

Nutrition in the Perfect Storm: Why Micronutrient Malnutrition will be a Widespread Health Consequence of High Food Prices

**Christine Klotz¹, Saskia de Pee^{1,2}, Andrew Thorne-Lyman¹,
Klaus Kraemer³, Martin Bloem^{1,2,4}**

¹World Food Programme, Rome, Italy; ²Friedman School of Nutrition Science and Policy, Tufts University, Boston, MA, USA; ³SIGHT AND LIFE, Basel, Switzerland; ⁴Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA

Correspondence: Christine Klotz, World Food Programme, Via Cesare Giulio Viola 68, Parco di Medici, 00148 Rome, Italy
Email: christine.l.klotz@gmail.com

Introduction

For the first time in the post-green-revolution era, the world is experiencing a dramatic and protracted surge in food prices, attributable to a complex combination of short-term cyclical and long-term structural factors that include lower agricultural production, weather shocks, greater demand for grain-fed livestock among a growing global middle class, biofuel development from grain crops, food stock hoarding, and globalized trade in food commodities. The increased prices and dwindling grain stockpiles have caused civil strife and political instability in more than 40 countries, particularly in poor, urban locations.

While recent media coverage and a high profile World Food Summit attended by many heads of state have discussed ways to quell the violent protests and cap the spiraling staple prices as well as debated the ethics of biofuel development, the potential deleterious impact that the food crisis will have on the health status of vulnerable groups

has received less attention. In particular, the overt focus on high cereal prices has overshadowed the consideration of micronutrient malnutrition. This is a serious underestimation. Several studies show that during times of economic crisis, households forego relatively expensive micronutrient-rich foods in order to maintain staple food consumption for as long as possible. In attempting to accurately predict the nutritional consequences of the current global food crisis, it is critical to scale up existing national-level research that substantiates the relationship between economic crises and poor nutrition outcomes. Drawing from several examples of national-level nutritional surveillance, this article examines how the current food crisis will force adjustments in the choices people make about food intake, reduce dietary quality, and, in turn, negatively impact population health. It also describes which nutrition indicators are most 'crisis-sensitive' and makes the case for using these in tracking the potential impacts of high food costs.

Costly cereals

Compared to other food-related humanitarian crises, like famines, the current situation is uniquely characterized by the existence of food on the markets that is simply unaffordable for hundreds of millions of people.¹ Particularly in countries with low staple food reserves, the market prices of these items have doubled or tripled in price over the past year.² After a modest but steady increase of 43 percent over the six-year period between 2000 and 2006, the price of a ton of wheat has more than doubled in the past two years and is up 55 percent from last year alone (**Figure 1**). Maize has increased in price by 70 percent in the past year and rice, which is the staple food of two-thirds of the world population, has tripled in price over the same time period, up from US\$325 in May 2007 to US\$963 in May 2008.³ These price increases cannot be dismissed as a temporary issue; although cereal prices are expected to peak in 2008, forecasts do not predict significant decreases for at least the next decade.^{4, 5} **Figure 2** provides

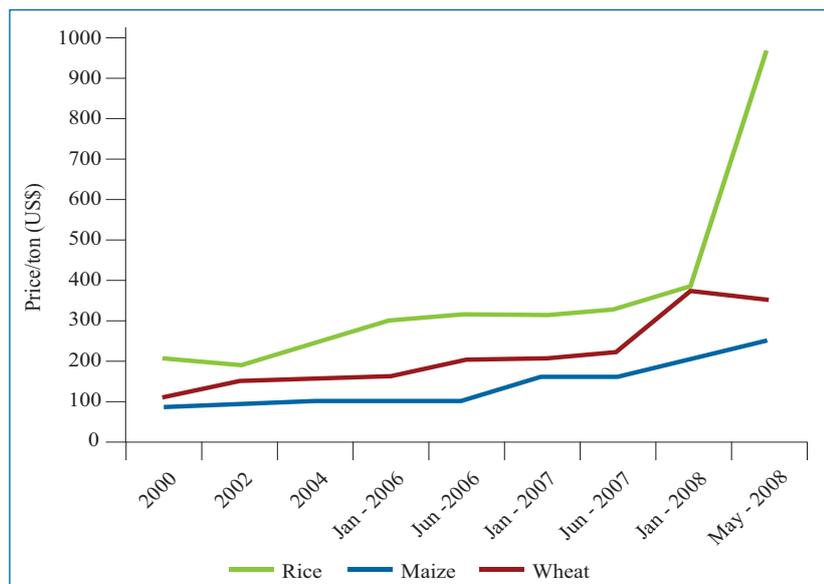


Figure 1: World cereal prices, 2000–2008 (in US\$)

