Malnutrition in LIC

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It is often emphasized that there are two main forms of malnutrition: **Malnutrition + and Malnutrition -**. The former is now at a higher level than the former. However in this compendium only the latter will be studied.

Global hunger affects nearly a billion people. The **five major forms of malnutrition** worldwide are: Protein-energy malnutrition, iron, iodine, zinc and vitamin A deficiencies. These deficiencies affect the mental, physical and emotional development of children and adults. They also impact on economic productivity.

Globally 45% of childhood deaths are directly or indirectly due to malnutrition with effects varying between different illnesses. Malnutrition is a significant factor in diarrhoea deaths in 61%, malaria 57%, pneumonia 52% and measles 45% i.e. 2.6 million of the total of 6.9 million child deaths globally (2010). The worst affected areas are sub-Saharan Africa, South Asia and Burma (Myanmar), North Korea and Indonesia. Huge problems in some communities to control or treat TB, diarrhoeal disease, malaria, measles, HIV and whooping cough are linked to a major risk of severe malnutrition. There are an estimated 1.02 billion children who are undernourished in 2008 and most of these are among the 1.3 billion people living in extreme poverty (living on <USD 1.25/person/day).

Globally 27% of all children are stunted (170 million) and in India this is 48%. Stunted children will on average earn 20% less when adults than non-stunted. However over the last 20 years there has been a significant positive shift of the curve for distribution of the height and weight of children in most countries of the world indicating some improvement in the general nutrition although the food price crisis in 2007/8 has had a negative effect.. In Sub-Saharan Africa the number of people in extreme poverty has increased over the last two decades mainly due to the debt crisis, conflicts and diseases such as malaria and HIV/AIDS. There will almost certainly be an increase in both stunting and wasting in at least 7 countries in this region.

Malnutrition on average reduces GNP in the poorest countries by 2-3%

Specific areas of malnutrition include **Vitamin A deficiency** affecting 100-140 million children with up to 500 000 becoming blind each year as a result. **Iron deficiency** affects 2 billion people and in pregnant women **anaemia** contributes to 20% of all maternal deaths. I**odine deficiency** affects 740 million people and results in mental impairment in at least 50 million with many others failing to achieve their potential educational goals.

Refugees are at great risk of malnutrition with 36 million in this risk group.

In 2008 a package of 13 direct interventions - such as Vit.A and zinc supplements, iodised salt, promotion of healthy behaviour such as regular handwashing, exclusive breast-feeding and

complementary feeding practices - were proven to have an impact on nutrition and health of children and mothers. These were identified in an article in Lancet. They could prevent 2 million deaths if delivered to children in the 36 countries that are home to 90% of the malnourished children and reduce stunting by 36%. This would cost USD 10-12 billion.

In a best practice setting even severe malnutrition should not have a mortality exceeding 5% but in practice there are many areas where the mortality is around 50% for these severely ill children.

Some of this failure to achieve good results is from the persistence of:

4 myths which lead to errors of management:

a. The assumption that a low plasma albumin is the basis of oedema and can be effectively treated with a high protein diet. The old idea that kwashiorkor was due to protein deficiency and marasmus due to calorie deficiency is a lie. Too early introduction of high protein diets to kwashiorkor children killed many as their liver went into failure.
b. Trusting in the use of diuretics to treat oedema. Many are already dehydrated and have sepsis such that diuretics could kill them.
c. Belief in the early use of iron to treat anaemia. Iron supplementation at this stage stimulates bacterial growth and 70% of the severest malnourished already have bacteraemia which will become life-threatening especially if iron is given.
d. Early introduction of catch-up feeding is dangerous before dealing with the life-threatening trio of **hypoglycaemia, hypothermia and infection** as well as marked fluid and electrolyte disturbances.

