Maternal iron–folic acid supplementation programs: Evidence of impact and implementation

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Abstract

Background. According to a World Health Organization (WHO) review of nationally representative surveys from 1993 to 2005, 42% of pregnant women have anemia worldwide. Almost 90% of anemic women reside in Africa or Asia. Most countries have policies and programs for prenatal iron–folic acid supplementation, but coverage remains low and little emphasis is placed on this intervention within efforts to strengthen antenatal care services. The evidence of the public health impact of iron–folic acid supplementation and documentation of the potential for scaling up have not been reviewed recently.

Objective. The purpose of this review is to examine the evidence regarding the impact on maternal mortality of iron–folic acid supplementation and the evidence for the effectiveness of this intervention in supplementation trials and large-scale programs.

Methods. The impact on mortality is reviewed from observational studies that were analyzed for the Global Burden of Disease Analysis in 2004. Reviews of iron–folic acid supplementation trials were analyzed by other researchers and are summarized. Data on anemia reduction from two large-scale national programs are presented, and factors responsible for high coverage with iron–folic acid supplementation are discussed.

Results. Iron-deficiency anemia underlies 115,000 maternal deaths per year. In Asia, anemia is the second highest cause of maternal mortality. Even mild and moderate anemia increase the risk of death in pregnant women. Iron–folic acid supplementation of pregnant women increases hemoglobin by 1.17 g/dL in developed countries and 1.13 g/dL in developing countries. The prevalence of maternal anemia can be reduced by one-third to one-half over a decade if action is taken to launch focused, large-scale programs that are based on lessons learned from countries with successful programs, such as Thailand and Nicaragua.

Conclusions. Iron–folic acid supplementation is an under-resourced, affordable intervention with substantial potential for contributing to Millennium Development Goal 5 (maternal mortality reduction) in countries where iron intakes among pregnant women are low and anemia prevalence is high. This can be achieved in the near term, as policies are already in place in most countries and iron–folic acid supplements are already in lists of essential drugs. What is needed is to systematically adopt lessons about how to strengthen demand and supply systems from successful programs.

Key words: Anemia, hemoglobin, iron deficiency, maternal health programs, maternal mortality, neonatal health programs, perinatal mortality, pregnancy

Background

Iron deficiency is a highly prevalent form of under-nutrition and is one of the most common causes of anemia [1]. Anemia is a widespread condition of pregnancy in many countries across all regions of the world [2]. The main risk factors for iron-deficiency anemia during pregnancy include a low intake of iron, poor absorption of iron from diets high in phytate or phenolic compounds, and enhanced iron requirements for the growing fetus [1]. Some women enter pregnancy with low iron stores caused by other factors, such as heavy blood loss during menstruation. Parasitic infections such as hookworms, ascaris, and schistosomiasis can lower blood hemoglobin concentrations. Acute and chronic infections, including malaria, also contribute to anemia. Other micronutrient deficiencies, including
those of vitamins A and B₁₂, folate, riboflavin, and copper, and the presence of hemoglobinopathies may raise anemia levels within some populations. There is global agreement that iron deficiency accounts for by far the largest burden of all grades of anemia in pregnancy worldwide [1].

Current World Health Organization (WHO) guidelines for nutrition and antenatal care recommend universal iron and folic acid supplementation for pregnant women where anemia is widespread [3]. However, many countries are not giving priority to implementing this recommendation, and anemia remains the most common health condition of pregnancy. According to a WHO review of nationally representative surveys from 1993 to 2005, 42% of pregnant women worldwide have anemia [2].

National health authorities have paid insufficient attention to iron–folic acid supplementation, in part because of the lack of easily accessible information regarding the importance of anemia in pregnancy, evidence that intervention programs can be successful in addressing the problem, and how large-scale programs have achieved results. This review summarizes current studies on the risk of maternal and perinatal mortality associated with iron-deficiency anemia, evidence of the impact of iron and folic acid supplementation on anemia from supplementation trials, and key factors for success in well-documented national programs.

