Lessons from successful micronutrient programs

Part III: Program impact

John Mason, Megan Deitchler, Ellen Mathys, Pattanee Winichagoon, and Ma Antonia Tuazon

Abstract

Micronutrient-deficiency control programs have been greatly extended at the national level in the last 10 to 15 years. However, rigorous evaluations of these are scarce, so that conclusions on impact are tentative and based mainly on indirect evidence. The coverage of vitamin A capsule distribution programs has exceeded 70% in most study countries. In countries implementing national iodized salt programs, the coverage reaches 60% to 90% of households with adequately iodized salt. Of the three micronutrients, coverage of iron tablet supplementation is the least well documented due to inadequate program monitoring systems and population survey data. Supplementation of preschool children 6 to 59 months of age with vitamin A capsules has plausibly contributed to the reduction in clinical vitamin A deficiency and its near-elimination in many countries. The impact of vitamin A capsule supplementation on children's biochemical vitamin A status (serum retinol) in national programs may be less. National data on salt iodization show a consistent relation to reduced prevalence of iodine-deficiency disorder symptoms (goiter); the rates of cretinism and other results of iodine deficiency are almost certainly falling too. The evaluation of the impact of salt iodization programs on biochemical iodine status is limited by a lack of data. Although trials have demonstrated the efficacy of iron supplementation in reducing the prevalence of anemia, the interpretation of national-level data is not so clear. Given the substantial financial and technical commitment required to implement national micronutrient-deficiency control programs, it is vital that investment enable the evaluation of the impact of these programs. It is becoming increasingly important to collect data on subclinical deficiency (e.g., biochemical data) to assess program impact.

Key words: anemia, Asia, fortification, goiter, iodine, iron, micronutrients, South Africa, supplementation, vitamin A

Introduction

This paper, the third in the series entitled "Lessons from Successful Micronutrient Programs," takes up the question of the evidence for the impact of micronutrient-deficiency control interventions, examining how far it is known whether national programs are associated with improvement in indicators of nutritional status, and by how much. This is based on a project involving 12 countries, all but one in Asia: Bangladesh, Cambodia, China, India, Indonesia, Laos, Myanmar, Philippines, South Africa, Sri Lanka, Thailand, and Vietnam.

Numerous efficacy trials starting decades ago have been conducted to assess the effects expected from large-scale micronutrient-deficiency control programs. Iodine provides a good model of systematic development of intervention. Thus, the importance of iodine along with the efficacy of supplementation was shown in the 1960s to the 1980s [1], leading to some well-documented national programs that greatly reduced iodine-deficiency disorders, notably in Latin America [2]. Understanding vitamin A interventions has been more complicated, with the focus shifting from preventing eye damage to reducing mortality and more limited testing of the efficacy of different approaches; this is discussed in the next section in some detail. Iron deficiency and anemia have been concerns for many years, but here there is a crucial gap between the efficacy of approaches at the pilot level (such as ferrous sulfate supplementation) and the limited known

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success (lack of data is a major problem) of these approaches in routine programs.

The research needed to move from efficacy at the pilot level to broad effectiveness has been limited. Hence the size and rate of reduction of deficiency to be expected from large-scale programs are not always clear. With most developing countries now implementing at least one (and in many cases three) nationwide micronutrient-deficiency control program or programs, it has become increasingly important to estimate the actual effects of these interventions on large populations in order to fine-tune their utility and support their continuation. This requires specific and carefully designed evaluations. However, these are very scarce for national (or large-scale) programs.

The extent of the impact of micronutrient-deficiency control programs in Asia can nonetheless be assessed to some degree. Most countries providing case studies have some outcome data on micronutrient status and on program implementation. However, almost all available outcome data are for clinical measures of micronutrient deficiencies. For vitamin A, the clinical prevalences are so low that this measure is not very suitable for evaluation, requiring huge samples to estimate effects. On the other hand, few survey results are available on subclinical measurements among less severely affected populations, even though subclinical prevalences are higher and thus potentially more suitable for evaluation. Although some project countries have multiple rounds of data on clinical indicators of vitamin A deficiency, only the Philippines has two rounds of national data on serum retinol. (China, Indonesia, South Africa, and Vietnam also have multiple rounds of serum retinol data available, but the survey coverage in all cases is subnational, and for many of these countries, information on the comparability of the serum retinol surveys was not available.) Likewise, almost all countries have at least two rounds of goiter data; however, only three countries reported multiple rounds of national data on urinary iodine excretion (China also has multiple rounds of urinary iodine excretion data available; however, only data on median urinary iodine values could be obtained.) At the same time, process data on implementation may be available, but these data are not often linked (except perhaps at the provincial levels) to the outcome, thus precluding much useful evaluation. The prevalence of anemia among pregnant women is assessed, but program coverage data are scarce for iron too. Few of the anemia prevalence data can therefore be linked to iron-supplementation programs.

The results on the prevalence of deficiencies from project countries have been compiled here to assess their trends and to shed some light on program impact achieved to date, as best as possible from the available data. The trends for clinical vitamin A deficiency are reasonably clear both for individual project countries and across countries in Asia. Most countries have considerable coverage data on vitamin A programs, so that some linkage can be attempted. The prevalence trends assessed by biochemical data on vitamin A deficiency are not as clear. For iodine deficiency, most country data indicate a decrease in prevalence with implementation of the national iodized salt program. This trend is observed for both clinical (goiter detected by palpation) and biochemical (urinary iodine excretion) indicators. In the case of iron-deficiency anemia, not as many conclusions can be drawn. Few countries have anemia data that can be linked to programs; only Thailand and Vietnam have prevalence and coverage data that allow for some crude assessment of program effectiveness.

For all three deficiencies, as a first step we have reviewed what results might be expected from effective implementation—mainly based on efficacy trials—as guidance to what to look for. The observed results are then related to the expected results, with focus on the situations with the most promising data.

Vitamin A

What is known from efficacy trials

A literature search was done to explore the extent of the effect to be expected by supplementation of children with massive doses (200,000 IU) of vitamin A. A number of both controlled efficacy trials and uncontrolled community trials of periodic dosing were identified. Most efficacy trials observing the effects of supplementation used data on clinical signs of vitamin A deficiency that had been obtained prior to the wide-scale adoption of vitamin A–supplementation programs. Although much less in number, some trials to date have observed the effects of supplementation on biochemical indicators of vitamin A deficiency, such as low serum retinol; these trials are discussed later.

Range of efficacy demonstrated by clinical data on vitamin A deficiency

Most efficacy trials used high-dose (200,000 IU) vitamin A capsules at approximately six-month intervals. The results of 25 trials of vitamin A capsules (19 in Asia; 20 measuring clinical vitamin A deficiency) analyzed in a previous review [3] were largely consistent in showing a significant impact on clinical indicators of vitamin A deficiency, often bringing the prevalence to nearly zero. Examples are studies conducted in India [4, 5],* Indonesia [6–9], and the Philippines [10].

The size of the impact varied considerably. For Bitot's

* Gujral, Gopaldas T. USAID assisted ICDS impact evaluation project in Panchmahals (Gujarat) and Chandrapur (Maharasthra), 1984–1990, 1991.

spots (X1B), the decrease in prevalence at 12-month follow-up ranged from 4.4 to 1.1 percentage points (4.7% to 0.3% in the study of Tarwotjo and co-workers [7]; 1.1% to 0.1% in other Indonesian studies [8–11]). Keratomalacia was observed as an outcome measure in one study; the results showed an odds ratio of 12.5 for keratomalacia and receipt of dose [4]. The effect of supplementation on active xerophthalmia ranged from 4.7 to 1.6 percentage points of decrease in prevalence (from 6% to 1.3% in Vijayaraghavan and colleagues [5], and from 1.9% to 0.3% in Sommer and co-authors [6]).

Longer follow-up periods demonstrated sustained effects on clinical signs. In Vietnam, a two-year trial was conducted in which a vitamin A dose (200,000 IU) was provided twice yearly. The results of the trial indicated no cases of xerophthalmia among the experimental group at the end of the follow-up period [12]. In the Philippines, 200,000 IU vitamin A capsule supplementation was provided to children with xerophthalmia. The results showed a 2.7 percentage points decrease in xerophthalmia at 24 months of follow-up.* A study in India with a six-year follow-up also showed a beneficial impact of vitamin A supplementation: among those groups receiving twice-yearly vitamin A doses, the prevalence of active xerophthalmia decreased from 4% to 1% in one intervention area and from 12% to 1% in the second intervention area studied.**

A few other trials have shown a lesser impact of vitamin A supplementation on clinical signs of deficiency. A trial in Sudan [13] showed little difference in the number of new cases of xerophthalmia after three doses of vitamin A were administered at six-month intervals. The prevalence of xerophthalmia was reported as 2.9% at baseline; after 18 months, it was 0.013% in the treated group and 0.015% in the control group, results that are hard to interpret. In the Philippines, no substantial difference in the frequency of xerophthalmia cases was found with the provision of vitamin A supplement (200,000 IU) to malnourished children (second and third degree underweight) every six months [14]. These results may indicate that under some conditions—possibly with other forms of malnutrition or underlying changes—the impact is reduced.

Some guidance as to the expected impact on clinical vitamin A deficiency from supplementation can be taken from these intervention trials. Overall, the results may be interpreted as showing that, whatever the starting prevalence, administration of vitamin A capsules in high doses every four to six months largely prevents new cases of eye signs and brings their prevalences down to nearly zero. Cautions in the interpretation of these results may be that existing Bitot's spots may persist and that the effect of vitamin A supplementation may be curtailed with concurrent protein–energy malnutrition. At the same time, since the starting prevalences of clinical vitamin A deficiency are very low (almost always less than 5%, and often only 1%), this indicator is not ideal for detecting change.

Range of efficacy demonstrated by biochemical data on vitamin A deficiency

Much less is known about the effect to be expected on serum retinol from supplementation. This is important, since subclinical vitamin A deficiency is far more prevalent and, moreover, it is thought that the mortality-reducing effects of vitamin A interventions are gained by reducing subclinical deficiency [15]. A number of studies on the effect of supplementation (to children) on serum retinol were extracted from the literature; the results are summarized in table 1, as no such compilation was identified. The time over which the effect of supplementation persisted became of concern with results from the Philippines presented in this project. Therefore the efficacy trials were reexamined to look into this aspect. The serum retinol studies available are relatively few in number, and the findings across these studies are not always consistent. The extent of impact ranged from a 12 percentage points decrease in vitamin A deficiency as indicated by low serum retinol (< 20 μg/dl) [16] to no biochemical improvement indicated among a group supplemented with vitamin A capsules [10].

The largest decrease in the prevalence of subclinical vitamin A deficiency was demonstrated in a trial conducted in Brazil by Araujo and co-workers [16], where the prevalence of serum retinol levels < 20 μg/dl dropped from 16.3% to 4.3% among preschool children after supplementation with vitamin A. However, because the study did not include a control group, the extent of the decrease in prevalence cannot be distinguished from the underlying trend in vitamin A deficiency. Ramakrishnan and co-workers [17] found a significantly higher mean serum retinol value among the experimental group receiving 200,000 IU vitamin A capsules three times a year compared with the control group receiving a placebo. The size of the difference between groups was not reported. Tilden et al.,*** on the other hand, conducted a study in Nepal and

* Klemm RDW, Villate E, Mendoza O. Integration of vitamin A supplementation and nutrition education into DOH community health services: a case study of impacts and processes. Presented at the 15th International Vitamin A Consultative Group meeting in Ecuador, 1992.

** Gujral, Gopaldas T. USAID assisted ICDS impact evaluation project in Panchmahals (Gujarat) and Chandrapur (Maharasthra), 1984–1990, 1991.

*** Tilden RL, Curtale F, Pokhrel RP, Muhilal, Pant CR, Pak S, Gorstein J, Pokhrel GP, Atmarita, Lepkowski J, Grosse RN, and the Vitamin A Child Survival Project Team (1993). Cost, coverage, and changes of several measures of health status associated with alternative approaches to the control of vitamin A deficiency in Nepal. Presented at the 15th International Vitamin A Consultative Group meeting, March 1993.

TABLE 1. Reported results of trials of the effect of periodic massive vitamin A doses on serum retinol

Country	Age, dose, frequency, and type of study	Effect on serum retinol[a]		
		Reported	At 2–3 mo	At 6 mo
Brazil [16]	0–5 yr 200,000 IU every 6 mo No comparison group	Substantial at 6 mo	+	+
Ghana, India, and Peru [18]	Infants 25,000 IU 3 times between 6 wk and 5 mo of age Randomized, double-blind, placebo-controlled	Effect at 2–3 mo, none at 6 mo	+	–
India [19]	2–5 yr 180,000 IU, once Comparison group	Effect at 10 wk, none at 25 wk	(+)	–
India [20]	2–6 yr 90,000 IU, once Comparison group	Effect at 8 wk, none at 18 wk	+	–
India[b]	Newborns 50,000 IU, Comparison group	Effect at 42 wk	+	+
India [17]	6–36 mo 200,000 IU every 4 mo Randomized, double-blind, placebo-controlled	Effect at 12 mo	?	+
Indonesia[c]	1–5 yr 300,000 IU, once Comparison group	No effect	–	–
Indonesia [21]	1–5 yr 100,000 or 200,000 IU, once Comparison group	Effect of 200,000 IU greater at 6 mo	(+)	+
Nepal[d]	6 mo–5 yr 200,000 IU every 6 mo Comparison group	Small effect only	?	–
Philippines [10]	6 mo 200,000 IU, once Comparison group	No effect	–	–
Philippines [22]	1–5 yr 200,000 IU, once Randomized, double-blind, placebo-controlled	Effect at 2 mo, probably not at 6 mo	+	–
Thailand[e]	Infants 100,000 or 200,000 IU, once No comparison group	No effect	–	–

a. +, Increased serum retinol; (+), minor or doubtful effect; –, no effect; ?, effect unclear.

b. Thanangkul O, Promkutkaew C, Waniyapong T, Damrongsak D. Comparison of the effects of a single high dose of vitamin A given to mother and infant upon plasma levels of vitamin A in the infant. Presented at a Joint WHO/USAID Meeting for the Control of Vitamin A Deficiency, NUT/WP/74.14. WHO, Jakarta, Indonesia, November 25–29, 1974.

c. Kusin JA, Sinaga HSRP, Smith EM. Vitamin A Status of preschool children in Suka Village, North Sumatra, after an oral massive dose. Presented at the 5th International Vitamin A Consultative Group meeting, NUT/80. WHO, Jakarta, Indonesia, October 13–17, 1980.

d. Tilden RL, Curtale F, Pokhrel RP, Muhilal, Pant CR, Pak S, Gorstein J, Pokhrel GP, Atmarita, Lepkowski J, Grosse RN, and the Vitamin A Child Survival Project Team. Cost, coverage, and changes of several measures of health status associated with alternative approaches to the control of vitamin A deficiency in Nepal. Presented at the 15th International Vitamin A Consultative Group meeting, March 1993.

e. Dhanamitta S, Stoecker B, Valyasevi A. Community approaches to prevention of vitamin A deficiency. Presented at a Joint World Health Organization/UNICEF/US Agency for International Development/Helen Keller International/International Vitamin A Consultative Group meeting on Vitamin A Deficiency and Xerophthalmia, Jakarta, Indonesia, October 13–17, 1980.

showed an effect of vitamin A capsules on Bitot's spots, but a much weaker impact on serum retinol. Likewise, although Solon and co-authors [10] documented an effect on clinical signs of vitamin A deficiency (the prevalence of xerophthalmia dropped from 3.1% to 0.6% among the group supplemented with vitamin A), the study showed no biochemical improvement from capsule supplementation alone; only the intervention group provided with a weekly supply (two packets per family per day) of monosodium glutamate (MSG) fortified with vitamin A showed an increase in serum retinol (from 21.0 to 28.5 µg/100 ml).

Few biochemical data exist to assess the potential protective period of the recommended dose of vitamin A supplementation. Only two such efficacy studies could be identified. One of these trials [21] showed that children supplemented with 200,000 IU retained significantly higher serum retinol values three and six months following supplementation than did children supplemented with 100,000 IU (the serum retinol values at baseline, three months, and sixth months for the 100,000 IU vs. the 200,000 IU group were 0.55 vs. 0.54, 0.53 vs. 0.63, and 0.81 vs. 0.89 µmol/L, respectively). A second study, conducted by Perlas et al. [22] in the Philippines, showed an effect of vitamin A supplementation on serum retinol, with a protective effect of the capsules that seemed to last up to about four months. The results of the Perlas study are described in more detail below, under General Evaluation Findings.

In addition to the above trials, some studies have explored the effect of supplementation on serum retinol among women postpartum. Studies by Roy et al. [23], Stoltzfus et al. [24], Rice et al. [25], and Tanumihardjo et al. [26] have shown that, in general, vitamin A supplementation to women postpartum is an efficacious strategy for controlling vitamin A deficiency among lactating women. This was indicated in the study of Rice et al. [25] by differences in mean milk vitamin A concentration among mothers and by differences in serum retinol and modified retinol dose response (MRDR) values among infants in different intervention groups; as in the study of Roy et al. [23], among women less effect was observed on serum retinol than among infants. In fact, in the study of Rice et al., a significant difference in serum retinol values was not demonstrated between any of the three groups of lactating women at any time during data collection.

In a controlled trial by Stoltzfus et al. [24], lactating women were supplemented with vitamin A (300,000 IU) or placebo shortly after delivery. The results showed that the mean serum retinol concentration for the intervention group was higher than that for the placebo group, and this finding was observed at both three and six months postpartum. The extent of the impact demonstrated, however, was relatively small: a difference of 0.15 µmol/L between the intervention and control groups (1.39 vs. 1.24 µmol/L) at three months. The same range of effect (0.15 µmol/L difference) was observed between the intervention and control groups (1.23 vs.1.08 µmol/L) at six months of follow-up. The findings suggest that the extent of the effect to be expected by vitamin A supplementation on serum retinol among lactating women should be considered. If consistent across studies, the observed results could have wider implications for indicators to include in future evaluations of postpartum vitamin A–supplementation programs.

Changes in serum retinol after administration of vitamin A capsules appear to be more dependent on the length of time after the dose than are changes in clinical signs. In more than half the trials assessed (table 1), the serum retinol levels had returned to predose values by six months after the dose, and probably earlier. Thus, the efficacy data suggest that vitamin A capsule supplementation may not have a persistent effect on the subclinical deficiency, as measured by serum retinol. Therefore we are unsure about what to expect when serum retinol is used to evaluate large-scale programs involving administration of vitamin A capsules.