Effects of malnutrition

The body's coping mechanism comes devastatingly into play in severe malnutrition:
1. Energy consumption is reduced by stopping growth, decreasing physical activity, reducing the work in many organs (heart, liver and kidneys), the active pump in cells pushing potassium in and sodium out is reduced or stopped, the response to infections is reduced or stopped e.g. less fever and less inflammation.
2. Body fat is used for energy, and muscle and other tissues are broken down for energy

Clinical assessment of undernutrition: wasting and stunting

There are at least three stages in the downward spiral of malnutrition. The first step is failure to grow and develop normally. This is followed by a child becoming underweight or stunted or both, and can end with a child who is obviously unwell with marasmus, kwashiorkor or a combination of both as marasmic-kwashiorkor. Many of the early stages will be missed unless children are followed up and weighed regularly since many of these will look normal if rather thin but otherwise well.
Stunting is a condition where the child is short for its age. It is often a sign of chronic malnutrition over a longer period.
Wasting is a condition where a child is underweight for its age and loses muscle and fat. It is a sign of current and often recent malnutrition.
A child who is both stunted and wasted indicates both long-standing and recent malnutrition.
The ***height for age chart*** is the best method to diagnose stunting. Any child who is less than 90% of the expected standard is stunted. For wasting, the ***weight-for-age*** chart or the ***weight-for-height*** chart is the best method. Any child who is under 80% of the standard is wasted. A simpler method

in wasting is to measure ***mid-upper-arm circumference*** (MUAC) which normally remains almost unchanged from the age of 1-5 years. Normal circumference at this age is around 16.5 cms. There is one cut-off point which is at 14 cms and below this the child is moderately wasted. A second level which shows severe wasting is if the circumference is below 12.5 cms.

There are some important preceding factors that may be involved and these are worth asking about. Any recent famine, disaster, migration or family loss is important to know about. Other questions include the birth weight of the child, the mother's age (either very young or very old mothers are at a greater risk of having a child who becomes malnourished), where the child has lived over the past three months. In some cultures the practice of leaving the child in the care of a grandmother or another relative may expose the child to a greater risk of malnutrition. If the child has suffered from an inter-current infection such as malaria, measles, diarrhoea, or a respiratory infection, this makes the child who is marginally undernourished vulnerable to sliding into true malnutrition.
If there is tuberculosis in the family, the child may have been exposed to the bacilli and may show malnutrition especially in a slightly older age-group (3-4 years). This may be the first sign of active tuberculosis.
One of the most important questions especially in younger children is the history of the breast-feeding pattern. This includes asking about the length of breast-feeding, how often, and whether or not this was exclusive.

Dominant causes of malnutrition vary with age

These are as follows:
0-6 months: Failure to breast feed dominates.
6-12 months: Here the risk increases with infections. The child's age and nature of complementary food is critical as well as whether breast-feeding is still being given.
1-3 years: This is the commonest age where malnutrition shows clinically. The risk is increased if the child is sent away to a grandmother or if famine or a family crisis supervenes. This is the time where kwashiorkor is most common.
3-5 years: Here the picture is dominated by tuberculosis and HIV / AIDS. However, in times of famine or disaster, pure lack of food may become the main cause at any age. At all ages and especially in marginal groups heavy intestinal worm infestation may tip the balance towards malnutrition.

