What Works?
A Review of the Efficacy and Effectiveness of Nutrition Interventions

Lindsay H. Allen and Stuart R. Gillespie

United Nations
Administrative Committee on Coordination
Sub-Committee on Nutrition (ACC/SCN)

in collaboration with the
Asian Development Bank (ADB)

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FOREWORD

Improving nutrition in developing countries is both humanitarian and an economic imperative. Yet, despite the gains that have been made, the greater progress that is urgently needed has been hampered by the lack of a systematic evaluation of what works and what does not. A major review of this key issue has been long overdue.

The monograph therefore fills an important gap by providing an overview on which nutrition interventions improve the nutrition status of women and children, with emphasis on the poor in developing countries. The purpose is to define a core menu of proven investment options supported by sound evidence of efficacy. We expect that this review will be a much-consulted reference to support evidence-based nutrition programming in developing countries.

This review takes the perspective of low-income Asia, because the study was commissioned by the Asian Development Bank to inform its policy dialogue with Asian governments. We believe the review will be useful for ADB and all development partners selecting nutrition interventions as stand-alone activities or components in integrated social development projects and programs. Notably, the review draws on global literature and its findings are relevant to all developing countries. The review emphasizes what works and why – for each of the major nutrition problems in Asia: micronutrient deficiencies (vitamin A, iodine and anemia), low birthweight, maternal malnutrition, child growth retardation and arrested cognitive development in early childhood. Supplementation and fortification efficacy and effectiveness trials are reviewed comprehensively. The monograph includes a broader review and impact assessment of food-based approaches to improve maternal and child nutrition. It concludes with recommendations on a core program that passes efficacy and effectiveness tests, and calls for a sensible level of investment in operations research and cost-effectiveness analysis to improve nutrition programming throughout the donor community and national budgets in developing countries.

The decision of the United Nations Sub-Committee on Nutrition and ADB to co-publish the monograph recognizes that Asia is the crucible for improving nutrition of children globally, and nutrition programs must be based on what works. We are committed to further dialogue with the nutrition and development communities to increase support for effective nutrition interventions that will support life-long learning and earning opportunities among Asian children. There is probably no more fundamental way to eliminate poverty than to raise the development potential of children. Nutrition is one of the keys to their proper physical and cognitive development.

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EXECUTIVE SUMMARY

This review tracks the life cycle impacts of malnutrition in the developing world, highlighting the dynamics of cause and consequence, and then considers what can be done to break the cycle: first from an efficacy perspective, then with regard to large scale effectiveness. The focus is on undernutrition, which may be manifest as stunting, wasting, underweight, foetal growth retardation, low body mass index and various micronutrient deficiencies. The perspective is low income Asia. The review focuses on the five major nutrition problems in Asia and the Pacific region: low birthweight, early childhood growth failure, anaemia, iodine deficiency disorders, and vitamin A deficiency. For each of these, the nature of the problem, its prevalence, distribution, consequences, and causes, are discussed. This is followed by a comprehensive review of existing knowledge of the efficacy of key "nutrition interventions" for preventing or alleviating these conditions. The final two sections review the effectiveness of large scale programmes and the process to be adopted for selecting and prioritizing options.

Preventing Low Birthweight

Asia has a higher prevalence of low birthweight (LBW) than any other continent, ranging from well over 30% in South Central Asia and Bangladesh to less that 10% in the People's Republic of China (PRC), the Philippines, Malaysia, and Thailand. LBW is strongly associated with undernutrition of mothers. About 60% of women in South Asia and 40% in Southeast Asia are underweight (<45 kg). LBW is probably the main reason why over 50% of the children in Asia are underweight. It also increases the risk of other health and developmental problems. Interventions to reduce the prevalence of LBW should therefore receive very high priority.

Randomized, controlled, efficacy trials to combat LBW have shown the following. Only supplements that provide more energy, rather than more protein, improve birthweight significantly. In populations where protein intake is adequate, high protein supplements (>25% of energy) to pregnant women may even increase neonatal death rates. Maternal supplementation can increase maternal weight gain, infant head circumference and, when there is a serious energy deficit, the length of the newborn infant.