Methods applied to country-level prevalence data

Evaluation of programs by clinical data on vitamin A deficiency is possible, although using biochemical data in addition would be valuable because the prevalences of clinical signs are so low. In the case of most project countries, the prevalence of night-blindness is low enough that the number of people actually affected by night-blindness is very small. This makes it somewhat difficult to use clinical indicators of vitamin A deficiency to relate data to population estimates. Still, clinical data are what most countries have available, and therefore they remain the most available means of assessing program effectiveness in these countries.

Baseline and follow-up data as reported are listed in table 2. The calculation of the rate of change in prevalence in percentage points for a 10-year period (percentage points/10 years) for clinical vitamin A deficiency was as follows:

$$\frac{\text{follow up prevalence} - \text{baseline prevalence}}{\text{follow up year} - \text{baseline year}} \times 10 \text{ years}$$

Caution must guide the interpretation of the results both within and across countries. Very few countries (if any) have yet conducted rigorous evaluations of their national vitamin A–supplementation programs, with valid comparisons over time and with and without the program. Furthermore, in some cases different age groups have been used for surveys in different years. In others, baseline data (i.e., obtained prior to program implementation) could not be found for a country program. For these countries, the earliest known

TABLE 2. Large scale vitamin A–supplementation programs: distribution methods, coverage, and vitamin A deficiency indicators

A Country	B Intervention	C Period of supplementation	D Target group	E Baseline VAD prevalence (group, year)	F VAD prevalence during intervention (group, year)	G Program coverage (year)	H Percentage point change/10 yr (time period)
Bangladesh	VAC distribution on NIDs	1973–current (1995 began with NIDs)	Children < 5 yr	XN 3.6% (children 6–59 mo, 1982)	XN 0.6% (children 6–59 mo, 1999)	99%+ (1999)	XN –1.76 (1982–99)
Cambodia	VAC distribution through routine immunization outreach	1993– current (1993–95 small scale, 1996 program began)	Children < 5 yr	XN 5.6% (children 1–6 yr, 1993)	XN 0.2%–2% (children 18–59 mo, 2000)	63% (Mar 2000)	XN –7.7 to –5.1 (1993–2000)
China	No national vitamin A–supplementation program; No program impact data available						
India	VAC distribution through UIP	1970– current	Children 6–36 mo	X1B 1.8% (1975–79)[a]	X1B 0.7% (1996–97)[a,b]	< 40% (year not reported)[a,c]	X1B –0.56 (1975/9–1996/7)
Indonesia	VAC distribution to children by *posyandus* (village weighing posts)	1974– current	Children 12–59 mo	XN + X1B 1.3% (preschool children, 1978)	XN + X1B 0.33% (preschool children, 1995)	66% (not reported)	XN + X1B –0.53 (1978–95)
Laos	VAC distribution to children through SNIDs	1996– current	Children 12–59 mo	XN 0.7% (children 24–71 mo, 1995)	XN 0.47% (children 6–59 mo, 2000)	73% (2nd round distribution, 1999)	XN –0.46 (1995–2000)
Myanmar	VAC distribution to children through NIDs	1993– current?	Children 6–59 mo	X1B 0.6% (children 0–5 yr, 1991)	X1B 0.38% (children 0–5 yr, 1994) X1B 0.23% (children 0–5 yr, 1997)[d]	> 90% (1997)	X1B –0.73 (1991–94); –0.62 (1991–97)
Philippines	VAC distribution to children through NIDs	1993– current	Children 12–72 mo	35.3% serum retinol < 20 μg/dl (children 6 mo–5 yr, 1993)	38% serum retinol < 20 μg/dl (children 6 mo–5 yr, 1998)	> 80% (1995); 80% (2000)	Low serum retinol +5.40 (1993–98)
Philippines	VAC distributed to women postpartum	1998– current	Women shortly after delivery	16.4% serum retinol < 20 μg/dl (lactating women, 1993)	16.5% serum retinol < 20 μg/dl (lactating women, 1998)	Coverage of women postpartum not available	Low serum retinol +0.20 (1993–98)
South Africa	No program for supplementation to children yet implemented; no program impact data available						
Sri Lanka	No program for supplementation to children yet implemented; no program impact data available						
Thailand	No national vitamin A–supplementation program; no program impact data available						

Vietnam	VAC distribution to children through NIDs	1988– current (1988–92 small scale) (1993–1997 program not linked with NIDs)	Children 6 mo–3 yr	XN 0.37% (children 0–5 yr, 1985–88)[e]	XN 0.05% (children 0–5 yr, 1994) XN 0.20% (children 0–5 yr, 1998)	77% (2000)	XN –0.43 (1985/8–94); –0.15 (1985/8–98)
Vietnam	VAC distribution to lactating women	1993– current	Lactating women	XN 0.58% (pregnant and lactating women, 1994)	0.90% XN (pregnant and women, 1998)	52.2% (2000)	XN +0.80 (1994–98)

VAD, Vitamin A deficiency; VAC, vitamin A capsule; NID, national immunization day; XN, night-blindness; UIP, Universal Immunization Programme; X1B, Bitot's spots; SNID, subnational immunization day.

a. Data presented by K. Vijayraghavan, Bangkok, June 2001 [36], from NNMB, National Nutrition Monitoring Board Second Repeat Surveys, 2000.
b. 2001 data are also available for Bitot's spots but are not included here, as comparability with other surveys is not known.
c. It is unclear which areas the X1B data represent, but no data for any area reported show higher than 40% coverage for children receiving two doses of vitamin A.
d. Data presented by government representative, Bangkok, June 2001; prevalence of X1B also available for 2000 but disaggregated by rural (0.1%) and urban (0.03%) areas for children 0 to 5 years of age.
e. Vietnamese data on prevalence of other clinical signs are also available: e.g. from 1988 to 1994, the prevalence of X1B decreased from 0.16% to 0.045%, and the prevalence of X2/X3A/X3B decreased from 0.07% to 0.005%.

Source: refs. 27–37. Also Aung P, Thein A (Ministry of Health, Myanmar). Myanmar. Case studies on nutrition intervention programmes of Myanmar. Presentation on Micronutrient Programs, INMU, Bangkok, June 2001. Vijayraghavan K (National Institute of Nutrition, Hyderabad). Micronutrients in India. Presented at a workshop on "Successful Micronutrient Programs" held at the International Union of Nutritional Sciences, Vienna, August 2001.

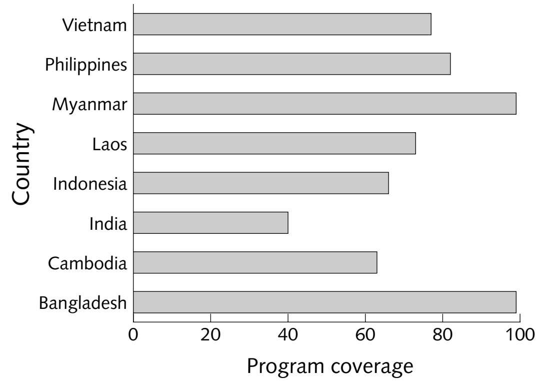

FIG. 1. Coverage of vitamin A capsule programs for children by country (data are for the most recent year available; see table 2).

prevalence data were used.

Coverage data on the percentage of members of the age group reported to receive vitamin A capsules for the (normally twice yearly) distribution are shown in figure 1. Coverage data were used for the closest year possible to that of the follow-up prevalence data point, normally for the most recent year available. As discussed later, reported coverage based on administrative records from the vitamin A capsule distributions—usually the number of capsules compared with local data on population in the target age group—was generally higher than estimates derived (when available) from sample surveys of households; however, there was no way of correcting this, so the data in figure 1 should be viewed as probably a high estimate of the actual coverage.

Evaluation findings

Impact of programs on clinical indicators of vitamin A deficiency

The characteristics and clinical outcomes of the large-scale programs reviewed here are compiled in table 2, drawing on the country studies [27–37].* Comparing the results of repeated national surveys shows the prevalence of clinical vitamin A deficiency to be decreasing (column H). Across project countries in Asia, the rates of change in the clinical prevalence of vitamin A deficiency (night-blindness or Bitot's spots) nationally range from –0.15 to –0.43 (Vietnam) to

* Also the following unpublished studies:

Aung P, Thein A (Ministry of Health, Myanmar). Myanmar. Case studies on nutrition intervention programmes of Myanmar. Presentation on Micronutrient Programs, INMU, Bangkok, June 2001.

Vijayraghavan K (National Institute of Nutrition, Hyderabad). Micronutrients in India. Presented at a workshop on "Successful Micronutrient Programs" held at the International Union of Nutritional Sciences, Vienna, August 2001.

TABLE 3. Iodine-deficiency control programs: types, timing, coverage, clinical indicators (total goiter rate)

A Country	B Intervention	C Period of program legislation	D Baseline goiter prevalence (year) [a]	E Goiter prevalence during intervention (year)	F Program coverage (year)	G Percentage point change/yr (time period)
Bangladesh	Iodized salt (current)	1995–current	11.3% (1981) 47.1% (1993)	NA	70% (1999) 55% (2000)	Not available
Cambodia	No program outcome data available. Iodized salt coverage estimated as 14% in 2000					
China	Iodized salt (current); iodized oil capsules (2000); iodine containers in wells (1997)	1994–current (testing of iodized salt began in 1956, with iodized salt in some areas in 1966)	20.4% (1995)	9.6% (1997) 8.0% (1999)	76% (1995) 91% (1999)	–5.4 (1995–97) –3.1 (1995–99)
India	No program outcome data available. Iodized salt coverage estimated as 70% (1995–2000)					
Indonesia	Iodized salt (current); iodized oil capsules to schoolchildren and young married couples (1987–current)	1986–current	27.2% (1980)	9.8% (1996)	58% (1996) 65% (2000)	–1.1 (1980–96)
Laos	Iodized salt (current); iodized oil capsules (1990–93)	1995–current (universal salt iodization program initiated in 1994)	24.9% (1993, North) 14.9% (1993, South)	9.1% (2000, North) 11.5% (2000, South)	71% (2000)	–2.3 (1993–2000, North) –0.5 (1993–2000, South)
Myanmar	Iodized salt (current)	1998–current (pilot program for iodized salt began in 1969, with acceleration of iodized salt program in 1996)	33.1% (1994) 25.1% (1997)	12.2% (1999)	53% (1999)	–4.2 (1994–99) –6.5 (1997–99)
Philippines	Iodized salt (current); iodized oil capsules to women of childbearing age (1993–95)	1993–current	0.8% (1987, boys) 0.6% (1993, boys) 6.4% (1987, girls) 4.8% (1993, girls)	Only urinary iodine excretion data available postprogram initiation	15% (1992–96) 22% (1999)[b]	–0.03 (boys, 1987–93) –0.27 (girls, 1987–93)
South Africa	No program outcome data available. Iodized salt coverage estimated as 62% (1998)					
Sri Lanka	Iodized salt (current)	1993–current (program for iodized salt came into operation in 1995)	18.8% (1989)	21% (2000)	48% (1995) 87% (2000)	+0.2 (1989–2000)

Thailand	Iodized salt (current); targeted iodinated water (current); targeted iodized oil capsules to pregnant women, women of childbearing age, and schoolchildren (current)	1994–current (pilot projects for iodized salt began in 1965 with expansion into national program in 1968)	9.8% (1993)	7.9% (1994) 5.7% (1995) 4.3% (1996) 3.3% (1997) 2.6% (1998) 2.2% (1999)	50% (1992–96) 74% (1999)	–1.9 (1993–94) –2.1 (1993–95) –1.8 (1993–96) –1.6 (1993–97) –1.4 (1993–98) –1.3 (1993–99)
Vietnam	Iodized salt (current)	1999–current	27.1% (1993–95) 14.9% (1998[c]	10.1% (2000)	72.8% (1998) 86.4% (2000)	–3.1 (1994–2000) –2.8 (1998–2000)

a. Goiter prevalence reported for Myanmar is for visible goiter rate, whereas for all other countries indicator reported is total goiter rate
b. Data source is Mason et al. [38].
Source: refs. 27–37; Mason et al. [38]; global micronutrient survey [39]; UNICEF [40]. Also Aung P, Thein A (Ministry of Health, Myanmar). Myanmar. Case studies on nutrition intervention programmes of Myanmar. Presentation on Micronutrient Programs, INMU, Bangkok, June 2001. Vijayraghavan K (National Institute of Nutrition, Hyderabad). Micronutrients in India. Presented at a workshop on "Successful Micronutrient Programs" held at the International Union of Nutritional Sciences, Vienna, August 2001.

–1.76 (Bangladesh) percentage points/10 years; Cambodia reports rates of –5.1 to –7.7 percentage points/10 years by regions. (Only the Philippines reported a slight increase in prevalence in subclinical indicators, as discussed in the next section.)

The decrease observed in clinical eye signs of vitamin A deficiency is, across project countries, in line with the trend demonstrated by a global assessment of trends in vitamin A deficiency (the prevalence of xerophthalmia, calculated by the sum of night-blindness and Bitot's spots, was the indicator used for assessing trends in vitamin A deficiency [38]), which compared the results of repeated national surveys available from 8 countries with a total of 35 data points across time (13 national surveys and 22 subnational surveys, irrespective of intervention programs). The trend was estimated as –0.84 percentage point/10 years for South Asia and –0.18 percentage point/10 years for East Asia and the Pacific region; the global average was –0.43 percentage point/10 years [38, table 6]. The results available here from the country reports are thus generally in the same range as the previous estimates.

Although the trend of observed improvement in clinical vitamin A deficiency is anticipated, the rate of change shown by project countries might be smaller than expected from the range of effect typically demonstrated by efficacy trials. A 1.6 to 4.7 percentage point decrease in the prevalence of xerophthalmia was demonstrated across efficacy studies at one year of follow-up. For night-blindness, the trials in Indonesia [8–11] showed a decrease of 0.87 percentage points over *one year* in the prevalence of night-blindness among the group supplemented with vitamin A, as compared with a decrease in the prevalence of night-blindness ranging from 0.17 to 1.76 percentage points per *10 years* for national vitamin A supplementation programs implemented. (The rate of change indicated by Cambodia is not included in the range stated here, as the values shown are extreme outliers and represent subnational estimates.)

Of the project countries having outcome data, Bangladesh shows a particularly strong decrease in the prevalence of vitamin A deficiency across time. The vitamin A–supplementation program appears likely to have contributed to this, with very high reported coverage. Vitamin A supplementation to children in Bangladesh began in 1973, but coverage at this time was not reported. The earliest data point that could be identified for the prevalence of night-blindness was 1982. At that time, 3.6% of children 6 to 59 months of age were reported to have clinical signs of night-blindness. A second data point for night-blindness was collected in 1999 and showed a prevalence of 0.6% for children 12 to 59 months of age. The rate of change is calculated as a decrease of 1.76 percentage points in prevalence per 10 years.

Bangladesh has achieved coverage of greater than

80% since the integration of supplementation with national immunization days. For the most recent year for which prevalence data are available (1999), coverage of 99% was reported. However, the full extent of the decrease in deficiency is probably related not solely to supplementation, but also to the underlying decreasing trend in prevalence seen in other countries without programs (or with lower coverage).

In Cambodia, small-scale implementation of vitamin A supplementation began in 1993. In 1995, distribution of capsules through national immunization days was pilot tested in eight communes, and by 1996, capsule distribution was fully integrated with national immunization days. During years in which the vitamin A supplementation was integrated with national immunization days, high coverage rates were achieved. From 1995 to 1998, more than 95% of the target coverage was reached for every year, with the exception of the year 1997, for which coverage rates reaching 90% of the target were reported. The high prevalence reported at baseline, together with the high rate of coverage obtained by the program twice yearly, supports the reported dramatic improvement in prevalence of vitamin A deficiency (table 2).

More common across project countries is a decrease in prevalence of around 0.5 percentage points per 10 years. Countries such as Indonesia and Vietnam (for 1988–1994) show rates of decrease of about this order. Although each of these countries has a fairly high program coverage, these are not as high as those achieved in Cambodia and Bangladesh. Indonesia, for example, reported coverage for the supplementation program as 66%. In 2000, Vietnam reported a coverage of 77% for the vitamin A program. Nonparticipants are likely to be the most remote and vulnerable.

India and Myanmar also show rates of decrease in clinical signs of vitamin A deficiency similar to those achieved in Indonesia and Vietnam, although in both of these countries, Bitot's spots is the indicator reported. Although Myanmar has reported especially high rates of program coverage (> 90% prior to integration with national immunization days and 99% in January 2000, when supplement distribution was integrated with national immunization days), the supplementation program in India has not achieved coverage rates of this magnitude. Although national program coverage data are not available for India, it appears, for example, that there was no state in which more than 40% of children received one dose of vitamin A in 1997. Given the marked difference in coverage between these programs, it is therefore interesting that a similar rate of decrease in Bitot's spots is indicated for the two countries. The similarity in the decrease in prevalence, despite the differences in program coverage, may again suggest that not all of the decrease in prevalence is attributable to program impact, but that an underlying improving trend is also present.

An interpretation of the efficacy data could be that when vitamin A capsules are provided under supervision, clinical vitamin A deficiency essentially disappears, and thus the rate of improvement is less important than the final prevalence. It is hard to judge with such low prevalences, but it seems plausible that clinical vitamin A deficiency was at significant levels in the baseline measurements (table 2, column E) and had reached lower levels, approaching zero, postintervention. What is less clear is how much of this was due to the underlying trend and how much to intervention. But given the combination of the high coverage data (fig. 1) and the known efficacy, at least in terms of clinical vitamin A deficiency, it seems plausible that, at a minimum, the vitamin A capsule programs hastened the improvement in clinical vitamin A status.

Impact of programs on biochemical indicators of vitamin A deficiency

The Philippines is the only project country for which the effectiveness of the national vitamin A–supplementation program can be assessed from biochemical data. In other countries for which two rounds of serum retinol data are available (China, Indonesia, South Africa, and Vietnam), the data are for subnational areas and, although useful for assessing program impact for those areas, do not provide a complete picture of the effectiveness of the national program. The national vitamin A–supplementation program consists of twice-yearly distribution to children one to five years of age. The program began in 1993 and was reported to reach high coverage (> 80%) by 1995 (when it was known as ASAP [Arawa ng Sangkap Pinoy, or national micronutrient day in Tagalog]). For children one to five years of age, the 1993 and 1998 data both showed a shift upwards in the distribution of serum retinol levels, when data from the no-dose group were compared with the pooled data from children one to six months after dosing. Thus, some program impact was apparent [32]. On the other hand, the estimated national prevalence of low serum retinol actually increased slightly, from 35% to 38%, over the period [41]. This presented a dilemma that required more complex analysis to unravel.