Damage to the body's functions

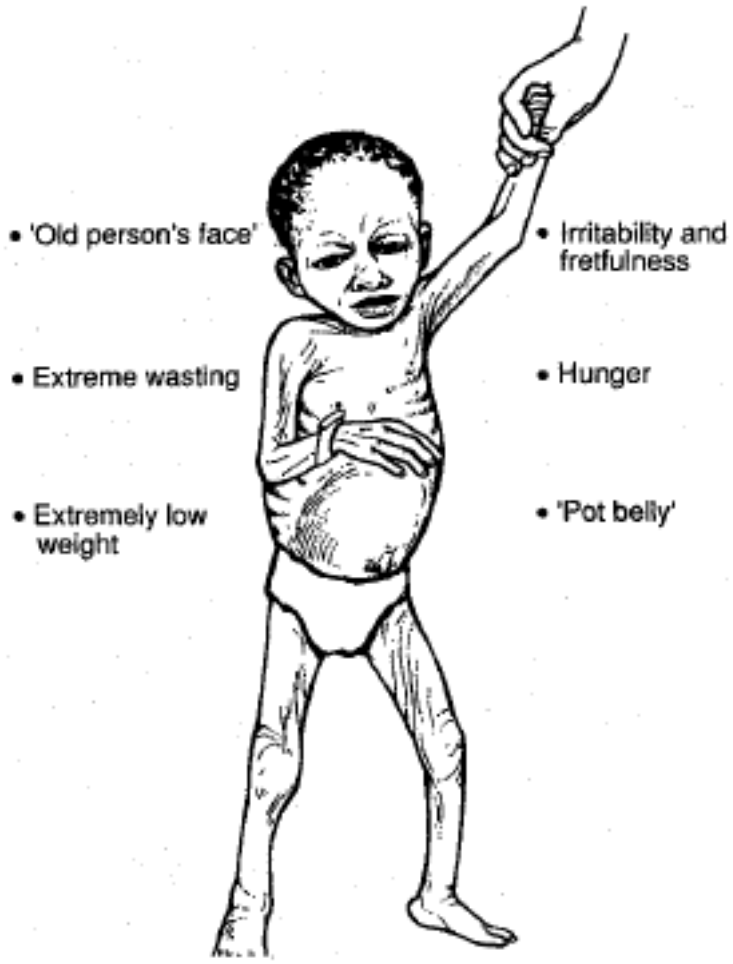
1. The liver cannot cope with large quantities of protein in the diet and makes less glucose.
2. The heart becomes smaller and weaker and cannot cope with excess fluids.
3. The gut wall becomes thinner, more porous and makes less digestive enzymes with resultant decrease in digestive and absorptive capacity.
4. The kidneys cannot cope with excess sodium or fluid.
5. Cell walls become "leaky" with potassium and magnesium leaking out and sodium leaking in. This means that the body finally has too little potassium and magnesium and too much sodium. With excess sodium comes excess fluid leading to oedema.

Most severe forms of malnutrition: marasmus and kwashiorkor

Marasmus

Here the child is often under two years of age and if there has been failure to breast feed it may be

under 1 year. There is usually extremely low weight for age under 60% of the standard with evident extreme wasting of arms, legs and buttocks. The child may show a face that looks old. There is usually a pot-belly. The child may be irritable and fretful but is often alert and hungry unless there



is an active infection. .

Child with Marasmus

Kwashiorkor **(named by Cicely Williams in Ghana from the Ga language - "the displaced one")**

This child is usually 1-3 years. There is oedema of the face, legs and arms. There is often a moon face and the child has usually a moderately low weight for age around 60-80% of the standard. There are wasted muscles especially over the shoulders, upper arms, and the scapulae. There is often a pot belly and the muscles are usually flabby. The child is usually miserable and apathetic with poor or no appetite. It is often pale, thin with peeling skin where dark "flaky paint" contrasts against pale "milk chocolate" coloured skin. The hair is often sparse and thin with a lighter colour and with poor roots so that it can easily be pulled out. It often has a reddish tinge. There is usually an enlarged liver.