Data sources:

U.N. Food and agriculture organization food price index

a forecast of cereal price development. Escalated prices impact all socioeconomic strata but particularly spell nutritional catastrophe for certain vulnerable groups already spending most of their house-

hold budget on food. Such consumers will reach a point at which they cannot increase the amount they spend on food and must instead sacrifice the quantity and quality of their diet.

Vulnerable and affected groups

Even before the food price crisis, 830 million people in the world faced acute food shortages, a figure that is certain to increase as staple food prices remain high.⁶ In developing countries, where poor families spend 50–70 percent of income on food,⁷ a 20-percent increase in food prices would push 100 million people below the dollar-per-day threshold of absolute poverty, which could slow progress toward the Millennium Development Goals (MDGs) by seven years and negate all the poverty reduction achievements made during the past decade of growth.⁸

While increased staple prices affect all consumers to some extent, the urban poor face grimmer prospects for maintaining good nutritional status during periods of reduced purchasing power compared to their rural counterparts for several reasons, particularly as the former are less likely to grow their own food. Many rural households grow at least some crops, demonstrate coping strategies to fall back upon during times of economic hardship, and can access government safety-net programs that are often focused on rural areas. For example, the Asian economic crises of 1997 disproportionately affected urban as compared to rural households in Indonesia, due to their reliance on cash income and market purchases to meet their nutrition needs.⁹ The ability to access affordable food and earn a cash income are integral to the achievement of food security in urban areas. So, when staple

Key messages

- Dramatically increased staple food prices around the world are forcing households to reduce their consumption of micronutrient-rich foods, which will have a range of health consequences, depending on the pre-existing nutritional status of a population.
- Among households with a diet of sufficient nutritional quality, an increase in staple food prices is likely to cause an increase in micronutrient deficiencies before weight loss as households forego relatively expensive, micronutrient-rich foods to maintain the consumption of consistent quantities of staple foods for as long as possible.
- For households among the third of the world's population already suffering from micronutrient deficiencies, the added stress of higher staple food prices will exacerbate pre-existing deficiencies; however, the already-high prevalence levels mean any increase will be limited.
- It is important to track data on prices, food expenditure, dietary diversity and nutritional status to assess the consequences among different population groups.
- The negative consequences of some micronutrient deficiencies are irreversible. Even temporary exposure to malnutrition induced by high food prices could produce severe long-term impacts, especially on children.
- While working towards long-term solutions to the food price crisis, governments and agencies should support micronutrient supplementation, fortification and food-based strategies to address micronutrient malnutrition among vulnerable population groups in the short and medium term.

food prices double or even triple, the urban poor – who are literally further from the food chain – lack any coping mechanism for alternative methods of food acquisition.¹⁰ Food shocks that become severe enough threaten not only the poor in urban areas, however; a study in urban Zambia before and after maize price increases during the southern African drought of 2001–2 showed impacts among the middle class.¹¹

UNICEF conceptual framework of malnutrition

The UNICEF conceptual framework for causes of malnutrition identifies food and health care access as two of the underlying determinants of nutritional status, both of which can be affected by an economic crisis. Household coping strategies depend on the setting and available resources. To free up a greater proportion of available income for food, poor households may forego health care or withdraw their children from school, which have negative implications for nutritional status. People with low educational status are less likely to possess knowledge about proper nutritional habits. In terms of food access, households with reduced purchasing power – due to reduced disposable income or higher food prices – may reduce the amount of money they allocate for foods purchased in the market. Rural families may produce more foods in the homestead, while urban families may stretch their limited funds by buying cheaper foods. All of these factors contribute to reduced access to food of sufficient nutritional quality.⁹

Difficult trade-offs: Maintaining staple food intake at the expense of other food groups