The expected benefits from maternal food supplementation in Asia have yet to be determined but are expected to be considerable. For comparison, in The Gambia, locally produced biscuits providing 1,017 kcal and 22 g protein per day from mid-pregnancy, reduced LBW prevalence by 39%, increased birthweight by 136 g and reduced infant mortality by about 40%. Such improvements in pregnancy outcome can be obtained by encouraging undernourished women to consume more of their normal diet, where possible, and providing appropriate energy supplements, ideally formulated from local foods. Where the normal diet is particularly low in protein or in micronutrients, it is important to ensure that these are also provided as supplements. Women with the lowest weights (from conception to early pregnancy) and the lowest energy intakes are the most likely to benefit. Targeting interventions based on maternal body mass index (BMI), skinfold thickness, and height is unlikely to be as useful as targeting based on weight.

There are conflicting data on whether supplementation during the second trimester or the third trimester is most effective for improving birthweight. It is clear that supplementation during either of these trimesters can reduce the prevalence of LBW. Young maternal age at conception is an additional risk factor for poor pregnancy outcome. Therefore, it is especially important to target interventions to pregnant women are still growing. Continued supplementation that is given to the mother during her subsequent lactation and next pregnancy may cause an even greater improvement in the birthweight of her next child.

Whenever possible, attention should be paid to improving the quality as well as the quantity of food consumed during pregnancy. There is little evidence

that supplementation with individual nutrients (including calcium, folic acid, iron, zinc and vitamin A) can improve birthweight, other than possibly through a reduction in preterm delivery. However, micronutrient supplementation of underprivileged pregnant women is extremely important. It can lead to substantial reductions in maternal anaemia and may also reduce maternal mortality, birth defects and preterm delivery. It improves breastmilk quality and infant nutrient stores. Trials are ongoing to test the efficacy of providing supplements containing balanced amounts of multiple micronutrients. In areas of endemic iodine deficiency, adequate maternal iodine status is critical for the prevention of neonatal deaths, LBW and abnormal cognitive and physical development of the infant. Non-nutrition interventions that can improve pregnancy outcome include reducing energy expenditure in physical work, increasing age at conception, malarial prophylaxis, and cessation of cigarette smoking.

Improving Child Growth

An estimated 70% of the world's stunted children live in Asia, and there has been little recent improvement in this situation. South Central Asia has the second highest prevalence of growth stunting in the world (44%) and the prevalence in South-East Asia (33%) is also high. Growth stunting in childhood is a risk factor for increased mortality, poor cognitive and motor development and other impairments in function. It usually persists, causing smaller size and poorer performance in adulthood. Nutrition intervention trials support the following recommendations.

Exclusive breastfeeding is strongly recommended for the first six months of life. There is probably no advantage to the infant of introducing complementary foods prior to 6 months, especially where the quantity and quality of such foods is inadequate. Breastfeeding should be continued when other foods are added to the infant's diet. In general, the quality of complementary foods is poor compared to breastmilk. The energy density of many gruels, soups, broths, and other watery foods fed to infants in developing countries, is often below the recommended 0.6 kcal/g. Energy intake can be increased by reducing where possible, the water added to foods, and by providing additional feedings. At present, there is insufficient evidence to promote the use of amylases to lower the viscosity of cereals. Adding extra energy in the form of oil or sugar can adversely affect the density of protein and micronutrients in the diet. Even where breastmilk intake is relatively low, the amount of protein in complementary foods is usually more than adequate. Therefore, adding protein alone or improving protein quality will not improve growth.

Randomized, controlled trials with processed, complementary foods have shown inconsistent impacts on growth. Among nine trials (mostly with infants aged 6 to 12 months), supplements increased weight and length in only three, and weight alone in two more. In the remainder, there was no effect on growth and the expected growth velocity for ages was not attained in any of the studies. The limitations of these trials included: variability in the age at which the intervention started; the composition of the foods and the amounts provided; the extent and replacement of breastmilk; and the baseline nutrition status and morbidity of the infants. Few trials supplied enough micronutrients to permit the children to consume recommended intakes from their diets, plus the supplements. Intervention with food supplements after 12 months is less effective than between 6 and 12 months. However, there is an increased risk of displacement of breastmilk with earlier high intakes of complementary foods, especially before 6 months of age.

