

THE LANCET

***The Lancet's* Series on Maternal and Child Undernutrition Executive Summary**



The problem of maternal and child undernutrition in developing countries

More than 3.5 million mothers and children under five die unnecessarily each year due to the underlying cause of undernutrition, and millions more are permanently disabled by the physical and mental effects of a poor dietary intake in the earliest months of life. By the time children reach their second birthday, if undernourished, they could suffer irreversible physical and cognitive damage, impacting their future health, economic well-being, and welfare. The consequences of insufficient nourishment continue into adulthood and are passed on to the next generation as undernourished girls and women have children of their own.

Undernutrition includes a wide array of effects including *intrauterine growth restriction* (IUGR) resulting in low birthweight; *underweight*, a reflection of low weight-for-age; *stunting*, a chronic restriction of growth in height indicated by a low height-for-age; *wasting*, an acute weight loss indicated by a low weight-for-height; and less visible *micronutrient deficiencies*. Undernutrition is caused by a poor dietary intake that may not provide sufficient nutrients, and/or by common infectious diseases, such as diarrhoea. These conditions are most

significant in the first two years of life, highlighting the importance of nutrition in pregnancy and the window of opportunity for preventing undernutrition from conception through 24 months of age.

Today, using recent estimates and latest data and standards, it is estimated that 13 million children are born annually with IUGR, 112 million are underweight and 178 million children under 5 years suffer from stunting, the vast majority in south-central Asia and sub-Saharan Africa (figure 1). Of these, 160 million (90%) live in just 36 countries, representing almost half (46%) of the 348 million children in those countries. An estimated 55 million children are wasted, of whom 19 million children are affected by severe acute malnutrition (SAM), defined as a weight-for-height measurement 3 standard deviations below the median.

Although in recent years the global public health and nutrition community has focused primarily on obesity and specific micronutrient interventions, maternal and child undernutrition continues to place a heavy burden on low- and middle-income countries. Because undernutrition is an intergenerational problem, countries with high rates of maternal and child undernutrition face an uncertain future in which the health of their

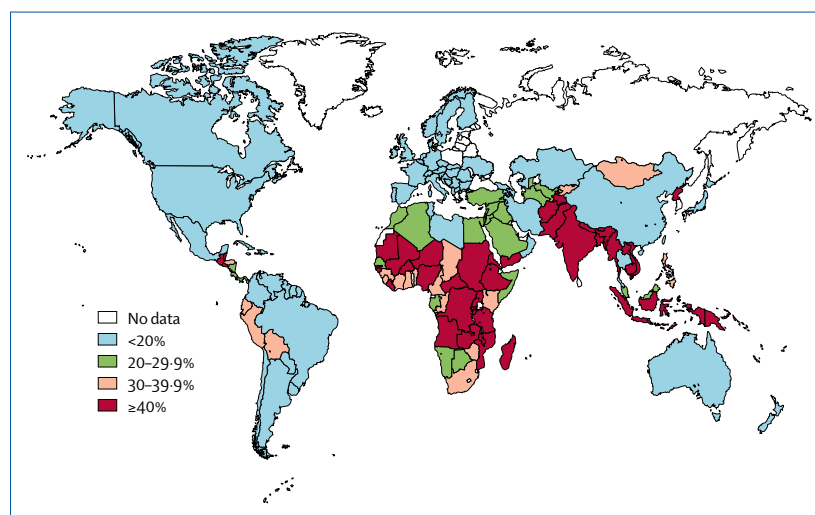


Figure 1: Prevalence of stunting among children under 5 years

workforce and their opportunity for economic development are at risk. Although undernutrition and poverty are often intertwined and long-term solutions to eradicate poverty and undernutrition must be linked, there are proven steps that can be taken now to alleviate the immediate effects of maternal and child undernutrition.

About the Series

The Lancet's Series on Maternal and Child Undernutrition provides new insight into the global prevalence and impact of maternal and child undernutrition. The Series

follows a number of earlier important series from *The Lancet*, such as those on Child Survival and Neonatal Health, that have shaped policy and action. The Series examines evidence-based interventions that, if implemented at scale, could significantly reduce the effects of maternal and child undernutrition. This reduction will require improved coordination between national agencies and international organisations, as well as efficient management of resources and a dedicated effort to strengthen global capabilities.