Cereals constitute the bulk or entirety of the dietary energy for most of the world population, including the roughly one billion people living in absolute poverty. These people consume the great majority of their calories in the form of staple foods instead of micronutrient-rich – and relatively more expensive – foods like eggs, fish, chicken, meat, dairy products, fruits and vegetables. During episodes of income shortages or high food prices, poor households are forced to readjust their food expenditure, which limits their choices

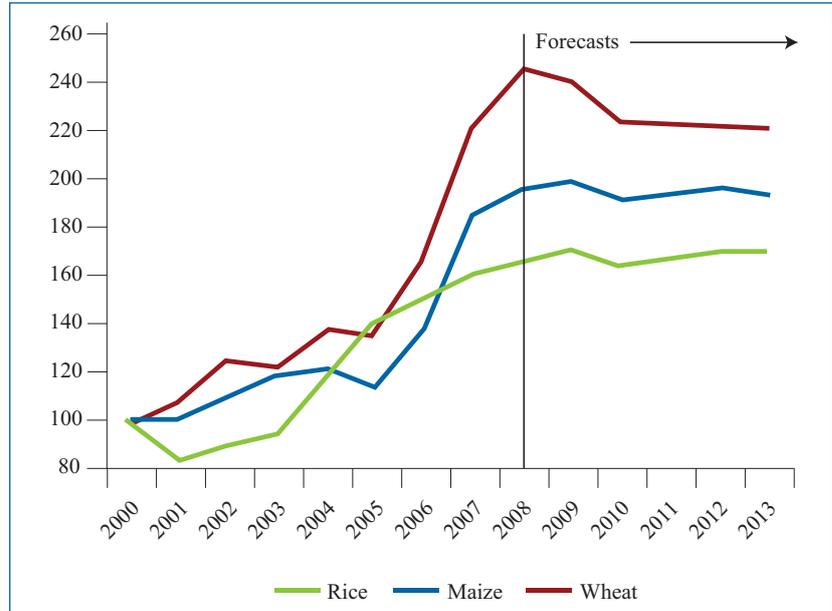


Figure 2: World cereal prices likely to peak in 2008 but remain high in coming years.

Actual and forecasted prices from EIU, FAPRI, IFPRI, OECD/FAO, USDA and world bank (2000 = 100)

Data sources: Adapted from World Food Programme High Food Prices Briefing Booklet, 12 June 2008

(Table 1). The first coping strategy may be to replace relatively more expensive micronutrient-dense products in their diet with cheaper, calorie-rich staple foods, which can cause micronutrient deficiency disorders. If this coping strategy does not produce sufficient ‘savings,’ households may resort to reducing their expenditure on basic foods, such as sugar, oil and salt, in addition to staple foods.¹⁰ A study in Bangladesh over an eight year period marked by significant rice price fluctuations (1992–2000) showed that, when rice was cheaper, more money was spent on additional food items; conversely, when rice was more expensive, less was spent on non-rice products.¹² Throughout these price fluctuations, rice consumption (in kilograms) was unchanged; thus, expenditure changes were purely a function of the rice price.

Dietary consequences of increased food prices depend on pre-existing nutritional status

Among households consuming adequate diets or diets of sufficient nutritional quality, an increase in staple food prices is likely to cause an increase in micronutrient deficiencies before weight loss as these households sacrifice dietary diversity to maintain a consistent level of staple food consumption (Figure 3). A study to investigate the effects of currency devaluation on dietary changes and the nutritional vulnerability of