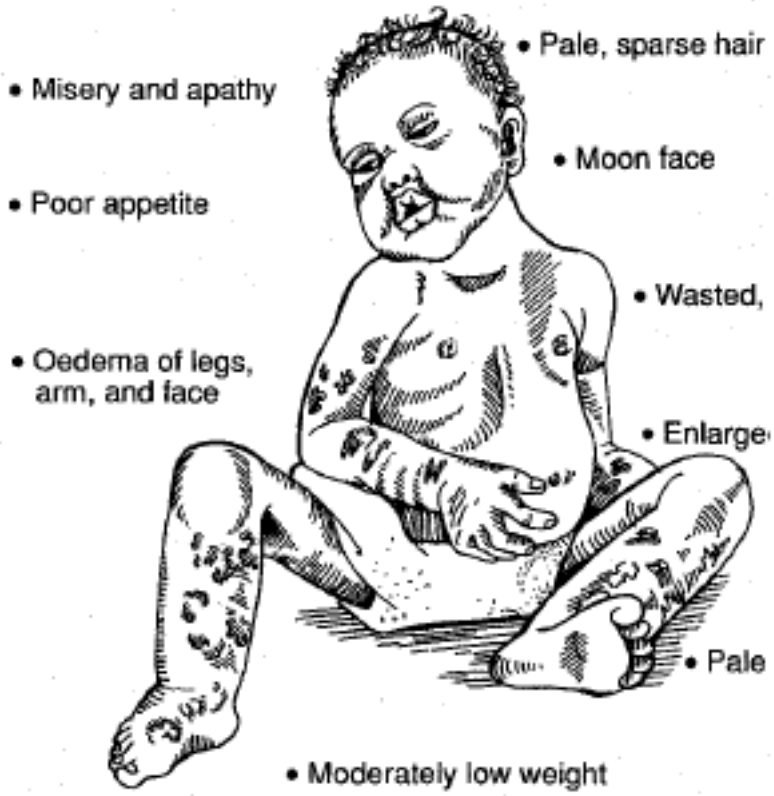


Fig. 17–2 A child with kwashiorkor.

Cell and biochemical damage

In all three of the above there is a major imbalance between the potential for **damage by free radicals** and the **protective antioxidant systems**. Infection, oxidative bursts and free iron all contribute to the risk for damage. Children with oedematous malnutrition have **severely reduced levels of glutathione** in blood and mortality is greatest in those with impaired activity of glutathione peroxidase. Marked malnutrition reduces the activity of the sodium/potassium pump with an imbalance in the distribution of electrolytes and fluids. The cell membranes become more "leaky" as ATP runs out and leads inevitably to **low intracellular potassium and high intracellular sodium.** Protein synthesis begins to shut down and all cell processes are damaged. Immune systems collapse and the microvilli of the intestine become more porous allowing bowel organisms into the blood stream. **Kwashiorkor is always severe malnutrition + infection or a toxin such as aflotoxin** or **extreme lack of antioxidants or micronutients.**

The first serious attack on the protein deficiency hypothesis came from Gopalan who examined the diets of village children in India. He could find no antecedent dietary difference between those who developed marasmus and those who developed kwashiorkor. Michael Golden then showed in Jamaica that kwashiorkor patients treated with low protein diets made a marked clinical improvement without any change in their plasma albumen and they lost all their oedema. Their survival was better than those children given a high protein diet in the early stages. In fact they were on a diet that had less protein than what they had before becoming ill. The rate of loss of oedema was entirely independent of the protein content of their diet. Further studies in adults with kwashiorkor by McCance showed the same results.

Treatment in malnutrition

There are three overall **aims of treatment** in malnutrition:

*to help recovery from severe complications including infections

*to regain lost weight so that weight-for-height returns to the normal range

*to grow at a healthy rate

Three stages of treatment:
resuscitation, early catch-up phase, late catch -up phase.

Interventions needed to achieve these aims:

Medical

1. Treatment of dehydration: when this is needed be careful not to overload with sodium. Potassium is needed in higher levels than in other children. Even children with gross oedema in kwashiorkor may be hypovolaemic because of the maldistribution of electrolytes and water. They are thus "dehydrated" in their blood system and need rehydration treatment. Rehydration should be with low sodium, high potassium fluids such as **Resomal (water 2 litres, WHO-ORS 1 packet, sucrose 50 g, electrolyte/mineral solution 40 ml).**

2. Treatment of infections. Virtually all children with severe malnutrition have multiple infections and up to **70% in the severest cases will have bacteria in their blood stream.** Thus in this group all should be treated with broad-spectrum antibiotics such as **chloramphenicol** or **penicillin + gentamicin**. They sometimes don't show up shadows on their chest xrays in pneumonia or pyuria in urinary tract infection as their immune system is so depressed that severe infection can take place without significant inflammation. Fever is often absent and tachypnoea may be absent in pneumonia. Some add **metronidazole** to reduce the bacterial overgrowth in the bowel.