The first two papers quantify the prevalence of maternal and child undernutrition and consider the short-term consequences in terms of deaths and disease burden, as measured by Disability-Adjusted Life Years (DALYs), and long-term educational and economic effects and associations with adult chronic diseases, particularly as countries go through the demographic, epidemiological, and nutritional transitions. The third paper estimates the potential benefits of implementing health and nutrition interventions that current evidence indicates are effective and applicable in low- and middle-income countries. The last two papers consider the current state of such interventions and how they could be implemented at scale through actions at national and global levels.

The full articles plus accompanying materials are available for download free of charge at www.globalnutritionseries.org.

Panel 1: Series key messages

- In poor countries maternal and child undernutrition is the underlying cause of more than one-third (3.5 million) of all child deaths under the age of 5 years, many of which are preventable through effective nutrition interventions operating at scale
- Pregnancy to age 24 months is the critical window of opportunity for the delivery of nutrition interventions. If proper nutrition interventions are not delivered to children before the age of 24 months, they could suffer irreversible damage into their adult life and to the subsequent generations
- Effective interventions are available to reduce underweight, stunting, micronutrient deficiencies, and child deaths. Among the currently available interventions reviewed, breastfeeding counselling, appropriate complementary feeding, and vitamin A and zinc have the greatest potential for reducing child deaths and future disease burden related to undernutrition. Interventions to reduce iron and iodine are important for maternal survival and for children's cognitive development, educability, and future economic productivity
- Ninety percent of the world's undernourished children live in just 36 countries. Intensified nutrition action in these countries can lead to the achievement of the Millennium Development Goal of halving severe hunger by 2015 (MDG 1) and greatly increase the chances of achieving goals for child and maternal mortality (MDGs 4 & 5)
- Nutrition should be a priority at all levels—sub-national, national and global—because it is a central component for human, social, and economic development. Undernutrition is a key factor in child development, maternal health, and productivity. The prevention of maternal and child undernutrition is a long-term investment that will benefit the current generation and their children
- Reducing maternal and child undernutrition will require improved coordination between national agencies and international organisations. Additionally, the international nutrition system requires significant reform in order to be effective: a new global governance structure is needed to provide greater accountability

The prevalence of undernutrition

Maternal and child undernutrition is highly prevalent in low- and middle-income countries, resulting in substantial increases in mortality and overall disease burden. An extensive review of evidence was used to estimate the effects of the risks related to measures of undernutrition, as well as to sub-optimal breast-feeding practices.

Measuring the burden of disease—DALYs

The health consequences of maternal and child undernutrition are often measured in deaths, contribution to overall rates of disease, and in the number of life years diminished by disease or disability. The burden of disease measures the gap between the current health of a population and an ideal situation where everyone in the population lives into old age in full health, in a unit of disability-adjusted life years (DALYs). DALYs combine years of life lost due to premature death and years of life lived with disabilities into a single indicator allowing assessment of the total loss of health from different causes. One DALY can be considered as approximately one lost year of “healthy” life.

Childhood underweight, stunting and wasting

In 2005, 20% of children younger than 5 years of age in low- and middle-income countries were underweight. The prevalences were highest in south-central Asia and eastern Africa where 33% and 28%, respectively, were underweight. An estimated 32% of children younger than 5 years of age in low- and middle-income countries were stunted. Eastern and middle Africa have the highest prevalence estimates where 50% and 42%, respectively, were stunted. The largest number of children affected by stunting, 74 million, live in south-central Asia. India, with a large population, is home to the most stunted children. There are 61 million stunted children in India, which is over half (51%) of all Indian children under age 5 years, and 34% of all stunted children worldwide.

Globally, 55 million (10%) children under 5 years are wasted (low weight-for-height). The highest prevalence is found in south-central Asia where 29 million children are wasted. An additional 19 million children in the world are severely wasted, a description often used to determine the need for urgent lifesaving actions, including therapeutic feeding.