The data available come from the Food and Nutrition Research Institute, which implemented National Nutrition Surveys in 1993 and 1998, collecting serum retinol data [41]. Additional variables included the age and sex of the child, participation in the national supplementation program, the month when the vitamin A dose (200,000 IU) was received, the month of data collection, and child anthropometric measurements, as well as information on other health-related variables. Although the data were not originally intended for program evaluation, their availability provided an unusual opportunity to investigate the effectiveness of the vitamin A–supplementation program for children both marginally and severely affected by vitamin A deficiency. The results drawn on here include those presented at the International Union of Nutritional Sciences in 2001 [32] and the results of further analyses presented at the International Vitamin A Consultative Group in 2003.*

Some key results are shown in figure 2. Improvement in the prevalence of low (< 20 μg/dl) serum retinol levels was evident for the first two months after dosing, as compared with those in the survey who (for whatever reason) did not get a vitamin A capsule dose, shown by the top two lines in figure 2. The data also showed an increase in the mean serum retinol level from 22 to 25 μg/dl one month after dosing (3 μg/dl, a 14% increase); this was the only significant difference. The improvements in the prevalence of low serum retinol were comparable to the results seen in efficacy trials at two months (lower line in fig. 2, from Perlas et al. [22]). However, from about two months after dosing, the prevalence levels nearly returned to either the predose or the nondosed levels. The effects of supplementation on increasing serum retinol appeared more transient in the national results than in the efficacy trial. One possible explanation is the difference in the prevalence of deficiency prior to supplementation. Seasonality effects were also evident.

The national Food and Nutrition Research Institute data thus suggest a smaller effect of supplementation on serum retinol levels than that expected from the efficacy trial [22]. The protective period following dosage appears to be shorter-lived, with most of the effect disappearing one to three months after supplementation. Additionally, analysis according to age group showed that children under one year of age had the highest prevalence of deficient serum retinol and the lowest mean value of serum retinol. This difference was greater in 1998 than in 1993. This suggests that the increasing numbers of babies with serum retinol deficiency meant that the supplementation program for children one to five years old had a rising tide to stem.

Overall, the vitamin A capsule program in the Philippines may be effective in preventing a recurrence of clinical vitamin A deficiency, which is said to have virtually disappeared; but it is not apparently affecting the overall prevalence of subclinical vitamin A deficiency measured by serum retinol. These results are uncommon, since very few surveys of serum retinol have been repeated. The one other case identified in Asia, from Orissa and Andrha Pradesh in India [42], showed similar transient effects of vitamin A capsules on serum retinol: in Orissa a similar temporary fall in prevalence was observed one month after dosing, and in Andrha Pradesh there was no reduction.

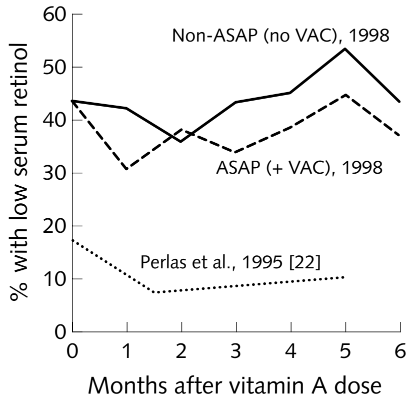

FIG. 2. Prevalence rates of low serum retinol (< 20 μg/dl), according to month after dose of vitamin A (200,000 IU), from the 1995 efficacy trial and the 1998 national ASAP (Arawa ng Sangkap Pinoy; National Micronutrient Day) program in the Philippines, with and without dose [22, 32].

Conclusions

The only data presented that allowed any comparison between groups receiving and not receiving vitamin A capsules were those from the Philippines on subclinical vitamin A deficiency. The clinical data from all other countries were obtained before and during supplementation, with no comparison group, so evaluation conclusions are tentative.

The clinical data showed that, in the most recent measurements, eye signs of vitamin A deficiency (night-blindness and Bitot's spots) were reaching very low prevalences of 0.1% to 0.7% (average, 0.6%), as compared with 0.4% to 5.6% (average, 1.8%) presupplementation (table 3, columns E and F). We do know that there is an underlying trend toward a decrease in clinical vitamin A deficiency, which has been observed both prior to and during the supplementation programs in other studies [3, 23]. The question is: What values would the clinical vitamin A deficiency prevalences have reached without supplementation?

Since coverage of vitamin A capsules was consistently reported as above at least 60%, it is clear that supplementation was successfully launched and sustained, even if some vulnerable groups remained to be reached. The efficacy data show that when vitamin A capsules are provided, usually twice yearly (under some supervision in trials), clinical vitamin A deficiency is almost abolished. Therefore it is reasonable on this basis to ascribe the very low levels of clinical vitamin A deficiency now observed in these countries at least in part to the vitamin A capsule programs. On balance, vitamin A capsule supplementation can plausibly be credited with helping in the near-elimination of clinical

* Madriaga JR, Pedro MRA, Barba CVC, Habito RCF, Deitchler M, Mason JB. The impact of the national vitamin A supplementation program on mean serum retinol and prevalence of subclinical vitamin A deficiency in Luzon, Visayas and Mindanao, Philippines. Poster presentation at International Vitamin A Consultative Group meeting, 2003.

vitamin A deficiency in these countries; but no doubt pockets of clinical deficiency persist.

The efficacy of vitamin A capsule distribution in raising serum retinol levels appears more variable (table 1). In the one case in which effectiveness could be studied in large-scale programs, in the Philippines, the effect of six-monthly doses of 200,000 IU of vitamin A to children one to five years of age at one to two months after the dose was modest, amounting to an increase in serum retinol of about 3 µg/dl (about 15%) and a reduction of 5 to 10 percentage points in the prevalence of serum retinol values below 20 µg/dl, from a prevalence of around 40% (fig. 2). The effect persisted for around one to three months, after which the serum retinol returned to predose levels. This means that over several rounds of repeated six-monthly doses, no established downward trend is to be expected, but rather fluctuations returning to predose levels each time. This is in line with the findings of an actual small *increase* in the prevalence over the period of program implementation [41].

It is uncertain whether the reduction of clinical and subclinical vitamin A deficiency resulting from the use of vitamin A capsules will be paralleled by a reduction in mortality, although the prevention of subclinical deficiency has been invoked as a mechanism for reducing mortality [15]. These results raise a question as to whether more frequent dosing (with other adaptations, such as targeting) would be advisable to ensure the intended impact on mortality (which has not been monitored). Modifications that could be considered include:

» Giving top priority to supplementation to the mother shortly after delivery, and promoting breastfeeding;
» Providing the supplement every three or four months to children one to five years of age;
» Reexamining whether children 6 to 12 months of age can be supplemented, directly or through blended food or sprinkles;
» Timing the mass supplementation program carefully in the light of seasonal effects;
» Providing other supplements.

Iodine

What is known from efficacy trials

The efficacy of iodine interventions (by lipiodol injection, oral supplement, or iodized salt) for the prevention of deficiency is well established by the results of numerous controlled trials [43–54]. In these, iodine has been shown to prevent the various health consequences of iodine deficiency by a reduction in the frequency of irreversible outcomes and/or by an improvement among those populations having reversible consequences. The range of impact observed varies, in part, with the severity of deficiency among the population. In those areas with endemic and more severe levels of iodine deficiency, provision of iodine would be expected to have a greater benefit in both efficacy trials and large-scale programs. In most cases, goiter prevalence has been a key indicator, and there is no doubt that iodine is efficacious in reducing the goiter prevalence in iodine-deficient populations.

However, the rate at which goiter—as the usual measure of iodine-deficiency disorders—is expected to decline with an effective salt iodization program is less well known. The World Health Organization (WHO) has established criteria for assessing the severity of the problem of iodine-deficiency disorders and monitoring progress [55]. A goiter prevalence of less than 5% would be regarded as indicating the absence of an iodine-deficiency disorder problem, and clearly this is the eventual goal. What is unsure is the rate at which this can be expected to be achieved by universal salt iodization.

Methods applied to country-level evaluation data

Clinical and biochemical data on iodine deficiency, along with data on program coverage, have been compiled for the 12 project countries (tables 3 and 4). As for vitamin A, iodine-deficiency data were selected to measure baseline and during-intervention prevalence, as best as possible. For these purposes, the year of adoption of iodized salt legislation was selected to mark the time of program initiation, although some countries already had efforts for iodized salt or other iodine–supplementation intervention efforts under way prior to program legislation. Although the year of adoption of legislation of iodized salt was fairly recent for countries such as Myanmar (1998), China (1994), Thailand (1994), and Vietnam (1999), all of these countries have had relatively longstanding efforts devoted to the control of iodine-deficiency disorders. Thailand, for example, launched its first pilot project on salt iodization in 1965, and Myanmar launched its first pilot program for the control of iodine-deficiency disorders (by means of iodized salt) in 1969. In China, iodized salt was tested at selected sites from 1956 onward. In addition, in Sinjiang, China, over 700,000 injections of iodized oil were provided between 1978 and 1981, and an additional 300,000 to 400,000 injections were provided in 1982 [1]. In the case of Vietnam, the date of initiation of iodized salt implementation could not be identified. However, it is clear from the coverage rates reported (table 2, column G, and table 3, column F) that large efforts for iodized salt were already under way before legislation was adopted.

For the prevalence data, goiter detected by palpation was the indicator used in almost all cases. Only for Bangladesh, China, Laos, and Vietnam were repeat surveys of urinary iodine excretion also available.

Coverage data for iodized salt programs were available for nearly all countries and were used for the year of "during-intervention" outcome data whenever possible. In most cases, the coverage data reported reflect the percentage of households using adequately iodized salt (as established by individual country standards for the iodine content of salt, usually > 15 ppm); the coverage data in tables 3 and 4 were shown graphically in the second paper in this series [56].

The rate of change in prevalence in percentage points per year was derived as follows:

$$\frac{\text{follow up prevalence} - \text{baseline prevalence}}{\text{follow up year} - \text{baseline year}}$$

Although the rate of change in prevalence (tables 3 and 4, column G) provides useful information about iodized salt programs at the country level, some caution should be taken before drawing conclusions about the impact of programs. First, as for other interventions, generally only data obtained before and during the intervention are available, without negative comparison groups.

Second, in most countries, only goiter rates are available (with the exception of Bangladesh, Laos, and Vietnam, in which urinary iodine is used also; China also has multiple rounds of urinary iodine excretion data available, but only data on median urinary iodine excretion values could be identified). Goiter has some drawbacks in terms of responsiveness to intervention and is a less preferred method of assessment of population iodine status [54, 57]. Moreover, assessment of goiter by palpation is regarded as a subjective means of assessing iodine deficiency. Low interobserver reliability is known to affect the results of goiter surveys, and the extent to which goiter is detected can be largely related to the level of training provided to the enumerators. An increase in goiter prevalence across time therefore may not reflect an actual trend in prevalence, but rather may be a consequence of improved training and more skilled detection of the manifestation of goiter.

The results of a recent national micronutrient survey in Nepal, in which palpation was compared with ultrasound of a subsample, highlight the questionable reliability of assessing goiter by palpation as a method of identifying iodine-deficient individuals [58]. The survey showed assessments of goiter by palpation and by ultrasound to be poorly correlated: for example, palpation showed a goiter prevalence of 57% and ultrasound a prevalence of 23% (although the cutoffs may not have been fully comparable).

Prevalence data from Bangladesh also illustrate the potential inconsistency in measurements of goiter by palpation. The increase in goiter prevalence rates reported for Bangladesh from 1981 (11.3%) to 1993 (47.1%) seems implausible. In this case, biochemical

TABLE 4. Iodine-deficiency control programs: types, timing, coverage, and biochemical indicators (urinary iodine excretion)

A	B	C	D	E	F	G
Country[a]	Intervention	Period of program legislation	Baseline prevalence of subclinical iodine deficiency[b] (year)	Prevalence of subclinical iodine deficiency during intervention	Program coverage (year)	Percentage point change/yr (time period)
Bangladesh	Iodized salt (current)	1995–current	68.9% (1993)	43% (1999)	70% (1999) 55% (2000)	–4.3 (1993–99)
Laos	Iodized salt (current); iodized oil capsules (1990–1993)	1995–current (universal salt iodization program initiated in 1994)	95% (1993)	26.9% (2000)	75.4% (2000)	–9.7 (1993–2000)
Vietnam	Iodized salt (current)	1999–current	84% (1993–95) 32.9% (1998)	31.2% (2000)	72.8% (1998) 86.4% (2000)	–12.8 (1993–95 to 1998) –0.9 (1998–2000)

a. China also has multiple rounds of urinary iodine excretion data available; however, only data on median urinary iodine excretion values could be identified.
b. Subclinical iodine deficiency is defined as urinary iodine < 10 µg/dl.
Source: ref. 29.

data are also available for trend assessment (see table 4), which seem to give more likely results, with an improving trend from 69% (urinary iodine < 10 μg/dl) in 1993 to 43% in 1999.

Evaluation findings

Impact of programs on clinical indicators of iodine deficiency

Given the established efficacy of salt iodization, a rapid improvement in the prevalence of iodine deficiency would be expected for those iodized salt programs successfully implemented at the country level. In a global review of progress in the control of micronutrient deficiencies [38], we observed substantial declines in the prevalence of iodine deficiency in several countries that had achieved improved rates of household utilization of iodized salt over the same time period. Bolivia, Peru, and Cameroon, for example, all demonstrated a rapid improvement in goiter prevalence, with wider consumption of iodized salt reported. Across the three countries, the rates of change were calculated to range from a 2.0 to 5.5 percentage point improvement in goiter prevalence per year of program implementation; the average for seven countries with time-series data showing improvement was 2.3 percentage points per year. The rates of change, as shown in column G of table 3, are generally in this range for countries with widespread and sustained iodized salt coverage.

The estimated rates of improvement in goiter prevalence vary from a decrease of 0.5 percentage point per year (Southern region of Laos) to a decrease of 6.5 percentage points per year (Myanmar) from national data. Vietnam, China, and Myanmar show the greatest impact. The rate of change for each of these countries is estimated as greater than a 2.5 percentage point decrease in goiter per year. Although both China and Vietnam showed rates of program coverage reaching around 90% (86.4% for Vietnam in 2000 and 91% for China in 1999), Myanmar reported a somewhat low rate of program coverage, with only 53% of households reported to have adequately iodized salt (> 15 ppm) in 1999. The rapid improvement in prevalence in Vietnam and China can therefore probably be explained by the wide program coverage achieved. Although the coverage rate reported for the iodized salt program in Myanmar seems somewhat low, the rapidly decreasing trend in prevalence for Myanmar could be attributed to complementary efforts that Myanmar has implemented for the control of iodine deficiency; these include control of iodine deficiency among schoolchildren by the use of iodinated drinking water.*

Sri Lanka is the only country reporting a possible increase in the prevalence of goiter since the adoption of legislation for iodized salt, from 18.8% in 1989 to 21% in 2000. Legislation for iodized salt was adopted in 1993, and the program for iodized salt came into effect in 1995. The rate of change of goiter prevalence is calculated as a slight increase of 0.2 percentage point per year. This can be attributed to several possible factors. As discussed earlier, increased effort on the part of enumerators to identify goiter is a possible explanation for the finding. In addition, Sri Lanka has relatively low program coverage; less than 50% of households in Sri Lanka are reported to use iodized salt [35]. Further, among those households consuming iodized salt, Sri Lanka, more than many project countries, reports difficulties with the quality of iodized salt. Although the minimum iodine content for salt is established by legislation, lack of strict quality-control measures has caused the iodine content of the salt available to vary over a wide range. A survey in 2000 was reported to give the iodine content of salt available in markets as varying from 5.3 to 418 ppm.

Impact of programs on biochemical indicators of iodine deficiency

Trends in urinary iodine excretion can be estimated from survey results in Bangladesh, Laos, and Vietnam (table 4). China has biochemical urinary iodine excretion data, but only median values were reported, preventing calculation of changes in prevalence. In addition to the urinary iodine data, each of these countries also has multiple rounds of national goiter data available.

In Bangladesh, data on goiter are available for 1981 and 1993, and on urinary iodine for 1993 and 1999. Legislation for iodized salt was adopted in 1995, although production of iodized salt had been initiated earlier. As mentioned before, the changes in goiter rate are considered implausible. The urinary iodine excretion data suggest marked improvements in iodine deficiency since legislation for iodized salt was adopted. The 1993 survey showed 68.9% of the population to have urinary iodine levels below 10 μg/dl, falling to 43% in 1999. Over the same time period, coverage of iodized salt increased from 20% in 1994 to 70% in 1999. It seems highly plausible that the salt iodization led to the decrease in low urinary iodine excretion and the improvement in iodine status.

The data available for Laos and Vietnam further suggest that impact was achieved with a successfully implemented iodized salt program. In Laos, there were eight major salt manufacturers and many small-scale producers. The primary salt manufacturers have the capacity to produce 90% of the salt required for the country, making importation of noniodized salt less of a problem than in other project countries. The program is well coordinated among ministerial sectors and international organizations, includes

* Aung P, Thein A (Ministry of Health, Myanmar). Myanmar. Case studies on nutrition intervention programmes of Myanmar. Presentation on Micronutrient Programs, INMU, Bangkok, June 2001.

information, education, and communication (IEC) activities as important program components, and implements routine monitoring to ensure the quality of iodized salt at the household level. Moreover, all data available for the program indicate high program coverage. Repeat data from two districts reported household utilization of iodized salt as 72% in 1996 and 96% in 1997–98. National program coverage for 2000 showed 94.3% of households to use iodized salt; 75.4% of these households had adequately iodized salt (> 15 ppm) when tested.

Data from Laos show a substantial decrease in the prevalence of iodine deficiency, as indicated by both goiter and urinary iodine data. In 1988, the baseline goiter prevalence was 25%; in 1993, it was 24.9% in the North and 14.9% in the South. The prevalence of urinary iodine less than 10 μg/dl in 1993 was 95%. The second round of national iodine-deficiency data was collected in 2000, five years after legislation for iodized salt had been adopted. The 2000 data showed goiter rates down to 9.1% in the North and 11.5% in the South; urinary iodine data indicated a marked improvement in the iodine status of the population, with 26.9% having urinary iodine less than 10 μg/dl. Iodized salt coverage for 2000 was reported as 75.4%.

In Vietnam, a high coverage of iodized salt was again related to an improving trend in iodine deficiency by both biochemical and clinical indicators. The most dramatic improvement appears to have occurred with the first efforts to iodize salt widely. Two periods were assessed: from 1993–5 to 1998, then 1998 to 2000. Goiter prevalence decreased from 27% to 15%, then 15% to 10% over this time. The prevalence of suboptimal urinary iodine excretion (< 10 μg/dl) decreased from 84% to 33%, then 33% to 31%. The rate of iodized salt coverage in 1998 was already high compared to that achieved by other countries: for 1998 it was reported as 72.8%, increasing to 86.4% in 2000.