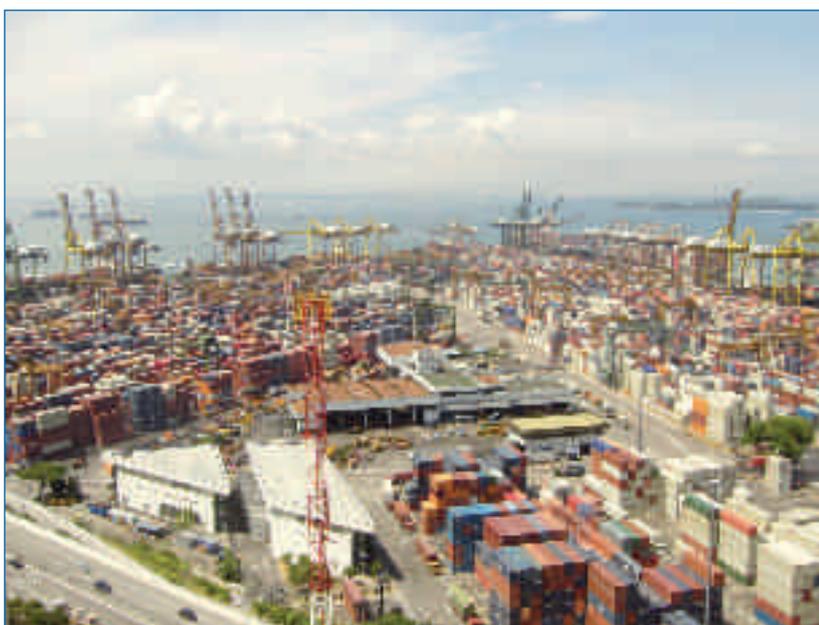
Table 1: Relative food choices of economic status groups

Economic status	Food choices	
Not poor	Rice + Vegetables + Eggs + Meat	
Less poor	Rice + Vegetables + Eggs	Rice + Vegetables + Meat
Moderately poor	Rice + Vegetables	Rice + Eggs
Very poor	Rice	

poor households in two African capital cities revealed that consumers frequently depleted the fat and vegetable content of meals, and eliminated desserts during periods of currency devaluation.¹⁴ Only during especially severe episodes of economic hardship, did households begin to reduce the quantity of staple food consumed, sometimes down to a single staple-based meal per day, after eliminating all ‘luxury’ foods like fruits, meat, and processed foods. Similarly, during the Indonesian economic crisis of 1997, when prices of food and other commodities considerably increased and large segments of the society experienced a decline in real income, the first effect was reduced dietary intake of animal products to maintain staple food

consumption. Across all socio-economic strata, household rice consumption – as measured in kilograms – did not change, even though it required an increase in absolute as well as relative expenditure on rice to maintain a consistent intake.⁹ To offset the greater rice expenditure, households decreased expenditure on non-staple foods (measured in this case by egg consumption to be generally representative of foods with high micronutrient quality). The relationship between expenditure (as a proxy for consumption) on non-staple foods and child nutritional status was also shown in Bangladesh; when non-rice food expenditure increased as a consequence of a lower expenditure on rice, the prevalence of child underweight decreased.¹²

Approximately a third of the world population suffers from micronutrient deficiencies. In particular, poor people in the developing world who do not have access to fortified foods and cannot afford vitamin- and mineral-rich animal products face a high risk of micronutrient deficiencies. For those households already suffering from micronutrient deficiencies, the added stress of higher staple food prices will increase the severity of pre-existing deficiencies, though the increase in prevalence will be limited due to the already-high rates. Heavily or exclusively staple-food-based diets generally cannot provide the range of nutrients required for good health.⁹ Even when consumed in sufficient quantities to provide adequate quantities of macronutrients, staple foods lack essential micronutrients, such as iron, zinc, iodine, vitamins A, C, E and the B vitamins. Population groups most affected by the decreased dietary quality are those with the highest requirements, including young children, pregnant and lactating women, and the chronically ill.⁷ While the presence of one micronutrient deficiency indicates the likely presence of multiple deficiencies, some deficiencies – such as anemia and vitamin A deficiency – are easier to diagnose and are often tracked because of their particular public health significance. Anemia can be identified by low hemoglobin levels and vitamin A deficiency by low serum retinol concentrations. Children aged 6–24 months are at particular risk of iron defi-



Food is transported far distances today.

ciency anemia because the iron supplied by breast milk is not sufficient to meet the needs of rapid growth and development; those from families unable to access iron-rich complementary foods will invariably be affected.⁹ Similarly, vitamin A deficiency prevails among populations whose diets are lacking in animal products.¹⁴

