

# Scaling up maternal nutrition programs to improve birth outcomes: A review of implementation issues

Cesar G. Victora, Fernando C. Barros, Maria Cecilia Assunção, Maria Clara Restrepo-Méndez, Alicia Matijasevich, and Reynaldo Martorell

## Abstract

**Background.** Maternal nutrition interventions are efficacious in improving birth outcomes. It is important to demonstrate that if delivered in field conditions they produce improvements in health and nutrition.

**Objective.** Analyses of scaling-up of five program implemented in several countries. These include micronutrient supplementation, food fortification, food supplements, nutrition education and counseling, and conditional cash transfers (as a platform for delivering interventions). Evidence on impact and cost-effectiveness is assessed, especially on achieving high, equitable, and sustained coverage, and reasons for success or failure

**Methods.** Systematic review of articles on large-scale programs in several databases. Two separate reviewers carried out independent searches. A separate review of the gray literature was carried out including websites of the most important organizations leading with these programs. With Google Scholar a detailed review of the 100 most frequently cited references on each of the five above topics was conducted.

**Results.** Food fortification programs: iron and folic acid fortification were less successful than salt iodization initiatives, as the latter attracted more advocacy. Micronutrient supplementation programs: Nicaragua

and Nepal achieved good coverage. Key elements of success are antenatal care coverage, ensuring availability of tablets, and improving compliance. Integrated nutrition programs in India, Bangladesh, and Madagascar with food supplementation and/or behavioral change interventions report improved coverage and behaviors, but achievements are below targets. The Mexican conditional cash transfer program provides a good example of use of this platform to deliver maternal nutritional interventions.

**Conclusions.** Programs differ in complexity, and key elements for success vary with the type of program and the context in which they operate. Special attention must be given to equity, as even with improved overall coverage and impact inequalities may even be increased. Finally, much greater investments are needed in independent monitoring and evaluation.

**Key words:** Food fortification, food supplementation, nutrition intervention, programs

## Introduction

Maternal nutritional interventions have been shown to be efficacious in improving birth outcomes in low- and middle-income populations. Most of the evidence on efficacy is derived from experimental studies in relatively small populations, in which interventions are delivered under optimal, or at least “best practice” conditions [1]. It is also important to demonstrate that interventions can be implemented successfully under routine conditions in large populations and thus achieve an impact on health and nutrition.

In this paper we build upon the findings on efficacy through a review of large-scale maternal nutrition programs that combine one or more interventions implemented at the national or at the very least at the provincial or state level. We review the main barriers and enabling factors affecting such programs, and pay

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particular attention to those with documented evidence of success or failure.

Because a broad review of all types of maternal nutritional programs would be prohibitive, we decided to focus on five main types of program that cover the scope of existing initiatives: food fortification—salt iodization; food fortification—flour fortification with iron and folate; micronutrient supplementation (iron, multiple micronutrients); integrated programs, including food supplementation and/or nutrition education and counseling; and conditional cash transfers (as a platform for delivering the above interventions).

This review is focused in experiences from sub-Saharan Africa and South Asia, with emphasis on three countries or regions—India, Northern Nigeria, and Ethiopia—that account for a large burden of maternal and child morbidity and mortality. Lessons learned from major programs in other low- and middle-income countries (e.g., Latin America, North Africa and the Middle East, and East Asia) are also reviewed when relevant.

One major element of this review is related to the typology of barriers and facilitating factors for scaling up health and nutritional interventions. This topic has received broad attention in recent years, either in general terms [2–4] or specifically for nutritional programs [5–13].

Two overarching dimensions of scaling up must be recognized. First, delivery of nutritional interventions and programs usually relies upon two platforms—health systems and food systems—either singly or in combination [11]. Health systems are often managed by the public sector, although in some regions of the world, such as South Asia, a thriving private sector is involved in delivering healthcare. Food systems include growing, harvesting, processing, packaging, transporting, marketing, consumption, and disposal of food and food-related items; these activities are primarily managed by the private sector, with a lesser role for the government in terms of legislation, regulation, and monitoring.

The second dimension refers to the need to consider both the supply and the demand sides; this applies to health-systems-based as well as to food-systems-based programs.

The review of the general literature on scaling up health and nutrition programs provides a detailed listing of the key elements required for success, as well as of constraints and enabling factors. **Table 1** summarizes our reading of this literature. In the next sections, the elements and enabling factors described in **table 1** will be used for benchmarking existing programs. The importance of each element will vary according to the program. For example, some of the key steps for food fortification will differ from those relevant for micronutrient supplementation programs.

## Methods

In addition to the review of the general literature on scaling up, summarized above, five separate searches were conducted on each type of program covered by this paper: food fortification—salt iodization; food fortification—flour fortification with iron and folate; micronutrient supplementation (iron, multiple micronutrients); integrated programs, including food supplementation and/or nutrition education and counseling; and conditional cash transfers (as a platform for delivering the above interventions).

We started with a systematic review of published articles on large-scale programs in PubMed, the Cochrane Library, the World Health Organization (WHO) Reproductive Health Library, and the Food and Nutrition Library. After agreement on the relevant search strategies, two separate reviewers (a PhD in nutrition and a doctoral student in epidemiology) carried out independent searches.

Because it was expected that many reports on large-scale programs would not be available in these databases, a separate review of the gray literature was carried out. This included the websites of the World Bank, UNICEF, the US Agency for International Development (USAID), the International Food Policy Research Institute (IFPRI), the Global Alliance for Improved Nutrition (GAIN), the Micronutrient Initiative, etc. The Google Scholar search engine was also used, but because thousands of references were produced from each search, we limited the detailed review to the 100 most frequently cited references on each of the five above topics.

The searches were focused on the identification of large-scale programs that were properly evaluated in terms of attained coverage and/or impact, with emphasis on those from sub-Saharan Africa and South Asia. For each type of program, we tried to identify examples of successes and failures. The criteria for identifying a program as successful were expanded from those proposed by Mason et al. [5]:

- » *Targeting*: program is adequately targeted at a sub-population that can benefit from it;
- » *Coverage*: a high proportion of the target population is reached;
- » *Equity*: coverage is equitable, that is, no subgroup of the target population is left behind;
- » *Resource intensity*: there is a sufficient amount of available resources per participant;
- » *Technology*: there is an appropriate and innovative (if applicable) use of technology;
- » *Sustainability*: program is sustained over a period of several years;
- » *Impact*: there is a measurable impact on health and/or nutrition (this is a desirable criterion, but it is recognized that few programs undergo rigorous impact

TABLE 1. Key elements of successful scaling up of maternal nutrition programs at the country level

Key elements	Enabling factors
Visibility of the nutritional problem	Nutritional problem perceived as important by government and civil society; reliable epidemiological information on burden available
Political will	Effective advocacy for key stakeholders and society as a whole; involvement of champions
Leadership and coordination	Strong government leadership with an effective national coordination structure in place; integration of program with the overall nutritional framework and agenda
Partnerships including public, private, and civic sectors	Full participation of multiple partners in technical assistance, funding, and implementing the program; clear division of responsibilities with adequate oversight; full involvement of the private sector (e.g., food fortification); engagement of civil society
Technical capacity for design and implementation	Strong technical capacity for policy making and program design; managerial capacity for implementation at national and local levels, monitoring and evaluation
Supporting policies	Clear and visible public policies and guidelines to enable program implementation, including incentives and penalties for all involved sectors and promotion of accountability mechanisms
Program design	Well-designed program in technical and managerial terms with appropriate targeting (if applicable); clear standards for fortification and use of appropriate food vehicles (in food fortification programs); appropriate delivery channels (e.g., facility, outreach, community, others)
Financing and costing	Stable, sufficient, coordinated, and sustainable funding for program start-up and implementation activities
Procurement of commodities	Guarantee of steady supply of commodities with avoidance of running out of stocks
Strength of implementation	Sufficient investment in training, deployment, and supervision of human resources; strong enforcement of legislation; community participation in implementation; promotion of adherence with intervention (e.g., outreach, counseling)
Consumer demand creation	Social mobilization and empowerment of communities; effective behavioral change and communication programs to ensure consumer awareness and adherence
Monitoring and evaluation	Strong documentation and monitoring system for outputs at producer and retail levels (e.g., quality assurance of fortified foods) and population coverage; regular and rapid feedback from monitoring to implementers; sufficient funding for operational and implementation research and for prospective, adequately designed impact evaluations; investment in obtaining evidence of positive impact with feedback to implementers and population
Sustainability	Political, financial, and managerial sustainability to ensure continuity of the program
Equity	Incorporation of equity dimension in policy-making, program design, implementation, monitoring, and evaluation to ensure that program reaches the neediest

evaluations).

The published literature search yielded very few relevant publications on properly evaluated large-scale maternal nutrition programs, typically fewer than 20 articles on each topic, often with more than one article referring to the same program. A greater amount of information resulted from the search of the gray literature, but most documents were internal, nonindependent evaluations and/or advocacy materials, whose objectivity was limited. These reports tended to emphasize the program achievements, often with limited data to back up their claims, whereas little or no attention was given to program shortcomings. Our review of the literature, therefore, may be overly positive, given the bias in the available documentation.