In most developing countries, and in some groups in developed countries, the micronutrient content of unfortified, complementary foods is inadequate to meet infant requirements. It is particularly difficult for infants to consume enough calcium, iron, and zinc. Moreover, riboflavin, thiamine, vitamin A, and vitamin B_6 intakes are often low. Micronutrient fortification of cereal staples is especially important where these are major constituents of complementary foods. Interventions with single micronutrients have shown the following benefits for children with low intakes and deficiencies: vitamin A, prevention of eye lesions, substantial reduction in mortality from measles and diarrhoea, and increased haemoglobin (Hb) synthesis; iron, improved cognitive and motor development of anaemic infants and children; zinc, improved growth of children who are stunted or have low plasma zinc; iodine, reduced infant mortality and prevalence of goitre, and improved motor and mental function; and vitamin B_{12}, improved growth and cognitive function.

Multiple micronutrient deficiencies occur simultaneously. Multiple micronutrient supplements improved height velocity in stunted children in Viet Nam, and infants aged <12 months in Mexico, but had no impact on the growth of children in Peru or Guatemala. Additional trials are underway to compare the benefits of multiple micronutrient and single micronutrient supplementation. Novel approaches to providing multiple micronutrients include a fat-based spread, which has improved growth and Hb in stunted children in one trial, and encapsulated "sprinkles".

Micronutrient intake in young children can be increased by higher consumption of animal products. Among 15 complementary feeding trials, in which dry skimmed milk was included as at least one ingredient, growth in length was significantly increased in 12 trials. However, a trial in which dry fish powder was added to fermented maize, showed no benefits. Animal products, such as chicken liver, could be rich micronutrient sources for infants and children, but controlled trials of their efficacy are still lacking.

Preventing and Treating Anaemia

Asia has the highest prevalence of anaemia in the world. About half of all anaemic women live in the Indian subcontinent: 88% of them develop anaemia during pregnancy. Vast numbers of infants and children are also affected. Low intakes of absorbable iron, as well as malaria and hookworm infections are the main causes of anaemia. Intervention trials have demonstrated the benefits from improving iron status and reducing anaemia. The greatest benefits are realized in the most severely anaemic individuals.

Randomized, controlled, clinical trials show that iron supplementation of pregnant women improves Hb and iron status, even in developed countries. Efficacy increases with iron doses of up to 60 mg/d. Where iron supplementation has not been effective this has been due predominantly to programmatic constraints such as lack of available supplements, and poor compliance. No conclusions can be made about the benefits of iron supplementation during pregnancy on maternal or foetal health, function or survival. Most trials have been conducted on relatively small numbers of women in developed countries. Severe anaemia during pregnancy is thought to increase the risk of maternal mortality but there have been no controlled intervention trials on this question. An association between anaemia and preterm delivery has been reported in several large studies but most placebo-controlled trials have been unable to confirm that anaemia causes prematurity. Maternal iron supplementation during pregnancy can improve both maternal and infant iron status for up to about six months postpartum. Daily supplementation during pregnancy is more effective than weekly supplementation for preventing anaemia, especially severe anaemia. The total amount of iron consumed is the most important predictor of the maternal haemoglobin (Hb) response. In malaria-endemic areas, antimalarial prophylaxis combined with iron supplementation is particularly important for preventing maternal anaemia and LBW. LBW infants are born with very low iron stores, and these are depleted by 2 to 3 months postpartum. Because breastmilk cannot meet their iron requirements, they should be supplemented with iron, starting at 2 months of age.

Anaemia during infancy can result in long term or permanent impairment of psychomotor function, although more studies are needed. Iron supplementation of anaemic preschool children improves their cognitive and physical development. Improved growth of iron-supplemented preschool children and school children has been observed in some studies but not in others. Anaemia is also associated with lower productivity, even in tasks requiring moderate effort such as factory work and housework. Iron deficiency that has not yet progressed to anaemia may also reduce work capacity. Efficacy trials have shown that iron supplements improve the work performance of anaemic individuals.