	Deaths	Percentage of deaths in children under 5 years	Disease burden (1000 DALYs)	Percentage of DALYs in children under 5 years
Underweight*	1 957 530	19.0	81 358	18.7
Stunting	1 491 188	14.5	54 912	12.6
Wasting*	1 505 236	14.6	64 566	14.8
Severe wasting*†	449 160	4.4	25 929	6.0
Intrauterine growth restriction-low birthweight	337 047	3.3	13 536	3.1
Total of stunting, severe wasting, and intrauterine growth restriction-low birthweight‡	2 184 973	21.4	90 962	21.2

*Deaths (138 739) and DALYs (14 486 400) directly attributed to protein energy malnutrition included. †Included in wasting. ‡Total takes into account the joint distribution of stunting and severe wasting.

Table 1: Global deaths and disease burden measured in disability-adjusted life-years (DALYs) in children under 5 years of age attributed to nutritional status measures in 2004

Stunting, severe wasting, and IUGR together are estimated to contribute annually to 2.2 million deaths and 91 million disability-adjusted life years (DALYs), 21% of the total for all causes for children less than 5 years old (table 1). Together, stunting, severe wasting, and IUGR are responsible for 7% of the total disease burden for any age group, making these conditions the highest of any risk factor for overall global disease burden.

Among micronutrient deficiencies, vitamin A and zinc are the greatest contributors to disease burden because of their direct effects on child health. Deficiencies of vitamin A and zinc were estimated to be responsible for 600 000 and 500 000 deaths, respectively, and combined, 9.8% of global childhood DALYs. The effects of iron and iodine deficiencies on child deaths are small, and as a result, these conditions resulted in fewer DALYs lost, though their impacts on cognitive development, educability, and future economic productivity potential are considerable. Iron deficiency is a risk factor for maternal mortality, and is estimated to be responsible for 115 000 deaths per year and 0.4% of global total DALYs. Sub-optimal breastfeeding increases the risk of poor nutrient intake and illness and was estimated to be responsible for 1.4 million child deaths and 44 million DALYs (10% of all DALYs in children less than 5 years old). Together these risk factors were responsible for more than one-third—about 35%—of under-five child deaths and 11% of the global total disease burden.

The continuing very high mortality and disease burden resulting from these nutrition-related factors make a compelling case for the urgent implementation of proven interventions.



Indian woman holds child

Long-term effects on development and health

The effects of undernutrition span into future generations, with a mother's nutritional status affecting the health of her future grandchildren. Conditions such as stunting, severe wasting, and IUGR in the first two years of life cause irreparable harm by impeding physical growth and—if followed by rapid weight gain in the 3–5 year age range—increasing the risk of chronic disease later in life. Children who are stunted or born with IUGR are also shown to complete fewer years of schooling and earn less income as adults, hindering their cognitive growth and economic potential. Lower income, poor health, and reduced access to proper nutrition then continue to impact the health of children born into the next generation, establishing a repetitive cycle.

Undernourished children are more likely to become short adults, to have lower educational achievement, and to give birth to smaller infants. Maternal and child undernutrition is also associated with lower economic status in adulthood, with effects that spill over to future generations. These findings reinforce existing assertions about the positive economic outcomes of good nutri-

tion and its importance as a prerequisite for economic development. This should serve as a wake-up call to finance ministries and development agencies in countries with a high burden of undernutrition.

Through an analysis of five long-running studies and an extensive literature review, the Series examines the lasting impact that a poor dietary intake in childhood can have. Data and the literature review support a strong association between maternal and child undernutrition and adult short stature, reduced school attendance, and diminished economic potential. Although the link between maternal and child undernutrition and adult disease is not as clear, there is solid research indicating that young children who are undernourished and gain weight rapidly later in childhood are at increased risk for chronic disease as adults.

There is substantial evidence linking stunting to cognitive development and school performance. It is unclear exactly what causes this connection, though undernutrition may impact brain development and impair motor skills. Improved nutrition could allow children to reach their intellectual potential and increase the strength of opportunities for future achievement. Healthy birthweight and weight-for-age are associated with higher economic productivity, but the best determinant of future capital is a child's height-for-age at 2 years old. Because irreversible stunting already affects undernourished children at this age, it is important to improve dietary intake including optimal breastfeeding in the earliest months of life to ensure growth and development.