Reduced economic potential of a malnourished population

Micronutrient deficiencies are both a cause and a consequence of poverty because they negatively and irreversibly impact the neuro-intellectual and physical development of an entire generation in the form of premature death, poor health and cognitive abilities, and low work capacity.^{15, 16} A vicious cycle arises when poor people cannot afford to access important

food sources of vitamins and minerals, such as relatively more expensive animal products. Reduced access leads to micronutrient malnutrition that adversely affects cognitive performance and work capacity.^{17,18} These deficiencies perpetuate poverty at both individual and population level because the economic gains of less-developed countries heavily rest on the health and output of their human resources. Labor-intensive industries, such as agriculture, manufacturing and construction, fuel the economies of many developing countries, so micronutrient deficiency disorders among workers reduce the productivity of these industries and the country’s economy.⁹ The median value of annual physical productivity losses due to iron deficiency in developing countries is an estimated 0.57 percent of GDP. Median combined physical and cognitive losses total just over 4 percent of GDP.¹⁷

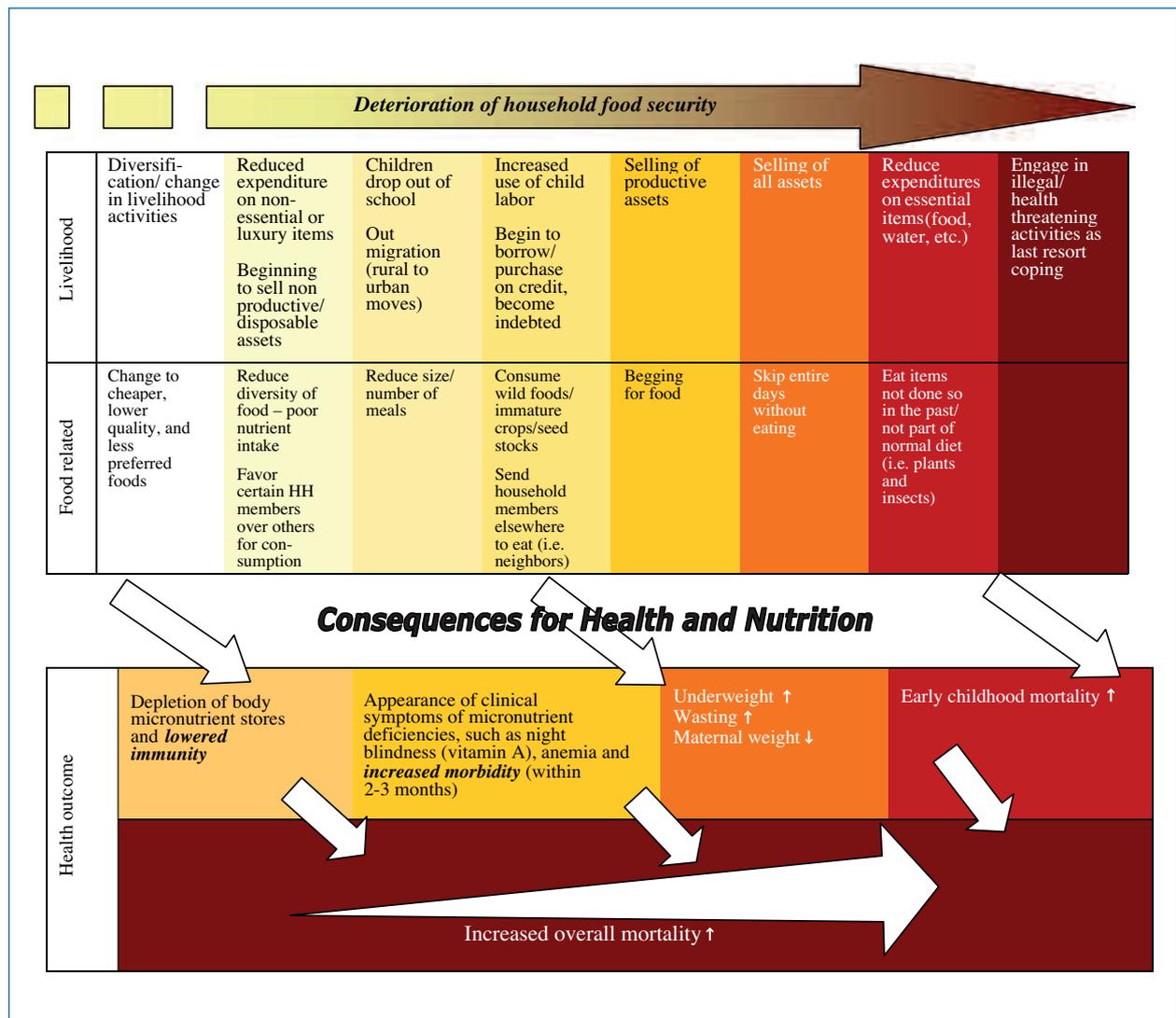


Figure 3: Health and nutrition consequences of stages of household food security

Data sources: Adapted from D. Maxwell, R. Caldwell. The Coping Strategies Index: Field Methods Manual, Nairobi: CARE Eastern and Central Africa Regional Management and World Food Programme, 2nd ed, Jan 2008.

Tracking the crisis with appropriate nutritional surveillance

Because nutrition indicators reflect very specific aspects of a person's nutritional status, they can be strategically utilized to reveal which food consumption trade-offs people are making during food crises and how it is affecting their nutritional status, including micronutrient status.^{19, 20} Pre-crisis food consumption and nutrition situation is the single most important determinant in deciding which indicators are most appropriate to monitor. Among those populations moving from micronutrient adequacy to deficiency as a result of high food prices, indicators of micronutrient status are best for detecting dietary changes. For those populations already suffering from micronutrient deficiencies, increased food prices will increase the severity of the deficiencies, but the limited capacity to detect prevalence changes points to the utility of monitoring anthropometry. Additionally, dietary diversity indicators show great promise for helping to understand the potential for the emergence of deficiencies. Dietary diversity has been validated against various indicators of micronutrient status, and