Except for iron fortification, there have been few attempts to assess the effectiveness of food-based strategies to improve iron status. Increasing intake of vitamin C, through local foods, is probably an inadequate strategy to improve iron status where iron deficiency is prevalent. Targeting animal products to those with the highest iron requirements, and supporting the production of poultry, small livestock and fish, would increase the intake of absorbable iron and other micronutrients. There are strategies available to increase the iron content of plants through genetic enhancement but the efficacy and effectiveness of this approach have not been evaluated. Fortification of foods with iron has produced improvements in iron status in the following countries: Chile, where nationally distributed dry milk, fortified with ferrous sulphate and vitamin C, lowered the prevalence of anaemia in infants from about 27% to close to zero; Ghana, where electrolytic iron, added to a complementary food, reduced anaemia and iron deficiency; India, where double fortification of salt, with iodine and iron, has the potential to prevent both iron and iodine deficiencies and has been effective for improved Hb concentrations; and Venezuela, with fortification of maize and wheat. The search for better fortificants continues. NaFeEDTA has good potential: when added to sugar in a community trial in Guatemala, it increased Hb and ferritin concentrations. Iron added as NaFeEDTA to soy sauce appears to be well absorbed and is being tested in large scale production and fortification trials in the PRC.

For children and adolescents, weekly delivery of iron supplements improves iron status almost as well as daily delivery. Delivery of weekly iron, through schools, community-based programmes etc., may be a cheap, effective way to prevent iron deficiency. However, daily supplements are still more effective for pregnant women. Supplements containing multiple

vitamins and minerals could be more effective for improving Hb response than iron alone, because several nutrients are required for Hb synthesis. Multiple micronutrient deficiencies often occur simultaneously and should be prevented and treated. Multiple micronutrient supplements are now being formulated and tested by international organizations.

Preventing and Treating Iodine Deficiency

Iodine deficiency disorders (IDD) are a serious problem in Asia. Their prevalence in South-East Asia exceeds that in all other regions of the world. The need to eliminate iodine deficiency is very clear, based on its widespread damaging effects and the large numbers of people affected. There are few randomized, placebo-controlled trials of the effects of iodine supplementation. However, the following conclusions are justified.

Salt iodization is by far the most important population-based intervention to combat IDD and has been efficacious where iodine concentrations in the salt were at appropriate levels at the time of consumption. Efforts toward establishing and sustaining national salt iodization programmes have accelerated over recent years. Effective partnerships have been forged between UN agencies, national and international NGOs, and the salt industry. Globally, 68% of households in countries with IDD, now consume iodized salt. Iodization rates are 70% in South-East Asia and 76% in the western Pacific; following the World Health Organization (WHO) definitions of these regions. These figures reflect household survey data where available; otherwise production level data are used as a proxy.

Cretinism results from maternal iodine deficiency during pregnancy. It can be prevented by supplementing the mother during pregnancy, preferably during the first trimester and no later than the second trimester. Supplementation in late pregnancy, if that is the first time the mother can be reached, may still provide some small benefits for infant function. In one iodine deficient region, iodine supplementation, even in the last half of pregnancy substantially reduced infant mortality and improved birthweight. Iodine deficiency during early life adversely affects learning ability, motivation, school performance and general cognitive function. It is not yet clear whether iodine supplementation, if started during childhood, benefits cognitive function. Neither is it clear whether supplementation improves the growth of children. Giving iodized oil to 6-week old infants caused a 72% reduction in mortality in the first two months. In areas where iodine deficiency is prevalent, it may be useful to administer iodized oil to young infants .

Preventing and Treating Vitamin A Deficiency

The prevalence of clinical vitamin A deficiency (VAD) is quite low. For the last years in which information is available on children in Asia, it ranged from 0.5% in Sri Lanka to 4.5% in Bangladesh. Other age groups are affected as well, especially pregnant and lactating women. A prevalence of >1% indicates a public health problem. Subclinical VAD is much more common, though the actual prevalence is uncertain owing to a paucity of reliable data at national level. The only national surveys of the prevalence of subclinical VAD in Asia are: 18% for the PRC; 50% for Pakistan; and 10% for the Philippines. These estimates were only for preschool children, and it is highly likely that the prevalence is now less where there have been national supplementation programmes. VAD causes: increased morbidity and mortality of infants, children and pregnant women; poor growth of children; and possibly increased mortality and morbidity of infants infected with HIV. It also contributes to anaemia by interfering with iron transport and utilization for Hb synthesis.