Children born with a low birthweight face an increased risk of chronic disease as adults. Children whose early growth in the first two to three years of life is restricted and who go on to gain weight rapidly in the next couple of years are more likely to have high blood pressure, diabetes, and both cardiovascular and metabolic disease as young adults. These same conditions are not as prevalent in children that gain weight rapidly in the first two years of life, even in those with IUGR. This indicates that by supporting early nutrition and growth during pregnancy and for the first two years, many common nutrition-related chronic diseases could be reduced.

Because maternal and child undernutrition has long-term, intergenerational effects, the prevention of conditions associated with undernutrition should be seen as an intergenerational investment. Undernutrition

leaves a lasting mark not only on health, but on the growth, education, and development of individuals and nations.

Evidence-based interventions to address undernutrition

The third paper in the Series summarises the state of the evidence for interventions with proven effectiveness in addressing undernutrition. The 45 interventions reviewed included breastfeeding promotion, complementary feeding promotion strategies with or without provision of food supplements, micronutrient interventions, and general supportive strategies for improving family and community nutrition and disease burden reduction (such as hand washing promotion and strategies to reduce the burden of malaria in pregnancy).

Table 2 summarises the various interventions with demonstrated impact on maternal and child undernutrition. Importantly, for each of the conditions contributing to nutrition-related disability and death there are already highly effective interventions available. Of the reviewed interventions, breastfeeding promotion, appropriate complementary feeding, supplementation with vitamin A and zinc, and appropriate management of severe acute malnutrition showed the most promise for reducing child deaths and future disease burden related to undernutrition.

Based on these new analyses, the authors estimate that universal coverage with the full package of proven interventions at observed levels of programme effectiveness could prevent about one-quarter of child deaths under 36 months of age and reduce the prevalence of stunting at 36 months by about one-third, averting some 60 million DALYs.

Correct breastfeeding is the behavioural outcome of effective interventions. The review showed that breastfeeding promotion that included individual or group counselling was effective in increasing rates of correct breastfeeding, and therefore analysis conducted for the series looked at the potential impact that breastfeeding promotion could have. With 99% coverage, breastfeeding promotion could reduce deaths at 36 months of age by 9.1% and DALYs at 36 months by 8.6%. However, this intervention does not have a large impact on reducing stunting.

Counselling on complementary feeding is more effective at reducing stunting than breastfeeding promotion.

Sufficient evidence for implementation in all 36 countries	Evidence for implementation in specific, situational contexts
Maternal and birth outcomes	
Iron folate supplementation	Maternal supplements of balanced energy and protein
Maternal supplements of multiple micronutrients	Maternal iodine supplements
Maternal iodine through iodisation of salt	Maternal deworming in pregnancy
Maternal calcium supplementation	Intermittent preventive treatment for malaria
Interventions to reduce tobacco consumption or indoor air pollution	Insecticide-treated bednets
Newborn babies	
Promotion of breastfeeding (individual and group counselling)	Neonatal vitamin A supplementation
	Delayed cord clamping
Infants and children	
Promotion of breastfeeding (individual and group counselling)	Conditional cash transfer programmes (with nutritional education)
Behaviour change communication for improved complementary feeding*	
Zinc supplementation	Deworming
Zinc in management of diarrhoea	Iron fortification and supplementation programmes
Vitamin A fortification or supplementation	Insecticide-treated bednets
Universal salt iodisation	
Handwashing or hygiene interventions	
Treatment of severe acute malnutrition	
*Additional food supplements in food-insecure populations.	
Table 2: Interventions that affect maternal and child undernutrition	

When considering the use of food and cash transfers to improve complementary feeding, it is important to differentiate between food secure and food insecure populations. Although nutritional counselling concerning optimal complementary feeding is important everywhere, food insecure populations may also require improving food access.

