

Daily Versus Weekly: How Many Iron Pills Do Pregnant Women Need?

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Introduction

Recent studies with rats show that their absorptive capacity for iron decreases when iron is given daily rather than intermittently.^{1,2} These studies have thrown into question the need for a daily dose of iron during pregnancy, and at least one group of researchers postulates that iron may be more efficiently absorbed in humans when mucosal cells in the intestine are renewed, which occurs every 3 days.² This theory is contradictory to previous findings that show no mucosal blockage when iron is given once versus continuously.³ However, because antenatal iron supplementation programs have been unsuccessful in most developing countries due to lack of supplies and compliance problems,⁴ a weekly or intermittent (two or three times a week) dose regimen is attractive because it would decrease the cost of buying large numbers of pills and the inconvenience of taking supplements daily. Advocates of a weekly or intermittent dose postulate that the absolute iron absorption per week would be the same as with a daily dose and that compliance would improve because taking a weekly or intermittent iron pill would reduce side effects that they infer is a major reason for nonadherence to iron supplementation.²

Because of its interest in decreasing unacceptably high rates of anemia in the world (more than 2 billion people), the World Health Organization (WHO) is funding studies to test the efficacy of a weekly or intermittent iron dose in humans.⁵ Other research groups interested in this topic but not funded by WHO have also conducted trials. Some findings have been published; however, iron experts around the world anxiously await the results of *all* the trials before changing long-standing policies. However, several developing countries have, or

very soon will, change their policies of giving pregnant women daily iron supplements to a policy of weekly or intermittent doses *before* the WHO-funded studies have been published in peer-reviewed journals, discussed internationally, and shown to have adequate efficacy.

The purpose of this article is to review the existing evidence for the efficacy of a weekly or intermittent dose compared to a daily dose and to discuss why it is premature to change any existing policy to one that would provide pregnant women with a weekly or intermittent dose of iron.

The Studies

To date, there have been 10 published studies on the efficacy of the weekly or intermittent iron dose. Most of the studies give groups of subjects either a daily or an intermittent dose of iron (weekly, semi-weekly, etc.) and compare changes in hemoglobin and/or another measure of iron status. Three studies come from Indonesia and are not part of the WHO-funded series of studies. Two of the three Indonesian articles are in peer-reviewed journals^{6,7} and one is a "Letter to the Editor."⁸ One article from the United States, also not part of the WHO-funded studies, is published in a peer-reviewed journal.⁹ This study compares the difference in iron absorption (rather than changes in hemoglobin or other measures of iron status) from ferrous sulfate tablets taken daily or weekly. Four studies are from the WHO-funded group of researchers or researchers associated with this group. These studies are from China^{10,11} and Guatemala.^{12,13} The study by Liu et al.¹⁰ has been published in a peer-reviewed journal and the others as abstracts in the proceedings from scientific meetings. There are also studies from the United States, not reviewed here, presented at the 7th Asian Congress of Nutrition,¹⁴ as well as from Malaysia.¹⁵ The latter looks at the change in hemoglobin when a weekly dose is given to adolescent girls but does not compare the weekly dose with a daily dose. There is also one editorial and several "Letters to the Editor" either supporting, not supporting, or questioning the actual efficacy

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and effectiveness of the weekly dose or offering alternatives to iron supplementation.¹⁶⁻¹⁹

Review of the Findings

In the eight studies that reviewed hemoglobin and/or serum ferritin, all^{6,8,10-13} but one⁷ showed increases that were larger for the daily dose than the weekly or intermittent dose. In the other studies, the daily dose increase was between 1.2 and 2.0 times larger than the weekly and intermittent doses. Viteri et al.¹² reported only serum ferritin values. In this study, serum ferritin increases were larger (+14.8 $\mu\text{g/L}$) for the daily dose, which provided a total of 420 mg of iron per week, than for the weekly dose (+0.3 $\mu\text{g/L}$), which provided 60 mg of iron per week. The study by Liu et al.¹⁰ also examined serum ferritin. They found that the increase in serum ferritin was larger (+42.0 $\mu\text{g/L}$) in subjects receiving the daily dose (36 mg/kg per week) than either the semiweekly (+35.0 $\mu\text{g/L}$) or the weekly (+15.0 $\mu\text{g/L}$) dose, which provided 12 mg/kg and 6 mg/kg per week, respectively. Three sets of authors^{6,8,10} state that while the changes were higher for the daily dose, they were not significantly different from the weekly or intermittent dose when either was regressed against initial values or by themselves. These authors conclude that the weekly or intermittent dose is just as efficacious as the daily dose.