## Results

### Food fortification—salt iodization

The two most widespread experiences with fortification of foods consumed by women of reproductive age that can improve the health of their offspring are salt iodization and fortification of flour with iron and folic acid (IFA). Providing iodine to iodine-deficient women during pregnancy has been associated with improved outcomes among their offspring [14]. In 1990, at the World Summit for Children, more than 70 heads of state committed to the “virtual elimination of iodine deficiency by the year 2000” through universal salt iodization. Salt iodization programs are in place in over 120 countries (<http://www.iccidd.org/media/IodineNetworkScorecard2010.pdf>) [9]. Survey-based estimates show that 72% of households in low- and

TABLE 2. Percentage of households using iodized salt, according to national surveys carried out from 2003 to 2008

Region	% of households
Africa	60
Sub-Saharan Africa	60
Eastern and Southern Africa	48
West and Central Africa	73
Middle East and North Africa	60
Asia	73
South Asia	55
East Asia and Pacific	86
Latin America and Caribbean	89
CEE/CIS	51

Source: UNICEF [15]

middle-income countries consumed iodized salt in the period from 2003 to 2008 [15]. The lowest regional coverage levels are in Eastern and Southern Africa, South Asia, and the former Soviet republics (table 2) [15]. Average coverage levels, however, can hide important disparities. Figure 1 shows consumption of adequately iodized salt ( $\geq 15$  ppm) and any iodized salt by wealth quintile for Nigeria, India, and Ethiopia; coverage levels for the whole population are 48%, 52%, and 20%, respectively, for adequately iodized salt and 97%, 76%, and 54% for any iodized salt. Coverage is reasonably equitable in Nigeria and Ethiopia, but in India there are marked inequalities. India used to have a nationwide law for salt iodization, but this legislation was subsequently rescinded, and the adoption and enforcement of laws governing salt iodization is now decided at the state level [16].

Kits for testing iodine content in salt are accurate for showing the presence of any iodine and relatively inaccurate for measuring quantity [17]. Therefore, results on the coverage of adequately iodized salt ( $\geq 15$  ppm) should be interpreted with great caution, as is exemplified by the Nigeria case study below.

#### Examples of large-scale programs

In Africa, some 36 countries are routinely fortifying salt with iodine, and several of these, including Benin, Cameroon, Mali, Nigeria, and Zimbabwe, have achieved high rates of salt iodization. Over 70% of all newborn babies are now protected from brain damage due to iodine deficiency (<http://www.fortaf.org/introfort.htm>).

#### Nigeria

The Nigerian program was widely regarded as a success story. Iodine-deficiency disorders were common in this country, largely due to high consumption of cassava, which is a known goitrogen. The national program was launched in 1993, when only 40% of the salt consumed in the country was iodized. Almost all salt consumed in Nigeria is imported by a handful of processing

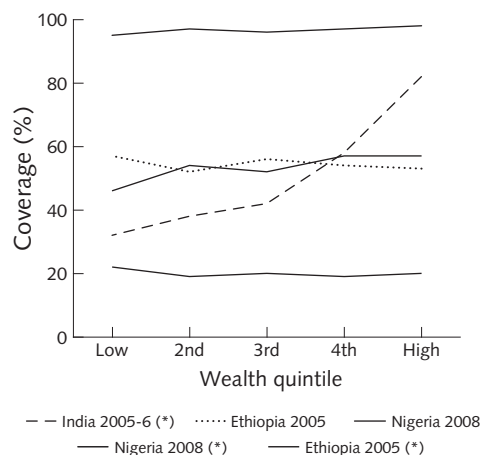


FIG. 1. Percentage of households using adequately iodized salt ( $\geq 15$  ppm; dashed lines, with labels marked with an asterisk) and any iodized salt (solid lines) according to Demographic and Health Surveys in Ethiopia, India, and Nigeria (<http://www.measuredhs.com/>). Information on use of any iodized salt in India by wealth quintiles was not available

industries through four ports. Fortification levels were set up and enforced by the Standards Organization of Nigeria at ports of entry and salt companies. Standards were revised upward in 1994 to compensate for losses of potassium iodide when salt was exposed in open-air markets, where salt is sold in bulk. Salt is expected to contain a minimum of 50 ppm iodine at the factory and port of entry levels and 30 ppm at the retail level. Factory surveys and wholesale assessments over time have revealed 100% adherence (iodine levels between 50 and 70 ppm), whereas retailer measurements revealed a 98% rate of adequate iodization ([www.iodinenetwork.net/documents/Nigeria\\_USI\\_review.pdf](http://www.iodinenetwork.net/documents/Nigeria_USI_review.pdf)).

Per capita consumption of salt varied by region, with averages ranging between 2.2 and 6.2 g per day. Nationwide surveys carried out in 1999, 2003, and 2008 employing salt testing kits showed that 98% of households were consuming iodized salt, with virtually no differences between socioeconomic groups (fig. 1).<sup>\*</sup> By 2005, Nigeria had been officially

<sup>\*</sup> There are some striking differences regarding the consumption of adequately iodized salt in the 2003 and 2008 in Nigeria. In 2003, 3.8% of households had no salt for testing; of the remainder, only 1.7% were using salt without iodine. In 2008, the corresponding figures were 5.8% and 3.4%. Therefore, in both surveys the vast majority of households were using iodized salt. The striking difference between the two surveys is that whereas in 2003 only 1% of salt samples were found to have inadequate levels of iodine, in 2008 the proportion increased to 45.1%. The reasons for this increase are unclear, because monitoring of salt samples at the retail level does not show a reduction in iodine levels. The most likely explanation is that kits for testing iodine in salt are inaccurate for the quantitative determination of iodine content; it is also possible that different test kits were used in the two surveys.

certified as the first African country to achieve universal salt iodization [18]. There was also evidence of impact on health. A survey of schoolchildren in areas with previous endemic goiter showed that by 2003 there was no further evidence of deficiency on the basis of urinary iodine levels [19]. Median urinary iodine excretion in Nigerian households has also been consistently above 100 µg/L (143 µg/L in 1998 and 185 µg/L in 2002). Goiter prevalence has also been on the decline (67% in 1988, 20% in 1993, 10.6% in 1998, and 7.7% in 2004) ([www.iodinenetwork.net/documents/Nigeria\\_USI\\_review.pdf](http://www.iodinenetwork.net/documents/Nigeria_USI_review.pdf)). A 2005 evaluation of the program supported by the implementers [18] listed the following enabling factors: conducive industrial and market environment; domestic financing; continuous improvement process; high-level commitment; private sector awareness, support, and collaboration; and establishment of a multisectoral iodine-deficiency disorders–universal salt iodization task force including government, UNICEF, salt producers, and bilateral agencies. The program was also regarded as being sustainable, because by 2005 it had been in place for over a decade.

Comprehensive reviews have summarized the main constraints and enabling factors for salt iodization programs [8, 9, 11, 20].

### Conclusions

The Nigeria experience fulfills all the criteria listed in **table 1**. In particular, the success of the program was related to the facts that industrialized salt was universally consumed and that there were few industries and ports of entry, which facilitates enforcement. Partnerships, coordination, and technical capacity were strong, and so was monitoring at all levels, from producers and importers to population surveys. This led to an equitable and sustainable impact.

### Food fortification: Iron and folic acid

Fortification of foods consumed by women of reproductive age with IFA is promoted for preventing neural

tube defects, low birthweight (LBW), anemia, and developmental delays in their children.

Wheat and less often maize flour have been the foods of choice for such fortification. Because virtually all flour fortification programs include both iron and folic acid, these will be reviewed together. However, the evidence for impact is stronger for folic acid than for iron supplementation.

Neural tube defects have long been associated with poor diets and with poverty in general [21, 22]. Poverty is also associated with iron-deficiency anemia: the prevalence of moderate or severe anemia in reproductive-age women, according to several Demographic and Health Surveys [23], tends to be 50% to 100% higher in the poorest quintile of the population than in the richest quintile. In India, the corresponding prevalence levels were 19.8% and 10.2%, respectively, in the 1998/99 Demographic and Health Survey [23]. In Ethiopia, the prevalence was 9.5%, 5.3%, and 3.1% in women with less than primary, full primary, and full secondary education, respectively, in the 2005 Demographic and Health Survey (<http://www.statcompiler.com/table-builderController.cfm?userid=315668&usertabid=340727>) Thus, strategies to reduce neural tube defects and anemia will only be successful if the poorest are reached.

According to a recent global implementation review [24] the worldwide coverage of wheat-flour fortification increased from 18% in 2004 to 27% in 2007. The coverage of fortification varies substantially by region of the world (**fig. 2**). It should be noted that these figures refer to any type of fortification with iron and folic acid, regardless of the amount and bioavailability of the compounds used.