The timely and appropriate management of severe acute malnutrition (SAM) in hospital and community settings using standardised criteria significantly improves clinical outcomes and survival. Studies suggest that home and community-based management strategies with new ready-to-use therapeutic foods (RUTF) have considerable potential for treating SAM at scale. Appropriate management of severe acute malnutrition could reduce deaths due to this condition by 55%, averting 3.6 million DALYs lost.

Interventions to provide micronutrients, whether through nutrient supplements or food fortification, will help to reduce the effects of maternal and child undernutrition. Vitamin A and zinc interventions could reduce deaths and DALYs in children by about 10%. Fortifying foods with iron could prevent 123 000 DALYs.

Iodisation of salt is another effective way to provide nutrients through fortification. Although the repertoire of maternal nutrition interventions is limited, taken together, universal calcium and iron and folic acid supplementation during pregnancy could prevent 24% of all maternal deaths.

The findings suggest that much can be done to improve maternal and child nutritional status with simple evidence-based interventions. The proven nutrition-related interventions offer many possibilities for improving maternal and child undernutrition and reducing the related disease burden in both the short and long term. Addressing the continuum of maternal and child undernutrition is critical to achieving several of the MDGs and must be prioritised at global and country levels. Countries with a high prevalence of undernutrition must consider which interventions are of the highest priority and ensure their effective implementation at high coverage to achieve the greatest benefit. The evidence for benefit from nutrition interventions is convincing and what is now needed is the technical expertise and the political will to make this happen in the countries that need it most.

National efforts to address maternal and child undernutrition

Effective implementation of evidence-based interventions will require a renewed effort at both the national and international levels. National managers and international organisations play key roles in improving maternal and child nutrition. Coordination on priorities and utilisation of resources must be improved.

The fourth paper in the Series reports on an assessment of actions addressing undernutrition in the 20 highest undernutrition-burdened countries and seeks to define strategies for improving maternal and child undernutrition in those countries.

National programme managers face a series of challenges in their efforts to improve maternal and child nutrition. Despite isolated successes in specific countries or for interventions such as iodised salt and vitamin A supplementation, most countries with high levels of undernutrition are failing to reach undernourished mothers and children with effective interventions supported by appropriate policies. The Series identified seven challenges to addressing undernutrition in the 20 countries that account for 80% of all stunted children

in the world, as well as ways that nutrition managers can work toward implementing effective programmes.

Challenge 1: getting nutrition on the national agenda

Undernutrition is not the only threat to mothers and children in these 20 countries. In recent years, they have faced government transitions, armed conflict, and non-nutrition related health crises such as HIV/AIDS. Each of these causes is competing for the same scarce national human and financial resources. Another explanation for why nutrition programmes are weak is a lack of political commitment. Little knowledge of the causes and implications of undernutrition and its importance as a determinant of health and development is also a barrier, and the inter-sectoral nature of nutritional issues can lead to situations where no group takes responsibility or advocates effectively. National leaders can facilitate change and should seek not only to build stronger nutrition strategies and programmes, but also to include nutrition goals in all appropriate sectors and their policies and operations.

Challenge 2: doing the right things

Most countries with high levels of undernutrition are not implementing the interventions and strategies shown to be efficacious in addressing the problem at scale. Some interventions are the result of recent advances in research and technology, so implementation is only beginning. Others, however, have been promoted for years or even decades and are still being implemented in only a few areas or not at all, even in countries where the interventions are included in national policies and plans. Examples of successful programmes that should continue include iron supplementation during pregnancy, universal salt iodisation, vitamin A supplementation for children 6 to 59 months of age, and breastfeeding promotion strategies including early initiation and exclusive breastfeeding for the first six months of life. Although each of these interventions were explicitly included in the nutrition action plans for each of the 20 countries studied, implementation is highly variable and should be strengthened. In contrast, many of the other proven interventions shown in table 2 are not part of national nutritional plans and strategies and urgently need to be introduced and taken to scale to achieve impact.