Conclusions

From the country case studies and data available, it would seem that marked improvement in iodine deficiency occurs with programs that are well implemented. However, there are still examples of countries in which programs are not yet demonstrating a rapid improvement in signs of goiter, such as the Philippines, and no doubt some underserved areas in other countries are lagging. But overall, iodized salt is a resounding success story, bringing improved health and nutrition to millions of people

The rate at which goiter prevalence is reduced can be as high as 5 percentage points per year; the improvement seems fairly steady where repeated data are seen (e.g., Myanmar and Thailand), and the scarcer urinary iodine data support this. By the time iodized salt distribution reaches and remains at high coverage, goiter rates usually reach prevalences of 10% or less; but it may be that the last few percent reduction is indeed turning out harder to achieve.

Problems remain with coverage and quality control of iodized salt and the outreach to remoter and (usually) poorer areas.

Certain implications emerge for future monitoring and evaluation. Salt iodization is so easy to test, and so widely used, that it succeeds in giving a key indicator. Goiter prevalences are perhaps better than expected as a general measure in terms of responsiveness, and they have the important advantage of being widely available for baseline (or early in implementation) reference. They are, however, clearly very inaccurately assessed, and this needs to be improved either with better technology (e.g., ultrasound) or more standardized training. Measurement of urinary iodine is not as widely available and also has the drawback that it assesses current intake; in this respect, the value that it adds to salt iodine testing may not be so great.

None of these tests measure the functional consequences of the deficiency; goiter itself can be innocuous. This argues for wider application of testing for thyrotropin in newborns (usually performed on cord blood, for which rapid immunoassay methods are now available). Perhaps more stress should be on this approach, complementing salt iodine testing.

Finally, in countries with low program coverage, there are likely to be large pockets of individuals particularly vulnerable to iodine-deficiency disorders. Because of the serious risk of damage in utero, in some instances complementary measures for the control of iodine-deficiency disorders may need to be considered until higher program coverage of iodized salt can be achieved. Targeting women of childbearing age or pregnant women with oral iodine supplementation, either as a single large dose of iodized oil, or in multiple micronutrient supplements provided as part of antenatal care, may be warranted in places where iodized salt may not yet be readily available or utilized.

Iron

What is known from efficacy trials

The results from a number of recent iron-supplementation trials were compiled by Beaton and McCabe [59], in which data from eight controlled trials providing iron supplementation to pregnant women were reanalyzed to study the efficacy of weekly vs. daily supplementation. For all of the trials, there were two treatment groups: one receiving weekly and one receiving daily iron tablet supplementation (except for the trial in China, which had a third study group that received a higher dose of iron). The results of the studies (table 5) are interesting here for consideration

TABLE 5. Effects of iron supplementation on anemia in pregnant women

Location of study	Target group	Anemia criterion (blood hemoglobin concentration in g/L)	Dosing schedule	*n*	Baseline prevalence (%)	Final prevalence (%)
Korea	Pregnant women	110	Weekly	13	38.5	15.4
			Daily	10	70.0	10.0
Malawi	Pregnant women	110	Weekly	102	63.7	62.7
			Daily	112	62.5	51.7
Maluku	Pregnant women	110	Weekly	199	25.6	24.1
			Daily	200	29.5	15.0
Bangladesh	Pregnant women	110	Weekly	74	50.0	20.0
			Daily	66	42.0	14
China	Pregnant women	110	Weekly	117	41.0	18.0
			Daily	64	39.0	22.0
			Daily, high-dose	56	45.0	28.0
Guatemala	Pregnant women	110	Weekly	54	27.0	24.7
			Daily	54	27.0	16.1
Mexico	Pregnant women	120	Weekly	39	10.3	20.5
			Daily	36	22.2	2.8
West Java	Pregnant women	110	Weekly	71	76.1	56.3
			Daily	68	66.1	45.6

Source: reprinted from Beaton and McCabe [59], p. 52.

of the possible sizes of effects with supervised iron supplementation.

In all eight studies, daily iron supplementation to pregnant women resulted in an improvement in anemia prevalence from baseline to post-intervention. The extent of the impact demonstrated varied widely across studies. The decrease in anemia prevalence from baseline to follow-up ranged from 10.8 percentage points (Malawi) to 60 percentage points (Korea). The criterion of anemia in all studies on pregnant women was defined as hemoglobin 110 g/L, with exception of the study in Mexico, which used 120 g/L as the criterion. The 60 percentage point improvement in anemia observed in Korea was exceptional; no other study included in the review showed an improvement in anemia prevalence by more than 30 percentage points. In general, the more controlled studies showed a higher rate of improvement in anemia from baseline to post-intervention. The trials conducted in Maluku, China, and Mexico, for example, were all tightly controlled; high compliance for the regimented dosing schedule among the participants would therefore be expected. In the case of the Malawi study, very few controls were implemented in the study design, and likewise, the difference in anemia prevalence from baseline to follow-up was the lowest (10.8 percentage points) for all the intervention trials reviewed. A consistent pattern of improvement in anemia was clearly observed in all studies for those groups provided with iron supplementation. Among the groups treated with daily supplementation, the median and mean decreases in anemia prevalence were 17 and 19.7 percentage points (excluding Korea, with a mean 60 percentage point decrease, regarded as an outlier).

From these and many earlier studies (reviewed extensively by Viteri [60]), substantial improvement in anemia prevalence is expected from daily (or weekly) ingestion of iron supplements by pregnant women, and probably greater improvement from ingestion of iron supplements by nonpregnant women. In theory, similar decreases could be achieved from a wide-scale program, although it is likely that under less controlled conditions a slower rate of improvement would be seen, even for those programs generally successfully implemented. In fact, much less is known about the extent to which large-scale iron-supplementation programs demonstrate effectiveness. Among countries, lack of data and limited capacity for program monitoring often preclude drawing firm conclusions about the effectiveness of iron-supplementation programs. In many cases, prevalence data cannot be linked to programs implemented, and it is often difficult to assess program participation. In countries located in subtropical areas, there are complications in assessing the prevalence of anemia caused by iron deficiency. Recent analysis of anemia data concluded that there was little evidence for overall change in the populations of developing countries, although direct trend estimates from surveys are very scarce [38, 61].

Iron-supplementation programs have the added problem of monitoring tablet compliance among program participants. Because these programs are designed to provide regular supplementation (usually daily) to women throughout pregnancy, the extent of the impact achieved would be expected to be related, in part, to the number of tablets a woman takes during pregnancy. There is, however, no easy or routine way to monitor daily consumption of iron tablets by pregnant women participating in a program of national scale.

Of the project countries, Vietnam and Thailand have the most comprehensive data on iron-supplementation programs. Although several other project countries have at least two rounds of anemia data available, the prevalence data cannot usually be linked to the programs implemented. Lack of process data and of knowledge of the underlying trends limits the possibility for evaluation analysis across countries. Even in the case of Thailand and Vietnam, complete data are not available. Given, however, that both countries have some process data available, various sources of data on anemia prevalence, and some information on program coverage, an assessment of program effectiveness for these countries has therefore been undertaken. The preliminary findings for each of these countries are discussed below.

Evaluation findings

Assessment of program effectiveness in Thailand

In Thailand, the main strategy implemented for the control of anemia among pregnant women is daily supplementation with iron/folate tablets [36]. The policy for supplementation recommends that pregnant women be provided with iron tablets from their first appearance at the antenatal clinic through four to six weeks postpartum. The main mechanism for program delivery is through the health-care system, with community health workers (village health communicators and village health volunteers) playing an important role in encouraging pregnant women to visit health centers for antenatal care and prophylactic iron supplementation. Although limited attention has so far been given to assessing the effectiveness of the iron-supplementation program, data on anemia and access to health services are available from various sources and can provide useful information about program effectiveness. Data on the prevalence of anemia are available from nationally representative surveys (1986 and 1996–97) and from surveillance data collected at health centers. However, the data available do have limitations for assessing program effectiveness. It is possible, for example, that the sampling design of the surveys may have been influenced by an over- or underestimation of the prevalence reported for anemia. For the national survey, the hemoglobin of pregnant women was measured in sampled households, which were defined by the presence of children under five years of age; in the case of surveillance data, hemoglobin was measured in areas with more sophisticated health services available, therefore probably resulting in an underestimation of the prevalence of anemia. In addition, none of the available anemia prevalence data could be disaggregated by gestational age. It is therefore unclear how accurately the prevalences reported reflect the extent of the problem.

Data on coverage of antenatal care are also available, but limited. Due to inadequate capacity for monitoring of program coverage, a proxy indicator of antenatal-care coverage is used, defined as the number of antenatal-care visits made during pregnancy, with four or more visits throughout pregnancy recommended as optimal. Using antenatal visits as a proxy for program

TABLE 6. Time-series data on anemia prevalence among pregnant women

Country	Iron-supplementation program implemented	% Prevalence of anemia (year)		Percentage point change in prevalence
		Time 1	Time 2	
Bangladesh	Iron/folate tablets to pregnant women twice daily and through 1st 6 mo of lactation	77 (1981)	49.2 (1997)	–27.8
Indonesia	Iron, folate, sugar, and vitamin C tablets to pregnant women	50.1 (1991)	50.9 (2000–01)	+0.8
Myanmar	Iron/folate tablets to pregnant women twice daily during 3rd trimester	58.1 (1993)	58.0 (1995)	–0.1
Philippines	Iron/folate tablets to pregnant women	43.6 (1993)	50.7 (1998)	+7.1
Thailand	Iron/folate tablets to pregnant women	27 (1988)[a] NE: 39 (1986)[b] SE: 48 (1986)[b]	17 (1999)[a] NE: 27 (1996–97)[b] SE:13 (1996–97)[b]	–10 –12 –33
Vietnam	Iron/folate tablets to pregnant women	53 (1995)	32 (2000)	–21

a. Data from national nutritional surveillance system.
b. Data from national surveys, with illustrative results by region (NE, Northeast; SE, Southeast) shown.
Source: refs. [27,30, 36, 41] and Aung P, Thein A (Ministry of Health, Myanmar). Myanmar. Case studies on nutrition intervention programmes of Myanmar. Presentation on Micronutrient Programs, INMU, Bangkok, June 2001.

coverage assumes, however, universal supplementation to all women receiving antenatal care during pregnancy and, therefore, could to some extent result in an overestimation of coverage achieved.

An improving trend in prevalence among pregnant women is evident from the available data (table 6). The two most recent national surveys (1986 and 1996–97), for example, show a decline in the prevalence of anemia among pregnant women.

Over the period of 10 years, a substantial and important decline in anemia prevalence was estimated for each region. Anemia prevalence among pregnant women in the Central/East, North, Northeast, and Southern regions of the country declined from 32% to 12 %, 42% to 8 %, 39% to 27 %, and 48% to 13 %, respectively. Other data support the conclusion of a decrease in prevalence indicated by the national data. Surveillance data show a decline of about 10 percentage points, from 27 percent to 17 percent, between 1988 and 1999. In addition, small research studies have shown that the severity of anemia among pregnant women has also declined. Moreover, an improving trend in attendance at antenatal clinics is also evident over time, with a high rate of antenatal coverage achieved in recent years. It is reasonable to suggest, although this is not proven, that part of the improvement may indeed be due to the iron-supplementation program.

The trend in anemia prevalence can be determined from data available on other demographic groups. Data on anemia prevalence among men and young children should indicate the underlying trend in anemia status, since no programs for these groups are yet implemented in Thailand. For men, two rounds of Health Examination Surveys (1991 and 1996–97) are available. For each region, the prevalence of anemia decreased across time; for two of the five regions, the decrease was substantial, amounting, for example to 20 percentage points in the Central-East region. The decreases for these groups (not targeted for iron supplementation) are in the same range as those for pregnant women. This casts some doubt on the effect achieved by the iron-supplementation program alone.

Assessment of program effectiveness in Vietnam

As in Thailand, the main strategy for the control of iron-deficiency anemia in Vietnam is providing daily iron tablet supplementation to pregnant women [37]. The program for iron supplementation was implemented in 15% to 20% of the country in 1995 to 2000. Programs for weekly supplementation to groups such as children and adolescents 6 to 15 years old, nonpregnant women 15 to 35 years old, and infants and children are also implemented in selected areas, but these interventions are still in the pilot testing phase. The protocol for the iron-supplementation program recommends daily iron tablets to be taken by pregnant women from first presentation at the antenatal clinic to one month after delivery. Although the capacity for program monitoring and supervision is reported to be limited, some data are available for crude assessment of the extent of the impact that may have been so far achieved.

Nationally representative data on anemia prevalence are available from a 1995 national anemia and nutrition risk survey and a national survey launched in 2000. As seen in Thailand, a strong improving trend in anemia prevalence is observed among pregnant women. In Vietnam, anemia prevalence rates of 52.7% and 32.2% were reported for pregnant women for the years 1995 and 2000, respectively, a 20.5 percentage point decrease in five years. Although other demographic groups also show a decrease in anemia prevalence across years, in this case for no other groups is the decrease as substantial. For nonpregnant women, children 0 to 60 months of age, and men, the respective decreases in anemia prevalence from 1995 to 2000 were reported to be 15.9, 11.2, and 6.3 percentage points. From this perspective, the more substantial decrease in anemia among those groups for which supplementation programs are implemented might indicate some program impact. Unfortunately, the program coverage data do not support this conclusion. From 1995 to 2000, a substantial *decrease* in program coverage was observed. Whereas 425,000 women were targeted for iron supplementation in 1995, less than 10% of that number (40,000) was targeted in 1996. Likewise, the number of provinces, districts, and communes to benefit from the program showed a pattern of similar decline between the years 1995, 1996, and 2000.

The conclusion for Vietnam (as for Thailand) has therefore to be that the decrease in anemia was probably real, but without better evaluation it is not possible to ascribe this to the supplementation program. Certainly part was due to a nonprogrammatic underlying trend.

Results from other countries

The limitations of the data available for evaluation of the iron-supplementation program in Thailand and Vietnam are common to most countries with national programs. In fact, other countries with programs for iron supplementation to pregnant women often have substantially fewer data available for assessment of program effectiveness. Of the project countries, Bangladesh, Myanmar, Indonesia, and the Philippines have data on anemia among pregnant women available for recent years (table 6), but few other data on the program.

Bangladesh shows a substantial decrease in anemia prevalence; an improvement of more than 27 percentage points among pregnant women, from 77% to 49%, was reported from 1981 to 1997. In Myanmar, Indonesia, and the Philippines, on the other hand, the rate of anemia among pregnant women appeared stagnant across time, despite implementation of national iron-supplementation programs. In Myanmar the rate of anemia remained at about 58% from 1993 to 1995; in Indonesia it remained at roughly 50% from 1991 to 2001; and in the Philippines it increased from 43.6% in 1993 to 50.7% in 1998. The lack of improvement probably stems from difficulties common to program implementation, as well as lack of change in the underlying prevalence of anemia.

Conclusions

The rate of improvement demonstrated by the efficacy studies compiled for the Beaton and McCabe [59] review thus appear larger than those seen at the program level, even when some improving trends are seen (as in Bangladesh, Thailand, and Vietnam). Improvements of the magnitude of 20 percentage points are rarely observed, and in those cases when such change across time is indicated, the effect can rarely be confidently attributed to program intervention. The lack of firm conclusions that can be drawn about program effectiveness highlights the importance of increased efforts to improve capacity for program monitoring and evaluation. Comparable surveys on anemia prevalence among supplemented groups in program and nonprogram areas, and data on program coverage across time and use of antenatal services, are essential for strong conclusions to be made about the effectiveness of programs. Information about the time of gestation on the date of blood collection and about tablet compliance would further help to elucidate the extent to which iron-supplementation programs are benefiting targeted populations, although such data are more difficult to obtain.

Summary of lessons learned on micronutrient-deficiency control program effectiveness and associated recommendations

Program evaluation

Micronutrient-deficiency control programs have been greatly extended at the national level in the last 10 to 15 years. However, rigorous evaluation of these is scarce, so that conclusions on impact are tentative and based mainly on indirect evidence.

The effects of programs need to be distinguished from underlying trends of improvement in population nutritional status. This underlying improvement is probably occurring for clinical vitamin A deficiency, but probably not for iodine and iron deficiencies (i.e., in the absence of intervention). Nonetheless (see below), taking account of this, it is plausible that twice-yearly distribution of vitamin A capsules, which has attained high coverage in most of the countries studied, has contributed to the near-elimination of clinical vitamin A deficiency in children, and that the use of iodized salt has brought goiter rates steadily down in the general population. For anemia, however, where significant improvement over time is seen (which is uncommon but may be occurring in Bangladesh, Thailand, and Vietnam), the existing information is insufficient to allow the trend to be ascribed to intervention, and there is evidence of improving trends in Thailand and Vietnam that are not due to iron programs. For all deficiencies systematic prospective evaluation is urgently needed.

Intervention efficacy

Efficacy trials have demonstrated that high-dose vitamin A supplementation of children results in significant reductions in the prevalence of clinical vitamin A deficiency.

Studies in India, Indonesia, the Philippines, and elsewhere have demonstrated that vitamin A supplementation is efficacious for the prevention and treatment of xerophthalmia: twice-yearly supplementation has resulted in a reduction of clinical vitamin A deficiency to nearly zero (down by 1 to 5 percentage points). The results for subclinical vitamin A deficiency are uncommon; and those available give equivocal results.

Many trials have demonstrated the efficacy of iodine supplementation in reducing the prevalence of goiter and other signs of iodine-deficiency disorders and improving population iodine status.

Mechanisms of supplementation tested include lipiodol injections, oral iodized oil supplementation, and iodization of salt. The results of the studies indicate efficacy for the prevention of cretinism, improvement of psychomotor skills and cognitive development, and prevention and treatment of goiter. Study countries in Asia include China, India, Indonesia, and Papua New Guinea.

Trials have demonstrated the efficacy of iron tablet supplementation in reducing anemia prevalence.

The mean reduction of anemia prevalence was roughly 20 percentage points with daily supplementation. The study countries included Indonesia, Malawi, China, and Korea. The magnitude of improvement appears to be associated with the extent of supervision of adherence to dosing regimes in the studies, indicating that efficacy is linked to the degree of participant compliance with the dosing regime.

Coverage of national programs

The coverage of vitamin A capsule distribution programs has exceeded 70% in most study countries (Bangladesh, *Myanmar, Philippines, Vietnam, and Laos).*

Only India (40%), Indonesia (66%), and Cambodia (63%) were estimated to have lower rates of coverage of vitamin A capsules. The utilization of national immunization days as the foundation for campaign-style programs accounts to a significant degree for the high coverage rates achieved. Coverage estimates derive in large part from program-monitoring data.