The main cause of VAD is low intake of animal products, many of which contain a large amount of retinol. Beta-carotene is the main provitamin A in plants. Although some plants are very high in beta-carotene, this is generally less well absorbed by humans than retinol. Beta-carotene from fruits and squashes is substantially better absorbed than that from leaves and vegetables in general. Populations with the highest prevalence of VAD consume low amounts of animal products and fruits rich in beta-carotene. Breastmilk is the main sources of vitamin A for infants. Clinical symptoms of VAD are rare in breastfeeding infants during the first year of life even where the prevalence of VAD is high. Poor maternal vitamin A status, and subsequently low breastmilk retinol content is a risk factor for the earlier onset of VAD in infants, as is early cessation of breastfeeding. Infection with *Ascaris lumbricoides* lowers serum retinol concentrations. Deworming has improved the values. Poor absorption of vitamin A may also occur in some types of diarrhoea and fever, during which there is also a higher rate of utilization and disposal of the vitamin. In severe protein-energy undernutrition, retinol binding protein synthesis is impaired. Zinc and iron deficiencies also interfere with the utilization and transport of stored retinol.

Most countries where VAD is known to be a major public health problem have policies supporting the regular supplementation of children. This is an approach of known large scale effectiveness that can reach the subpopulations affected by and at risk of, VAD. Supplementation of women during pregnancy reduces

their higher prevalence of night blindness in areas of endemic VAD. Night blindness carries a higher risk of maternal morbidity and mortality. Maternal mortality from pregnancy-related causes was reduced by 40% with weekly vitamin A supplements and 49% with weekly beta-carotene supplements, in an area of rural Nepal with high VAD. These results need to be confirmed by further studies. High dose vitamin A supplements cannot be given safely to pregnant women.

A high dose vitamin A supplement given to infants on the day of birth lowered total mortality during the subsequent 4 months, though a multicentre trial of the efficacy of high-dose vitamin A failed to find an impact on mortality or morbidity during the first year of life. It is likely that the dose given was too low to improve infant vitamin A status for long. Maternal supplementation postpartum can improve both maternal and infant vitamin A status, the latter through higher breastmilk content of the vitamin. Meta-analysis has revealed that high dose vitamin A supplementation reduced mortality from diarrhoea and measles by 23% for infants and for children age 6 months to 5 years. Severe diarrhoea was reduced by low dose vitamin A in one study of severely malnourished children, but the reported benefits of high dose vitamin A on diarrhoea-related outcomes have been variable. Little impact has been found on recovery from acute lower respiratory tract infections. Ongoing research will clarify the benefits of vitamin A supplementation in HIV-infected populations. Evidence to date suggests that supplementation of HIV-positive women may improve pregnancy outcome and that supplementation of infected infants and children can reduce mortality.

Food-based strategies have good potential for preventing VAD. Some of food-based interventions have been implemented on a large scale, but few have been evaluated adequately. Significant progress has been made in understanding how to bring about behavioural change in such programmes, and which food-based strategies are likely to be effective for improving vitamin A status. Food-based approaches need to be pursued more vigorously so that they become a larger part of the longer term global strategy for alleviating VAD. However, the recent finding that the bioconversion of provitamin A in dark green leafy vegetables is less than one quarter of that previously thought, has raised doubts about the degree of efficacy of certain diet modification approaches in improving vitamin A status. Breastfeeding promotion, protection, and support remain an essential component of control programmes for young children, as does infectious disease control, not only through immunization, but also via complementary hygiene and sanitation interventions. There is also an urgent need to expand efforts in fortification, where foods reaching the target population groups are processed or where local fortification is feasible. Fortification of oils with vitamin A is mandatory throughout most of South Asia although this is not often enforced. Control approaches, based on improved availability of vitamin A rich foods and possibly genetic modification of staple foods to enhance vitamin A availability, as with iron, have been slower to develop and more difficult to implement, but progress is being made.

How Effective are Large Scale Interventions?