Vietnamese woman breastfeeding her child

Challenge 3: not doing the wrong things

National resources are scarce, so it is vital that programmes are as effective as possible and actually improve the nutritional status of mothers and children. Some frequently used programmes such as growth monitoring and school feeding initiatives have not been proven to be effective nutrition interventions. In their review of policies and programmes, nutrition leaders at country and sub-national levels should examine actions taking place in the name of nutrition and the extent to which they are likely to improve nutritional status among mothers and among children under 24 months of age.

Challenge 4: acting at scale

Effective programs to address maternal and child undernutrition are often phased in slowly and not implemented broadly enough. A shift to relying on full implementation with universal access to interventions will have a significant impact on rates of undernutrition. Country experience shows that the integration of nutrition interventions into maternal, newborn, and child health programmes and their scale-up must be context-specific and accompanied by mechanisms to ensure and sustain intervention quality.

Challenge 5: reaching those in need

In addition to acting at scale, programmes must be targeted to those most in need. Programmes aimed at women, young children (especially those under 2 years), and the poor can have the greatest effect on maternal and child undernutrition. Health and nutritional counselling and feeding interventions have frequently been characterised by inappropriate targeting and a resulting failure to reach intended groups.

Challenge 6: data for nutrition decision making

Improved evaluation of current programmes designed to address maternal and child undernutrition would help to more accurately gauge the effectiveness of efforts. Because most currently available information is related to programme efficacy, not effectiveness, additional data could allow managers to improve the use of resources.

Challenge 7: building strategic and operational capacity

Governments must build internal capacity dedicated to addressing undernutrition because implementing lasting change will require increased political, institutional, and financial support. A long-term commitment to maternal

and child undernutrition must be reflected in policy goals. Improved operational capacities, including access to training, programme evaluation, and clear priorities at a national and international level will allow countries to be more effective.

As reflected in the seven challenges outlined above, the reasons why nutrition programmes at national level and below have been ineffective are complex. The charge to nutrition leaders at country level is to review their existing strategies and programmes to ensure that priority is given to interventions with demonstrated impact on undernutrition among pregnant women and children less than 2 years of age, and then to develop feasible strategies for increasing public demand for these interventions and delivering them at scale.

International efforts to improve undernutrition

As national governments reevaluate programmes designed to address undernutrition, international groups must do the same, focusing on how they can best support national efforts. The fifth paper in the Series seeks to explain why the international nutrition system has not been able to do this more effectively.

The authors argue that the international nutrition system should deliver in four functional areas to directly support national actors in high-burdened countries: (1) stewardship, (2) mobilisation of financial resources, (3) direct provision of nutrition services when national groups are unable or unwilling to do so, and (4) human and institutional resource strengthening.

Stewardship

Stewardship is the idea of fostering good management of resources. In international development, stewardship is seen in international legislation and in the guidance organisations provide to national groups. Numerous groups are currently working to improve the nutritional status of women and children, but with so many organisations involved, the guidance provided to national officials is often inconsistent and does not translate well from idea to implementation. This leaves national programme implementers overwhelmed with guidance, yet with no clear indication of how resources could be allocated most effectively. To improve their impact, international organisations must come together to create simple, consistent, and prioritised normative guidance.

Gathering evidence about what works is an essential precursor to the development of guidance, yet rigorous impact evaluations of projects and programmes are scarce, and many international organisations have not undertaken any impact evaluation of their investments in nutrition. The nutrition community should ensure that the new International Initiative for Impact Evaluation helps fill these gaps.

Finally, effective stewardship implies not just evaluating past actions, but also anticipating the future. The international nutrition system urgently needs a better understanding of the implications for nutrition for major global change processes such as international trade liberalisation, climate change, and rising energy prices.