In countries implementing national iodized salt programs, the coverage reaches 60% to 90% of households with adequately iodized salt.

Quality control, maintaining coverage, and further measures to reach underserved populations should become the current priorities. Coverage estimates are normally based on testing for the level of salt iodization in households in sample surveys.

Of the three micronutrients, coverage of iron tablet supplementation is the least well documented due to inadequate program-monitoring systems, lack of population survey data, and lack of accurate estimates of adherence to the dosing regimen.

Only two countries have reasonable monitoring systems. Vietnam indicates a coverage level of 15% to 20% of the country, and coverage is reported to be quite high in Thailand based upon estimates of antenatal-care attendance.

National program effectiveness

Vitamin A capsule supplementation of children 6 to 59 months of age has plausibly contributed to the reduction in clinical vitamin A deficiency and its near-elimination in many countries (fig. 3).

The national rate of decline in measured night-blindness in project countries in Asia ranges from –0.15 percentage point per 10 years (Vietnam) to –1.76 percentage points per 10 years (Bangladesh). Although the level of impact appears to be less than in controlled trials, it is in the range of 0.5 percentage point per 10 years. This rate depends on contextual and program factors such as high baseline prevalence and high program coverage. Both of these factors may account for the exceptionally high impact seen in Cambodia (–7.7 percentage points per 10 years) and Bangladesh (–1.76 percentage points per 10 years). Most countries have multiple programs implemented (see the previous article in this issue on Implementation), so the synergistic effects of multiple intervention strategies (combined with the usage of national immunization days as the mechanism for delivery of vitamin A capsule) may account in part for the impact seen.

The impact of vitamin A capsule supplementation on children's biochemical vitamin A status (serum retinol) in national programs may be lower than the impact on clinical vitamin A deficiency.

Limited research from national programs in the Philippines indicates that the impact of supplementation on serum retinol levels is of shorter duration than the impact on clinical signs of deficiency. This would in part explain the slight *increase* in subclinical vitamin A deficiency in the Philippines during implementation of vitamin A capsule programs. The collection of biochemical and clinical data in the same subjects would contribute to the clarification of the nature and extent of impact to be expected from supplementation. Additionally, more research is needed to evaluate the relative benefits of alternative dosing regimens (e.g., two times vs. three times a year). Similar results and conclusions were reached in a recent study in India [42].

National data on salt iodization show a consistent reduction in the prevalence of iodine-deficiency disorder symptoms (e.g., prevention and treatment of goiter); the rates of cretinism and other results of iodine deficiency are almost certainly falling too (fig. 4).

At the population level, the most common mechanism for providing iodine is salt iodization. This has largely superseded the use of iodized oil, given orally or by injection. The data for study countries indicate a steadily improving trend in the prevalence of clinical iodine-deficiency disorders, consistent with a dramatic global trend of decreased prevalence of iodine-deficiency disorders with the implementation of national salt iodization programs (reductions in goiter prevalence of 20 to 54.5 percentage points per 10 years). There is enormous variation in the improvement in the prevalence of iodine-deficiency disorders among study countries, from 0.5 percentage point per year (Southern region of Laos) to 6.5 percentage points per year (Myanmar). Vietnam, China, and Myanmar showed improvement of greater than 2.5 percentage points per year. Variation in prevalence estimates is likely to result in part from measurement error: increased awareness of the value of monitoring of goiter is thought to result in higher estimates, leading to spurious conclusions of increased goiter prevalence.

The evaluation of the impact of salt iodization programs on biochemical iodine status is limited by a lack of data (and a lack of urinary iodine data linked to program data).

The impact of salt iodization on both clinical and biochemical indicators (urinary iodine excretion) can be measured only for Bangladesh, Laos and Vietnam. The prevalence of low urinary iodine has declined at a rate of 4.3 percentage points per year in Bangladesh and 10.2 percentage points per year in Vietnam. Laos has also exhibited a very sharp decline of 9.7 percentage points per year. In the case of Bangladesh, the data suggest an encouraging trend in the prevalence of

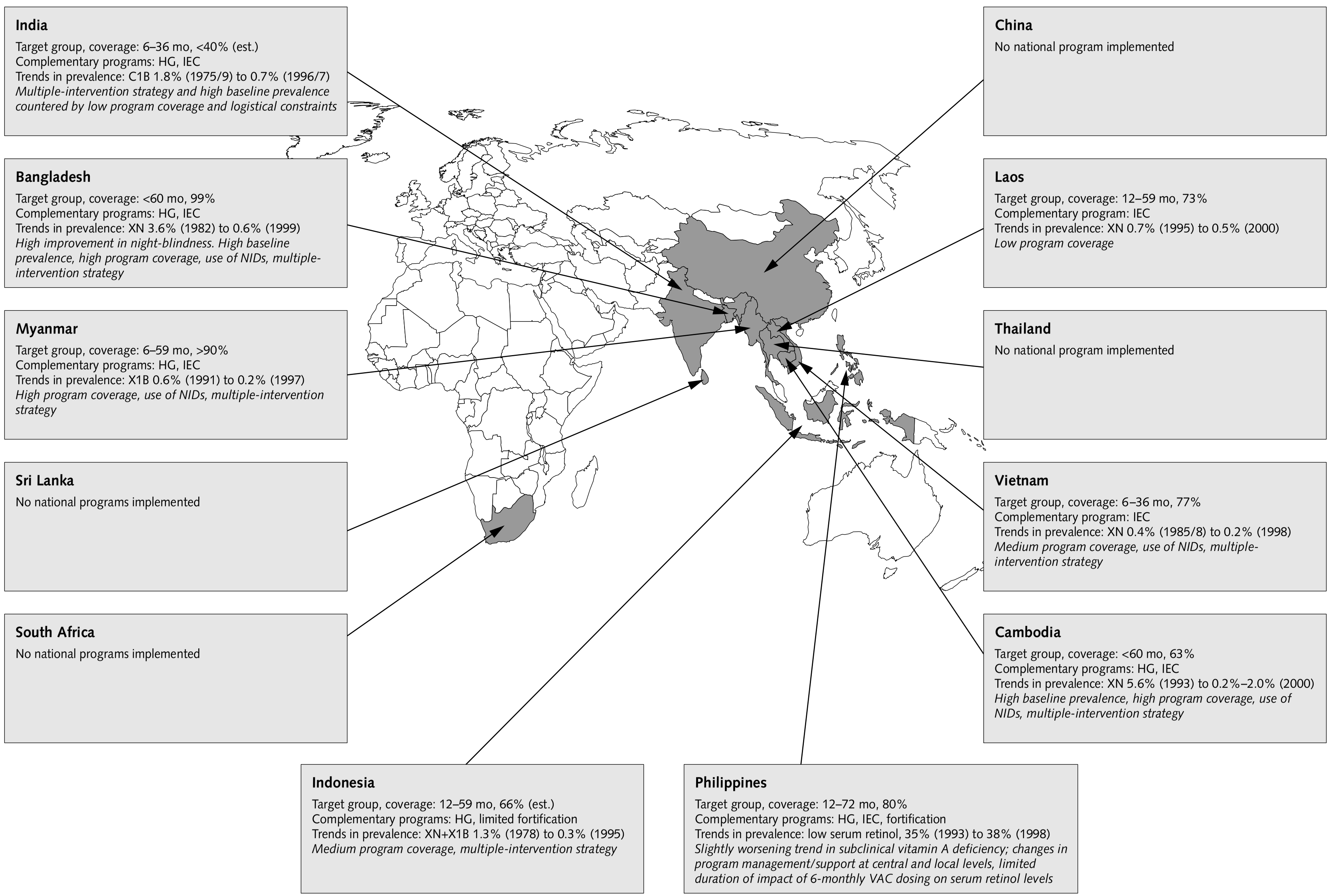

FIG. 3. Impact on vitamin A deficiency of national-level distribution of vitamin A capsules (VAC) to children. HG, Home gardening; IEC, information, education, and communication; XN, night-blindness; X1B, Bitot's spots; NID, national immunization day. Data for subclinical vitamin A deficiency are provided for the Philippines.
Source: refs. 27–37. Also Aung P, Thein A (Ministry of Health, Myanmar). Myanmar. Case studies on nutrition intervention programmes of Myanmar. Presentation on Micronutrient Programs, INMU, Bangkok, June 2001. Vijayraghavan K (National Institute of Nutrition, Hyderabad). Micronutrients in India. Presented at a workshop on "Successful Micronutrient Programs" held at the International Union of Nutritional Sciences, Vienna, August 2001

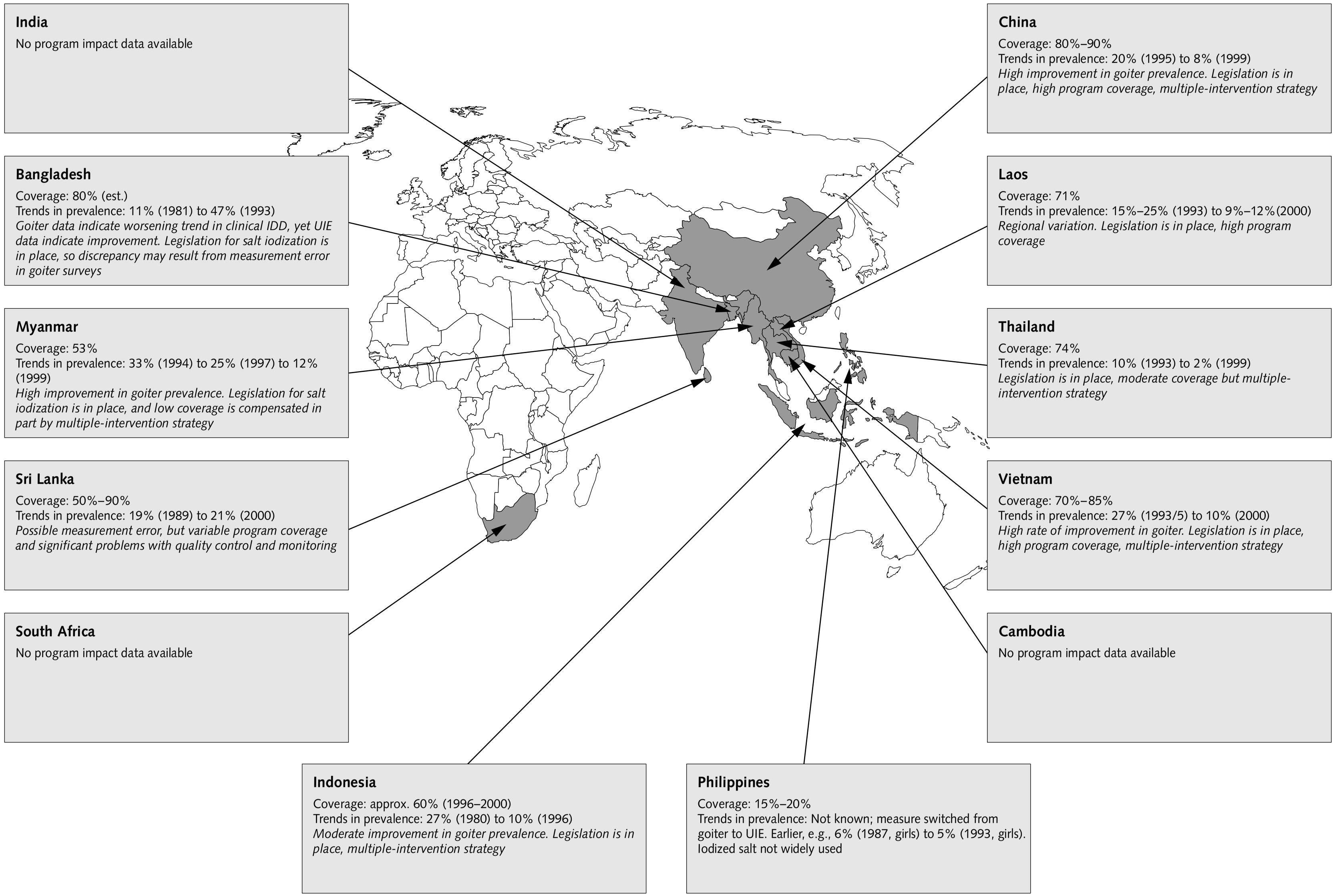

FIG. 4. Impact on iodine-deficiency disorders (IDD) of national-level iodization of salt. Coverage refers to the percentage of households using iodized salt. Prevalence refers to the percentage of the population with goiter. UIE, urinary iodine excretion.
Source: see table 3.

iodine-deficiency disorders, in contrast to a worsening, and quite possibly spurious, trend shown by the goiter data.

Although trials have demonstrated the efficacy of iron supplementation in reducing the prevalence of anemia, the interpretation of national-level data is not so clear.

The rate of improvement would be expected to be less in national programs than in controlled trials because of reduced adherence to daily (or weekly) dosing protocols in the community setting. In terms of evaluating national program effectiveness in reducing anemia, only Thailand and Vietnam have anemia prevalence and program coverage data available. In Thailand, daily supplementation of pregnant and postpartum women appears to have been associated with a substantial decline in anemia prevalence (of 1 to 3.5 percentage points per year in different regions of the country). However, data from men and from children under five years of age suggest a comparable trend in anemia improvement. This calls into question the degree to which improvement among pregnant and lactating women can be attributed to program impact. In Vietnam, the data suggest that populations (pregnant women, nonpregnant women, and children under five) showed lower prevalence rates of anemia. However, the data available do not allow the conclusion to be drawn that the differences result from program impact. Anemia data across other study countries suggest that anemia—unlike clinical vitamin A deficiency and clinical iodine-deficiency disorders—is not showing marked improvements, but remains high. This may be due to common constraints to program initiation (see Part I in this issue) and implementation (see Part II in this issue), or to changes in other determinants of anemia. Perhaps even more than vitamin A deficiency and iodine-deficiency disorders, priority is needed on monitoring and evaluation of national iron-deficiency control, to better understand how anemia may be reduced in vulnerable population groups.

Next steps in evaluation

Given the substantial financial and technical commitment required to implement national micronutrient-deficiency control programs, it is vital that investment enable the evaluation of the impact of these programs.

Although further development of systems for monitoring program coverage is necessary in the study countries, even coverage data are inadequate to monitor program impact. Collection of process and outcome data, particularly through representative sample surveys and program-monitoring systems, is required for the assessment of a program's effects. Research on noninvasive methods of assessment (for anemia and subclinical vitamin A deficiency) for use in routine surveys would be helpful for this.

The prevalence of clinical manifestations of micronutrient deficiencies—including vitamin A deficiency (xerophthalmia) and iodine-deficiency disorders (goiter)—is in sharp decline in many countries. As a result, it is becoming increasingly important to collect data on subclinical deficiency (e.g., biochemical data) to assess program impact.

The collection of multiple rounds of national serum retinol or urinary iodine data is infrequent. These indicators will increase in importance for evaluation as the nutritional status of populations improves and the effects of deficiency are largely subclinical. More research is required to clarify the utility and interpretation of biochemical indicators for impact assessment.

Global trends in micronutrient deficiency data indicate possible secular trends of improvement.

The widespread reduction in the prevalence of clinical vitamin A deficiency, as well as the reduction of anemia in program and nonprogram groups in Thailand (and probably Bangladesh and Vietnam), highlights the importance of differentiating secular (non-program-related) trends from program impact. Because such trends may coincide with program implementation, the design of evaluation studies needs to make comparisons of groups before and after intervention, and with and without intervention, to estimate the effect attributable to program participation.

In conclusion, the clearest evidence of program effectiveness is found with salt iodization.

The national-level implementation of salt iodization programs, with adequate provision for salt accessibility and consumption, is associated in study countries with an often sharp reduction in the prevalence of iodine-deficiency disorders. The effectiveness of vitamin A supplementation in the reduction of clinical vitamin A deficiency is likely, but its effectiveness on biochemical indicators of vitamin A is unclear. Additionally, the anticipated phaseout of national immunization days following the virtual eradication of polio calls for more targeted research on alternative and effective intervention models. Finally, evidence on the effectiveness of iron-deficiency programs, specifically iron tablet distribution, is inconclusive because of lack of accurate coverage data and evidence that improvements in iron status may be due to improved living conditions where data are available (Vietnam and Thailand).

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Summaries of country case studies

John Mason, Ellen Mathys, and Megan Deitchler, editors

The following are summaries of country case studies that were presented at a workshop on "Successful Micronutrient Programs" held at the International Union of Nutritional Sciences, Vienna, August 2001. The complete texts of the case studies are available at www.inffoundation.org. No summaries or texts are available for the case studies from India and Myanmar.

1. Bangladesh

Fighting micronutrient malnutrition in Bangladesh: Progress made over the past decade

M. Hossain and T. Hussain

In the past decade, Bangladesh has made substantial improvement in food production. However, people still suffer from imbalance in nutrient intake, characterized by protein and micronutrient deficiencies. From 1991 to 1999, among children under five years of age, the prevalence of stunting decreased from 71% to 55%, and the prevalence of underweight decreased from 72% to 61%. Women had, in 1991–1999, an average pregnancy weight gain of less than 6 kg. Over half of the adult population was undernourished during this time, with 10% suffering from severe malnutrition.

The government operates nationwide programs for the control of vitamin A deficiency, iodine-deficiency disorders, and iron-deficiency anemia. However, control of iron-deficiency anemia is still unsatisfactory. Vitamin A deficiency was a huge problem, with 3.6% of children six to nine months of age having nutritional blindness during 1982–83. In 1999, the prevalence of nutritional blindness was 0.3%, and vitamin A capsule distribution coverage was almost 100%. However, some children (22%) still have low (< 20 μg/dl) serum retinol concentrations, and 2.7% of lactating mothers and 1.7% of nonpregnant, nonlactating women have night-blindness. The rate of usage of iodized salt is satisfactory (> 85%). However, a substantial number of poor and uninformed people still use cheaper noniodized salt, which comes through illegal importation from neighboring India. Iron-deficiency anemia in Bangladesh is estimated to cause an annual loss equivalent to 2% of the gross domestic product. Although recent nationally representative data on iron-deficiency anemia control programs are not available, a 1997 report concluded that 49% of pregnant women and 53% of preschool children were anemic. Because of programmatic difficulties in the current methods of iron distribution and patient compliance, the emerging food-fortification technology may be a good alternative. However, wheat flour as a food vehicle will not be a universal choice here; the possibilities for rice or potato need to be investigated.