**Figure 2** documents important disparities among countries in the coverage of flour fortification programs. Isolated studies suggest that within-country socioeconomic disparities may also be important due to inequalities in the consumption of fortified foods. For example, folic acid fortification in the United States had less impact among blacks than among whites [25]. In Australia, the impact was restricted to the white

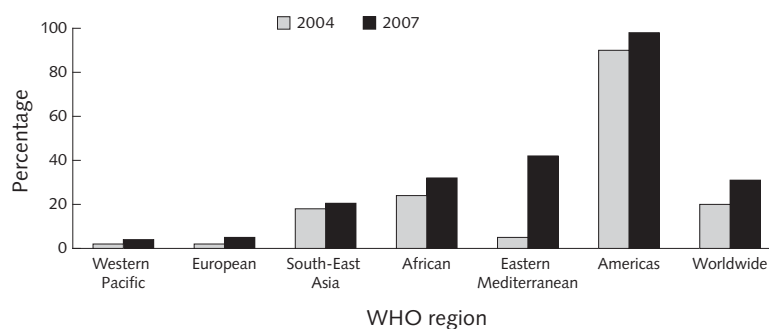


FIG. 2. Percentage of wheat flour processed in roller mills that was fortified, worldwide and by World Health Organization (WHO) region, 2004 and 2007

population, while the aboriginal population had no benefit [26]. An evaluation of the wheat flour fortification program in Guatemala concluded that it was unlikely to benefit the neediest: the consumption of IFA in fortified wheat flour was about 15 times higher among nonpoor than among extremely poor families [27]. This is related to the fact that rural indigenous populations in the Guatemalan highlands tend to consume corn rather than wheat. Because fortified foods are often more expensive than other dietary alternatives and therefore are less likely to be consumed by the poorest women—whose children are already more likely to suffer from the consequences of maternal micronutrient deficiencies—fortification programs may contribute to increasing inequalities.

Successful food fortification programs require that fortified products be consumed by the target population in sufficient amounts, and that high-bioavailability micronutrient compounds be used. This is particularly relevant for iron, because the low-cost compounds, including atomized or hydrogen-reduced iron powders, have low bioavailability. Hurrell et al. [28] recently reviewed 78 national programs, of which 47 did not stipulate a specific iron compound, and thus it was assumed that nonrecommended, low-cost, low-bioavailability products were being used. Even among countries where efficacious iron compounds (ferrous sulfate, ferrous fumarate, electrolytic iron, or sodium iron ethylenediaminetetraacetate [NaFeEDTA]) were being used, flour consumption was deemed too low for fortification alone to have an impact on iron deficiency. Only nine national programs (Argentina, Chile, Egypt, Iran, Jordan, Lebanon, Syria, Turkmenistan, and Uruguay) were judged likely to have a significant positive impact on iron status if coverage is optimized [28]. The authors conclude that legislation needs updating in many countries so that flour is fortified with adequate levels of the recommended iron compounds.

Of the three focus countries for this review, there is no fortification program in Ethiopia ([http://www.sph.emory.edu/wheatflour/africatable/Ethiopia\\_Sept09.pdf](http://www.sph.emory.edu/wheatflour/africatable/Ethiopia_Sept09.pdf)), there are pilot programs and three state-wide programs in India (<http://www.sph.emory.edu/wheatflour/India.php>), and there is a national program in Nigeria in which the type of iron compound is not defined (<http://www.sph.emory.edu/wheatflour/Nigeria.php>) [28]. This information is available on the Emory University website, but it does not specify the type of iron compounds allowed in each country.

#### **Examples of large-scale programs**

To be successful, a program must enforce the correct laws, setting and monitoring national standards, make sure that they are followed by both the public and the private sector, and guarantee access to and correct use of the product by the population, especially those most in need, who are poor women of reproductive age and

children [11]. A number of middle-income countries were able to implement successful programs of flour fortification with folic acid. This is the case with Chile and Costa Rica [29, 30]. Most evaluations and success stories report on folic acid, not iron. We now concentrate on two more recent programs that underwent evaluations, those in South Africa and Brazil.

#### **South Africa**

The South African program was launched in 2003 and included the fortification of wheat flour and maize meal with six vitamins and two minerals, including folic acid and iron [31]. Implementing agencies claim that their success can be attributed to seven critical factors: adherence to the legislation by all millers, large and small; presence of baseline survey data; government subsidies for the purchase of fortification equipment by small millers; monitoring of adherence by trained government staff; stability of the fortification mix; properly equipped and staffed laboratories for monitoring; and consumer awareness [31]. Time trend analyses in four provinces showed that implementation of the program was associated with declines of approximately one-third in the incidence of and mortality due to neural tube defects [32]. Nevertheless, critics note that assessments of the quality of and adherence to the program are yet to be done, and that only very limited data are available on additional intake of folic acid and on biochemical markers [30, 33]. Even though the program may well have had an impact on malformations due to increased folic acid intake, the impact of iron fortification is questioned by some authors, given that the program did not specify the types of iron compounds that are allowed [28]. Summing up, evidence supporting the seven critical factors claimed by the program implementers is still limited.

#### **Brazil**

Another example of a national program of iron fortification comes from Brazil. Fortification became mandatory in 2004, but there was no definition of the types of iron compound that should be used, nor was there regular monitoring of iron content in different brands of flour. An evaluation in the city of Pelotas showed that intakes of flour-based products by children were insufficient; that 5 of the 23 brands of flour tested were not fortified, and of the remainder most were fortified with low-bioavailability compounds; and that mean hemoglobin levels in children under 5 years of age 24 months after fortification was launched were exactly the same as in the prefortification phase. Although this study did not assess hemoglobin levels among women of reproductive age, it is unlikely that the results would have been different. The authors attribute the lack of impact to inadequate intake of flour, low bioavailability of iron added to food, and possibly to the regular consumption of food rich in iron-absorption inhibitors [34].

### Conclusions

Overall, flour fortification programs have not been as successful as salt iodization initiatives. **Table 3** shows some differences between these programs that became evident during our review. Salt iodization programs seem to attract more advocacy and champions; there is a clear message stating that iodine helps improve intelligence; salt is universally consumed, cheap, and produced by a handful of companies in most countries; iodine compounds are cheap and bioavailable; monitoring is therefore relatively easy at the producer level, and monitoring at the household level is simple and inexpensive with spot tests. In contrast, there seem to be fewer advocates for iron fortification; there are multiple producers in most countries and therefore monitoring is complex; production of flour at the community or household level competes with commercial products, and thus consumption of processed flours may be low among the poor; the bioavailability of iron varies markedly among different compounds, and testing for the presence of iron compounds in flour requires specialized laboratories. Taken together, these barriers account for the fact that most evaluations of flour fortification programs with iron fail to document an impact.

Within flour fortification programs, the achieved health impact of folic acid on neural tube defects seems to be stronger than that of iron on iron-deficiency anemia. This may be related to the higher bioavailability of folic acid compared with that of iron, to the fact that other components of the diet do not hamper absorption of folic acid, and possibly to the multifactorial and more complex etiology of anemia compared with that of neural tube defects.

### Micronutrient supplementation programs

Iron (with or without folate) and multiple micronutrients are the most frequent supplements given to pregnant women that also affect the health of their offspring. In this section we will refer to iron supplementation, even though in many countries iron-folic acid (IFA) tablets are provided to pregnant women. Prescription of iron tablets to pregnant women is a standard component of antenatal care in most if not all countries [6]. However, iron supplementation programs tend to be less well developed than programs aimed at other micronutrients, such as iodine or vitamin A. As a result, limited data are available on iron supplementation programs at the international level [16], and we were unable to find any recent global reviews on how many countries have such programs.

An analysis of 54 Demographic and Health Surveys showed a median prevalence of 53% of reported use of iron tablets in pregnancy among women with one or more births in the 5 years before the survey. The rate of use ranged from 16% in Turkmenistan to 89% in the Dominican Republic. Regional average coverage levels are shown in **table 4**. These data refer to any reported use of iron tablets, regardless of dose or duration. These results confirm an earlier analysis of Demographic and Health Survey data [35], suggesting that in most countries the coverage of iron supplementation through antenatal care is inadequate.

Because antenatal care is the most frequently used delivery channel for iron tablets, and since antenatal care attendance tends to vary strongly according to wealth [36], it is not surprising that coverage with supplementation is also quite inequitable. **Figure 3** shows

TABLE 3. Differences between salt iodization and flour fortification with iron programs that may explain their success or failure

Characteristic	Salt iodization	Flour fortification with iron
Champions, advocacy, visibility	Strong. Clear, simple key message: iodine increases IQ by > 10 points	Often weak. Several health messages, yet anemia not widely recognized as an important problem
Number of producers or importers in the country	Often very few	Often very many
Adherence at producer and retail level	Relatively easy due to existence of few producers and importers	Difficult due to existence of many producers and importers
Household-level monitoring	Easy due to the availability of spot tests	Difficult, requires testing in specialized laboratories
Bioavailability	High	Variable, depending on compound
Role of other dietary items	No important antinutrients	Antinutrients (e.g., phytates) may impede absorption
Source of food vehicle (or similar alternative foods)	Commercial	Commercial or community/domestic
Consumption of food vehicle	Universal or nearly so; no marked socioeconomic inequalities	Variable for most foods; socioeconomic inequalities may be important
Cost of fortified foods	Low	Variable, may be relatively high
Legislation	Straightforward	Difficult due to multiple types of iron compound

TABLE 4. Percentage of women with one or more births in the 5 years before the survey who reported using iron tablets in pregnancy

Region	% of women
Sub-Saharan Africa	56
Middle East and North Africa	29
South Asia	44
East Asia and Pacific	59
Latin America and Caribbean	71
All countries	53

Source: Gwatkin et al. [23]

the percentage of women who received any iron or IFA tablets during pregnancy by wealth quintile for our three focus countries.