Most large scale nutrition interventions can potentially affect most of these problems, though there is an extraordinary dearth of well designed evaluations of community-based nutrition interventions. In this section, a series of guidelines is provided for improving the effectiveness, and ultimately the impact, of key nutrition interventions. These derive from lessons learned with past experience in large scale programmatic settings. The key strategies discussed are growth monitoring and promotion, integrated care and nutrition, communications for behavioural change, supplementary feeding for women and young children, school feeding, health-related services, micronutrient supplementation, and food-based strategies.

Prioritizing Options

Having discussed both the efficacy evidence and the factors conditioning large scale effectiveness of different interventions, this review concludes with a consideration of the process that needs to be initiated for deciding on the type of action or mix of actions that are most appropriate for combating the problem of undernutrition in different situations. The choice will depend on the actual nature and distribution of the malnutrition problem, its causes, and the type of resources that are available. No single intervention or mix of interventions should ever be prescribed in isolation from a participatory process of problem assessment, causal and capacity analysis, and programme design. Cost-benefit and cost-effectiveness analyses may help in deciding priorities. "Key minimum packages" are discussed. As malnutrition usually results from many factors, there are potential synergies between many actions—carried out by multiple actors across sectors—and that the combined effects of such interventions are often not merely additive, but multiplicative. Programme goals should be prioritized with consideration to the level of a country's development. The review concludes by describing the main elements of successful programme management practices. Community-based nutrition intervention programmes in seven Asian countries are summarized in an Appendix.

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LIST OF ABBREVIATIONS

ACC/SCN	Administrative Committee on Coordination (of the United Nations)/Sub-Committee on Nutrition
ADB	Asian Development Bank
AGW	*Anganwadi* worker (India)
AKU	Aga Khan University
ANC	Antenatal care
ANM	Auxiliary Nurse Midwife (India)
ARI	Acute respiratory infection
AusAID	Australian International Development Agency
BHA	Butylated hydroxyanisole, an antioxidant used to prevent lipid oxidation
BINP	Bangladesh Integrated Nutrition Project
BFHI	Baby-Friendly Hospital Initiative (People's Republic of China and Pakistan)
BMI	Body mass index measured as weight (in kg) divided by height (in m) squared.
CASD	Community Action for Social Development (Cambodia)
CBC	Communications for behavioural change
CBNC	Community-based nutrition component (Bangladesh)
CDD	Control of diarrhoeal disease
CF	Conceptual Framework
CIDA	Canadian International Development Agency
CNC	Community Nutrition Center (Bangladesh)
CNO	Community Nutrition Organizer (Bangladesh)
CNP	Community Nutrition Promoter (Bangladesh)
CNW	Community Nutrition Worker (India)
CPCC	National Programme of PEM Control for Vietnamese Children
CRSP	Collaborative Research Support Programme
DALYs	Disability-adjusted life years
DPT	Diphtheria-polio-tetanus immunization
DSD	District Secretary's Division (Sri Lanka)
ELC	Early Childhood Learning Centre
EPI	Expanded Programme on Immunization
EU	European Union
Fe	Iron
FNB	Food and Nutrition Board
FWA	Family Welfare Assistant (Bangladesh)
GM	Growth monitoring
GNP	Gross National Product
HANDS	Health and Nutrition Development Society (Pakistan)
HA	Height-for-age
Hh	Household
Hb	Haemoglobin
HKI	Helen Keller International
ICCIDD	International Coordinating Committee on Iodine Deficiency Disorders
ICDS	Integrated Child Development Services (India)
ICRW	International Center for Research on Women
ICMR	Indian Council for Medical Research
IDECG	International Dietary Energy Consultative Group
IDA	Iron deficiency anaemia
IDD	Iodine deficiency disorders
IEC	Information-education-communication
IFPRI	International Food Policy Research Institute
IMCI	Integrated Management of Child Illness
INACG	International Nutritional Anaemia Consultative Group
INCAP	Instituto de Nutricion de Centro America y Panama
IQ	Intelligence quotient
IRDP	Integrated Rural Development Programme (India)
IU	International Units
IUGR	Intrauterine growth retardation
IUGR-LBW	Refers to infant's born at term (>37 weeks) with LBW (see below)