Bangladesh has positive cultures, policies, programs, and institutions to support breastfeeding. Prolonged breastfeeding up to the second year of life is common (97%); but both early and late starting of complementary feeding are still problems. The rate of exclusive breastfeeding in the first six months is 55%; some infants (22%) are given only liquids or rice water in addition to breastmilk, while 6% receive

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no complementary food at all. Despite reasonable achievements to solve various nutritional problems, Bangladesh still shows the highest level of malnutrition in the world. Therefore, the country needs large-scale studies to get a clear picture of the dimension and nature of the nutritional problems. Capacity building of the existing nutrition institutions of the country is urgently needed. There is an opportunity for the whole world to learn from Bangladesh through working with the local institutions.

2. Cambodia

The micronutrient-deficiency control program in Cambodia

O. Poly

Interventions to address micronutrient deficiencies are somewhat recent in Cambodia, with broad application of micronutrient interventions dating from the mid-1990s. Experience is still being gained from implementation of iodized salt, vitamin A, and iron supplementation interventions in Cambodia. Some data are available for assessment of program coverage or impact.

Efforts to establish a national program to address iodine deficiency began largely in response to documentation of the extent of the problem. The results from the first national goiter survey (1996–97) indicated that 17% of children 8 to 12 years of age were iodine deficient. Shortly thereafter, a national subcommittee consisting of 8 governmental ministries, 12 international agencies, and several local nongovernmental organizations was formed. The national program for salt iodization began in 1999, with the subcommittee participating in program areas related to legislation, monitoring, and quality control, as well as in the development of educational and training materials to promote the use of iodized salt. A Demographic and Health Survey in 2001 showed only 13% of households using iodized salt, a finding that contributed to a new thrust (with UNICEF support) to promote its use.

Development of the national vitamin A–supplementation program was also catalyzed largely by the results of a national survey that documented the extent of the problem. Soon after the prevalence findings from a 1993 vitamin A survey were reported, the first national vitamin A policy and implementation document was adopted by the government. This early policy document recommended universal vitamin A capsule supplementation to children between the ages of six months and six years two times per year. More recently, the national policy has changed to include vitamin A supplementation to women during their first few weeks postpartum. Over the course of program implementation, the distribution system for vitamin A capsules has also transitioned. With the phaseout of national immunization days, capsule distribution began to be linked more strongly with routine immunization outreach and routine health services, including immunization and maternal health services, as well as during supplemental distribution campaigns such as school health days and bed net distribution interventions.

Cambodia's policy for addressing iron deficiency is iron supplementation to pregnant women, with delivery through the antenatal system for health care. However, recent initiatives demonstrate government concern for addressing anemia among demographic groups wider than pregnant women. In 2001, the Ministry of Health, in cooperation with the Ministry of Social Affairs and with the support of the World Health Organization (WHO) and UNICEF, launched a one-year study in select communities to introduce a program of preventative iron supplementation to women of reproductive age and to secondary-school girls, complemented by social marketing and health-education campaigns. The objectives of the study include assessing the effectiveness of weekly iron supplementation in improving the knowledge, attitudes, and practices as well as the hemoglobin status of women of reproductive age and secondary-school girls. On the basis of this study, it is planned to extend the iron supplementation program.

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3. China

The status of micronutrients and the efficiency of intervention in China

Y. Shi-an

In the last 20 years, the nutritional status of the Chinese population has greatly improved, in association with economic development and increased income. At present, malnutrition in the form of severe protein–energy malnutrition, vitamin A deficiency, or thiamine deficiency is not common. However, marginal deficiencies in micronutrients such as iron, vitamin A, iodine, calcium, zinc, and vitamin B_1 are rather common among children, adolescents, and women of childbearing age in urban and rural areas. Despite substantial progress in health and economic indicators over the last two decades, nutritional anemia, rickets, vitamin A deficiency, and zinc deficiency remain public health problems in China. These deficiencies have potentially adverse consequences for the growth and development of children and the health of women.

The extent of iron-deficiency anemia and its causes among men, women, and children were studied as part of the 1992 National Nutrition Survey. The data showed anemia to be most prevalent among children under three years of age, with a prevalence of 11% to 23% in urban areas and 16% to 29% in rural areas. The prevalence of anemia among children 3 to 5 years of age was lower, less than 12% for both girls and boys, but it showed an increase among children aged 6 to 10 years. Among young adults, anemia prevalence was estimated at around 10%, and the difference in prevalence between males and females was more marked than for children. The anemia rate for young adult females was much higher than for young adult males. Among the middle-aged and aged population, the prevalence of anemia was higher than that among young adults; there was no difference in prevalence between males and females.

On the basis of results from the 1992 National Nutrition Survey, the estimated iron intake by the Chinese population is adequate. Nevertheless, iron deficiency and iron-deficiency anemia are the most common nutritional deficiency problems, particularly among women and children. Because of poor absorption of iron from plant foods, the iron absorbed from plants fails to meet the requirements of the body. To improve the iron status of the population, it therefore seems necessary to increase dietary diversification as well as to explore the possibility of enriching food with iron.

In order to promote the use of an iron-fortified food as a national strategy for the control of iron-deficiency anemia, a two-year soy sauce fortification study, supported by the International Life Sciences Institute and the Micronutrient Initiative, was conducted to test the efficacy of NaFeEDTA-fortified soy sauce in combating iron deficiency and anemia linked with low hemoglobin levels. The study also evaluated the effects on vitamin A and anthropometric status. The prevalence of anemia among the group receiving fortified soy sauce decreased significantly after six months of intervention. Given the impact on anemia, the next step is to make the fortified soy sauce widely available to consumers. This process involves working with national authorities to promulgate regulations and standards for the control of NaFeEDTA-fortified soy sauce, and with the national soy sauce association to gradually expand the production and distribution of NaFeEDTA-fortified soy sauce.

Vitamin A deficiency remains a major public health problem among preschool children in China. In China, plant provitamin A carotenoids account for about 70% of dietary vitamin A. As in many developing countries, seasonal variations in the availability of plant foods may result in fluctuations in provitamin A intake, and thus vitamin A status generally declines during the fall and winter seasons. Data on the prevalence of vitamin A deficiency are available from multiple sources and, in each case, indicate a high rate of marginal vitamin A deficiency among preschool children. A survey in 1999–2000 collected measures of vitamin A deficiency among 8,669 children zero to five years of age from 14 provinces. The survey found that 1,018 children (11.7%) had serum retinol levels below 20 μg/dl, and 3,396 (39.2%) had serum retinol levels between 20 and 30 μg/dl. Clinical indicators of vitamin A deficiency were also prevalent: 8 children (about 0.14% 8/8669 = 0.09%) were found to suffer from night-blindness, 7 children (about 0.12%) 7/8669 = 0.08% were diagnosed as having signs of xeroma, and 61 mothers were reported to have night-blindness.

Recent studies have confirmed the efficacy of high doses of vitamin A in reducing the incidence of diarrhea and respiratory diseases among children. The serum vitamin A level among those receiving one capsule containing 50,000 IU vitamin A every three months was significantly higher than that in the control group. However, these studies had yet to lead to national vitamin A–supplementation programs.

More than 425 million people in China live in areas of endemic iodine deficiency; this figure accounts for close to 40% of the affected world population and 66%

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of the affected Asian population. Iodine deficiency has a wide distribution in China, occurring to varying degrees in 29 provinces, municipalities, and autonomous regions, except Shanghai and Taiwan Province.

The use of iodized salt increased on average from 40% of households to over 90% between 1995 and 1999, in association with a drop in goiter rates from 20% to 8%. The use of adequately iodized salt was greater than 80% in most provinces. Increased use of iodized salt can be seen to parallel substantial reductions in goiter and increases in urinary iodine. Such results attest to the effective and rapid prevention of iodine-deficiency disorders by the use of iodized salt in much of China.

4. Indonesia

Micronutrient programs in Indonesia

Hardinsyah and Suroso

Policy and programs for controlling micronutrient problems have been developed in Indonesia since the 1980s, starting with distribution of iron tablets and vitamin A capsules, followed by iodization of salt. Nutrition- and health-related policy also includes immunization and sanitation programs and antenatal care. The first Indonesian dietary guidelines, called a guide to a balanced diet, were formulated and published in 1994. In 1998, the Indonesian Government adopted the formulation of a Food and Nutrition Plan of Action (FNPA).

The prevalence of clinical iodine-deficiency disorders in schoolchildren was 28% in 1988 and 10% in 1999. In previous surveys, goiter prevalence ranged between 2% and 38%. The prevalence of iodized salt intake was stagnant at around 64% in 1998 and 2000, respectively. Since the 1980s, the Government of Indonesia and the private sector have received significant funding for reducing the problem of iodine-deficiency disorders through salt iodization programs. Although the problem of iodine-deficiency disorders still exists, the prevalence of iodine-deficiency disorders has decreased very significantly during the last 20 years, mainly because of salt iodization.

Iron-deficiency anemia is still prevalent, especially in pregnant women and young children. The most current (2002) estimates of prevalence are 63% in pregnant women, 65% to 85% in children under two years of age, 40% in children under five years of age (2000), 40% in women of reproductive age, and 60% among the elderly. From 1985 to 2002, the prevalence of iron-deficiency anemia among pregnant women decreased by only about 10% to 15%.

In 1998, Ministry of Health Decree 632/1998 established the mandatory fortification of wheat flour. Wheat flour produced and distributed in Indonesia must be fortified with iron, zinc, thiamine, riboflavin, and folic acid. With support from UNICEF and the United States Agency for International Development (USAID), fortification of wheat with iron was initiated in Indonesia. From January 1999 to January 2000, a grant of US$850,000 from USAID through UNICEF was given to the Indonesian Government to purchase 340 metric tons of iron premix, which has been distributed to Bogasari, Berdikari Sari Utama, Citra, and Sri Boga Ratu Raya Flour Mills for fortification of wheat flour (60 ppm of iron). In 2001, the wheat flour industry received 240 metric tons of premix from the Canadian International Development Agency .

In addition to the above decree, in May 2001 the Ministry of Industry and Trade issued Decree 153/2001 on the Mandatory Application of the National Standard of Indonesia (SNI) for Fortified Wheat Flour. Both imported wheat flour and domestically produced wheat flour must follow this SNI. According to the SNI, the wheat flour must be fortified with 50 ppm iron, 30 ppm zinc, 2.5 ppm thiamine, 4 ppm riboflavin, and 2 ppm folic acid.

A decreasing trend in the prevalence of clinical vitamin A deficiency is evident, but for lack of data, trends could not be assessed for sub-clinical vitamin A deficiency. Regarding vitamin A supplementation, twice per year, infants between 6 to 12 months of age should receive vitamin A supplementation in the amount of 100,000 IU and children between 1 to 5 years should receive 200,000 IU.

Mass campaigns for distribution of vitamin A capsules are held every February and August. Village midwives or health center personnel should provide vitamin A supplements of 200,000 IU to every mother within the first 30 days after she gives birth.

Fortification of complementary foods is a current

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priority. The following are some challenges faced by the complementary food industry in fortifying foods for young children: The current available national capacity cannot fulfill more than 25% to 30% of the total requirement; the duration of usage of complementary food is shorter than that of usage of milk; the perceived image of complementary food is still low among mothers; regulations need to be revised and established; and there is a lack of long-term strategic nutritional plans and programs at the regional level.

5. Lao People's Democratic Republic

Programs for micronutrient-deficiency control in the Lao People's Democratic Republic

S. Naphayvong, P. Vongvichit, and M. Deitchler, and J. Knowles

This paper addresses iodized salt and vitamin A–supplementation programs. The case study aims to describe these programs, document the story leading to program initiation, describe the challenges and successes met in program implementation, and provide data on the extent of the impact achieved.

High rates of micronutrient deficiencies have been documented in recent years in Laos. Prior to adoption of national micronutrient-deficiency control programs in the country, approximately 95% of school-aged children were reported to have suboptimal iodine status (urinary iodine < 100 μg/L), and 65% of children were reported to have deficiencies in iodine (urinary iodine < 20 μg/L). The prevalence of night-blindness was estimated as 0.7%, among children 24 to 71 months of age and 5.7% among lactating women.

The Laotian Government responded to reports of widespread micronutrient deficiencies in the country by adopting national programs for iodized salt and vitamin A supplementation. Both the iodized salt program and the vitamin A–supplementation program have been consistently implemented since initiation, and although they have faced various constraints and challenges in program implementation, they have both achieved notable success in program delivery.

The iodized salt program has already achieved a high level of impact nationwide. All recent coverage and prevalence data available show high use of iodized salt (> 75% of households using adequately iodized salt in 2000) and low rates of iodine deficiency (27% with urinary iodine < 100 μg/L). Data on vitamin A supplementation are more difficult to interpret; the Ministry of Health reported coverage to children of 70% for almost all rounds and years of VAC distribution. However, a national survey in 2000 showed that among children under five years of age, 44.7% had serum retinol < 20 μg/dl and more than 7% had serum retinol < 10 μg/dl.

The consistent implementation of the iodized salt and vitamin A–supplementation programs is evidence of the Laotian Government's commitment to controlling micronutrient deficiencies in the country. The national government's collaboration with international and bilateral agencies, as well as with foreign governments, in the design and implementation of the program has facilitated program delivery. The various successes already achieved by the programs are due largely to the collaborative efforts of these bodies in establishing appropriate systems for enhanced program delivery, monitoring, and evaluation. However, some aspects of both the iodized salt and the vitamin A–supplementation programs still need further development. Increased capacity for improved program delivery and enhanced systems for monitoring and evaluation of each of the programs are desired. Ensured sustainability of currently implemented programs and identification of a longer-term strategy for the control of vitamin A deficiency are additional program concerns.

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6. Philippines

Impact, policy, and program implications of the Philippines vitamin A–supplementation program

M. R. A. Pedro, R. L. Cheong, J. R. Madriaga, and C. V. C. Barba

The Philippine Government addresses vitamin A deficiency with the implementation of a universal twice-yearly high-dose (200,000 IU) vitamin A–supplementation program for children 1 to 5 years of age. The program, which started in 1993, has been a centerpiece in the country's nutrition efforts. The paper reviews the vitamin A–supplementation policies and program in the Philippines on the basis of the general guidelines, administrative documents, and records of implementing and cooperating agencies, such as the Department of Health and Helen Keller International, and a cost-effectiveness analysis by a Philippine Cost-Effectiveness Study Team; it also examines the program impact on the basis of the results of the 1993 and 1998 National Nutrition Surveys. The results of the review had significant program and policy implications. Among the programmatic changes was the shift from being centrally managed by the Department of Health to being a program devolved to local government units. A declining coverage of target children after the early years reflected the lack of a smooth transfer of program ownership to local government units. On the other hand, a preferential access to the program by children from poor households was apparent in some provinces. The 1993 and 1998 National Nutrition Survey results revealed indications of positive impact of the vitamin A–supplementation program: a shift to the right in the distribution of plasma retinol among children 1 to 5 years of age between 1993 and 1998, and between children without and with vitamin A supplementation in both years. This was despite the overall increase in the prevalence of low serum retinol from 35% to 38% over this same time [1]. In further studies, the main impact was shown to be in the most deficient areas, but possibly persisting for only four months after the dose.* This suggested that thrice-yearly vitamin A capsule distribution might be advisable.

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* Madriaga JR, Pedro MRA, Barba CVC, Habito RCF, Deitchler M, Mason JB. The impact of the national vitamin A supplementation program on subclinical vitamin A deficiency in pre-school children in the Philippines. Presented at XXI International Vitamin A Consultative Group (IVACG) Meeting, February 2003.

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7. Philippines

The National Salt Iodization Program of the Philippines

M. A. Tuazon and R. C. F. Habito

Iodine-deficiency disorders remain a public health problem in the Philippines. From 1987, the prevalence of goiter has been on the rise, and the latest National Nutrition Survey conducted by the Food and Nutrition Research Institute of the Department of Science and Technology in 1998 revealed that 36 of every 100 children 6 to 12 years of age were suffering from moderate to severe iodine-deficiency disorders, based on urinary iodine excretion levels.

As a response to this problem, the Government of the Philippines enacted a law on December 20, 1995, known as Republic Act 8172, II entitled "An act promoting salt iodization nationwide and for other purposes." Also known as the ASIN Law, it mandates that all salt producers and traders make iodized salt available to all Filipinos.

For the nationwide implementation of the National Salt Iodization Program, intersectoral organizational machinery was created, with the main responsibility

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vested in the Department of Health. The program has four main components: production, marketing and distribution, promotion and advocacy, and management and coordination.

An in-depth assessment of the National Salt Iodization Program showed the following strengths: strong political commitment of national leadership in addressing iodine-deficiency disorders; availability of local technology for salt iodization; responsive participation of private industry, nongovernmental organizations, and other relevant sectors; promotional and advocacy efforts that have contributed to the generation of much-needed resources and political will and support; and regular consultation and dialogues that have effectively contributed to issue resolution and have forged alliances.

However, there are still a number of weaknesses that need to be addressed: the availability of iodized salt is still a bottleneck; nationwide compliance and enforcement of the ASIN Law need to be strengthened, particularly the implementation of the regulation and monitoring scheme; the personnel and testing facilities of Bureau of Food and Drugs (BFAD) as the primary agency responsible, should be upgraded; and information dissemination targeting consumers should be intensified to bridge the gap between awareness and utilization of iodized salt. Furthermore, the government can consider utilizing existing networks such as the National Food Authority (NFA) system for importation and distribution of iodized salt nationwide, while at the local level, the *takal* system (repackaging salt sold loose) of selling iodized salt provides a workable and acceptable system for marketing iodized salt. It is also evident that a stronger government–private sector–nongovernmental organization partnership has to be forged, where sharing of resources and expertise can take place, if the National Salt Iodization Program is to be sustainable.

8. South Africa

Micronutrient programs in South Africa

C. Witten, P. Jooste, D. Sanders, and M. Chopra

Although South Africa is a middle-income country, persistent social and economic inequalities have resulted in large numbers of people living in poverty. National surveys consistently found that more than a quarter of children were stunted in 1994, rising to over 40% in many rural areas. Marginal vitamin A deficiency (serum retinol < 20 µg/dl) was prevalent in 33% of preschool children (6 to 72 months of age) [1]. Even after a universal salt iodization program, over 10% of schoolchildren were iodine deficient. The South African Government has recognized malnutrition as a key priority issue and developed an Integrated Nutrition Programme. Micronutrient malnutrition control is one of the focus areas of the Integrated Nutrition Programme, which addresses micronutrient deficiencies in the population through a combination of strategies, namely, supplementation, food fortification, the promotion of dietary diversification, and related public health measures [2–4].

In order to support the implementation of the focus areas of the Integrated Nutrition Programme (on micronutrient and other deficiencies), the Department of Health placed considerable emphasis on the development of a coordinated intersectoral approach to solving nutrition problems in South Africa through community-based nutrition projects. A number of general management aspects were identified as constraints to the implementation of community-based nutrition projects: complex financial procedures and delays in funding, lack of staff, inadequate staff training, and inadequate technical support. This highlights the crucial gap between policy and successful implementation [5].