Financing

Each year, the international community invests large amounts of money in improving nutritional outcomes in poor countries. Exactly how much is difficult to determine because each donor's financial management information system is different, and it is also difficult to isolate a discrete set of nutrition investments to track. However, it is clear that despite the seriousness of the problems associated with maternal and child undernutrition, the amount of nutrition-related aid provided to the 20 countries with 80 percent of globally stunted children is a small sliver of the total aid provided to these nations. Total investment in basic nutrition in low- and middle-income countries from 2000 to 2005 was in the order of \$250 million to \$300 million annually

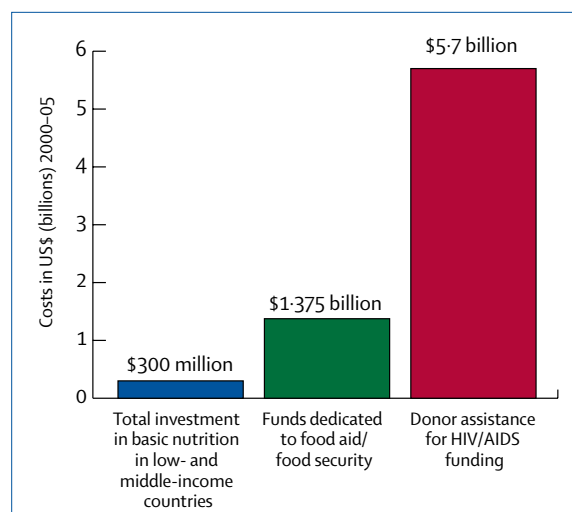


Figure 2: Comparison of funds dedicated to basic nutrition and food aid vs. HIV/AIDS

(coming essentially from just 20 donors), while funds dedicated to food aid/food security was approximately 5 times this amount each year. In comparison, donor assistance for HIV/AIDS funding was \$5.7 billion, even though no more DALYs are lost to HIV than to maternal and child undernutrition (figure 2).

Nations burdened with high rates of maternal and child undernutrition often rely on international assistance to implement interventions, but to do this effectively, donations will have to be doubled or even quadrupled, with much better targeting. International donors must begin to see these funds as an important investment in the future of low- and middle-income countries.

Direct service provision by international organisations

Most service provision is, and should be, the purview of national actors. But natural disasters and armed conflict often preclude effective action against undernutrition by national groups, and in these circumstances the international system can assist with both situation assessment and humanitarian response. Nutrition assessment includes information generated by early warning information systems and surveys. While these information systems are costly, the monitoring can save resources often expended in inappropriately responding to emergencies.

Nutrition-related humanitarian response ranges from a narrow food or nutrition action such as therapeutic to

selective or supplementary feeding programmes (for either moderately or severely wasted individuals), counselling, micronutrient supplementation, and cash and/or food transfers either through employment schemes or free distribution. Information on coverage of these services in emergencies is difficult to obtain. The dynamic nature of the emergency makes estimating coverage challenging, with difficulties compounded by the fact that some have questioned the ethics of conducting even applied research in these environments.

There is little published information on the impact of humanitarian response on nutrition outcomes or, more specifically, on the impact of nutrition interventions in emergencies. One key challenge is the absence of an agency with responsibility for taking an overview of the effectiveness (and cost-effectiveness) of different types of intervention. A number of groups are providing guidance on best practice in emergency settings. Building on and consolidating these experiences will generate a minimum set of operational standards and a source of much-needed documentation, and better coordination would allow organisations to improve emergency response efforts.

Strengthening human and institutional resources

Although strengthening human resources for tackling undernutrition must ultimately take place at country-level, international actors also play a major role: at least

Panel 2: How can international aid organisations be more effective in supporting national nutrition efforts?

- **A new global governance structure.** All those interested in working to eliminate maternal and child undernutrition need to come together to review the current international architecture for nutrition to identify options for a structure that would more effectively represent supra-national organisations, the private sector, and civil society, as well as facilitating dialogue with national actors from high-burden countries
- **A more effective United Nations.** In the short term, the United Nations Standing Committee on Nutrition needs to become a forum that makes individual UN agencies accountable for results. In advance of the 2008 annual session, all member agencies need to publicly state that they are interested in allowing the Committee to exercise this function, and the Chair and Secretary then need to explain how results-based facilitation of the working groups will be managed
- **Fewer parallel organisations, but also fewer mandate gaps.** Donors should immediately clarify how they plan to contribute to the simplification of the current system, ending redundant programmes and parallel nutrition strategies
- **More investment in capacity strengthening in high-burden countries.** New funding should be committed in 2008, representing an appropriate balance between needs-based training for talented individuals, budget support for key organisations and flexible, demand-led technical assistance for sectoral or cross-sectoral institutional reform
- **Research leadership in areas that matter.** The editors of academic journals with an interest in maternal and child undernutrition should meet in 2008 to develop a strategy to increase the profile and programmatic relevance of the topic and to reduce fragmentation. Major donors should clarify how their funding will reduce the imbalances noted in this analysis, and research and training groups in high-income countries should review how they could contribute new knowledge in the area of scaling up of successful nutrition projects, programmes and policy initiatives