The study by Ridwan et al.⁷ provided women with either weekly (120 mg of iron per week) or daily (420 mg of iron per week) doses according to which health center the women attended. This study showed no difference in the change in hemoglobin between the anemic women receiving the two different doses (both increased by 8 g/dL) and the slightly larger increase in hemoglobin for nonanemic women taking the weekly dose. Serum ferritin values decreased in all women taking both the daily and the weekly regimens, but the decrease was not as large for women taking the daily dose. There was an increase in serum ferritin for anemic women taking the daily dose (+2.5 $\mu\text{g/L}$) but a decrease in serum ferritin values in anemic women taking the weekly dose (-1.6 $\mu\text{g/L}$). Comparing between group differences shows that the daily dose was significantly better (although the difference was small) at improving serum ferritin than the weekly dose. The authors conclude that the weekly dose is just as effective as the daily dose.

Cook and Reddy⁹ noted that absorption of iron was larger for the weekly dose (50 mg of iron per week [9.8% without food]) than the daily dose (350 mg of iron per week [8.5% without food]), but the authors state that there was no significant difference in absorption between the two regimens. The authors conclude that because absorption of the week-

ly dose is not significantly different than the daily dose, it could never provide the amount of iron needed in most situations where iron supplementation is used, such as pregnancy.

Review of Methodologies

In a 1996 editorial on the effectiveness of iron supplementation, Yip¹⁶ refers to "efficacy" as "the effect (of the therapeutic regimen) initially observed during vigorous clinical trials." A review of the methodology of these studies suggests that they may have been less than "vigorous."

Supervision

All the daily versus intermittent trials have given similar groups of subjects either a daily or an intermittent dose of iron for the same period of time and compared changes in hemoglobin and iron status (usually serum ferritin) or the absorption of iron. Of the current studies, only one study¹⁰ uses the words "under direct supervision." Liu et al.¹¹ state that treatment was given "under supervision"; however, the extremely small increase in hemoglobin (<10 g/L for any group) raises doubts as to how much iron any of these subjects took. In the study by Schultink et al.,⁶ parents administered iron. Although there was some involvement of "supervising health staff," it is unclear how much of the iron intake was supervised by health professionals. One-quarter of the children dropped out of the study because they refused to take the iron drops, although comparisons were made only with children completing the study.

In the study by Cook and Reddy,⁹ which measured the absorption of iron from daily and weekly doses of iron, initial doses of either the daily or the weekly doses appeared to be supervised. However, women taking the daily dose of iron took the pills at home without supervision, although the authors state that the women taking the daily dose were "highly motivated." Supervision is considered essential when comparing the efficacy of two treatments. Because most of these studies did not report that pill taking was rigorously supervised, it is unclear what these studies are comparing. It may be that, in most cases, little difference in the daily and weekly or intermittent doses was found because, without the proper motivation, noncompliance with a daily dose of iron is significant. From the limited information available on this subject, compliance with iron supplementation ranges from 65% to 90% in developing countries.⁴ Could it be that researchers in these studies were actually comparing intermittent and intermittent doses?

Sample Size and Controls

All these studies use small sample sizes (most involved fewer than 100 subjects for both or all groups). The larger increase in hemoglobin or serum ferritin levels for the daily dose might become significant if larger sample sizes were used. Only one study¹¹ appears to have used controls even though previous recommendations say that this is essential.²⁰ Using matched controls should be a priority during pregnancy when hemodilution causes hemoglobin values to change dramatically by trimester.

Comparisons with Previous Findings: Dose Size, Iron Status, and Duration of the Dose

Based on a review by Sloan et al.²¹ of 24 supervised iron trials over the period 1966–1989 (including a WHO-funded study in Burma and Thailand), albeit also with small sample sizes, improvements in hemoglobin were larger when the dose was higher, the subject was more anemic, and the duration of supplementation was longer. In the present studies, hemoglobin levels increased more when the daily dose was taken. Liu et al.¹⁰ looked at the difference between daily, twice-weekly, and weekly doses of iron and their impact on hemoglobin and serum ferritin. Anemic subjects showed better improvement in both hemoglobin and serum ferritin values when they took the daily dose; the twice-weekly dose gave a better response than the weekly dose. This relationship did not hold for nonanemic subjects.