The Department of Health has had relative success with mandatory salt iodization since 1995. However, small weaknesses still exist in the national salt iodization program, such as domestic use of noniodated agricultural salt in 6.5% of households [6]. The 1999 National Food Consumption Survey (NFCS) findings indicated that one of every two children had a dietary vitamin A intake less than half the recommended level. The Department of Health set out a policy for a supplementation program as a primary prevention strategy, to form part of routine mother and child health services. This program targets all children aged between 6 and 60 months and postpartum women in the period six to eight weeks after delivery [7]. Based on the findings of the NFCS, it was recommended that maize and wheat flour be fortified with vitamin A and iron, among other nutrients, to provide a person 10 years old or older with 25% of his or her RDA of both micronutrients from 200 g of raw maize or wheat flour [8].

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9. Sri Lanka

Case studies of successful micronutrient programs: The Sri Lankan experience

C. Piyasena

Sri Lanka has achieved considerable successes in the sphere of community health services owing to the well-established network of primary health-care workers. Immunization coverage of over 90% has been achieved, while growth monitoring is successfully implemented even at the remote village level. Advances have also been made in related sectors. For example, approximately 75% of the Sri Lankan population has a safe drinking water supply. The food authority has implemented a wide range of regulations by the food act ensuring food safety and hygiene. Food and agriculture policy has taken different dimensions during the last few decades, moving from the objective of self-sufficiency toward a free-market economy and liberalization of foreign exchange transactions, thereby increasing private sector participation and privatization of state enterprises.

Although low food acquisition power is a key factor exposing the poor sections of the community to a greater risk of micronutrient deficiencies, wrong beliefs and lack of knowledge have contributed to the present pattern of food consumption. Addressing issues of food quality, in line with goals set up by the World Health Organization and UNICEF, national policy makers endorsed and adopted a declaration and plan of action for the virtual elimination of vitamin A deficiency, the virtual elimination of iodine deficiency, and reduction of iron deficiency in women by one-third.

Clinical vitamin A deficiency is not commonly seen in Sri Lankan children. The latest survey in 1995–96 revealed that 36% of Sri Lankan preschool children had suboptimal serum vitamin A levels, with the prevalence of night-blindness (0.8%) and Bitot's spots (0.8%) indicating vitamin A deficiency as a moderate public health problem in the country. Control measures have been implemented for some years, such as free distribution of milk, vitamin A supplementation, diagnosis and treatment of vitamin A deficiency at school medical inspections and hospitals, and provision of supplementary food fortified with vitamin A. Following the 1995–96 survey, vitamin A policy was reformulated, and the provision of vitamin A megadoses routinely to children and postpartum mothers was introduced. Achieved coverage rates have not been reported.

Iodine-deficiency disorders have long been recognized as an endemic problem in the southwest wet zone of Sri Lanka. Provision of potassium iodide to pregnant women and adolescent girls in high-risk areas was among the early interventions initiated in the 1950s. Surveys at that time revealed an increased prevalence of goiter in spite of interventions, which indicated that the increased prevalence of goiter was not due to iodine deficiency or was due to ineffective intervention.

Studies showed that the prevalence of goiter remained high in schoolchildren (19%) and pregnant women (63%). Based on these findings, a national program on salt iodization was adopted, and a universal salt iodization law was enacted from 1995. A follow-up national survey of iodine-deficiency disorders (2000) indicated a reduction in prevalence in one district (Kalutara) where the iodine-deficiency disorders control program had been implemented for more than five years, although the national data showed an increase in the prevalence of iodine-deficiency disorders from 19% to 21%. Moreover, the highest prevalence was

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observed in the North-central province, previously a nonendemic area. The same study led to estimates of the prevalence of iodine-deficiency disorders from urinary iodine assays showing that the prevalences of mild, moderate, and severe iodine deficiency were 22%, 7%, and 1.4%, respectively. In pursuing improvement of the situation, Sri Lanka has identified the need to determine thyrotropin levels of newborns and to develop a database on the iodine content of foods, goitrogens in local foods, and the effects of fertilizer, pesticides, and insecticides on the bioavailability of iodine in food.

Anemia is a major public health problem in Sri Lanka, affecting all segments of the population and contributing to increased morbidity and mortality rates. Anemia prevalence in 1973 was estimated as 38% among men, 68% among women, 70% among primary schoolchildren, and 52% among preschool children. The prevalence was 60% among pregnant women in 1988–89. In 2001 the prevalence was estimated as 32% among nonpregnant women, 30% among pregnant women, 22% among adolescents, 21% among primary schoolchildren, and 30% among preschool children. Operational studies on the iron-supplementation program have indicated that further strengthening is required to achieve optimal results. A comprehensive national strategy was formulated, including iron/folate supplementation to all pregnant women; antihelminthic use and malaria control; promotion of dietary diversification; information, education, and communication (IEC) campaigns to improve compliance; provision of safe drinking water and sanitation; and proper monitoring and further research to improve efficiency and effectiveness. Additional target groups to be included were infants, preschool children, schoolchildren, nonpregnant women, and displaced persons. The possibility of iron fortification as a strategy has been looked into. Challenges ahead for optimal control are proper monitoring and evaluation, securing adequate human resources, improving the bioavailability of micronutrients in foods, promoting food-based methods, and issues related to iron fortification.

10. Thailand

Current situation and status of micronutrient policies and programs in Thailand

P. Winichagoon, T. Pongcharoen, and J. Yhoung-aree

Thailand has set goals for alleviating three major micronutrient deficiencies that since the early 1980s have been regarded as major public health problems. The prevalence of vitamin A deficiency has decreased, along with the reduction of protein–energy malnutrition among young children and mothers. Iodine and iron deficiency, however, have required additional efforts through salt iodization and iron-supplementation programs during the past two decades. Currently, clinical micronutrient deficiencies have become rare, and the severity of persisting deficiencies has declined to the subclinical level. These remain a significant challenge.

Iron supplementation is the major program addressing anemia during pregnancy. The anemia surveillance system has been an integral part of the efforts to alleviate anemia among school-aged children and pregnant women. Village health volunteers provide the major resource for identifying pregnant women and advising them to attend antenatal care, as well as promoting safe delivery in the hospital. Daily iron supplementation has been provided throughout pregnancy, but adherence to supplementation is not monitored. Severe anemia among pregnant women has substantially declined as a result of improving the referral system and ensuring compliance to iron therapy. There have been no specific programs for anemia in infants, preschool children, or adolescent girls. Meanwhile, weekly supplementation in primary schools has been piloted but not yet expanded nationwide.

Legislation for iodization of salt has been a major step forward as a nationwide strategy to alleviate iodine deficiency. Continued attention is still needed to ensure the sustainability of salt iodization and household consumption of iodized salt. Cyclic monitoring of the iodine-deficiency situation has been launched, and data on urinary iodine from pregnant women and school children are being used to monitor the situation. Fortification of various foods to address multiple micronutrient deficiencies has been studied, and some products have been commercialized. Partnerships among government, the private sector, and academics have been established since the early stage of the program. The private sector and academic institutions have worked together to formulate the products, and government sectors assist in promoting the use of fortified foods. Systematic evaluation of these programs will be useful in elucidating lessons learned from Thailand.

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11. Vietnam

Successful micronutrient programs: Micronutrient-deficiency control strategies in Vietnam

N. X. Ninh, N. C. Khan, N. D. Vinh, and H. H. Khoi

Vitamin A deficiency, iron-deficiency anemia, and iodine-deficiency disorders have been reduced during the past decade but still remain issues in Vietnam. Since the early 1990s, the Ministry of Health has implemented a nationwide program for the control of vitamin A deficiency. An implementation network has been set up from the commune to the central level by a strong preventive health structure with the active participation of mass organizations. A comprehensive strategy has been developed, including nutrition education; universal distribution of vitamin A capsules to target children, in combination with national immunization days, and to lactating mothers in the community; and promotion of the production and consumption of vitamin A–rich foods at the household level. The data in 1994 and in 2000 showed that the prevalence of clinical xerophthalmia was lower than the cutoff point established by the World Health Organization for a public health problem; however, the prevalence of subclinical vitamin A deficiency was still high in 2000 (11% in children and 50% in lactating mothers).

The groups highly vulnerable to iron-deficiency anemia are women of childbearing age and children (53% of pregnant women, 40% of nonpregnant women, and 60% of children under 24 months old suffered from iron-deficiency anemia in 1994). The iron-deficiency anemia control program has consisted of supplementation of women with iron/folic acid tablets while providing them with nutrition education, together with the prevention of intestinal parasites, especially hookworm. However, the program has been implemented in only 1,282 out of more than 10,000 communes in the whole country so far; moreover, there is no policy for iron supplementation of children under two years of age.

Iodine-deficiency disorders are also very widespread in Vietnam. More than one-quarter (27%) of school-aged children had goiter in 1995; the prevalence was reduced to 14.9% in 1998. There is geographic and ecologic variation in goiter prevalence. Since 1999, universal salt iodization has been adopted by government legislation. By 2001, at the country level, 61% of households used iodized salt; however, the rate of usage was rather low in the Mekong River Delta, and about 30% of people in this region were reported to have low levels of urinary iodine (< 10 μg/dl).

In the coming years, greater attention should be paid to more sustainable measures. Food fortification with micronutrients may be an important approach. Iron-fortified fish sauce, which was proved to have both efficacy and effectiveness in community-based trials, will be developed on a larger scale, while other vehicles, such as sugar, instant noodles, and processed complementary foods, should be considered for micronutrient fortification. As committed by the National Nutrition Strategy, ratified by the government, we are making ongoing efforts to combine different strategies to maintain success and sustain further achievements.

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International Workshop on Food Aid

Contributions and Risks to Sustainable Food Security—Berlin Statement

Preface

For decades, food aid has been a contentious instrument for addressing hunger and food insecurity. The workshop carefully considered the pros and cons of food aid on the basis of past and current evidence, including practitioners' experiences. In particular, the workshop re-visited food aid in view of the perspectives of the ongoing WTO trade negotiations, the experience gained with the Food Aid Convention, the initiatives related to the human right to adequate food resulting from the World Food Summit, and the challenges of health crises, i.e. HIV/AIDS.

The "Statement" results from an open and participatory process of working groups, and from more comprehensive plenary presentations by main actors in food aid (recipient governments, bilateral and multilateral donors, international agencies, NGOs). While reflecting a fair amount of consensus, the individual workshop participants and delegates cannot be held responsible for the "Statement". It is meant to serve stimulation of further discussion for innovation and improvement of key aspects of food aid for sustainable food security.

General issues and recommendations

1. The *Millennium Development Goal* to cut hunger in half by 2015 will not be achieved with business as usual. A massive scaling up of food security actions globally, and by the countries with high prevalence of food insecurity is needed. Simply meeting aggregate food needs or GDP growth targets at the national level will not suffice. Too many countries are currently regressing on the measures used to define the food security objective as stated by the FAO Food Summit. Taking responsibility for the persistence of world hunger at international and government levels has to be more than words.
2. The *definition of 'food aid'* should not just be focused on its source of funding, or on specific transactions, such as "items donated from external donors to recipient", but should include consideration of a) all related international and domestic actions and programs, and b) the role of non-food resources brought to bear jointly with food to address key elements of hunger problems. As such, food aid can be understood as all food supported interventions aimed at improving the food security of poor people in the short and long term, whether funded via international, national, public or private resources.
3. *Food aid is only one of a multitude of instruments* in the fight against hunger. Food aided food security interventions should not be planned in isolation of other key food security policies. Food aid policy should be consistent and coherent with agriculture and trade policy. Food aid must be assessed in the broader context of food security policy, as one element of an insurance policy for the poor, which means to an exceptional measure, rather than the usual. The impact of food aid on the food security of people depends on national government policies, international policies, the acuteness of local conditions, the country context, and the appropriateness of food aid management modalities.
4. Food aid policies and deliveries should *respect and promote the human right to food*. International food aid should assist countries in need, but only after they have exhausted their own related food resources. The use of food aid can contribute to the realization of the right to adequate food if it is a reliable source of support in emergencies. Such a source should be provided by the donor community, rather than individual donors being held accountable. The management of food aid must also not work counter to the human right to food by undermining the capacity of people to feed themselves.
5. *Good governance of the whole food system* in developing countries will contribute over time to a decreased need for food aid. Food aid should be provided only when it is the most effective and appropriate means of assistance, compared with real, which means immediately available, alter-

natives including forms of financial assistance. Corruption in the food system must be countered as in any other public domain. As it affects the poorest, it requires particular attention.

6. *Civil society organizations* including national and international NGOs, should play key roles in facilitating good governance of the food aid systems, and in grass roots needs assessment and as donors in food aid delivery.
7. *Food aid must address well-defined problems* involving immediate food shortage in flexible ways, with the aim of:
   » saving lives
   » protecting livelihoods and assets of the poor affected by natural and manmade disasters;
   » protect livelihoods of chronically vulnerable social groups, including refugees, internally displaced persons, the disabled, AIDS orphans and the destitute;
   » support complementary and synergistic efforts to improve the human resources of vulnerable people where food shortage is a major constraint.
8. Food aid allocation should be based on *sound 'needs' assessment*, involving both recipient and donors, and optimally targeted to the needy and vulnerable groups. Optimal targeting entails due consideration of the costs of targeting, and utilization of accessible timely information.
9. A *"do no harm" approach* to food aid delivery is called for. Food aid, which involves commodities provided directly to the recipient government or its agent for sales on local markets, has often been driven by surplus disposal intentions or market stabilization policies of donor countries. The cutting back of food aid on the one hand, and its expansion on the other hand driven by international food ups and downs of prices is unacceptable. Multi-lateral food aid adds to independent response capabilities. Further strengthening of multi-lateral, undirected, food aid is therefore called for.
10. *The international governance of food aid* requires reform and streamlining in order to achieve predictability, accountability of appropriate volumes, and timely delivery of food aid. This calls for due consideration of food aid policy in the WTO Development round and re-assessment of the Food Aid Convention.

Specific issues and recommendations

Emergency Food Aid in the context of natural disasters, armed conflict and population displacement

1. *Adequate attention should be put to natural disasters as well as conflicts*. Success in mitigating the effects of natural disasters and conflicts indicates that food aid has a continuing role in emergency relief, post-crisis rehabilitation, and potentially in pre-next-crisis mitigation which can contribute to the transition between relief, rehabilitation and long-term development.
2. Maintain and enhance famine *early warning systems*, and couple early warnings with timely response by donors and governments. Systems to predict climate-related humanitarian crisis are used nowadays to anticipate and prepare food aid deliveries. Efforts to improve these systems should continue, with a focus on enhancing the international community's ability to conduct rapid emergency needs assessment that pay closer attention to a) non-food needs (in addition to food), and b) times when food is not needed. This facilitates appropriate exit strategies from food aid and avoids dependencies.
3. Food aid in emergencies should be *restricted to situations where it is the most appropriate means* to solve the underlying problem, i.e.:
   » to provide relief in cases of protracted crisis;
   » as a contribution to strategic reserves and safety nets;
   » for operations linking relief, rehabilitation and development
4. Poor targeting, including that due to mistiming of deliveries, often reveals itself through price adjustments on local food markets as supply increases at a faster rate than demand. Food aid should be *timely delivered in emergencies*. In this case, local purchases may have the advantage of providing food aid on time. National food policy capacities must be strengthened in developing countries to appropriately deal with food (and other development) aid instabilities.
5. While emergency relief facilitates future development, it also should be *linked with long-term development action*. The provision of food aid in emergency situations should take particular account of longer-term rehabilitation objectives.

Food aid for development

1. Food based activities are indicated in regions and under circumstances only, *where the envisaged developmental objectives cannot be met more cost-effectively or in a more sustainable way by non-food activities*. More resources need to be made available for effective 'development needs assessments' (compared with emergency needs assessments) so that those regions and circumstances can be appropriately determined and the food-versus-other-resource decisions can be more empirically informed.
2. Food aid has been shown to be useful in support-

ing development where it has *protected assets and prevented vulnerable people from falling into destitution*.

Where food aid is the appropriate intervention in this sense, it should focus on

» *infrastructure* development and reconstruction (by food for work),
» *human capital* (e.g., by food for education or school meals) health and nutrition (e.g., by maternal and child health programs).

3. *School feeding* programs providing large coverage but adjusted to local needs and where needed, supported by food aid, should be considered. Where possible these should draw on local food production, but only with government buy-in assured.
4. The role of food aid in *poverty reduction strategies (PRSPs)* as part of food security actions warrants further attention.

Food aid in the context of health crises, including HIV/AIDS

1. For poor households, *HIV/AIDS represents a massive and irreversible shock* that seriously affects their ability to sustain their livelihoods and remain food security. They are faced with significantly reduced income, fewer people available to work and an unrelenting need for food and medicine. Special attention needs to be given to orphans.
2. In areas of high food insecurity and high HIV prevalence, food assistance can provide a *safety net to catch families before they become destitute*, and thus even more vulnerable to the risk of infection, and they can support the needs of orphans and foster families in the aftermath of family dissolution due to AIDS.
3. Food aid project design should generally target people on the *basis of food insecurity rather than on the basis of their HIV/AIDS status*. As there are serious stigma issues involved, many people with HIV do not yet know that they are infected, and other non-affected households may be equally vulnerable for other reasons. The complex issue of scaling up many pilot programs needs due attention and learning from shared experiences.

Food aid management and delivery

1. Food aid has to *avoid disrupting markets, investment, and production*, whether it is delivered from overseas or purchased within the region. In order to promote local agricultural development, strengthen regional and local markets, and ensure sustained food security, consideration shall be given to using direct cash contributions for the purchase of food within the recipient country, or region. While local purchases have many benefits they too must be guided by careful assessments of availability, potential price effects, food safety, and comparative costs.
2. Food aid should be culturally acceptable and respect *nutritional needs* and eating habits, and adhere to food safety standards. Food aid must adhere to *food and bio-safety standards*. In view of limited capacities of recipient countries, donors must only deliver food aid which meets safety standards accepted by the Codex Alimentarius. The capacities of food and bio-safety standard assessment in recipient countries need strengthening so that countries can make informed choices, including on genetically modified organisms.
3. *Strengthening the role of civil society organizations and of the private sector* (in market and retail business) should be explored to facilitate effectiveness and efficiency of food aid delivery.
4. Food aid may be a suitable instrument under certain conditions such as inefficiency of local markets or administrative structures. Because of *high transaction costs*, it is often less efficient than cash based interventions. Sustainable impact can only be reached when combined with other developmental interventions.
5. *Shared analytical frameworks are needed* in a rapidly changing domestic and international context, and increased dialogue is needed for coordinated analyses of food aid, including participatory approaches at local levels.