20 major universities in high-income countries offer postgraduate training related to international nutrition, and international donors provide much of their support for nutrition in the form of technical assistance. Yet the shortage of appropriately skilled personnel continues to be one of the major constraints to better nutrition programming.

In interviews with a variety of international training centres the authors found that, with some notable exceptions, social, economic, and food sciences are poorly represented and training methodologies are seldom problem-oriented and do not support policy and programme needs. Expanding and improving the educational opportunities available in these fields would both provide additional personnel and draw the attention of researchers and academics to work that could be done to improve maternal and child nutrition.

Since nutrition research output is likely to objectively reflect the disciplinary preferences of university staff combined with the priorities of the major donors, the authors reviewed recent nutrition- and food-related publications and found that despite the vast public health and economic burden associated with undernutrition in low- and middle-income countries, researchers interested in these countries focus overwhelmingly on overnutrition. Secondly, the analyses

show that research into micronutrients is far more prominent than research into other aspects of undernutrition. Programme-relevant research published in prominent journals would increase the visibility of maternal and child undernutrition in the research community and with grant-making organisations.

Considerable deficits remain in the performance of the international nutrition system (panel 2). If the challenge of reducing global undernutrition is to be met, then all the organisations that are part of this system need to individually re-examine their strategies, resources, and internal incentives, and the system as a whole should undertake a similar exercise. Significant improvements in the international nutrition system to strengthen strategic and operational capacities will allow countries and districts to achieve sustainable and equitable improvements in maternal and child undernutrition.

Intensified nutrition action in countries with the highest burden of undernutrition can lead to achievement of the Millennium Development Goal of halving severe hunger by 2015 (MDG 1) and greatly increase the chances of achieving goals for child and maternal mortality (MDGs 4 & 5), and offer the chance of a better, more productive life for the children born each year in the countries which are most severely afflicted by undernutrition.

Panel 3: additional research needs

The Series highlights the lack of rigorous programme evaluation data upon which to build strong evidence-based guidance for national nutrition programmes. In light of the major contribution of undernutrition to the global burden of disease, the amount of research on this topic is unacceptably small and insufficiently solution-oriented. Improving the quality and relevance of nutrition research is a critical part of supporting national nutrition actions and strengthening the international nutrition system. There are many pressing research needs for nutrition, and each paper in the series details additional research recommendations, which include:

- Prevalence of nutritional deficiencies and their consequences for mortality from HIV/AIDS, malaria, diarrhoea, pneumonia, and other important infectious diseases, as well as for immune competence, brain development, cognitive ability, and other possible effects
- Effects of IUGR, rates of weight and height gain, and micronutrient deficiencies in childhood on educational level, economic potential, and health in adulthood, as well as on the risk of chronic diseases
- Large-scale effectiveness evaluations of nutrition interventions in national health systems, including cost-effectiveness estimates, both for individual and packaged interventions
- Assessment of the contribution of strengthening national leadership, strategic capacity, and information systems to advancing national nutrition actions
- Analysis of the linkages between nutritional outcomes and broader initiatives such as agricultural development and microcredit programmes, as well as the effects of global trends such as climate change, trade liberalisation migration, remittances, and energy prices; and
- Research into the quality and effectiveness of international aid for improved nutrition, to include rigorous assessment of the impact of public-private partnerships in nutrition

Acknowledgments

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The Bill & Melinda Gates Foundation provided financial support for the preparation of the Series, the Wellcome Trust provided support for Paper 2 analyses, the World Bank provided support for some of the background papers, and the UNICEF Innocenti Research Centre and the Rockefeller Foundation Bellagio Conference Center provided meeting support.