A Demographic and Health Survey-based analysis in 25 countries showed a large proportion—typically over half—of women with three or more antenatal visits failed to receive 90 or more IFA tablets [37], indicating that there are many missed opportunities. **Figure 4** shows marked inequalities among Indian women for antenatal care attendance and for receiving IFA tablets. Inequalities are accentuated as the outcome measure becomes more stringent; for example, 10% of the women in the poorest quintile received 90 or more tablets (one-fifth of those who received any IFA), compared with 49% of those in the wealthiest quintile (over half of those receiving IFA). Therefore, missed opportunities for supplementation are much more common among the poor.

In order to achieve population impact, several steps are needed:

First, it is essential that all women attending antenatal care receive a sufficient number of iron tablets at each visit. This will require generic measures to improve health worker performance, such as training and supervision [38], as well as a steady supply of iron or IFA tablets. A multicountry qualitative study concluded that inadequate supply was the major barrier to effective supplementation [39], confirming the findings from earlier reviews [40].

Second, it is important to work on the demand side to improve compliance. Behavioral barriers identified in the multicountry study [39] included lack of recognition of anemia as an important health problem, poor knowledge about why iron tablets are prescribed, beliefs against taking medicines during pregnancy, and fear that supplements might cause a large baby and make delivery difficult. Contrary to what was expected, compliance was around 90%, and only one-third of women complained about any side effects [39]. Enabling factors, on the other hand, included well-being after alleviation of anemia, improved appetite, and appreciation of a positive effect for the fetus. We present below programs from Nicaragua and Nepal, both of which had strong community components.

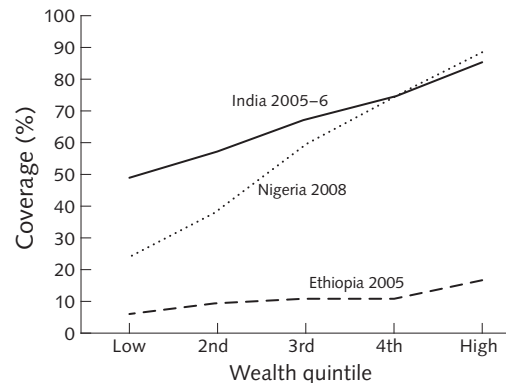


FIG. 3. Percentage of women in India, Nigeria, and Ethiopia with one or more births in the 5 years before the survey who reported having taken any iron or iron-folic acid (IFA) tablets during the last pregnancy according to wealth quintile (<http://www.measuredhs.com/>)

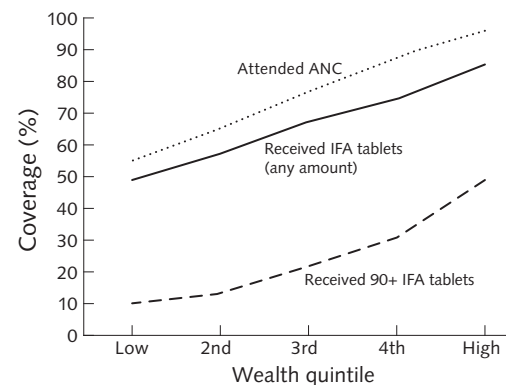


FIG. 4. Percentage of Indian women who received any antenatal care (ANC) from a skilled provider and who received iron-folic acid (IFA) tablets during the last pregnancy according to wealth quintile (<http://www.measuredhs.com/>)

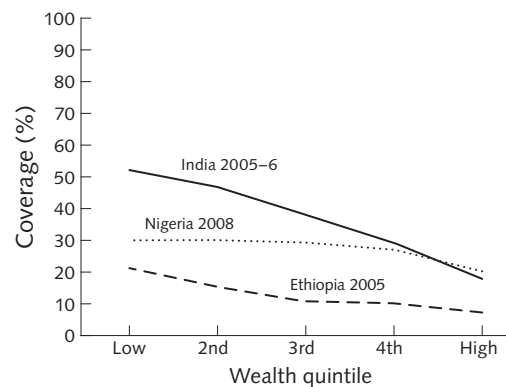


FIG. 5. Percentage of women in India, Nigeria, and Ethiopia aged 15 to 19 years with a body mass index below 18.5 kg/m<sup>2</sup> according to wealth quintile (<http://www.measuredhs.com/>)



Third, in countries where there are important inequalities in antenatal care attendance—which include most low- and middle-income countries [36]—it is essential to reduce barriers to universal access, such as user fees [41]. It is also important to invest in additional delivery channels, such as outreach or community-based distribution, to reach women who are being excluded from antenatal care.

#### *Examples of large-scale programs*

In our review of the gray and published literature, few large-scale programs were identified that had been properly evaluated. One possible reason for the lack of studies is that supplementation activities are usually embedded in broader, horizontal delivery systems such as antenatal care, rather than being stand-alone vertical programs for which funders require specific evaluation studies.

The three national programs most frequently heralded as success stories are those in Nicaragua, Thailand, and Nepal [6, 8, 11, 30]. We will describe the Nicaragua and Nepal experiences in some detail. The Bangladesh Integrated Nutrition Program and the SEECALINE project in Madagascar, which also reported an important increase in IFA use among pregnant women, are discussed in later sections of this paper.

#### *Nicaragua*

In Nicaragua, IFA supplementation through antenatal care clinics was launched in 1993. It became part of an ambitious national program that also included flour fortification with iron; behavioral change and communication; health worker training of health service personnel; measures to improve the supply of IFA tablets in antenatal care clinics; involvement of community health volunteers (known as *brigadistas*) and nongovernmental organizations (NGOs); and monitoring and evaluation [42]. According to a comprehensive evaluation, “Steps for implementing IACS comprised: clear policies; updated technical guidelines; incorporation of iron and iron/folic acid supplements in the official list of essential medicines; addressing supply issues by establishing effective systems for procurement and logistical management of supply, as well as demand and compliance issues; and conducting operational research to address key constraints to implementation” [42]. An innovative aspect of the program was the involvement of the *brigadistas*, who delivered supplements and promoted compliance through follow-up visits and counseling. Over time, national coverage of IFA reached and was sustained at 80% [42], but some degree of socioeconomic inequalities persisted: coverage ranged from 63% in the poorest quintile to 91% among the wealthiest [23]. From 1993 to 2003, the prevalence of anemia among reproductive-aged women in Nicaragua declined from 33.6% to 16.1%.

This decline has been largely attributed to the program [23, 30] but evaluators also note that there was also a sharp decline in anemia among nonpregnant women, and that other factors—including greater expenditure on health, improved water and sanitation, food distribution programs, etc.—may also have played a role. For these reasons, it is difficult to assess how much of the observed impact was actually due to the program.

#### *Nepal*

The Nepal national supplementation program is part of the 2003 National Anemia Control Program, which also included deworming of pregnant women, dietary diversification, food fortification, and promotion of appropriate maternal care practices. The program was initiated in five districts, and by 2007 46 districts had been covered, with the ultimate objective of reaching all 75 districts by 2010 [8, 11]. Community involvement was reportedly a key component of the program [8]. Female community health volunteers were trained to distribute the iron supplements, and monitoring efforts included community-level micronutrient registers to track pregnant women.

The proportion of women receiving iron supplements during pregnancy increased from 23% in 2001 to 59% in 2006 [43]. In the same period, the prevalence of anemia among pregnant women fell from 75% to 42% [43]. In the 2006 survey, iron supplementation coverage was 34% in the poorest and 80% in the wealthiest quintiles.

#### *Conclusions*

Both the Nicaragua and the Nepal programs show many of the key elements of successful scaling up described earlier. In Nicaragua, there were broad recognition of anemia as a public health issue, clear policies and technical guidelines, due attention to the supply and demand side, involvement of communities and civil society, and appropriate monitoring and evaluation. In Nepal, the following enabling factors were singled out: good high-level coordination among development partners; stable funding by government and external funders; strong national coordination in training and tablet distribution; technical capacity, including training of female volunteers; strong monitoring through annual surveys of coverage and compliance; and a targeted communications program [11]. An additional enabling factor may be the availability of local efficacy data, as Nepal was the site of several randomized trials on iron and other micronutrients.

It should be noted, however, that important socioeconomic disparities in supplementation coverage remain in both countries. Coverage in the poorest and wealthiest quintiles was 34% and 80% in Nepal, respectively, and 63% and 91% in Nicaragua. The challenge of reducing inequalities remains in both countries, in spite of programs that are widely heralded as success stories.

### Integrated nutrition programs including food supplementation and/or behavioral change interventions

Efficacy studies show that providing food supplements to pregnant women can improve birthweight and reduce the prevalence of small-for-gestational-age births in subpopulations with inadequate diets [44].