Toward reforming the food aid regimes at global and national levels

1. Food aid should be *clearly separated from commercial trade*. The provision of food aid should not be tied directly or indirectly, formally or informally, to commercial exports of agricultural products or other goods and services to recipient countries. The WTO negotiations should lead in this direction.
2. Food aid to LDCs should be provided *exclusively in grant form* in order not to increase the debt burden of vulnerable countries.
3. Neither the *Food Aid Convention nor the WTO Marrakech Agreement* (of the Uruguay Round) has acted as an effective coordination mechanism for global food aid nor as an effective safety net for the poor.
4. The *Food Aid Convention has had limited and unsatisfactory impact* in reducing fluctuations or setting minimum levels of food aid needs. This raises serious questions about the credibility of the Convention in establishing a safety net and the most appropriate form of international commitments for protecting the food security of developing countries. The Food Aid Convention should arguably be discontinued in its current form after 2005.

5. Consideration should be given to replace the Food Aid Convention by *a new type of Food Aid Compact* that could be brought for example under the WTO as an element of the WTO Development Round.
6. The reform of food aid regimes at *international* and at *national* level should be accompanied by an international *Code of Conduct* strengthening accountability, effectiveness, fairness, and transparency, and monitored by an appropriate independent body under the auspices of, for example, the WTO. A participatory process toward developing such a Code of Conduct, building on existing components, should be designed.
7. A reformed global food aid governance system must *not entail dominance* of global organizations in the food aid system, given the complexities of the national food security problem, regional diversity, and comparative advantages of organizational strengths.

Note: The Statement was tabled in closing of the International Workshop on Food Aid—Contributions and Risks to Sustainable Food Security upon invitation by the organizers by Joachim von Braun, Director General of the International Food Policy Research Institute (IFPRI), Washington D.C. (http://www.ifpri.org/).

The workshop was hosted by the Federal Ministry of Consumer Protection, Food and Agriculture (BMVEL), the Federal Ministry for Economic Cooperation and Development (BMZ), the Federal Foreign Office (AA) and the Deutsche Welthungerhilfe / German Agro Action (DWHH). It was organized by the German Technical Cooperation (GTZ) and InWEnt—Capacity Building International, Germany. Presentations and other workshop results are available for download at http://www.foodaid-berlin2003.de/, where also an electronic discussion group is set up.

Joachim von Braun, "Berlin Statement on Food Aid for Sustainable Food Security," presented at the International Workshop "Policies against Hunger II, Food Aid Contributions and Risks to Sustainable Food Security," September 2–4, 2003, Berlin, Germany.

Book reviews

Handbook of clinical nutrition and aging. Edited by Connie Watkins Bales and Christine Seel Ritchie. Humana Press, Totowa, N.J., USA, 2003 (ISBN 1-58829-055-7) 698 pages, hardcover. US$145.00.

To create a context for a review of the *Handbook of Clinical Nutrition*, the most recent book to discuss nutrition and aging, it is useful to revisit some previous books dealing with the same topic. Until well into the 1970s, books and articles on aging tended to be pessimistic litanies of degenerative changes. Neither the 1976 book by Winick [1] nor the 1984 treatise by Arbrecht et al. [2] go far beyond this tradition, although a final chapter in the latter emphasizes a relationship between the intake of specific nutrients and mental function.

By 1986 a book edited by Eleanor Young [3] on nutrition, aging, and health states in its preface that we are only beginning to appreciate that specific disease states more commonly associated with the aged probably have their origin early in life. Another chapter concludes that when we view the intimately interwoven aspects of aging we are beginning to realize that "it is continually influenced by a multitude of environmental, biosocial, biocultural, economic and physiological factors." The similarity of some of the signs of aging to those of nutritional deficiencies is noted in another chapter, with the suggestion that prolonged, subtle deficiencies of single or multiple nutrients over time may be a factor. There is also mention of dietary modification to reduce the risk of atherosclerosis.

In the 1989 book by Horwitz et al. [4], the opening chapter on the epidemiology of nutrition of the aged reviews factors responsible for individual variation in the aging process; these are discussed in more detail in subsequent chapters. The 1995 book by Morley at al. [5] has a chapter on the interaction of the decline in immune function with specific nutrients, but is mainly descriptive of the decline in various other systems with age and nutrition management and support. The chapter on physical activity focuses only on the factors contributing to reduced physical activity in the elderly.

In 1991 the book by Evans and Rosenberg [6], *Biomarkers: the 10 determinants of aging you can control,* broke new ground by describing how the aging process could be slowed and renewed strength and vitality acquired at any age. The findings were based largely on the studies of nutrition and aging at the USDA Human Nutrition Research Center on Aging at Tufts University. This was followed in 1998 by the MacArthur Foundation Study on Successful Aging [7], whose findings demonstrated that lifestyle choices "more than heredity, determine your health and vitality." The results of these two studies exploded the myths about aging that had long shaped individual and institutional attitudes toward growing older. These books outline the vital lifestyle choices, including diet, type of exercise, mental stimulation, and self-reliance, that make a difference no matter how early or late in life they are made.

The *Handbook,* with 31 chapters, provides an excellent summary of trends in nutrition and health in older adults; the fundamentals of geriatric nutrition; geriatric syndromes related to nutrition, such as diminished sense of taste and smell; and the impact of specific disorders on nutrition. The handbook provides detailed and up-to-date nutrition information for health workers responsible for the care of the elderly and can also be used for their training. However, it is designed only to provide guidance on the management of nutrition-related problems that are common in the elderly, and does not address their causes. It is a serious defect that this latest book on nutrition and aging virtually ignores the role of lifestyle and environmental factors from conception onward in the nutrition and health problems of the elderly. Any modern book on nutrition and aging should include emphasis on ways of preventing or delaying many of the changes that have been attributed entirely to biological aging. The messages in the preceding two books [5, 6] should be included in the training of all health professionals concerned with aging, and should influence national health policy and legislation.

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Fish to 2020: Supply and demand in changing global markets. Christopher L. Delgado, Nikolas Wada, Mark W. Rosengrant, and Siet Meijer Mahfuzuddin Ahmed. International Food Policy Research Institute, Washington, D.C., and World Fish Center, Malaysia, 2003 (ISBN 0-89629-725-X) 226 pages, softcover. US$19.95.

Captures of wild fish have leveled off since the mid-1980s, and many stocks of fish are threatened by overfishing. Meanwhile, increasing demand has been met by fish farming. This book explores the limitations of aquaculture by using computer modeling and explores the environmental problems that aquaculture will face as it expands. The model shows that developing countries will consume and produce a much greater share of the world's fish and that trade in fisheries commodities will increase. The causes and implications of these changes are discussed, and specific actions and policies that can improve outcomes for the poor and the environment. are proposed.

The book concludes that global fish consumption will increase by about 1.5% per year through 2020, driven primarily by developing countries. Almost all of this increase will come from aquaculture, and prices will continue to rise. The demand for fish meal as feed for fish requires that its use for feeding nonruminant animals must be replaced to a greater degree by vegetable protein sources such as oilseed meals. Milk and meat are likely to become cheaper relative to fish. The effects on poverty will be mixed. Entry points for policy actions are identified and priorities suggested for further policy research. Supplementary tables give detailed information on the production and consumption of food fish. This book does not deal with the technical aspects of aquaculture, but it is the most authoritative treatise currently available on its economic and policy implications.

Food Inc.: Mendel to Monsanto: The promises and perils of the biotech harvest. Peter Pringle. Simon & Schuster, New York, 2003 (ISBN 0-7432-2611-9) 356 pages, hardcover. US$24.00.

Food and Nutrition Bulletin readers are aware of the raging controversy over the introduction of genetically modified (GM) foods. All of our foods today are the result of genetic modification through years and sometimes centuries of plant breeding, but the ability to insert genes from unrelated species is new, and for some, frightening. This book is one more effort, this time by a journalist, to provide an impartial summary of the pros and cons of this inflammatory issue. In general he succeeds, and he has produced a readable and balanced book that explores the key issues in depth.

Unfortunately, in such a book it is necessary to devote many pages to comment on the statements and policies against GM foods that are not science based. Some large multinational companies and other advocates of genetically modified organisms (GMOs) have made unwise, foolish, or arrogant claims. Companies that tried to introduce their products into the market without telling people about them made a serious mistake, but the activists who indulge in unsubstantiated scare-mongering are doing a great disservice. The author notes that "transgenic foods have been eaten by contented and discerning consumers in America for a decade" and concludes that "biotech agriculture is another step in the evolution of human foods" and that the promise of producing more food in African deserts or the wetlands of Asia is worth the time and money spent on the research.

The author presents evidence that genetic engineering has practical value for developing countries, but "only if it is properly integrated into their agricultural systems." He concludes that GM foods are "here to stay and full of promise but also represent a potential hazard." This leads him to call for more caution from those who regulate and grow these foods and close study by those who eat them. Although this caution is appropriate, it must be accompanied by a willingness on the part of regulators to accept reasonable scientific evidence. Readers interested in the agricultural implementation of these considerations should refer to the small book by Pinstrup-Anderson and Schiøler, reviewed in the September 2002 issue of the *Bulletin* (vol. 23, no. 3) [1].

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Modern aspects of nutrition: Present knowledge and future perspectives. Edited by Ibrahim Elmadfa, Elke Anklam, and Jurgen Konog. Proceedings of the 17th International Congress of Nutrition, Vienna, 2001. S. Karger Publishers, New York, 2003 (ISBN 3-8055-381-2) 434 pages, hardcover. US$198.25.

These are the full-text plenary lectures, symposia, and workshop presentations of the 17th International Congress of Nutrition of the International Union of Nutrition Sciences (IUNS) held in Vienna, Austria, August 26–31, 2001. The 180 papers cover the full range of topics in modern nutrition. This large and well-presented volume has 306 authors, 179 figures, 165 tables, and 434 pages. Author and subject indexes and organization by theme make the papers accessible. The volume is useful not only for the wide range of topics presented, but also for identifying contemporary nutrition leaders throughout the world.

Nutritional biochemistry of the vitamins. 2nd edition. David A. Bender. Cambridge University Press, Cambridge, U.K., 2003 (ISBN 0-521-80388-8) 512 pages, hardcover. US$100.00.

As knowledge of the vitamins continues to expand, it is useful for nutrition and health workers to have available authoritative and comprehensive reviews of current available information. This is the second edition of a book that explores the biochemical function of each vitamin, including the effects of deficiency and excess and their role in optimum health and well-being. It provides a compact and authoritative reference volume of value to students and specialists in nutrition. Its value is enhanced by its coverage of gaps in knowledge and of areas where more research is required. Written by a single author, it has an admirably uniform approach and coverage in each chapter.

The final chapter covers a series of marginal compounds and phytonutrients, including carnitine, choline, creatine, inositol, taurine, ubiquinone, and phytocompounds in plant foods of potential biological significance. The chapters are well organized, with multiple subheads, and the many tables and figures are well conceived. In addition to references in the text gathered in a single bibliography at the end, each chapter has suggestions for further reading. This up-to-date review is a convenient reference for clinicians and nutritionists and an appropriate advanced text in nutritional biochemistry.

Physical activity epidemiology. Rod K. Dishman, Richard A Washburn, and Gregory W. Heath. Human Kinetics, Champaign, Ill., USA, 2004 (ISBN 0-88011-605-6) 488 pages, hardcover. US$59.00.

A global epidemic of overweight and obesity is affecting most industrialized and developing countries. A major factor is steadily decreasing physical activity due to the changing lifestyles associated with the development process. Several good books give guidelines for exercise and strength training for the general public [1, 2]. However, the book under review here, written for students in nutrition, health, and related fields, is the first to take a comprehensive epidemiological approach to understanding the significance and importance of physical activity. It will help these readers to understand the risks of the diminishing physical activity associated with worldwide economic and social change.

It was not until 1980 that the US Public Health Service identified physical fitness and exercise as a means for improving human health. The first International Conference on Exercise, Fitness, and Health was held in 1988 and the second in 1992. In the same year (1992), the American Heart Association recognized lack of activity to be an independent risk factor for atherosclerosis. The American Medical Association followed with a similar recognition in 1995. A report from the US Surgeon General in 1998 introduced the concept of physical epidemiology. Since then the field has developed rapidly, and physical activity has become recognized as an important means for improving health, whereas a sedentary lifestyle has been demonstrated to contribute to poor health.

This book provides an introduction to physical activity epidemiology, including origin, concepts, methods, measurement, and surveillance, as well as physical activity and disease mortality, risk factors, obesity, hypertension, cardiovascular disease, diabetes, osteoporosis, cancer, and the immune system. Each chapter has a good bibliography and a list of relevant Web sites. The book is intended "as a textbook for upper level undergraduates and master's degree students who are being introduced to activity epidemiology for the first time and as a reference text in courses in public health." It is well suited to these purposes.

References

1. Exercise: a guide from the National Institute on Aging. Washington, DC: National Institutes of Health, 2001. http://www.nia.nih.gov/exercisebook/. Accessed 21 January 2004.
2. Nelson ME. Strong women stay young. New York: Bantam Press, 1998.

The epidemiology and treatment of childhood anemia in Western Kenya. Meghan Desai. Ph.D. Dissertation, University of Amsterdam, Netherlands, 2003 (ISBN 90-8170-745-2) 147 pages, softcover.

This Ph.D. dissertation consists of seven separate studies, each of interest to nutrition and health workers among populations in which malaria is an important factor. One study demonstrates the high overlapping of malaria, malnutrition, and diarrhea that is responsible for severe anemia among children 3 to 24 months of age and, therefore, the importance of starting prevention in early infancy. Another shows that primary caregivers can be trained to recognize severe anemia (hemoglobin < 5 g/dl), although with only moderate accuracy. One of the studies finds that in this hyperendemic malaria area, daily administration of iron to preschool children for six weeks gives better hematological results than twice-weekly administration. In a final study, the author found no evidence for clinically relevant modifications by hemoglobin S phenotype in the results of iron supplementation of young children with anemia.

—*Nevin S. Scrimshaw*

News and notes

5th Report on the World Nutrition Situation

This report makes the argument that nutrition has a crucial role to play as a key strategy in attaining many of the Millennium Development Goals (MDGs). Conventionally, nutrition is seen as integral to the first MDG, on hunger and poverty; however, nutrition is also instrumental in the achievement of goals for primary education enrollment, improved gender equity, reduced risk of child mortality, improved maternal health, and improved ability to combat disease. The report also provides examples of how to engage nutrition within existing development policies.

This report will be launched at the 31st Session of the Standing Committee on Nutrition at the United Nations on March 22–26, 2004. Copies of the report can be obtained from the SCN Secretariat (e-mail: scn@who.int) or downloaded from http://www.unsystem.org/scn/Publications/html/RWNS.html.

WHO update on global guidance in the area of HIV and infant feeding

To minimize vertical transmission of HIV infection from mothers to their infants through breastfeeding, the Interagency Task Team on Prevention of Mother-to-Child Transmission of HIV recommends for mothers who are known to be HIV positive*:

» When replacement feeding is acceptable, feasible, affordable, sustainable, and safe, avoidance of all breastfeeding by HIV-infected mothers is recommended. Otherwise, exclusive breastfeeding is recommended during the first months of life.

» To minimize HIV transmission risk, breastfeeding should be discontinued as soon as feasible, taking into account local circumstances, the individual woman's feeding situation, and risks of replacement feeding (including malnutrition and infections other than HIV).

» When HIV-infected mothers choose not to breastfeed from birth, or stop breastfeeding later, they should be provided with specific guidance and support for at least the first two years of the child's life to ensure adequate replacement feeding.

» Programs should strive to improve conditions that will make replacement feeding safer for HIV-infected mothers and families.

While clear guidance is available for complementary feeding of breast-fed infants after 6 months of age, there have been requests for better information regarding feeding of infants of HIV-positive mothers who stop breastfeeding early. In response, WHO's Department for Child and Adolescent Health and Development, in coordination with the Departments of Nutrition for Health and Development, HIV/AIDS Prevention and UNICEF Headquarters, conducted informal consultations with experts and commissioned a technical review of alternative feeding options considering various scenarios (including where other milks and animal source foods are available and where they are not). The review forms the basis of an informal meeting to discuss practical generic guidelines for feeding infants 6 to 24 months of age who are not breastfed and a process for their application in countries, 8–10 March 2004, in Geneva, Switzerland. As an outcome of the meeting, WHO is hoping to develop a new set of guidelines, complementary to the Guiding Principles for Complementary Feeding of the Breastfed Child**, that can guide program managers in identifying adequate feeding recommendations that are affordable and feasible for caregivers, families, and communities to implement.

* WHO. New data on the prevention of mother-to-child transmission of HIV and their policy implications. Conclusions and recommendations. WHO technical consultation on behalf of UNFPA/UNICEF/UNAIDS/ Interagency Task team on mother-to-child prevention of HIV. WHO/RHR/01.28, Geneva: World Health Organization, 2000.

** Pan American Health Organization. Guiding Principles for Complementary Feeding of the Breastfed Child. Washington, DC: Pan American Health Organization, World Health Organization, 2002.

For more information on the outcomes of the meeting, please consult the Child and Adolescent Health website at http://www.who.int/child-adolescent-health/NUTRITION/HIV_infant.htm or contact Dr. Peggy Henderson (hendersonp@who.int) or Dr. Bernadette Daelmans (daelmansb@who.int) .

Call for information from former UNU Fellows

The United Nations University (UNU) is updating its information on former UNU fellows. If you are a former UNU fellow, we urgently request you to forward your current postal and e-mail addresses, a description of your current responsibilities, and any other relevant information, including publications, honors, and awards, to UNUfellows@inffoundation.org. Also indicate whether you are currently receiving the *Food and Nutrition Bulletin*. The resulting database will serve as a resource for fellows to reestablish contact with former colleagues, for the UNU and training institutions to compile information on the long-term outcomes of their training efforts, and for both the UNU and the International Nutrition Foundation (INF) to obtain additional support for fellowships. Please also ask any other UNU fellows whom you know to send their information to the above address. This information will be placed on the INF website as it becomes available, and the *Bulletin* will publish periodic reports based on it. A similar INF database and website will be maintained for holders of the current Ellison Medical Foundation–International Nutrition Foundation Fellowships in Nutrition and Infection.

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2. Committee on Enzymes of the Scandinavian Society for Clinical Chemistry and Clinical Physiology. Recommended method for the determination of gammaglutamyltransferase in blood. Scand J Clin Lab Invest 1976;36:119–25.

Book or other monograph reference

—personal author(s):

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