3. Keeping the body at normal temperature. Severe malnutrition often leads to hypothermia even in the tropics. A blanket and radiant heat and frequent feeding are needed.

4. Hypoglycaemia is common in severe malnutrition and they need frequent feeds day and night to survive, in the worst cases hourly. Occasionally i.v. glucose 50% may be needed if they do not respond.

5. Mineral, vitamin and micronutrient supplementation. All severely malnourished children are deficient in **potassium**, **magnesium** and those with chronic diarrhoea and with skin changes are short of **zinc**. **Zinc and Vitamin-A are important in healing the microvilli.** Zinc supplementation reduces the incidence, frequency, severity and persistence of diarrhoeal disease. Many are short of copper, iodine and selenium.

Be wary of iron supplementation in the early phases as free transferrin exerts bacteriostatic effects and if bound to iron this is lost. If anaemia is severe rather give a blood transfusion 10 mls/kg. Most are short of folic acid, vitamin A, niacin, riboflavin, and other vitamins.

Dietary

Feeding at three stages:

Resuscitation - usually with a milk mixture aiming at 400kJ/kg body weight per day for children 6-24 months. The amount of protein should be kept low at this stage with 0.6 g/kg/day. While the anorexia is severe this might have to be by tube feeding. If there is serious hypoglycaemia and hypothermia feeding may need to be hourly day and night. A voracious appetite usually signals the end of the resuscitation phase.

Early Catch-up phase - build up the calorie intake slowly and thereafter the protein intake. The

number of feeds can now be reduced. If suddenly high energy refeeding is introduced too early the child may develop cardiac failure, profuse diarrhoea and circulatory collapse.
Late Catch-up phase - high energy feeds
Return to good mixed meals using family foods
Vitamin and mineral supplements including iron if they are anaemic.

Failure to respond
Any child who fails to respond to the above measures within 3 weeks must be assessed carefully for other possible causes of malnutrition especially TB or HIV.

Social and emotional. These aspects are at least as important as the first two
Comfort, affection, and mental stimulation for the child
Support and sympathy for the family
Help with the family's social problems
Counselling for AIDS if necessary

Educational
Show the family how to feed the child
Talk with the family about the children's food needs
Encourage mothers to learn from each other in the ward
If available follow up with a period in a Nutrition unit with practical experience of better cultivating and preparation of the most nutritious foods that are appropriate and affordable locally.

Conclusion
"We are guilty of many errors and many faults, but our worst crime is abandoning the children, neglecting the foundation of life. Many of the things we need can wait. The child cannot. Right now is the time his bones are being formed, his blood is being made and his senses are being developed.
To him we cannot answer "Tomorrow". His name is "Today"."

Gabriela Mistral, 1948

Appendix - the curent debate about the best solutions 2013
Food security and malnutrition remain some global development's biggest challenges. Latest UN figures show that 870 million people were chronically undernourished between 2010–12; the vast majority of whom, 850 million, live in developing countries. Yet despite this the UN's Scaling Up Nutrition (SUN) movement said in it's report that 2012 was the year "when chronic under-nutrition moved from the side-lines to the centre". It argues that the international community has now realised the need to shift focus from simply food quantity, to one of food quality. In a word: nutrition.
There are, however, differing views as to how best to increase nutrition levels. Monique Mikhail, policy adviser on sustainable agriculture at Oxfam, welcomes initiatives such as SUN, which has 28 developing country government members. But she and many others in the NGO community fear

that international efforts to target government agricultural policies often result in more cereals to be sold as export, rather than the locally-produced diverse foods needed to improve nutrition. "A lot of the discourse out there is pushing this large-scale, mono-culture model, without realising the impacts of that on communities", says Mikhail. "Land is being taken away from small-scale producers."