Our review of the literature showed that recent large-scale programs providing food supplements also include—to a greater or lesser extent—a component of nutrition education and counseling (behavioral change and communication). These are often described as “integrated nutrition programs,” in which community health and nutrition workers play a central role [5]. We thus include both supplementation and education and counseling programs in the same review. Programs that included cash transfers in addition to food supplementation are reviewed in the next section.

One important limitation is that the large-scale programs identified are primarily targeted to young children rather than pregnant or lactating women. As a consequence, program reports and evaluations provide limited information on the specific effect of improved nutrition during pregnancy.

Limited information is available on the number of countries with food supplementation or educational programs targeted at pregnant women. A 2008 review of the 20 countries with the highest burden of undernutrition [7] showed that 10 countries had supplementation of pregnant women included in their national nutrition plans, but that none of these had achieved national-scale implementation. No information is available on how many countries promote behavioral change and communication activities among pregnant women with the objective of improving nutrition.

Food supplementation programs have received a fair amount of criticism, which reveals some of the main constraints to their implementation. These include the fact that food is expensive, consuming a large share of available resources for nutrition programs. Supplementing pregnant women and adolescent girls in order to prevent maternal depletion is especially expensive, because they eat more than children [45]. In addition, it is difficult to ensure that the food gets to the target group rather than being shared widely within the family, or that supplements do not replace foods that the woman would normally eat. Cultural barriers may also play a role: in some populations women tend to “eat down” during pregnancy to avoid the risks associated with delivering large babies [45]. Operational issues are also complex: procurement, preparation, and distribution of food supplements are more complex than is the case for micronutrients, for example.

A key issue in food supplementation programs—in contrast to the three types of program reviewed above—is that of targeting. Unlike iodized salt or iron

tablets, not all pregnant women need food supplements. Successful programs should target supplements to women at high risk for nutritional deficits, such as those below the poverty line or with anthropometric evidence of undernutrition. Equity considerations are therefore important. **Figure 5** shows that there are clear socioeconomic gradients in India, Nigeria, and Ethiopia in the proportion of women of reproductive age with a low body mass index (BMI).

#### Examples of large-scale programs

Some of the best-known large-scale programs that included activities aimed at pregnant women, as well as young children, are the Tamil Nadu Integrated Nutrition Program (TINP) in India, the Bangladesh Integrated Nutrition Program (BINP), and the SEECALINE program in Madagascar. The first two programs provided food supplements in addition to educational or behavioral change and communication activities, whereas SEECALINE was limited to the latter.

#### India (Tamil Nadu)

The Tamil Nadu Integrated Nutrition Program (TINP) was a large-scale program in an Indian state where one-third of the population belonged to households with a per capita intake of less than 1,700 calories a day [46]. Its first phase lasted from 1980 to 1989 (TINP I) and included growth monitoring, nutrition education, and food supplementation activities run from village-level Community Nutrition Centres, targeted at pregnant and lactating women and children under 3 years of age [47]. The 9,000 centers covered less than half the rural area of the state. TINP I was largely financed by the World Bank. It is mentioned that 30% to 60% of pregnant women in the population were eligible to receive supplementary snack foods, but the eligibility criteria are not described in the available literature [46]. The supplements included a cereal/pulse/groundnut/sugar powder that was reconstituted into “small balls” at the nutrition centers; each woman was given four such balls a day. We were unable to obtain information on the nutritional contents of the supplements. It is reported that the supplements were not aimed at covering a substantial proportion of daily energy requirements, but rather were used as an incentive to attend educational sessions. There was no documented evidence of improvement in maternal nutrition, birthweight, or any other pregnancy outcomes. [45, 48]. Antenatal care attendance (one or more visits) was reported for 56% of participant pregnant women, and 18% reported having taken 90 or more iron tablets during pregnancy; no comparison data are available [46].

At the end of TINP I, the state government took over its basic running costs, and a new World Bank project (TINP II, 1990–97) financed additional activities. One of the stated objectives of TINP II was to reduce the prevalence of LBW by 50% [49]. Antenatal care

coverage with at least one visit increased to 90% of women, but only 10% received at least 90 iron tablets during pregnancy—a lower figure than in TINP I. Food supplementation for at least 16 weeks was received by 45% of pregnant women and 30% of lactating women, whereas the corresponding program targets were 60% and 90% [49]. Again, no impact on maternal or fetal nutrition was reported [48]; even the internal evaluation states that any changes in birthweight are unlikely to be ascribed to the program.

At the end of TINP II, it was absorbed by a pre-existing national program, the Integrated Child Development Services Program, which had been launched in 1975 and currently covers an area with a total population of 300 million.

TINP is heralded by some as a success story in terms of improving child nutrition [46], but its critics argue that actual evidence of impact is questionable [48]. By reviewing the scarce literature on TINP, it becomes evident that the maternal nutrition component was a secondary objective, as the program focus was on young children. It is also striking how limited the monitoring and evaluation activities were, and how little is known about the targeting performance, coverage, behavioral outcomes, or health impact of maternal supplementation.

### Bangladesh

The Bangladesh Integrated Nutrition Program (BINP) was launched in 1995. Its main objective was to promote large-scale nutritional counseling aimed at producing behavioral change, complemented by supplementary feeding for pregnant women and young children in rural areas. BINP was designed to address three underlying causes of malnutrition: inadequate food, poor access to health services, and inadequate caring practices. About two-thirds of the overall program budget was allocated to Community-Based Nutrition [50]. This component included growth monitoring and promotion for children, integrated with a supplementary feeding program directed at children as well as pregnant and lactating women, with a strong education and counseling component. In this review we focus on the Community-Based Nutrition component of the program and on its effect on pregnant and lactating women. The project's goal pertinent to maternal nutrition was the reduction of LBW by 50% over a 5-year period—a very ambitious target [51].

BINP started in six *thanas* (subdistricts) in 1996 and was expanded to 59 of the 464 *thanas* in the country by 2002, when it was replaced by the National Nutrition Program aimed at covering 105 *thanas* throughout the whole country. Community nutrition promoters were recruited locally and trained to deliver the program. Pregnant women with a low BMI were the target group for receiving supplementary feeding from 4 months of pregnancy. The BINP food supplement consisted

of packets containing rice powder, pulse, molasses, and soybean oil, each providing 150 kcal; the women were expected to eat four packets a day. The packets were produced locally by women's groups. The BINP designers stated that the purpose of the supplement was primarily educational rather than therapeutic, aimed at demonstrating the importance of supplementary foods [52].

BINP has been the subject of several evaluations [50–57] that show sometimes contrasting results. Key findings of the evaluations included:

- » Targeting of pregnant women was suboptimal. An evaluation in a rural community showed that over a third of eligible women who were seen at the program's nutrition center failed to be enrolled. Among those enrolled, only 37% started supplementation at the correct gestational age, and only 10% received supplementation for the recommended number of days [56]. Other evaluations found similar results for targeting and compliance among pregnant women and their children [58, 59].
- » Several indicators of maternal knowledge and practices improved among those enrolled in the program; the program was successful in promoting caregiver knowledge and behavior change and improving utilization of antenatal care, dietary habits, and use of iron tablets during pregnancy [51, 53, 57]. Use of IFA tablets during pregnancy was up to 40 percentage points higher among those enrolled in the program than among a comparative group.
- » There was no overall impact of the program on birthweight [56] or maternal weight gain associated with participation in the project. In subgroup analyses, there was evidence from separate evaluations that greater intake of the supplement was associated with higher birthweights, particularly among the poorest women, and after the food insecurity season [50, 51, 59]. It should also be noted that the supplements also included pounded seeds that are rich in phytates, which reduce iron absorption.

One undeniably positive result is that BINP succeeded in raising attention to the problem of undernutrition and creating a sustained nutrition program in the country [51]. It also led to important improvements in knowledge and behavior. However, as is the case for many large-scale programs, implementation was faulty and targeting was poor, which resulted in few women taking full advantage of the supplementation—either because they failed to be enrolled, were enrolled too late in pregnancy, or did not consume the recommended amount of supplement. For these reasons, there was little if any population impact on nutritional indicators, although there was evidence of such an impact among pregnant women who were undernourished and who consumed large amounts of the supplement at the right seasons of the year. It should also be noted that many of the original program

targets were absolutely unrealistic, such as the reduction of LBW by 50% over a 5-year period.

There is also no question that the quality and scope of monitoring and evaluation activities, in such a large and ambitious program, were poor [60]. The main evaluation, funded by the World Bank, was plagued by methodological problems that made it impossible to analyze the data in a longitudinal way as initially planned, with baseline, midterm, and endline evaluations [54]. Other evaluations were carried out after the program had been implemented [56–59], which could not control for baseline differences. Also, most evaluations have looked at a population as a whole, rather than at subgroups that have a potential to benefit. Additional methodological issues that could not be ruled out were contamination of neighboring districts used as a comparison group, and inability to adjust for the secular trend of a rapid reduction in undernutrition in the whole country [61].