Cook and Reddy⁹ found that absorption was no different for a weekly versus a daily dose but was “almost significantly better” in women with low iron stores taking the daily dose than those taking the weekly dose. This suggests that absorption efficiency of the daily dose becomes better than the weekly dose as iron status declines.

Short durations for supplementation also are a potential problem in the studies measuring change in hemoglobin or serum ferritin (supplementation in all these trials was from a minimum of 8 weeks to a maximum of 16 weeks). If the supplementation periods were longer, would the differential be even larger for the daily than the weekly dose?

How Much Iron Do Pregnant Women Need?

Viteri¹⁷ points out that the study by Cook and Reddy⁹ shows that the iron provided by a weekly dose would be adequate to improve the iron status of nonpregnant women with adequate iron stores by replacing the 0.5 mg lost per day because of menstruation. It would also increase iron stores in women with inadequate stores before they become pregnant. This would require lifetime supplementation

of nonpregnant women outside of pregnancy, which Viteri has advocated in other papers.^{2,5} Distributing iron weekly to a quarter of the population in most developing countries throughout their lives would require a well-developed and well-financed logistics and supply system. Women would have to take a weekly dose of iron over the course of their reproductive lives, which defies all the findings of the drug compliance literature and is far more costly than the alternative (i.e., food fortification plus iron supplementation during pregnancy). Food fortification as suggested by Dutra-de-Oliveira et al.¹⁹ is a more cost-effective way of decreasing iron deficiency in reproductive-age women and would address iron deficiency in other vulnerable groups (i.e., small children), but it requires identifying food sources that are easily fortified and commonly consumed by the target population.

The current push in several countries to change their policies from a daily dose to a weekly or intermittent dose regimen relates to the care of pregnant women. Only three of the eight studies on this subject tested efficacy in pregnant women. Most countries do not have policies that give women iron pills outside of pregnancy unless it is for a short period of time after delivery (e.g., lactation). There are exceptions to this. The ministries of Labor and Health in Indonesia, for example, are collaborating to provide a weekly dose of iron to nonpregnant women at the workplace (Achadi E. personal communication). Because most existing iron supplementation programs are for pregnant women, the most pressing question faced by ministries of Health in developing countries is whether the current efficacy trials on the daily versus the weekly or intermittent dose of iron provide convincing evidence that pregnant women who take a weekly dose of iron will be meeting their iron requirements.

Iron needs during a normal pregnancy are between 800 mg and 1000 mg.^{23,24} Based on previous studies, it has been well accepted that iron absorption does increase in pregnancy. Svanberg et al.²⁴ found that iron absorption from a 30-mg dose of iron taken with a meal was 1.8%, 2.7%, and 6.48%, respectively in the first, second, and third trimesters of pregnancy. Iron absorption during the first and second trimesters looks similar to that in nonpregnant women, where it was found that absorption was 2.3% and 2.6% for a daily and weekly dose, respectively, when taken with a meal.⁹ Svanberg et al.²⁴ found that absorption nearly doubled when pills were taken without food, while Cook and Reddy⁹ noted that there was almost a fourfold increase. Based on this information and the observation of Cook and Reddy⁹ that absorption is not significantly different between the daily and weekly dose, the latter (60 mg) taken over the course of pregnancy

would provide only 86 mg with food and 172 mg without food. A daily dose, taken with food, would provide nearly 600 mg of iron. Cook and Reddy⁹ found that in women with low iron stores, absorption increased for both the daily (28.18%) and weekly (21.60%) doses when taken without food. Absorption was almost significantly better for the daily dose in women with low iron stores. In the best case scenario, where iron stores remain low, the amount of iron provided by a weekly dose would be 518 mg over the course of pregnancy and 4734 mg for the daily dose. In reality, absorption would not remain constant because as iron status improves, absorption will decrease, so women will never obtain the amount of iron shown here for either dose. For the weekly dose to provide 1000 mg during pregnancy, the average absorption for a 60-mg dose would have to be 42% (1000 mg/40 weeks of pregnancy/60 mg/week \times 100%). This correlates with information on absorption from small amounts (<1 mg) of iron,²⁵ but it has not yet been shown that larger doses of iron can provide this efficiency.