Methods

Evidence of anemia–mortality relationships

The analysis showing the association of maternal mortality with anemia is described by Stoltzfus et al in detail [4]. The authors reviewed prospective observational studies of pregnant women in which hemoglobin concentration was the risk factor for mortality. The relative risks for perinatal mortality (10 studies) and maternal mortality (6 studies) were estimated using random-effects models. Global anemia prevalence data were taken from the WHO database [5]. Anemia prevalence was converted to mean hemoglobin concentrations assuming normal distribution and observed standard deviations from a large number of studies. To estimate the effects of reduction of iron deficiency on hemoglobin levels, the authors assumed that the prevalence of anemia in women would be reduced by 51% based on evidence from supplementation trials. The authors explored the possibility of an impact on maternal mortality at hemoglobin levels between 5 and 12 g/dL, the range that includes the vast majority of pregnant women. Six studies provided information on the relationship between the risk of death and maternal anemia in this range. These studies were selected from the systematic review by Brabin et al. [6]. All six studies were observational. There were no intervention trials with maternal mortality as outcome. Odds ratios were calculated for maternal mortality associated with a 1 g/dL increase in hemoglobin during pregnancy for high malaria-prone areas and nonmalaria areas. Ezzati et al. [7] then converted lives saved due to direct and indirect effects on mortality to disability-adjusted life years (DALYs) using standard procedures for risk factors that were applied for all interventions in the Global Burden of Disease project.

Evidence of impact from iron supplementation trials on anemia outcomes

Kulier et al. [8] provided a synthesis of systematic reviews and individual randomized, controlled trials of nutritional interventions during pregnancy. In all, 25 randomized or quasirandomized trials were included. The authors systematically extracted data on pretrial hemoglobin levels, the trial settings, the number of trials, and participants’ characteristics. The same paper examined other nutrient interventions and selected maternal outcomes.

The analysis of Stoltzfus et al. (2004) [4] also reviewed meta-analyses of iron supplementation studies, including one by Sloan et al. [9]. Data from randomized, controlled trials published between 1966 and 1998 were pooled in the Sloan paper. Meta-analyses of the relative change in maternal hemoglobin that was associated with iron supplementation were stratified by initial hemoglobin levels, duration of supplementation, daily gestational supplement dose, and supplementation with other nutrients.

Evidence on the impact of scaled-up iron supplementation programs on anemia

Two national programs that are well documented include the Integrated Anemia Control Strategy (IACS) in Nicaragua and Thailand’s National Anemia Reduction Program [10]. In order to establish whether the observed trends in anemia rates in these countries may plausibly be attributed to iron–folic acid supplementation, the available data on program performance indicators (provision, utilization, coverage) were examined vis-à-vis the observed effects on the prevalence of anemia. Other possible contributing factors and potential confounding variables were taken into account.

Results

Evidence of anemia–mortality relationships

The study for the Global Burden of Disease (GBD II) project in 2004 showed the well-known relationship between hemoglobin levels and maternal deaths [4].
As hemoglobin increased, maternal deaths declined. The first set of analyses indicated a threshold effect at about 5 g/dL, below which maternal mortality increased rapidly. The authors went a step further to look more closely at possible impacts of mild, moderate, and severe ranges of anemia from 5 to 12 g/dL. This analysis showed an increased risk of death from even mild and moderate forms of anemia. The results showed that the risk relationship was continuous. When the risks of all forms of anemia were summed up, this represented a large number of attributable maternal deaths. Similar analyses of perinatal mortality by the same authors also showed even greater reductions in risk of death. The relationship held in areas with high malaria prevalence and in other settings.

This Stoltzfus analysis [4] concluded that the relative risks associated with a 1 g/dL increase in population mean hemoglobin were 0.75 (95% CI, 0.62 to 0.89) for maternal mortality and 0.72 (95% CI, 0.65 to 0.81) for perinatal mortality. Subgroup analyses suggested that the relative risk for perinatal mortality in malaria-endemic regions (0.65; 95% CI, 0.56 to 0.75), was lower than in regions without endemic Plasmodium falciparum malaria (0.80; 95% CI, 0.73 to 0.87).

The authors then applied the relative risks to current prevalence levels of anemia in pregnancy and estimated the potential impact of reduction in iron deficiency. Based on these estimates of iron-deficiency anemia as a risk factor for mortality, iron deficiency was found to result in 591,000 perinatal deaths and 115,000 maternal deaths globally [11]. The associated loss of healthy life-years amounts to more than 19 million DALYs from perinatal causes and more than 3 million DALYs from maternal causes.

A recent WHO survey of the causes of maternal mortality found that in Asia, anemia is the second highest cause of maternal deaths [12]. Anemia, independently of deaths from postpartum hemorrhage, accounted for 12.8% of all maternal deaths. This is also the region with the largest numbers of anemic pregnant women.