In terms of the framework for successful implementation of large-scale programs, BINP has many positive aspects, such as high-level advocacy and coordination, sustained and adequate funding from the World Bank, governmental leadership, good technical design aimed at tackling the broad determinants of undernutrition in the country, and use of appropriate, locally made supplements. However, its technical design in terms of screening eligible women, avoiding spillover, and ensuring adherence was deficient. Lastly, insufficient attention was given to monitoring and evaluation activities, particularly in view of the magnitude of the program.

BINP evolved into the National Nutrition Program, but by 2010 it was still short of reaching its 25% coverage target. Concerns regarding the National Nutrition Program include lack of funding and poor integration with health services when referral is required (B. Ljungqvist, personal communication).

#### *Madagascar*

The SEECALINE (Surveillance et Education des Ecoles et des Communautés en Matière d'Alimentation et de Nutrition Elargie) project was implemented in Madagascar from 1997 to 2006 with support from the US Agency for International Development (USAID) [62, 63]. After a 2-year period dedicated to start-up activities, implementation started in two provinces in 1999 and was scaled up to cover more than half of the country's districts. Selection of districts was based on the prevalence of child undernutrition; selection of communities within a district was based on accessibility.

The program components included policy and partnerships (over 50 groups, mostly NGOs, were included), capacity-building, community support, and behavioral change and communication, aimed at improving the nutrition of children and pregnant and lactating women. The program was contracted out to

local NGOs for implementation, and paid community nutrition workers were in charge of nutrition education and counseling. The focus of the program was on child nutrition through monthly growth monitoring and promotion sessions. Unlike the two programs reviewed above, SEECALINE did not provide any food supplements to pregnant women or their children.

A before-and-after evaluation restricted to program areas showed some important improvements in coverage of maternal interventions. Use of any IFA supplements during pregnancy increased from 32% in 2000 to 76% in 2005, and use of postpartum vitamin A supplementation increased from 17% to 54%. There is no information about impact on birthweight [63]. A second evaluation including comparison areas before (1997/98) and after (2004) the program was implemented [62] showed that the program successfully targeted the poorest and more malnourished areas of the country, and helped close the gap in child undernutrition between intervention and the comparison areas. Within the intervention areas, however, more educated mothers and better-off villages benefited most, in terms of translating gains in the behavioral indicators into gains in children's nutritional outcomes. The evaluation showed that mothers in program areas were more likely to receive postpartum vitamin A than those in comparison areas (difference in differences 34 percentage points; coverage level not reported). Effects on IFA and birthweight were not mentioned.

The SEECALINE program is generally considered a success story, having received additional funding from USAID, the World Bank, and the Madagascar government after the initial phase, and having evolved into the National Community Nutrition Program [12]. In terms of the framework for successful programs, SEECALINE has important elements such as increasing the visibility of nutritional issues, generating political will and leadership, involving multiple partners, appropriate geographic targeting and delivery channels, and sustainable financing. Areas that need further investment include program monitoring and evaluation, a reassessment of some technical issues—e.g., possibly the excessive focus on growth monitoring activities—and the fact that the program seems to benefit the better-off and more educated, rather than the poorest families.

From the standpoint of the present review, the two available evaluations of SEECALINE provide very limited information on changes in the coverage of interventions or behaviors during pregnancy that could have influenced child health.

#### *Conclusions*

The internal evaluations of the three programs reviewed above—TINP, BINP, and SEECALINE—claim success. These claims are largely based on their ability to improve the visibility of nutrition issues, to build partnerships, and reportedly to improve

coordination. This was often achieved in contexts, such as those of India and Bangladesh, where national-scale programs are remarkably difficult to implement. To a greater or lesser extent, these programs report improved intervention coverage and health-related behaviors, although the achievements tended to be well below the programs' ambitious initial targets. This is even more evident for health impact targets, which in retrospect are unrealistic; for example, both BINP and TINP aimed at reducing LBW by 50% in short time frames [48]. Although such levels of reduction have been described for special populations—for example, in refugee camps [64] or in migrants to high-income countries [65]—there are no examples of such levels of improvement for large populations remaining in their geographic areas.

In particular, all three programs had major limitations in terms of monitoring and evaluation activities, which have deprived the international audience from learning more from their successes and failures. For example, none of the three projects included appropriate assessments of the effect of maternal supplementation and/or behavioral change and communication on birthweight.

#### Conditional cash transfers (as a platform for delivering maternal nutrition interventions)

Conditional cash transfer programs provide cash to poor families in exchange for their participation in health, nutrition, and/or education activities, known as conditionalities [66, 67]. Conditional cash transfers were pioneered by Mexico and Brazil in the late 1990s, where such programs rapidly grew to national scale [68]. Conditional cash transfer programs were under way in approximately 30 countries by 2008 (fig. 6), having been endorsed by many national and international organizations [69]. It is difficult to obtain precise information on the number of countries with such programs, because some countries are currently at the pilot stage in selected areas, and because there are also issues of definition—for example, whether or not cash payments are dependent on conditionalities, and how many payments are made (e.g., a single payment for hospital delivery versus monthly payments for regular attendance at clinics or schools).

The focus of this review is not on conditional cash transfers as a whole, but on their potential impact on maternal nutrition and related child outcomes. Such impact could be achieved through several pathways [66, 70], which are discussed below:

- » Conditional cash transfers may provide extra cash for purchasing foods and services. There is considerable evidence from different countries that conditional cash transfer is associated with greater household expenditure on food [67, 71, 72].
- » Conditionalities such as antenatal care attendance

or participation in nutrition education sessions may improve maternal nutrition. Bassett [68] reviewed 20 conditional cash transfer programs with specific nutrition-related conditionalities: 14 in Latin America and the Caribbean (Brazil had 2 programs in succession), 3 in Asia (Indonesia, Philippines, and Turkey), and 2 in Africa (Kenya and Uganda). Eleven of the 20 included antenatal care attendance as a conditionality. Only five included educational sessions, but in Colombia attendance was voluntary and in Peru the target audience did not include pregnant women.

- » Programs may include the direct distribution of foods or micronutrients to pregnant women. Of 20 programs reviewed [68], only Oportunidades in Mexico provided maternal supplementation with iron and food (see below). A recent review of the impact of conditional cash transfer programs on micronutrient status was focused on children rather than mothers [72], showing significant improvements in anthropometric measurements but very little impact on micronutrient status.
- » A fourth pathway, which is not mediated by nutritional variables, is through women's empowerment. Because cash is normally paid to women rather than to their husbands, conditional cash transfer may help empower them to obtain better healthcare for themselves and their children. An analysis of the Mexican Oportunidades program reported that beneficiaries placed greater demands on the health services and had better-quality antenatal care, as assessed by the number of medical procedures they received [73].

The 2008 review by Bassett shows that several conditional cash transfer programs reported impacts on child nutrition [68]. However, she notes that there is plenty of scope for doing even better. Further actions include limiting conditional cash transfer eligibility to the age window of opportunity for nutritional improvement (pregnancy and the first 2 years of life), prioritizing evidence-based nutrition-related conditionalities, giving greater attention to supply-side investments for nutrition and health services, and improving coordination with other agencies active in the nutrition field [66, 68].

The literature on the impact of conditional cash transfers is heavily biased toward child nutrition, rather than maternal nutrition [66, 68]. Child anthropometry is a common outcome in most evaluations. Although pregnant women are also included among program beneficiaries in several programs [67, 68], we found only two in which impact on birthweight was investigated. The evaluation of the Colombian conditional cash transfer program [74] had a before-and-after design comparing communities with and without conditional cash transfers. The analyses were based on intention to treat (that is, all eligible families in the conditional cash transfer group were included, whether or not they enrolled and received the benefits).