It's Not the Dose Alone That Matters

Much attention has been focused on the iron dose required by women, even though past studies have shown that the daily dose of iron is efficacious. If the weekly or intermittent dose is also shown to be efficacious, the dose alone will not improve the delivery and compliance problems with current iron supplementation programs.

Access and Supplies

Yip¹⁶ suggests that there are no guarantees that a weekly dose would enhance current iron supplementation programs. As evidence for this, he points to a review of national iron supplementation programs in five countries (Burma, the Caribbean, India, Indonesia, and Thailand) that found the greatest barriers to program success were lack of access to antenatal care and poor supplies of iron pills.²⁶ The majority of women have limited or no contact with the health system and iron pills; these barriers would exist with any dose. Furthermore, there is no reason to believe that countries not committed to providing enough daily iron pills for all pregnant women would be willing to purchase and deliver a weekly supplement.

Compliance

The claims about the benefits of a weekly or intermittent dose of iron also extend to compliance. Both Cook¹⁸ and Viteri¹⁷ suggest that failure of most supplementation programs is due to noncompliance.

Gastrointestinal side effects are often touted as a reason that women stop taking iron supplements.²⁷ To address this, a great deal of effort has been made to develop and test iron preparations that are absorbed more slowly. A study with one such preparation, the gastric delivery system (GDS), showed that GDS causes fewer side effects and is absorbed more slowly and efficiently.²⁸ However, another study comparing GDS and conventional ferrous sulfate shows that hemoglobin values were similar when compliance in the conventional ferrous sulfate group improved to 50%.²⁹ This study compared one GDS dose with two ferrous sulfate doses per day so the comparisons about compliance might not be totally appropriate.

As stated earlier, promoters of the weekly or intermittent theory claim that women would experience fewer side effects with these regimens, and compliance would improve. From the studies reviewed here, there are mixed results about compliance from the studies that measured side effects. The study by Ridwan et al.⁷ found no significant difference in compliance between the daily and weekly doses, although compliance decreased in both groups with the duration of the supplementation period and when women reported side effects. On the other hand, Liu et al.¹⁰ found that children taking a weekly or semiweekly dose of iron had fewer side effects than those taking the daily dose. Viteri et al.¹² found that the rate of attrition from their study was twice as high for the daily than the weekly dose, mainly due to side effects. Chew et al.¹³ found that side effects were six times more frequent with the daily than the weekly dose, even though the weekly dose was three times larger in 1 day (180 mg) than the daily dose (60 mg). Liu et al.¹¹ found that the proportion of pregnant women reporting side effects was higher with both daily doses (60 mg and 120 mg) than the weekly dose (120 mg). To make the case that compliance will not improve much with a weekly dose, Yip¹⁶ points out that experience with compliance for malaria medication, which also is taken weekly and can cause gastrointestinal side effects, is poor—only 36% in one study.

A review of available literature on iron supplementation programs shows that side effects may be a less important reason for noncompliance than lack of supplies.⁴ Results from qualitative research in West Java, Indonesia,³⁰ and preliminary results from qualitative research in Malawi,³¹ Bolivia,³² and South Kalimantan, Indonesia,³³ all show that approximately one-third to one-half of women experience side effects initially. However, few women stop taking iron pills if they are properly counseled that side effects may occur, and that they are not serious, and are told how to manage them. In ad-

dition, there may be other motivational messages that are needed to encourage women to take pills over the entire course of pregnancy. Most women recognize anemia or the symptoms of it and like taking iron pills because they make them feel better; however, they often discontinue taking pills because they think they are "cured." Introducing the concept of "preventing" anemia is needed in most countries. Qualitative research also shows that some women are afraid to take any medication for long periods during pregnancy. One concern for women is that medication, including iron pills, might harm their baby in some way. Another problem is that health workers have tried to motivate women to take iron pills by telling them that iron will make their babies bigger. Unfortunately, women generally do not see this as a positive thing because they think that a bigger baby means a more difficult delivery. In some cultures, women believe they need a balance of blood in their bodies. They see "too little" blood as a problem that can be cured by taking iron pills, but they also think that taking too many iron pills might cause "too much" blood, which might make them bleed more during delivery. These are but a few examples of the important behavioral barriers that need to be addressed if improved compliance with iron supplementation is to be accomplished.