**Evidence of the impact of iron supplementation on anemia outcomes**

The review of iron supplementation trials by Kulier et al [8] showed consistent positive effects of iron–folic acid supplementation across different settings, although the impact was not large. Routine iron supplementation resulted in a substantial reduction in women with hemoglobin levels below 10 g/dL in late pregnancy. One trial compared selective supplementation based on the presence of anemia with routine or universal supplementation and found a reduction in need for blood transfusion in the routine-supplementation group as compared with the group that was supplemented only after screening for the presence of anemia [13]. The Kulier review concluded that increasing iron and folic acid intake through supplements will reduce the number of women with low predelivery hemoglobin. Researchers in Asia have provided further evidence that weekly supplementation of adolescent girls and women of reproductive age also improves iron status and reduces anemia [14].

Sloan et al. [9] conducted a meta-analysis of hemoglobin response to iron supplementation in pregnant women in randomized, controlled trials. Of 70 trials in the literature, 23 met their inclusion criteria, and 15 of those were from developing countries. The response to iron supplementation was strongly related to iron dose, and the hemoglobin response was smaller in study samples with higher initial hemoglobin.

The GBD analysis concluded that 1.17 g/dL is the best estimate of the size of the predicted effect of iron supplementation on hemoglobin, as this was the average effect seen in women from developed countries and was very similar to that seen in women from developing countries with initially low hemoglobin (1.10 to 1.13 g/dL).

**Evidence on the impact of scaled-up iron supplementation on anemia prevalence**

Several countries, including Indonesia, Nepal, Thailand, Nicaragua, Honduras, Uganda, and India, attempted to strengthen their anemia control programs through prenatal iron–folic acid supplementation [15]. However, only two national programs for prenatal anemia reduction have been well documented, those in Nicaragua and Thailand.

**Nicaragua**

Nicaragua had experienced high levels of anemia in the 1990s, with a prevalence of 28.5% among children 1 to 4 years of age and 33.6% among nonpregnant women 15 to 45 years of age.* The Ministry of Health subsequently developed and implemented an Integrated Anemia Control Strategy (IACS). Anemia levels in women declined to 23.7% in 2000. Under the IACS, Nicaragua developed and distributed anemia control policies and updated technical guidelines that, among other principles, listed iron and iron–folic acid supplements as essential medicines. They established efficient supply systems to procure and manage iron supplement stocks and processes to monitor adherence to protocols. Operational research was conducted to address implementation constraints. Community health volunteers (brigadistas) were expected to deliver supplements and provide clients with follow-up counseling. Eventually the program reached high coverage with iron and iron–folic acid supplements for pregnant women and iron

fortification of wheat flour. These activities are likely to have combined to result in a reduction of anemia in the population.

The causal link between iron supplementation and anemia reduction is strengthened by data showing that 87% of women recalled taking iron–folic acid supplements during the last pregnancy, and of these, 53% took the supplements for more than 6 months. The supplements were distributed and promoted for daily intake. Weekly supplementation was introduced as a policy in 1997, but it was not widely adopted, as by then government health services were decentralized, leaving decisions regarding these alternatives up to district health managers.

Behavior change communication activities in Nicaragua were monitored in 2001 after 1 year of implementation. Women knew about the importance, causes, and consequences of anemia and the need for taking iron supplements with enhancers of iron absorption and avoiding inhibitors. Women recognized adverse effects but also significant beneficial effects, and they did not perceive difficulties in accessing iron supplements either at health posts or at local pharmacies. About 77% reported having been taught by healthcare personnel about the importance of iron during pregnancy and childhood; 96% got clear instructions on how to take iron–folic acid tablets; 52% were advised to take the tablets with orange juice or lemonade, and 27% were advised not to take them with coffee; and 96% reported no significant side effects for themselves or their children. The behavior change communication strategy also aimed at increasing iron intake from natural sources and fortified foods by promoting changes in feeding practices resulting in dietary diversification.

There is good agreement about what key elements explain Nicaragua’s success:

- The supplements were distributed universally (no screening) and routinely through several channels, such as antenatal care clinics and community-based workers;
- Community-based workers provided follow-up and counseling;
- The supply was acceptable, although improvements were still needed;
- There was a good behavior change program, and extensive training was undertaken;
- Side effects were not reported as a major issue, possibly due to good community-based follow-up and counseling.