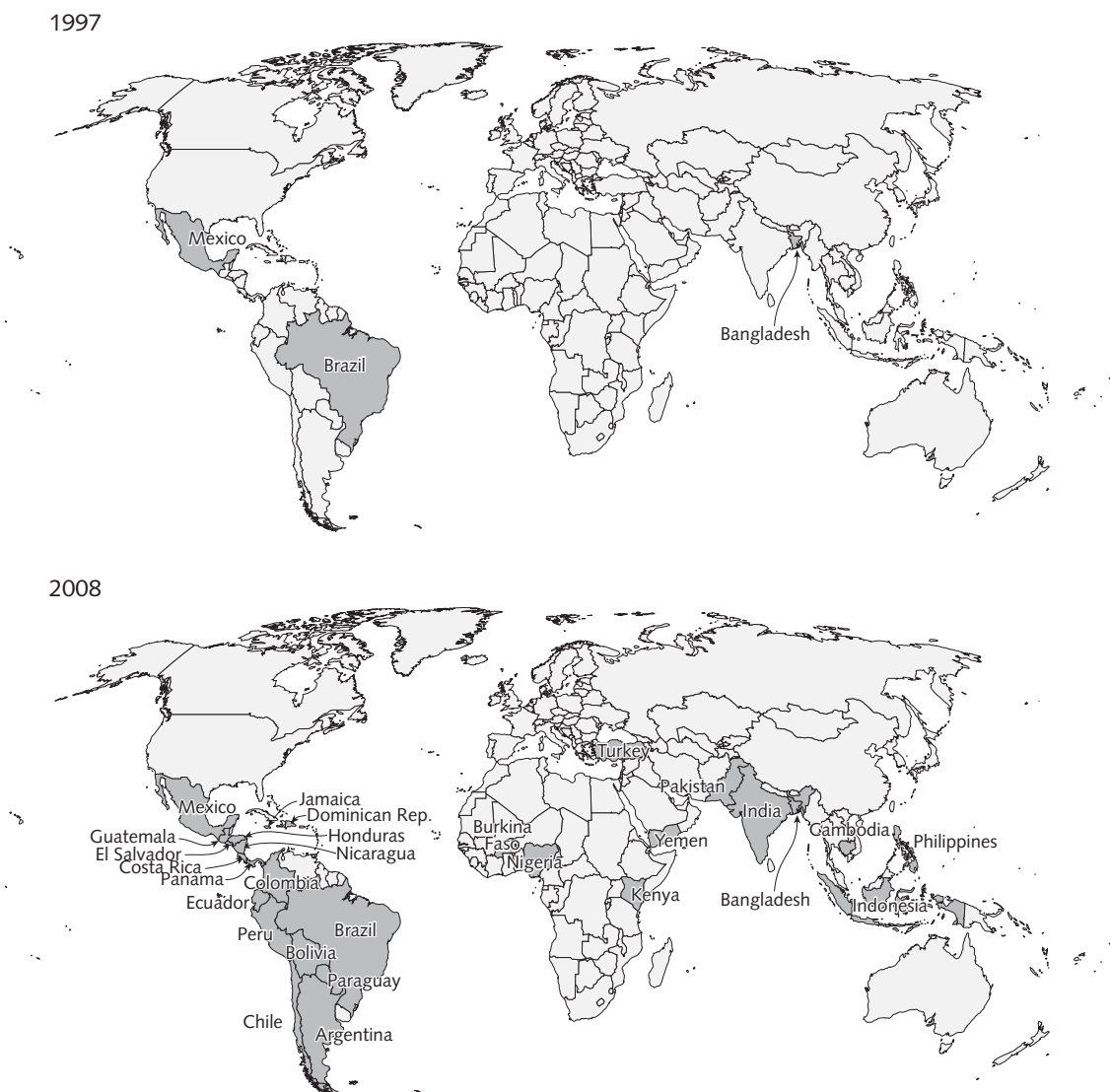


FIG. 6. Countries with conditional cash transfer programs in 1997 and 2008. Source: Fiszbein and Schady [69].

The difference in differences method was used to assess the impact of the program on several outcomes, including “newborn weight” (used as a proxy for birthweight). The net effect of the program on newborn weight was 176 g in rural areas (nonsignificant) and 578 g in urban areas ( $p < .05$ ). This is a remarkably large effect, but the authors do not provide any further discussion on its plausibility or potential mechanisms. No information is given on the program’s effect on maternal diets, knowledge, use of health services, or other health-related behaviors. In the Cochrane review, these results were not included because the study was judged to have a high risk of bias [66]. A positive effect on birthweight was also reported from Mexico and is discussed below [70].

The main focus of this review has been on how conditional cash transfer programs—in settings where these are currently being implemented—can make a difference in terms of improving maternal nutrition and related child outcomes. We showed that whereas conditional cash transfer programs are rapidly gaining popularity and being implemented in a growing number of countries, poor use is being made of them as potential platforms for improving maternal nutrition.

#### *Examples of large-scale programs*

The best known conditional cash transfer program, and also the most thoroughly evaluated, is the Mexican Progresa/Oportunidades. Of all programs reviewed, it is also by far the one with the most intense nutritional

component directed at pregnant women, including multiple strategies such as cash payments, food and micronutrient supplements, nutrition education, and healthcare promotion.

#### Mexico

In 1997, the Mexican Federal Government implemented a CCT program (Progresa) targeted to about 300,000 low-income households in rural areas. Renamed as Oportunidades in 2001, the program was expanded to about 5 million low-income households (about 25% of the national population) in both rural and urban areas by 2005 [75]. Cash transfers are provided to women as financial incentives for preventive health and nutrition behaviors and for retaining their children in school. Families do not receive cash benefits unless their members regularly attend health clinics where health and nutrition services are provided. This became the best-known conditional cash transfer program in the world, not only because of its large scope but also because it was subjected to a high-quality, randomized impact evaluation covering over 500 communities [76].

Oportunidades also provides a nutritional supplement to pregnant and lactating women, all children between 4 and 24 months of age, and undernourished children aged 2 to 5 years. The supplement for pregnant and lactating women (Nutrívida) was designed specifically for the program [68]. Nutrívida is a dry mix of whole dry milk, sugar, maltodextrin, vitamins, and minerals, presented in banana, vanilla, chocolate, or natural flavors, to be reconstituted with water. The 52-g daily ration provides 250 kcal of energy and 12 to 15 g of protein and includes iron, zinc, vitamin B<sub>12</sub>, vitamin C, vitamin E, folic acid, and iodine, covering 20% of caloric and 100% of micronutrient requirements [77]. Mothers are given a monthly supply when attending the health clinic for their health checkups.

Mothers are also required to attend lectures (*pláticas*) conducted by physicians and nurses trained in health and nutrition covering topics on nutrition, hygiene, immunization, and family planning [78]. The *pláticas* also reinforce appropriate use of the supplements as well as optimal diet during pregnancy [68]. Monthly meetings also occur between beneficiary women and the *promotoras*, who are beneficiary women elected by other beneficiaries to act as a liaison between Oportunidades and the communities.

From the equity standpoint, Oportunidades was shown to be efficiently targeted at the poorest families [79]. In the randomized evaluation, the program was associated with faster growth in height among the poorest and youngest infants; there was also a reduction in anemia prevalence [76]. Impact on birthweight was assessed in a retrospective survey that compared women who delivered before and after the program was initiated; 84% of eligible women in the original

sample were interviewed, and 82% of these were able to report on birthweight. Program affiliation was not significantly associated with antenatal care use or with the number of consultations. Nevertheless, children born to beneficiaries were on average 82 g heavier (127 g heavier in the adjusted analyses) than those of nonbeneficiaries, and the prevalence of LBW was 4.6 percentage points lower in beneficiaries in the adjusted analyses—a 45% reduction in LBW [70, 73, 80]. The authors attribute this impact to better-quality prenatal care, arguing that Oportunidades affected quality by empowering women with information about adequate healthcare content. They provide some evidence that beneficiaries underwent a larger number of medical procedures during antenatal visits [73]. The authors dismiss the possibility that the higher birthweights were due to supplementation, citing a small qualitative study that reported on running out of stocks of Nutrívida in health centers as well as poor acceptability by some mothers [81]. No information is provided on maternal nutritional status, either before or after program implementation.

The reported effect of about 100 g on birthweight, therefore, should be interpreted with caution. No information was provided on maternal weight gain or biochemical markers that could justify a nutritional pathway's leading to such an impact. The author's claim that improved birthweight was due to a slight increase in the number of routine procedures carried out during antenatal care is also to be interpreted with caution, as it is unclear how the procedures reported would impact on birthweight [70, 73, 80].

#### Conclusions

The Mexican experience provides an excellent example of how the conditional cash transfer platform can be used to deliver maternal nutritional interventions that included supplementation with food and micronutrients and nutrition education aimed at changing behaviors and increasing health services utilization. The impact of conditional cash transfer on child nutrition was thoroughly evaluated in a randomized study published in 2004 [76], but less attention was given to impact on fetal nutrition, which was only evaluated in the last couple of years in studies that did not take advantage of the randomized design, thus providing less strong evidence for a possible impact [70, 73, 80].

As is the case for Progresa/Oportunidades, most documented examples of conditional cash transfer programs come from middle-income countries in Latin America. In Africa and Asia, most conditional cash transfer programs are recent and still at early, pilot stages [69]. A search of the gray literature identified small-scale programs in many countries, but several of these are targeted to AIDS orphans and do not include pregnant women in their target populations. Few programs are properly described in the literature, and even

fewer have been evaluated.

A few examples include the following:

- » In Nigeria, Care for the Poor was launched in 2008 with conditionalities that include health service attendance, but no evaluations are available so far [82].
- » In Ethiopia, a combination of safety net programs provides employment in public works, food or cash transfers, or a combination of these during the hungry season. Pregnant and lactating women are one of the target groups, but there are no conditionalities. Families receiving paid employment plus other benefits had improved food security, but no evidence is available regarding impact on maternal or child nutrition [83, 84].
- » In Malawi, the Social Cash Transfer program was piloted in six districts; an internal evaluation suggested positive effects on child nutrition, but effects on maternal nutrition are not reported [84].
- » In India, the Suraksha Yojana program provided cash benefits to low-income pregnant women who opted to deliver their children in a health facility. A rigorous randomized evaluation showed that, although targeting was far from perfect, there was an important increase in the utilization of antenatal and skilled delivery services, leading to a reduction in perinatal and neonatal mortality [85]. However, the program did not have a nutrition component.