Conclusion

There are no easy answers to improving iron supplementation programs around the world. The weekly trials are an honest attempt to improve existing programs. These trials should be taken seriously, but changes in national policies to a weekly or intermittent dose for pregnant women should be deferred until all the results from pending studies are published and scrutinized by the international community and found to be efficacious, with substantial improvement over current practices. In addition, if the current studies are shown to be efficacious, a sufficient number of studies need to be undertaken on pregnant women to show that the weekly dose is efficacious for pregnant women.

The total iron needs of pregnant women need to be considered during these discussions. If recommendations to change the daily dose to a weekly or intermittent dose are made for pregnant women, they also should be accompanied by recommendations to improve supplies of pills and logistics to deliver them; develop motivational messages and materials; train health workers in the proper use of these messages and materials and in interpersonal communication and counseling; and sensitize and educate policy makers so that proper budgetary allowances are made to provide iron pills through the

public health sector. Private sector supplies of iron pills should be developed so that once demand is created, women will not have to rely only on supplies available through the public health system. Private sector supplies of iron also may prove to be more sustainable than those financed through the government.

In addition, where anemia prevalence is high, countries need to identify ways to improve the iron status of the entire population. If possible, iron fortification of foods that are commonly consumed by vulnerable groups should be investigated and institutionalized in the private sector but regulated by the public sector. Improving the iron status of nonpregnant women may also be a possibility in countries where some infrastructure exists (e.g., factories, plantations, schools). However, recommendations to give iron to nonpregnant women should be made only if it does not compromise iron supplies for pregnant women.

This paper has focused exclusively on pregnant women because they stand to lose the most if national policies are changed to provide them with only a weekly or intermittent dose of iron. However, other vulnerable groups also are at risk for anemia. A similar exercise of scrutinizing the weekly and intermittent iron dose studies should be conducted for small children and other vulnerable groups to ascertain if this regimen would supply them with optimal amounts of iron.

1. Wright AJA, Southon S. The effectiveness of various iron-supplementation regimens in improving the iron status in anaemic rats. *Br J Nutr* 1990;63:579-85
2. Viteri F. Iron deficiency in children: new possibilities for its control. *International Child Health: A Digest of Current Information* 1995;VI(1):49-61
3. DeLeeuw N, Lowenstein L, Hsieh Y-S. Iron deficiency and hydremia in normal pregnancy. *Medicine* 1966;45:291-315
4. Galloway R, McGuire J. Determinants of compliance with iron supplementation: supplies, side effects, and psychology? *Soc Sci Med* 1994;39(3):381-90
5. Viteri F. The consequences of iron deficiency and anaemia in pregnancy on maternal health, the foetus, and the infant. *SCN News* 1994;11:14-8
6. Schultink W, Gross R, Gliwitzki M, Karyadi D, Matullessi P. Effect of daily vs twice weekly iron supplements in Indonesian preschool children with low iron status. *Am J Clin Nutr* 1995;61:111-5
7. Ridwan E, Schultink W, Dillon D, Gross R. Effects of weekly iron supplementation on pregnant Indonesian women are similar to those of daily supplementation. *Am J Clin Nutr* 1996;63:884-90
8. Gross R, Schultink W, Juliawati. Treatment of anaemia with weekly iron supplementation. *Lancet* 1944;344:821
9. Cook J, Reddy M. Efficacy of weekly compared with