In considering alternative explanations for Nicaragua’s drop in anemia, improvement in socioeconomic conditions has been noted. But only moderate changes in poverty levels took place during this period. Improvement in health status due to greater access to safe water, declining fertility rates, and better availability of education has also been identified. Although expenditure on health increased from 11% to 13% and expenditure on education increased from 9% to 15% of the national budget, it is unlikely that the impact on anemia would have occurred at the observed rate and on this scale without direct interventions.

**Thailand**

Thailand successfully reduced the prevalence of anemia among pregnant women over a 10-year period from more than 25% in 1988 to below 15% in 1997, according to data from the national anemia surveillance system, by integrating iron supplementation, deworming, community-based follow-up, and other related programs into primary health care and community development programs [10].

Since the mid-1970s, Thailand has addressed nutrition in national development policy, including efforts to reduce iron-deficiency anemia. Nutritional improvement has been implemented as an integral part of primary health care and community development extending beyond government services to include community participation. Village health volunteers have been a crucial feature of the program.

Thai policy recommended giving iron supplements to all pregnant women during antenatal care visits. Village health volunteers oversaw compliance and encouraged pregnant women to complete the antenatal care schedule. Health service providers shifted their focus to preventing anemia rather than treating anemia in pregnant women (i.e., screening before supplementation). The Thai government also supported other anemia prevention strategies, such as food fortification, promoting improved diets, and complementary public health measures to reduce infections.

Survey and surveillance data indicate that anemia rates declined among pregnant women and preschool children, although there has been no formal evaluation of the program effect. Universal iron supplementation has been the major strategy for pregnant women, using village health volunteers to encourage continuation of the antenatal care schedule and encouraging a preventive approach by health service providers. Program obstacles have included a lack of access to iron tablets by some populations and lack of understanding of the importance of anemia. Women’s compliance was a constraint due to the fear of having a large fetus, forgetting to take pills daily, and some side effects.

Other strategies that contributed to reducing iron deficiency included food fortification, dietary improvement, and complementary public health measures. The results are not definitive, as program monitoring and evaluation required strengthening to attribute the results to intervention strategies. The possibility that the decline in anemia was partly due to socioeconomic conditions is strengthened by reports that in the midst of steadily declining trends, a small increase was observed in anemia prevalence among pregnant
women around 1998, which coincided with Thailand's economic crisis.

**Discussion**

Nutrient requirements increase during pregnancy to support fetal growth and maternal health. The iron requirements of pregnant women are approximately 50% of those of nonpregnant women because of increased blood volume during pregnancy, increased needs of the fetus, and blood losses that occur during delivery [16]. If iron intake does not meet increased requirements, iron-deficiency anemia is likely, particularly when iron status before pregnancy is poor [17]. Iron-deficiency anemia of pregnancy is responsible for significant morbidity, such as premature delivery and low birthweight [18–23]. Now the evidence for the impact of any level of anemia on maternal mortality has also been identified.

Iron deficiency is by far the primary cause of anemia of any severity. In some areas, malaria, worm infections, other micronutrient deficiencies, and genetic disorders can play a part. The extent to which iron deficiency is the main factor can be determined through dietary surveys or hematologic studies. The Maternal Survival Lancet series recently summarized global evidence on maternal survival interventions and placed universal iron–folic acid supplementation for anemia prevention at the top of the list for all pregnant women [19].

Several major health organizations recommend universal prenatal iron supplementation to help women meet their heightened iron needs in pregnancy. According to WHO, each pregnant woman should follow a 6-month regimen of a daily supplement (for a total of 180 supplements) containing 60 mg of elemental iron along with 400 µg of folic acid [3]. In settings where anemia prevalence is high (> 40%), WHO recommends postpartum doses for 3 additional months. The US Centers for Disease Control and Prevention and the Institute of Medicine of the National Academy of Sciences also support iron supplementation during pregnancy [19, 20].