The World Bank identifies **five 'pathways'** that link food production to nutrition: subsistence-oriented production, income-oriented production for sale in markets, increased agricultural production, empowerment of women to control household food and health, and macroeconomic growth.

But in practice, one is favoured over another. According to SUN, a 2005 Ethiopian health survey found that chronic malnutrition was highest in its most agriculturally productive regions. The inference was large-scale production can lead directly to export, or simply a lack of local food diversity. It is a problem that Samuel Hauenstein Swan, senior policy adviser, Action Against Hunger, recognises. "Malawi promoted corn (maize) – it didn't dramatically improve the food security of the people, but it dramatically improved the exports. They are one of the big maize exporters now. But did that reduce the numbers of stunting? Not really ... ministers of agriculture are still focussed on these very few grains while nutritious crops like sweet potatoes are not easily commercial."

NGOs working on the ground, therefore, are increasingly promoting small-scale food production within communities. Cristina Ruiz, humanitarian programme unit manager, Africa, at Christian Aid, has recently returned from two years in the Sahel region of Africa – one of the world's most malnourished regions. "We start by working with communities to do a capacity assessment, which lasts for two or three days in a community, conducting an in-depth analysis of the risks and threats they face and the capacity they have in the community to deal with that", she explains. "Out of that comes an action plan for how they could improve their resilience to those risks."

The Sahel's staples of millet and maize, of low nutritional value and severely diminished by years of drought, are now supplemented by market gardening, says Ruiz. "We help them to grow vegetables they can eat but also sell as a cash crop locally. That has been the biggest change and the biggest success. You need water to do that – so we have been providing bore holes and solar pumps."

Mikhail also advises that development professionals look to small-scale farming when addressing malnutrition. "Small-scale livestock is also incredibly important. Consuming more meat, milk and protein contributes greatly to your overall nutritional status in a way that allows you to absorb vitamins from the other vegetable products," he says.

Crucially NGOs seem to be finding more success by concentrating their efforts on women. The FAO argues that when women have control over household income, more money tends to be spent on items that improve nutrition and health. Mikhail agrees: "The important role that women play as carers, food producers and providers is the critical nexus for improving agricultural production, increasing production, as well as improving the quality and nutrition at consumption ... I think where we had mainly fallen short in the past was that we hadn't focussed directly on women."

Hauenstein Swan believes that food security remains dominated by calorie intake and food aid. But he says the knowledge now exists to move beyond that towards resilience, empowerment and hardier, more nutritious staples such as sweet potato, QP Maize and golden rice, rather than allocating vast amounts of land for export crops. "On the global level", he says, "you can't escape

nutrition now when you talk about food security."

A field guide nutrition checklist

1. Identify the scale and cause of undernutrition. Collect information about the magnitude of undernutrition, its causes and severity. Then identify and target the most vulnerable groups, especially pregnant mothers and children under two.
2. Assess food consumption patterns. Gain an understanding of what the community eats, where they obtain food, and the nutritional gaps.
3. Assess the level of government commitment. Look at the national nutrition strategy and policy framework and the level of current/planned budget to roll that out, including local representation and extension services.
4. Identify care and health practices. This includes informal care –mothers, siblings,fathers, as well as formal health care services in the area.
5. Promote biodiversity and sustainable agricultural practices.
6. Give women the means to empower themselves.
7. Promote the production and consumption of meat, dairy products and fish (where available).
8. Reach out through multiple channels. Home visits, agricultural extension services, nutrition counselling, women's groups, dramas and storytelling. These could be combined with other essential health services such as immunisation.

Breaking News

Lancet article on malnutrition: Maternal and Child Nutrition
Published June 6, 2013

Malnutrition is the underlying cause of death for at least 3.1 million children, accounting for 45% of all deaths among children under the age of five and stunting growth among a further 165 million, according to a set of reports released ahead of a nutrition summit in London.