A woman affected by Cyclone Sidr in Bangladesh sprinkles a sachet with micronutrients (MixMe™) on her food.

dietary changes – as the causal factor for many micronutrient deficiencies – may be detected before changes of micronutrient status.²¹

Child hemoglobin level and maternal vitamin A status (night blindness and serum retinol concentration) have been demonstrated as the most responsive micronutrient status indicators for monitoring the impact of economic shocks. Among an Indonesian population that had just previously achieved improved micronutrient status, the economic crisis sparked high rates of child anemia and maternal vitamin A deficiency.⁸ Child anemia is a good proxy for a decrease in the intake of micronutrient-rich foods, because it is less likely than maternal anemia to be affected by other factors, such as the performance of health care services, including supplementation with iron/folic acid for pregnant women, other feeding or caring practices, varying biological factors, or environmental hygiene.⁹ Although anemia in young children is a very sensitive indicator of changes in dietary quality, child vitamin A status is not, because successful distribution of vitamin A capsule distribution in much of the world is relatively unaffected even during periods of crisis. And this vitamin A distribution will mask most of the reductions of vitamin A status due to lowered intake. Mothers, however, are not targeted with vitamin A capsule distribution, except for the immediate postpartum period when coverage is generally low, so maternal night blindness is a useful indicator of the micronutrient quality of the diet.¹¹

Anthropometric indicators like child underweight and maternal body mass index are more responsive among populations that were already suffering from poor micronutrient status prior to higher staple food prices. As family caretakers, mothers are more likely to reduce their own food intake before that of their children or husbands during periods of hardship, which will result in maternal thinness; this was seen as a consequence of the Indonesian and Congolese economic crises.^{22, 23} Even though the quality of a child's diet is likely to be affected sooner than the quantity, as other household members sacrifice their own food intake to maintain that of the children, anthropometric measurements provide valuable indications of nutritional status during particularly severe crises, when other coping strategies have been exhausted, or in situations of increased illness, which affects child weight.⁹ Underweight among children under five was a very good indicator of change in rice prices in Bangladesh.¹² **Table 2** summarizes nutritional indicators that are useful to detect changes in dietary quality among vulnerable population groups.