**Iron–folic acid supplementation and maternal mortality**

The current evidence suggests that severe anemia directly causes maternal death from heart failure and that moderate anemia causes maternal death from other causes, such as hemorrhage, infection, obstructed labor, and others due to poor ability to withstand the adverse effects of excessive blood loss, an increased risk of infection, or maternal fatigue. These potential contributions of low hemoglobin to various causes of maternal mortality have not been quantified systematically. Some argue that women with a massive postpartum hemorrhage would die without treatment, irrespective of their hemoglobin levels. Some argue that anemia may be over-reported as a cause of death, as it provides an alternative explanation to poor quality of obstetric care. Another issue is that the low hemoglobin seen in women who went on to die shortly afterwards may be a marker for another event precipitating admission. Some studies may not have fully adjusted for other confounders. It is possible that severe anemia is caused primarily by malaria, hemoglobinopathies, and hookworm, and not dietary iron deficiency. However, recent evidence points to all grades of anemia increasing the risk of death.

Arguments that stepped action is needed to reduce anemia in pregnancy are based on proven high levels of anemia, affecting 42% of the world's pregnant women [2] Mortality assessments have shown that anemia is a nontrivial cause of maternal death [13]. It is a significant risk factor that increases pregnant women's chances of dying of other causes and often goes unreported. Clinicians often fail to record the contribution of anemia as an underlying cause of death, and WHO only recently moved ahead with a revised classification scheme to record underlying risk factors.

About half of anemia cases (51%) are iron-deficiency anemia resulting from low intakes of absorbable iron, as found in dietary surveys in Asia and Africa in particular. Supplementation of pregnant women increases hemoglobin levels by 1.17 g/dL in developed countries and 1.13 g/dL in developing countries. According to the Global Burden of Disease analysis [20] iron-deficiency anemia is the ninth most important factor contributing to the global burden of disease. Iron supplementation should have a considerable impact on maternal mortality.

Iron deficiency anemia can be considered a risk factor for maternal mortality due to its direct and indirect effects. It is recognized that the sum of the mortality attributable to a single risk factor separately is often more than the combined mortality attributable to a groups of risk factors [21]. Only 46% of child mortality can be attributed to the joint effects of three leading risk factors of child underweight; unsafe water, sanitation and hygiene, and indoor smoke. But individually they add up to 75%. Similarly when joint effects are taken into account the additional contribution of iron deficiency alone may not be as high as we have reported in this paper.

**Evidence of program effectiveness**

The national programs of Thailand and Nicaragua were implemented effectively, and anemia prevalence decreased in pregnant women and women of reproductive age. The Innocenti review [11] concluded that the iron supplementation program components probably contributed to the decrease in anemia prevalence, but
the evidence available was not sufficient to quantify those contributions. Applying a rigorous evaluation framework to program implementation is challenging, given the multiple etiologies of anemia and ethical considerations that rule out randomization with and without supplementation. It is questionable whether the evidence for program effectiveness is likely to improve significantly in the near future.

The plausibility that the observed changes in anemia are most likely related to the national programs in Thailand and Nicaragua derives from the temporal relationship between program implementation and the rapid declines in anemia prevalence when coverage of iron–folic acid supplementation increased and the absence of documented changes in other known determinants of anemia. This relationship would have been even stronger if data on iron status indicators were also available. In Nicaragua, as the breadth and intensity of the iron interventions increased at two distinct stages, anemia levels were found to decline in parallel. Other public health programs that may have contributed to anemia reduction were also reviewed, but coverage of these programs, e.g., improving women’s reproductive health and survival during pregnancy, was not found to improve in the same time frame as the reduction in anemia.

Monitoring and evaluation of the supplementation programs has proved to be challenging, even in the well-documented programs. Several programs have had to rely on maternal recall of the last pregnancy (e.g., Demographic and Health Survey questions). Routine health information systems rarely include data from the distribution points of supplements. Coverage rates at the national, district, and even local level are rarely available, unlike the case for vitamin A supplementation. Establishing an effective monitoring system for supplies, distribution, and inventories of supplements at key administrative levels has been a difficult task, but when addressed systematically it has proved feasible.

**Lessons learned**

It was documented some time ago that assured supplies at distribution points were the main challenge in achieving success in programs. Supply systems for iron–folic acid supplements (and for malaria and deworming drugs) have been given more attention recently. This resulted from assessments by the US Agency for International Development A2Z Project and the Micronutrient Initiative, which found supply constraints at distribution points to be the main challenge. This resulted from assessments by the US Agency for International Development A2Z Project and the Micronutrient Initiative, which found supply constraints at distribution points to be the main challenge. It was documented some time ago that assured supplies at distribution points were the main challenge in achieving success in programs. Supply systems for iron–folic acid supplements (and for malaria and deworming drugs) have been given more attention recently. This resulted from assessments by the US Agency for International Development A2Z Project and the Micronutrient Initiative, which found supply constraints at distribution points were the main challenge.