The shocking figures, published in the Lancet on Thursday, emerged as world leaders prepare to meet on Saturday to pledge extra money for nutrition, ahead of the G8 summit of industrialised countries on 17 June.

"The Lancet series today shocked us into a new truth: undernutrition is an even deadlier threat to child survival than we ever thought," said Molly Kinder, director of agriculture and nutrition policy at ONE, the anti-poverty group. "These alarming facts are now irrefutable. Undernutrition is responsible for 600,000 more child deaths each year than was previously realised."

The latest Lancet reports follow the journal's series in 2008, which helped put nutrition on the development agenda.

"Countries will not be able to break out of poverty or sustain economic advances when so much of their population is unable to achieve the nutritional security that is needed for a healthy and productive life," said Professor Robert Black, of Johns Hopkins Bloomberg School of Public Health, who led the Lancet research.

"Our findings strengthen the evidence that good nutrition is a fundamental driver of a wide range

of development goals, and while the impetus for improving nutrition today is stronger than ever, the costs of inaction are enormous."

Aid for basic nutrition came to $418m in 2011, only 0.4% of total official development assistance. Similarly, nutrition has been a low government priority in Africa.

Saturday's nutrition summit, co-hosted by the UK, Brazil and the Children's Investment Fund Foundation (CIFF), is expected to see financial pledges from rich governments and declarations of commitments from poor countries.

Aid campaigners, who see the summit as the biggest opportunity in a decade to secure financial and political commitments on nutrition, expect pledges that will take the overall figure for nutrition to between $600m and $800m a year. Enough Food For Everyone IF, a coalition of more than 200 NGOs and faith groups, which is holding a rally in Hyde Park on Saturday to coincide with the summit, is calling for $1bn a year by 2015.

Even if the summit comes up with more money, it will fall far short of the $9.6bn a year the Lancet says is needed to reduce the number of deaths from malnutrition among under-fives by 1 million. The money would be targeted at 34 countries with high malnutrition rates, supporting interventions identified in the 2008 Lancet series as cost-effective. These include exclusive breastfeeding and appropriate, healthy foods for infants; providing mothers and children with sufficient vitamins and minerals, including vitamin A and zinc supplements, iodised salt, and other micronutrient powders and fortified foods; and the prevention and treatment of cases of acute, severe malnutrition.

Maternal nutrition is also crucial, said the Lancet, not just for the mother's own survival, but for her child's chances of survival and development. Undernourished women are more likely to die in pregnancy, to give birth prematurely, and to have babies who are too small for their gestational age. Iron and calcium deficiency are identified as key contributors to maternal death, putting mothers at increased risk of anaemia and pre-eclampsia; maternal iron deficiency is also found to be associated with low birth weight.

"They [governments] need to do something as they have so many stunted children," said Kinder. "They need to come up with money."

Brazil has been one of the success stories in reducing malnutrition. Daniel Silva Balaban, a director at the UN World Food Programme who was involved in Brazil's nutrition policy, emphasised that hunger and malnutrition was a political problem, not an economic one.

"When countries have the political will to tackle malnutrition, it is possible to deal with it, for example in Rwanda," he said.

Balaban pointed out that the success of a school feeding programme key to Brazil's success in tackling malnutrition involved not just the ministry of education but also the co-operation of the education, health, social development and finance ministries.

"You also need a line in the budget to show that you believe in the programme and that you have a

plan," he said. "You put what money you can in the budget and donors can support you in finding the money."

Balaban said it was important to create a legal framework so that the commitment to tackle malnutrition outlasts any government changes He also stressed the need to enlist the public, including smallholder farmers who can provide produce directly to school or municipalities.

The Lancet's 2008 series stimulated political commitment to a reduction in malnutrition and led to the creation of the Scaling up Nutrition (Sun) movement, which emphasises the importance of a child's first 1,000 days. National commitment in poorer countries is growing, donor funding is increasing, and civil society and the private sector are more engaged.