Table 2: Nutritional indicators useful for showing changes in dietary quality and food security among vulnerable groups

	Micronutrients quantity		Micronutrients quality	
	Body mass index	Underweight, wasting, stunting	Hemoglobin level	Vitamin A status (night blindness and serum retinol concentration)
Mother	X			X
Child		X	X	

Responding to the specific types of malnutrition that are likely to arise in each setting

In addition to government imposed economic strategies to avert high food prices and provide additional funds to aid agencies, which are beyond the scope of this article, nutritional surveillance should comprise an integral part of the response to the high cost of food. Appropriate indicators – appealing due to their ease of collection in large study populations – can inform policy makers about targeted, resource-effective nutrition responses across varying time frames. Those heading surveillance efforts should understand how to interpret the different indicators, and whether they reflect undernutrition or micronutrient status. Furthermore, once a change in indicators is seen, assistance and nutritional rehabilitation needs to be strategically directed. Efforts to support dietary diversity, delivery of multiple micronutrients through supplements or home-fortification products, national fortification of staples, and provision of fortified blended foods constitute several appropriate responses to improve population nutritional status, particularly micronutrient status.⁹

Conclusion

As perhaps the world’s first truly ‘globalized’ humanitarian disaster, the current food-price crisis underscores the interconnectedness of many causal factors. The manifestation of high food prices will be observed in terms of micronutrient-deficiency-induced morbidity and mortality, a potential ‘lost generation’ of unhealthy children, and irreversible economic loss. Until long-term solutions are worked out (i.e. adjustments to international agricultural policy and the realization of a second green revolution), it is important not to let vulnerable groups slip through the cracks. Apart from the examples mentioned in this article, the impact of economic shocks on food security and the nutritional status of the poor is not well documented, making it imperative to set up surveillance programs as the current situation unfolds. Tracking child hemoglobin levels, maternal

vitamin A status, thinness and child anthropometry is the most efficient way of detecting nutritional distress, increased morbidity, and impaired development due to high food prices. These indicators can be used to target short-term interventions, like the distribution of micronutrient powders and fortified blended foods. Failing to act now to protect the health of the world’s most vulnerable people is likely to result in an even starker contrast between the economic aspirations and reality of poor nations than we have in the present.

Acronyms

- EIU (The) Economist Intelligence Unit
- FAO Food and Agriculture Organization of the United Nations
- FAPRI Food and Agriculture Policy Research Institute
- IFPRI International Food Policy Research Institute
- OECD Organisation for Economic Co-operation and Development
- USDA United States Department of Agriculture
- UN United Nations
- UNICEF United Nations Children’s Fund
- WFP United Nations World Food Programme