JRY	Food-for-work scheme (India)
JFT	Janasaviya Trust Fund (Sri Lanka)
LA	Length-for-age
LBW	Low birthweight
LHW	Lady Health Worker (Pakistan)
LMP	Last menstrual period
MCH	Mother and child health
MICS	Multiple Indicator Cluster Survey (UNICEF/Cambodia)
MIS	Management information system
MOH	Ministry of Health (Pakistan)
MOHFW	Ministry of Health and Family Welfare (Bangladesh)
NAS	National Academy of Sciences (USA)
NCHS	National Center for Health Statistics
NDTF	National Development Trust Fund (Sri Lanka)
NERP	Nutritional Education and Rehabilitation Programme (Viet Nam)
NFA	National Food Authority (Philippines)
NGOs	Nongovernmental organizations
NIDs	National Immunization Days
NIDDEP	National Iodine Deficiency Disorders Elimination Programme (People's Republic of China)
NNMB	National Nutrition Monitoring Bureau
NMMP	National Mid-Day Meals Programme (India)
NNNCP	National Nutritional Anaemia Control Programme (India)
NNPA	National Nutrition Plan of Action (Cambodia)
NRC	National Research Council (USA)
NREP	National Rural Employment Programme (India)
ORT	Oral rehydration therapy
PAHO	Pan-American Health Organization
PAR	Population-attributable risk
PDS	Public Distribution System (India)
PEM	Protein-energy malnutrition
PHM	Public Health Midwife (Sri Lanka)
PI	Ponderal index
PNIP	Participatory Nutrition Improvement Project (Sri Lanka)
PRB	Population Reference Bureau
RE	Retinol Equivalent
RETA	Regional Technical Assistance
RR	Relative ratio
SGA	Small-for-gestational-age
T_3	Triiodothyronine
T_4	Thyroxine
TB	Tuberculosis
TBA	Traditional birth attendant (Pakistan)
TGR	Total goitre rate
TINP	Tamil Nadu Integrated Nutrition Project
TPDS	Targeted Public Distribution System (India)
TSH	Thyroid stimulating hormone
UNICEF	United Nations Children's Fund
UNU	United Nations University
USAID	United States Agency for International Development
USI	Universal salt iodization
VAC	Vitamin A capsule
VAD	Vitamin A deficiency
VDC	Village Development Committee (Cambodia)
VAP	Village Action Plan
WA	Weight-for-age
WH	Weight-for-height
WHO	World Health Organization
WL	Weight-for-length

GLOSSARY

Anganwadi	Courtyard in Hindi. Anganwadi workers are community-based workers in Integrated Child Development Services (ICDS) in India
Bayley score	Performance on the Bayley tests of motor and mental development
Bitot's spots	Lesions of the conjunctiva that occur in vitamin A deficiency
Body mass index	A measure of adult nutritional status, essentially thinness; defined as bodyweight in kilograms divided by height in metres squared (kg/m^2)
Dais	Midwives (Pakistan)
Development quotient	The conversion of raw scores of development to standardized scores; e.g. for motor or mental development.
Eclampsia	Maternal convulsions in late pregnancy; one symptom of pregnancy-induced hypertension.
Electrolytic iron	Iron produced by electrolysis; used for fortification
Elemental iron	A generic term for iron powders produced by various processes (e.g. H-reduced, electrolytic, carbonyl, atomized) and used as food fortificants.
Grama Niladhari	Administrative unit (Sri Lanka)
Height-for-age	An indicator of the degree of stunting of a child (see below), defined as his/her height in relation to the median height of a reference population of that age.
Intrauterine growth retardation	Birthweight below a given low percentile limit for gestational age (e.g., birthweight less than 10th percentile for gestational age); typically reflects inadequate supply of nutrients and oxygen to the foetus.
Jaggery	Raw sugar
Low birthweight	Weighing less than 2,500 grams at birth.
Megaloblastic anaemia	An anaemia characterized by the presence of large, nucleated red blood cells, as occurs in severe folate or vitamin B_{12} deficiency.
Odds ratio	The ratio of the odds of a condition or disease in an exposed population to the odds of the same condition or disease in a nonexposed population.
Phytates	Phytic acid combined with minerals. These constitute 1-2% of the weight of whole grain cereals, nuts, seeds and legumes, and impair mineral absorption from these foods.
Population-attributable risk	In an exposed population of those who have a condition or disease, the proportion for whom this is attributed to being in the exposed (vs. nonexposed) group.
Ponderal index	Weight/length^3; an indicator of wasting in young infants.
Pre-eclampsia	Development, during pregnancy, of hypertension with proteinuria and/or oedema.
Prelacteal feeding	The potentially harmful practice of delaying breastfeeding, and feeding the newborn such foods as milk, honey, or sugar water. These prelacteal feeds are unnecessary and can introduce infection in the baby. They also interfere with the physiology of lactation and delay establishment of breastmilk.
Primagravidae	Women who are in their first pregnancy.
Raven's progressive matrices	A non-verbal IQ score that is allegedly free from culture bias.
Relative risk	The ratio of the probability of a condition or disease in an exposed population to the probability of the same condition or disease in a nonexposed population.
Samurdhi	A poverty alleviation programme in Sri Lanka
Small-for-gestational-age	At or below the 10th percentile of a birthweight-for-gestational-age curve