"Undernutrition has a complex set of political, social and economic causes, none of which are amenable to easy solutions that fit within the timeframe of a single political cycle," said Dr Richard Horton, editor-in-chief of the Lancet.

"For this reason, the outlook today for nutrition is not wholly good. However, the forthcoming nutrition for growth event in London and G8 leaders' summit present an immediate opportunity to foster political support for the interventions that can be quickly scaled up or linked to nutrition programmes."

Breaking News

JAMA article on Estimates of Global Prevalence of Childhood Underweight in 1990 and 2015 Published June 2, 2014

Worldwide, underweight prevalence was projected to decline from 26.5% in 1990 to 17.6% in 2015, a change of –34% (95% confidence interval [CI], –43% to –23%). In developed countries, the prevalence was estimated to decrease from 1.6% to 0.9%, a change of –41% (95% CI, –92% to 343%). In developing regions, the prevalence was forecasted to decline from 30.2% to 19.3%, a change of –36% (95% CI, –45% to –26%). In Africa, the prevalence of underweight was forecasted to increase from 24.0% to 26.8%, a change of 12% (95% CI, 8%-16%). In Asia, the prevalence was estimated to decrease from 35.1% to 18.5%, a change of –47% (95% CI, –58% to –34%). Worldwide, the number of underweight children was projected to decline from 163.8 million in 1990 to 113.4 million in 2015, a change of −31% (95% CI, −40% to −20%). Numbers are projected to decrease in all subregions except the subregions of sub-Saharan, Eastern, Middle, and Western Africa, which are expected to experience substantial increases in the number of underweight children.

In Africa, the prevalence of underweight was forecasted to increase from 24.0% in 1990 to 26.8% in 2015, a change of 12% (95% CI, 8%-16%). The prevalence of childhood underweight was estimated to increase in sub-Saharan Africa by 9% (from 26.8% to 29.2%) and in Eastern Africa by 25% (from 26.7% to 33.3%). The prevalence of childhood underweight was projected to be reduced by 15% for Middle Africa; 5%, Southern Africa; and 6%, Western Africa. Only Northern Africa, with a forecasted reduction in the prevalence of childhood underweight from 9.5% to 4.2%, was estimated to reach the Millennium Development goal.

In Asia, between 1990 and 2015 the prevalence was estimated to decrease from 35.1% to 18.5%, a change of –47% (95% CI, –58% to –34%). The largest decline was estimated in Eastern Asia, where the prevalence of underweight children was forecasted to decrease by 84% in the same period. Southeastern and South Central Asia were also forecasted to experience substantial improvements, with reductions in the prevalence of underweight of 49% and 42%, respectively. However, both subregions are projected to still have high levels of childhood underweight in 2015. Western Asia was estimated to be the Asian subregion with the lowest reduction in the prevalence of childhood underweight (29%).

According to our analysis, despite an overall improvement on the global situation, neither the world as a whole nor the developing regions are expected to achieve the goal. This is largely due to the deteriorating situation in Africa where all subregions, with the exception of Northern Africa, are expected to fail to meet the goal. Moreover, sub-Saharan and Eastern Africa are forecasted to experience an increase in the prevalence of underweight children during the 25-year period. In Asia, Eastern Asia (mainly driven by China), and Southeastern Asia are forecasted to reach the goal, while South Central and Western Asia are not. Moreover, our estimates project that in 2015, most subregions in Africa and South Central Asia will continue to have very high prevalences of underweight children. According to our projections, all subregions in Latin America will achieve the Millennium goal.

The vast majority of underweight children live in developing regions, mainly in Asia and Africa. The projected trends in the prevalence of underweight children combined with the different population growth these regions are experiencing (increasing in Africa, decreasing in Asia)[11] will narrow the gap between their respective contributions to the total number of underweight children. While in 1990, of 100 underweight children, 80 were estimated to live in Asia and 16 in Africa; in 2015, these numbers are expected to change to 60 and 38, respectively, if recent trends continue.