Food market

References

1. Bartiromo M. Food emergency: on the front line with the U.N.'s Josette Sheeran. *BusinessWeek*. 1 May 2008. Internet:http://www.businessweek.com/magazine/content/08_19/b4083021406152.htm (accessed 8 May 2008).
2. United Nation's Food and Agriculture Organisation. International Commodity Prices. Internet: <http://www.fao.org/es/esc/prices/PricesServlet.jsp?lang=en> (accessed on 22 May 2008).
3. Worthington S. The global food crisis: the "perfect storm" requires a coordinated & comprehensive response. Washington, DC: Inter Action, American Council for Voluntary International Action, June 2008. [Inter Action Issue Brief.]
4. Organisation for Economic Co-operation and Development, Food and Agriculture Organization. OECD-FAO Agricultural Outlook 2007-1016. Paris, France: OECD/FAO, 2007. Internet: <http://www.oecd.org/dataoecd/6/10/38893266.pdf> (Accessed 13 May 2008).
5. Blas J. Signs of an end to soaring food prices. *Financial Times*. 14 May 2008. Internet: http://www.ft.com/cms/s/0/7dca1496-21df-11dd-a50a-000077b07658,dwp_uuid=a955630e-3603-11dc-ad42-0000779fd2ac.html?nclick_check=1 (accessed 15 May 2008).
6. United Nations Economic and Social Council Special Meeting on Global Food Crisis 7th Meeting (PM). Economic and social council president, in special meeting on global food crisis, calls for increased food production to ensure adequate future supplies. 20 May 2008 <http://www.un.org/News/Press/docs/2008/ecosoc6331.doc.htm> (accessed 23 July 2008).
7. World Food Programme, United Nations Children's Fund. Increased food prices-interventions required to prevent deterioration of health and nutritional status. Rome, Italy: WFP/UNICEF, May 2008. [WFP-UNICEF Issue Brief.]
8. Carstens A, Zoellick R, Strauss Kahn D. Transcript of Development Committee Press Briefing, Spring Meetings 2008. 12 April 2008. Washington, D.C.: World Bank News & Broadcast. Internet: <http://web.worldbank.org/WBSITE/EXTERNAL/NEWS/0,,contentMDK:21728519~pagePK:34370~piPK:34424~theSitePK:4607,00.html> (Accessed 23 July 2008.)
9. Bloem MW, de Pee S, Darnton-Hill I. Micronutrient deficiencies and maternal thinness: first chain in the sequence of nutritional and health events in economic crises. 3rd ed. In: Bendich A, Deckelbaum, RJ, eds. *Preventive nutrition: the comprehensive guide for health professionals*. Totowa, NJ: Humana Press, 2005: 689-710.
10. Ruel MT, Garrett JL, Haddad L. Rapid urbanization and the challenges of obtaining food and nutrition security. In: Semba RD, Bloem MW, eds. *Nutrition and health in developing countries*. Totowa, NJ: Humana Press, 2008: 639-656.
11. Ruel MT, Garrett JL, Haddad L. Rapid urbanization and the challenges of obtaining food and nutrition security. In: Semba RD, Bloem MW, eds. *Nutrition and health in developing countries*. Totowa, NJ: Humana Press, 2008: 639-656.
12. Torelesse H, Kiess L, Bloem MW. Association of household rice expenditure with child nutritional status indicates a role for macroeconomic food policy in combating malnutrition. *J Nutr* 2003;133(5):1320-1325.
13. Fouéré T, Maire B, Delpuech F, Martin-Prével Y, Tchibindat F, Adoua-Oyila G. Dietary changes in African urban households in response to currency devaluation: foreseeable risks for health and nutrition. *Pub H Nutr* 2000; 3(3):293-301.
14. De Pee, West CE, Permaesih D, Martui S, Muhihal, Hautvast JG. Increasing intake of orange fruits is more effective than increasing intake of dark green leafy vegetables increasing serum concentrations of retinol and beta carotene in school children in Indonesia. *Am J Clin Nutr* 1998; 68:1058-1067.
15. Howson CP, Kennedy ET, Horwitz A. *Prevention of micronutrient deficiencies: tools for policymakers and public health workers*. Washington, DC: National Academy Press, 1998.
16. Ramakrishnan U, Huffman SL. Multiple micronutrient malnutrition. What can be done? In: Semba RD, Bloem MW, eds. *Nutrition and health in developing countries*. Totowa, NJ, Humana Press, 2001:365-391.
17. Horton S, Ross J. The economics of iron deficiency. *Food Policy* 2003;28:51-75.
18. Grantham-McGregor S, Ani C. A review of studies of the effect of iron deficiency on cognitive development in children. *J Nutr* 2001;131:649s-668s.
19. Bloem MW, de Pee S. Micronutrient malnutrition and poverty. In: Pettifor JM, Zlotkin S, eds. *Micronutrient deficiencies during the weaning period and the first years of life*. Basel, Switzerland: Nestle Nutrition Workshop Series Pediatric Program (vol 54), 2004: 105-118.
20. Kiess L, Moench-Pfanner R, Bloem MW, de Pee S, Sari M, Kosen S. New conceptual thinking about surveillance: using micronutrient status to assess the impact of economic crises on health and nutrition. *Malays J Nutr* 2000;6:223-232.
21. Ruel M. Operationalizing dietary diversity: a review of measurement issues and research priorities. *J Nutr* 2003; 133(11 Suppl 2):3911s-3926s.
22. De Pee S, Bloem MW, Sari M, Soekarjo DD, Tjiong R, Kosen S, Muhilal, Satoto. Indonesia's crisis causes considerable weight loss among mothers and adolescents. *Mal J Nutr* 2000;6:203-214.
23. Martin-Prével Y, Delpuech F, Traissac P, Massamba JP, Adoua-Oyila G, Coudert K, Trèche S. Deterioration in the nutritional status of young children and their mothers in Brazzaville, Congo, following the 1994 devaluation of the CFA franc. *Bull WHO* 2000;78(1):108-118.