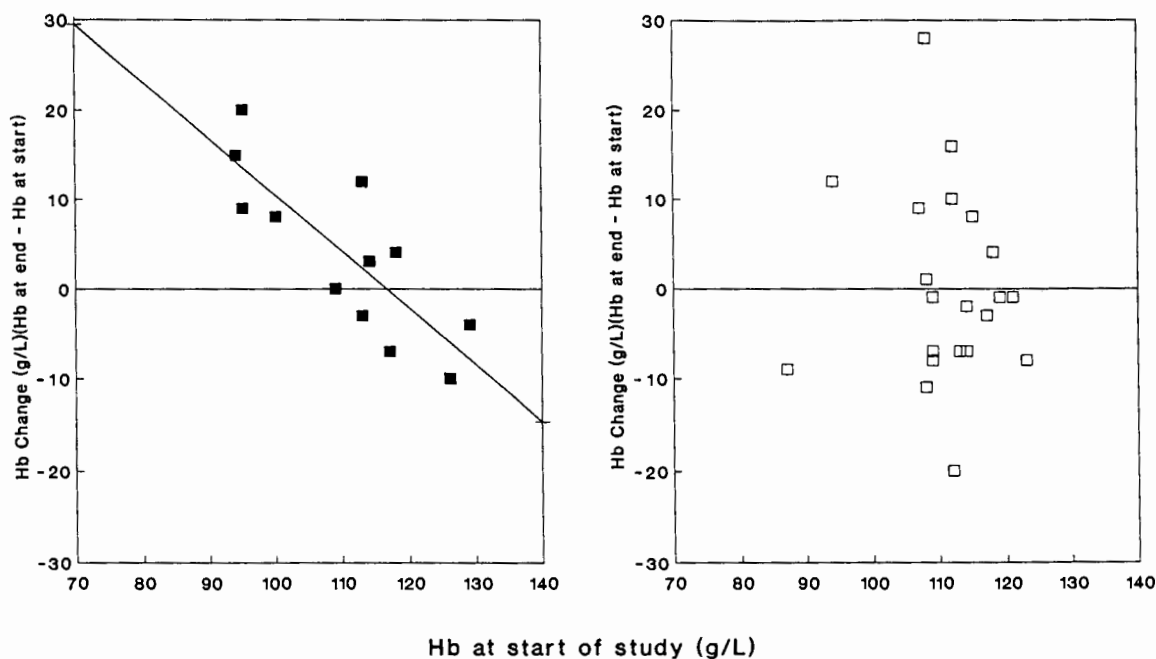


FIG 1. Relationship between hemoglobin concentration (Hb) at start of study and the change in Hb after 2-mo supplementation. □, no iron in stool, $n = 21$, $r = 0.09$; ■, iron in stool, $n = 12$, $r = 0.81$ ($P < 0.001$), $y = 72.8 - 0.63x$.

with foods that contain inhibitors of iron absorption. The influence of these inhibitors would be relatively larger when the daily supplement dose is low.

The third possible factor hindering improvement of iron status among the women may be low serum retinol concentrations in some of the women. In pregnant women a positive association has been found between hemoglobin and serum retinol concentrations (3). Similar results are reported for anemic children whose hemoglobin concentration increased after vitamin A supplementation (15). In the present study, however, no information is available on this possible interaction.

It is concluded on the basis of these findings that an important factor causing a failure to decrease anemia prevalence among pregnant women in Jakarta was the lack of compliance. Important factors influencing iron-tablet intake reported by others are negative side effects, either from the iron tablet directly or from the effects of the pregnancy itself (7, 16). In addition a lack of understanding about anemia and the need to take iron tablets may have influenced compliance (17). In the present study only two women complained about nausea and vomiting. This may have been caused by the relatively low dose of 60 mg elemental iron. Most women stated that they often just forgot to take their daily tablet, which may indicate a lack of motivation and understanding. However, even women ($n = 4$) who knew the purpose of taking iron tablets (to increase the amount of blood) did not take them.


Field trials in Thailand, Burma, and India (6, 7) demonstrated that iron-supplementation programs integrated into primary health care systems may be able to decrease the prevalence of anemia among pregnant women quite effectively. However, the efficiency of ongoing established supplementation programs may not be that high as is demonstrated by the present study. To

increase the effectiveness of the supplementation program in Jakarta the following three points may be considered.

First, increase the daily iron dose to 120 mg of elemental iron as recommended by WHO (4). The dose we used does not seem to be sufficient to increase average hemoglobin concentration and because there were almost no complaints about side effects it seems worthwhile to increase the iron dose. As an alternative to conventional tablets a gastric delivery system (GDS) for iron could be used. It is reported that absorption from GDS iron compared with ferrous sulphate is three to four times higher and is without side effects (18).

Second, the motivation and awareness level of the pregnant women and of the health center staff has to be improved through nutrition education, for example. The importance of this fact has already been stressed by other authors (7, 17). Effective nutrition education becomes even more important when the daily iron dose is increased because of the elevated costs of this higher dose, even though in general the costs for iron treatment are relatively low. Improving the motivation and awareness level of health center staff may prevent situations in which women do not receive sufficient iron tablets, as apparently occurred in the present study.

Third, the results of this study demonstrate the importance of a reliable monitoring and evaluation system. It is clearly not enough to register the number of distributed iron tablets or the number of health centers involved in the program in order to record performance. It is also not enough to just ask women whether they take their iron tablets regularly, as was shown by the present study. Most suitable seems to be a combination of randomized measurements of hemoglobin concentration and determination of iron in stool. Hemoglobin measurement to detect iron-deficiency anemia is suitable in field circumstances

where other additional methods are less suitable and make analysis complex. Furthermore, hemoglobin measurements give a satisfactory estimate of the prevalence of iron deficiency when prevalence is high (19). Considering that the impact of experimental studies may not be the same as the impact of established intervention programs, more operational research is necessary. 

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