In spite of growing interest in conditional cash transfers in low income-countries, most experiences so far are still at the pilot stage. Promising results from middle-income countries should not be directly extrapolated to poorer settings. In terms of the framework presented at the beginning of this paper, conditional cash transfers in low-income countries would have to overcome some important barriers. First, these are extremely expensive programs that middle-income countries may be able to afford but that would depend heavily on foreign aid in low-income countries. Second, in most middle-income countries, maternal undernutrition is concentrated in poor, often remote areas. This characterizes a situation of “marginal exclusion” [86], also known as “bottom inequality” [87]. Under these circumstances, it is relatively easy to target the minority in need of cash transfers, and therefore conditional cash transfer programs are affordable. On the other hand, in many low-income countries national resources are scarce and most of the population would be eligible, which makes conditional cash transfer programs less likely to be implemented. Third, the administrative requirements for running such large and complex programs may prove to be too complex for low-income countries; these include appropriate targeting, documenting compliance with conditionalities, transferring cash, monitoring and evaluation, etc.

Over the next few years, the experience currently being accumulated in low-income countries will

provide further evidence on whether conditional cash transfer programs can be scaled up successfully and achieve impact on maternal and child nutrition. Conditional cash transfer programs, however, remain a powerful platform for delivering nutritional interventions in countries with the financial and administrative capacity to implement them.

## Conclusions

What can be concluded from the analyses of the large-scale implementation of programs affecting maternal nutrition?

*First, programs differ in terms of complexity.* These differences arise from the key elements listed in **table 1** and reflect their potential to be scaled up in order to reach and have an impact on women. If we had to rank the six types of programs from least to most complex, a possible ordering would be (1) salt iodization, (2) flour fortification, (3) micronutrient supplementation, (4) nutrition education, (5) food supplementation, and (6) conditional cash transfer programs.

Fortification programs are in theory the easiest to implement, but as discussed in **table 2** there are some differences that led to salt iodization having had greater success than flour fortification. We would rank micronutrient supplementation programs next because these involve delivering supplements to individuals, which is more complex than fortification. Nutrition education does not involve commodities, but training, supervising, and motivating health educators adds an extra level of complexity—and ensuring adequate demand is also more critical than for supplementation. Food supplementation is quite expensive, and in terms of complexity it is second only to conditional cash transfer programs, which need sophisticated targeting and continuous monitoring of conditionalities, as well as ample resources. This ranking exercise is rather arbitrary, and different experts might come up with different rankings.

The main purpose of this ranking exercise is not to decide if one type of program is more important than another, but to highlight their different levels of complexity, which should be taken into consideration when advocating for each type of approach. It is also important to note that this is not a comprehensive list of maternal nutrition programs, and many other types of programs—including those addressed at changing distal determinants of nutrition, such as overall education—were not reviewed in this section.

*The second main conclusion is that context matters.* The key to effective programs is the context in which they operate [88]. A review of success stories in Asia showed that programs that succeeded “were built on a favorable base, which depended on factors such as women’s status and education, and the existence of



suitable community organizations and structures” [88]. Programs that failed often had to face less favorable conditions, including social exclusion of target groups. The latter conditions can be changed over time but will require long-term strategies, whereas where fertile ground already exists, impact on nutrition may be achieved in the short term [89]. Key elements of context that need to be taken into account when planning programs include social and ethnic inequalities, urban or rural residence, the strength of the public and private sectors, the status of women, the level of community organizations, and so on. Finally, governance issues are paramount: for example, how democratic a country is, how much corruption there is, and how much political will exists to improve living standards for the whole population, particularly those who have been chronically left behind.

*Third, key elements for success vary according to the type of program.* Whereas a general typology of constraints and enabling factors (such as that described in **table 1**) is helpful for analyzing all programs, it becomes clear that for some programs certain elements are more important than for others. For example, generating demand for cash among the poor does not require much effort, but ensuring that they attend nutrition education classes without any palpable immediate rewards seems to be more difficult. Also, the visibility of micronutrient deficiencies—the “hidden hunger”—is much lower than that of inadequate intake of proteins and calories, and therefore greater investments are needed in raising the visibility of the former than for the latter. The financing and costing needs of

different programs are another example: salt iodization does require funding, but at a much lesser scale than food supplementation or conditional cash transfers.

**Table 5** brings us back to the conceptual framework proposed in **table 1** and shows an arbitrary ranking of how important each element is for each of the six programs reviewed here. Again, this scoring exercise is somewhat arbitrary, and different experts might come up with different scores, but it is sufficient for making the point that program designers may need to think ahead about what the main roadblocks will be for a given program. This exercise may also contribute to setting up priorities for research and development by predicting which elements need to be tackled more intensively by each type of program.

*Fourth, special attention must be given to equity.* Even programs that are judged as being successful based on overall coverage and impact may maintain or even widen inequalities among different socioeconomic groups, genders, ethnicities, or residents in urban, periurban, and rural areas. We have shown that important inequities are present in some delivery channels—for example, antenatal care—and unless programs take special measures to reach pregnant women who are currently being left out, their net contribution may lead to exacerbated inequalities. For programs that are not needed by every pregnant woman, such as food supplementation and cash transfers, knowledge about inequalities at baseline is essential for targeting. Understanding inequality patterns can help improve programs [87, 90, 91]. For example, salt iodization programs in India (**fig. 1**) should target the poor, because

TABLE 5. Importance of key elements of successful scaling up of maternal nutrition programs at the country level<sup>a</sup>

Key element	Salt iodization	Flour fortification	Micro-nutrient supplementation	Food supplementation	Education and behavior change	Conditional cash transfers
Visibility of the nutrition problem	*	*	***	*	**	**
Political will	**	**	**	**	**	***
Leadership and coordination	***	***	**	**	**	***
Partnerships including public, private, and civic sectors	***	***	**	***	**	**
Technical capacity for design and implementation	**	***	**	***	***	***
Supporting policies	***	***	***	***	**	***
Program design	**	***	**	***	***	***
Financing and costing	*	**	***	***	**	***
Procurement of commodities	***	***	***	***	—	—
Strength of implementation	***	***	***	***	***	***
Consumer demand creation	*	**	**	**	***	*
Monitoring and evaluation	***	***	**	**	**	***
Sustainability	**	**	**	***	**	***
Equity	***	***	***	***	***	***

a. —not critical, \*needs to be considered, \*\*very important, \*\*\*extremely important.

coverage is already quite high among the better-off. In Ethiopia, on the other hand, coverage is low among all social groups, and there is no rationale for targeting; in fact, it has been argued that when coverage is uniformly low, earlier adoption of the intervention by the better-off may be beneficial, as it sets a positive trend that is later followed by the rest of society [91]. Monitoring and evaluation systems must be designed in a way that not only allows the measurement of overall coverage and impact but also allows disaggregation by population subgroups.

*Fifth, much greater investments are needed in monitoring and evaluation.* Monitoring requires not only keeping track of inputs and outputs (for example, the type and amount of iron added to flour available in marketplaces), but also regular population coverage survey to ensure that the program is reaching those in need. The number of high-quality, independent evaluation studies identified in our review of the literature was absolutely disappointing. Major programs such as BINP were subjected to incomplete, biased evaluations. Even in a program like Progres/Oportunidades, which is held as one of the best examples of good evaluation practice, the high-quality studies addressed child outcomes, and evaluations of fetal growth leave much to be desired. The lack of adequate monitoring and evaluation also affected our ability to judge which programs were successful. Several large programs were only subjected to internal evaluations carried out by the implementing agencies, which do not have the independence necessary for an unbiased assessment [92]. Finally, we also note that several programs had completely unrealistic goals, such as reducing LBW by half, and few gave due attention to the long time frame required for full implementation and for an effect on nutrition to take place.

Two closing comments. Going through the literature gives the clear impression that most programs are primarily directed at children, not pregnant women. Furthermore, they are often targeted at children older than 2 years of age and thus fail to take into account evidence for the 1,000-day window of opportunity for nutrition interventions, from minus 9 to 24 months of age [45, 93, 94]. This lack of emphasis on pregnant women, and on women's health in general, meant that important outcomes such as nutritional intake during pregnancy, maternal weight gain, and the child's birth-weight were seldom reported in existing evaluations. A major shift is required to ensure that sufficient attention is given to women in general, and to mothers in particular, in designing future programs. Giving more emphasis to integration of nutrition in antenatal care is a potential mechanism, given that antenatal care has high coverage in most low-income countries.

Last, concentrating on how maternal nutrition affects child outcomes—the purpose of this review—means that we are taking a perspective that may be too narrow. Some of the programs reviewed here, including those with no evidence of an impact on child health as a consequence of improved maternal nutrition, may have had important effects on the health of women in general or other effects on child health and nutrition that do not operate through improving maternal nutritional pathways. Many of the programs reviewed here have multiple components addressing a variety of health, nutritional, and other outcomes in several groups of the population, including men, young boys and girls, and the elderly. A comprehensive evaluation approach is needed, because there is a danger of dismissing a broad, effective program due to lack of impact on a small set of outcomes.

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