Behavior change communication has been an important component of effective programs when it is designed to create awareness, provide relevant information (e.g., preventing side effects), and motivate changes in behavior (e.g., importance for fetal brain development, maternal mortality risks). Systematic use of procedures to assure quality and impact is key and is often missed in behavior change communication programs with poor results.

Wasantwisut and Winichagoon* recently summarized the lessons learned from Indonesia as well. They found that commitment from the government was a major factor, in addition to raising awareness and program promotion through community and religious leaders. Operational elements of the program that led to successful scaling up included availability of clear program guidelines and protocols, increased availability of supplements, use of health facilities and community health workers to distribute the supplements, and also private sales. On the demand factors, clear messages were provided to mitigate side effects, and efforts were made to improve the packaging and taste of the commodities. In India, USAID supported the states of Jharkhand and Uttar Pradesh (UP) to successfully strengthen supplies and expanded the direct promotion of iron–folic acid supplements through auxiliary nurse midwives (ANMs) and community-based Integrated Child Development Services (ICDS) workers with an emphasis on interpersonal communication.

In summary, the main lessons are the following:

- Effective country programs used multiple-intervention, comprehensive approaches for addressing major preventable causes of anemia. The key program interventions included iron and iron–folic acid supplementation for pregnant women, mandatory universal fortification, behavior change communication, intensive training of health services delivery staff, and person-to-person education and counseling targeted to mothers through local health services and community-based volunteers.

- Increasing the scale of the program was a goal of effective programs from the start, and the program expanded coverage and quality of iron supplementation through antenatal services with the active participation of community health workers. Strengthening of health systems was accompanied by community-based promotion and support. In both Thailand and Nicaragua, program interventions have been implemented countrywide with increasing coverage and quality over at least a decade.

- Successful programs systematically identified barriers and addressed them in a focused way. A key component has been comprehensive training of both health service personnel and community health workers, and use of multiple communications and supplement distribution channels focused on reaching the target groups.

- Special attention to removing supply constraints

included effective logistics management systems to secure a continuous supply of supplements and establishing effective delivery systems to local levels and frontline providers, eventually utilizing nonconventional distribution networks (e.g., nongovernmental organizations, community health workers).

A prerequisite for effective and sustained program performance is a functional health system that facilitates reaching and maintaining high enough coverage and quality of health care, particularly of antenatal services. Important program features are proper selection of target groups and interventions, updated protocols and guidelines for program implementation, intensive and motivating training of health-care personnel, a properly designed behavior change strategy, provisions to address supply, and a functional program monitoring and evaluation system. In some countries, pharmaceutical companies have successfully marketed a range of products for pregnant women that contain various levels of iron combined with one or more other nutrients. The public health impact of these activities has not been documented, but they provide an important adjunct strategy to support large-scale adoption of routine prenatal supplementation.

Conclusions

The available evidence suggests that iron-deficiency anemia contributes substantially to death and disability in women, in addition to impacts on neonatal mortality and morbidity. The great majority of this disease burden derives from anemia in pregnancy and is highest in Asia and Africa, where almost 90% of anemic women reside. The prevalence of maternal anemia can be reduced by one-third to one-half within a decade.

In areas where nutritional anemia is highly prevalent, as seen in dietary surveys showing low absorbable iron intakes and/or where hematologic anemia studies so indicate, routine iron and folic acid supplementation will reduce anemia and contribute to Millennium Development Goal 5 (lowering maternal mortality).

As summarized in this paper, program processes have been documented to improve supply systems and to improve adherence to protocols through behavior change strategies. Two countries where documentation resources were available have shown how large-scale national programs can achieve success.

A combination of adequacy and plausibility assessments supports the contention that the remarkable declines in anemia rates in Thai and Nicaraguan women are plausibly the results of the implementation of focused nationwide programs.

Meanwhile, the evidence base for improving the effectiveness of iron–folic acid supplementation programs can be further strengthened with additional country experiences and evidence of anemia reduction with improvement in iron status. Because the estimates in this paper are uncertain in some respects, countries should motivate their public health scientists to provide more definitive evidence through improved monitoring and evaluation of such programs.

References