Stunting	The anthropometric index 'height-for-age' reflects linear growth achieved pre- and postnatally, with deficits indicating longterm, cumulative effects of inadequacies of nutrition and/or health. Shortness in height refers to a child who exhibits low height-for-age that may reflect either normal variation in growth or a deficit in growth. Stunting refers only to shortness that is a deficit, or linear growth that has failed to reach genetic potential as a result, most proximally, of the interaction between poor diet and disease. Stunting is defined as low height-for-age; i.e., below 2 standard deviations (or 2 Z-scores) of the median value of the National Center for Health Statistics/World Health Organization International Growth Reference for length- or height-for-age
Teratogenic	Causing abnormal foetal development, such as birth defects.
Thalassaemia minor	Thalassaemias are inherited disorders in which haemoglobin synthesis is impaired. Thalassaemia minor is the heterozygous form and is usually asymptomatic, with a mild hypochromic, macrocytic anaemia.
Thana	Administrative district in Bangladesh (see "union")
Thriposha	Supplementary feeding programme in Sri Lanka
Total goitre rate	The prevalence of goitre (enlargement of the thyroid gland) in a specific population group, usually expressed as a percentage. Goitre reflects significant iodine deficiency in the population.
Underweight	The anthropometric index 'weight-for-age' represents body mass relative to age. Weight-for-age is influenced by the height of the child and his or her weight and is thus a composite of stunting and wasting (which makes its interpretation difficult). In the absence of wasting, both weight-for-age and height–for-age reflect the long term nutrition and health experience of the individual or population. General lightness in weight refers to a child having a low weight-for-age. Lightness may represent either normal variation or a deficit. Underweight specifically refers to lightness that is a deficit and is defined as low weight-for-age, i.e.; below 2 standard deviations (or 2 Z-scores) of the median value of the National Center for Health Statistics/World Health Organization International Growth Reference for weight-for-age.
Undernutrition	A condition in which the body contains lower than normal amounts of one or more nutrients.
Union	Administrative unit (Bangladesh)
Wasting	A recent and severe process that has produced a substantial weight loss, usually as a consequence of acute starvation and/or severe disease. Chronic dietary deficit or disease can also lead to wasting. The anthropometric index 'weight-for-height' reflects body weight relative to height. Thinness refers to low weight-for-height and may indicate normal variation or a deficit in weight. Wasting refers to thinness that is a deficit, defined as low weight-for-height, i.e., below 2 standard deviations (or 2 Z-scores) of the median value of the National Center for Health Statistics/World Health Organization International Growth Reference for weight-for-height. The statistically expected prevalence of wasting (as with underweight and stunting) is between 2-3%, given the normal distribution of wasting rates.
Weight-for-age	An indicator of the degree of underweight of a child (see above), defined as his/her weight in relation to the median weight of a reference population of that age.
Weight-for-height	An indicator of the degree of wasting of a child (see above), defined as his/her weight in relation to the median height of a reference population of that age.
Z-score	The deviation of an individual's value from the median value of a reference population, divided by the standard deviation of the reference population.