- daily iron supplementation. *Am J Clin Nutr* 1995;62:117-20
10. Liu XN, Kang J, Zhao L, Viteri F. Intermittent iron supplementation in Chinese preschool children is efficient and safe. *Food Nutr Bull* 1995;16:139-46
 11. Liu XN, Yang W, Zhang J, et al. Weekly iron supplementation is effective and safe in pregnant women. *FASEB J* 1995;9:A5658
 12. Viteri F, Ali F, Tujague J. Weekly iron supplementation of fertile-age women achieves a progressive increment in serum ferritin. *FASEB J* 1996;10:1680
 13. Chew F, Torun B, Viteri F. Comparison of weekly and daily iron supplementation to pregnant women in Guatemala (supervised and unsupervised). *FASEB J* 1996;10:4221
 14. Viteri F. A new concept in the control of iron deficiency (ID): community-based preventive supplementation (PS) of at-risk groups by weekly intake of iron supplements. Beijing: 7th Asian Congress of Nutrition. [Abstract] 1995
 15. Tee E, Cavalli-Sforza L, Kandiah M, et al. A study of the effectiveness of weekly iron supplementation in adolescent secondary school girls in Malaysia: preliminary findings. Beijing: 7th Asian Congress of Nutrition. [Abstract] 1995
 16. Yip R. Iron supplementation during pregnancy: is it effective? *Am J Clin Nutr* [Editorial] 1996;63:853-5
 17. Viteri F. Weekly compared with daily iron supplementation. Letters to the Editor. *Am J Clin Nutr* 1996;63:610-4
 18. Cook J. Reply to FE Viteri. Letters to the Editor. *Am J Clin Nutr* 1996;63:610-4
 19. Dutra-de-Oliveira JE, Marchini JS, Desai I. Fortification of drinking water with iron: a new strategy for combating iron deficiency in Brazil. *Am J Clin Nutr* [Letter to the Editor] 1996;63:610-4
 20. Baker S, Ramachandran K. *The design and analysis of iron supplementation trials*. A Report of The International Nutritional Anemia Consultative Group (INACG). Nutrition Foundation, 1984
 21. Sloan N, Jordan E, Winikoff B. *Does iron supplementation make a difference?* Working Paper 15. The John Snow, Inc./MotherCare Project, funded by the United States Agency for International Development, 1992
 22. Hallberg L. Iron balance in pregnancy. In: Berger H, ed. *Vitamins and Minerals in Pregnancy and Lactation*. Nestle Nutrition Workshop Series, Vol 16. New York, NY: Raven Press; 1988
 23. WHO/FAO. Requirements of vitamin A, iron, folate and B₁₂. Report of a Joint Food and Agriculture/World Health Organization Expert Group, 1988
 24. Svanberg B, Arvidsson B, Norrby A, Rybo G, Solvell L. Absorption of supplemental iron during pregnancy—a longitudinal study with repeated bone-marrow studies and absorption measurements. In: Absorption of iron in pregnancy. *Acta Obstet Gynaecol Scand* 1975;(Suppl 48):87
 25. Bothwell T, Charlton R. Iron deficiency in women. Prepared as a report for The International Nutritional Anemia Consultative Group (INACG). Nutrition Foundation, 1984
 26. Gillespie S, Kevany J, Mason J. *Controlling iron deficiency*. A report based on an ACC/SCN workshop. ACC/SCN State-of-the-Art Series. Nutrition Policy Discussion Paper No. 9, 1991
 27. DeMaeyer EM. *Preventing and Controlling Iron Deficiency Anaemia Through Primary Health Care. A Guide for Health Administrators and Programme Managers*. World Health Organization, 1989
 28. Cook J, Carriaga M, Kahn A, Schalch W, Skikne B. Gastric delivery systems for iron supplementation. *Lancet* 1990;335:1136-9
 29. Ekstrom EC, Kavishe F, Habicht JP, Frongillo E, Rasmussen K, Hemed L. Adherence to iron supplementation during pregnancy in Tanzania: determinants and hematologic consequences. *Am J Clin Nutr* 1996;64:368-74
 30. Moore M, Riono P, Pariani S. *A qualitative investigation of factors influencing use of iron folate tablets by pregnant women in West Java: a summary of findings*. A report to the John Snow, Inc./MotherCare Project, funded by the United States Agency for International Development. The Manoff Group and Centre for Child Survival, University of Indonesia, 1991
 31. Williams L, Semo L, Behague D, Sibale C, Franco C. *A qualitative study of constraints to reducing iron deficiency and anaemia in women of reproductive age in Thyolo District, Malawi*. Draft report to the John Snow, Inc./MotherCare Project, funded by the United States Agency for International Development. Maternal and Child Epidemiology Unit, London School of Hygiene and Tropical Medicine; Department of Sociology, Chancellor College, University of Malawi; and Project HOPE, 1996
 32. Johnson B. *Control program of anemia in pregnant women: the results of the qualitative investigation*. Draft report to the John Snow, Inc./Opportunities for Micronutrient Interventions (OMNI) and MotherCare Projects, funded by the United States Agency for International Development, 1996
 33. Marsaban J. *Qualitative research on anemia in South Kalimantan, Indonesia*. Draft report to MotherCare. Program for Appropriate Technology in Health, 1996