

## Review

# Food security and population health and well being\*

Dov Jaron PhD<sup>1</sup> and Osman Galal MD PhD<sup>2</sup>

<sup>1</sup>*School of Biomedical Engineering, Science and Health Systems, Drexel University, Philadelphia, Pennsylvania, USA*

<sup>2</sup>*School of Public Health Center for Health Sciences, Center for Global and Immigrant Health, University of California Los Angeles, California, USA*

---

Food security is an important element in the multi-factorial systems analysis of health and well being. The interaction between food supply and other important factors making up the system can shed light on individual and population health. A critical analysis of the health system must also include consideration of disparity in food security since it represents one of the most dramatic indicators of economic and health inequality. A large fraction of the world's population -- particularly in Sub-Saharan Africa and in South East Asia -- is chronically hungry. Distributing food commodities alone does not appear to significantly reduce global food insecurity. In addition, promoting agricultural development, economic growth, and education assistance is needed in order to mitigate the underlying causes of chronic hunger, and in turn improve health and well being.

**Key Words:** diet, food supply, food insecurity, health, well being

---

## INTRODUCTION

There is a growing need to understand how the health of both the individual and the population are shaped by external factors at the global level, and how these factors are influenced by human interventions and natural phenomena. Some of these factors include environment, nutrition, water supplies, and disease, as well as social and political conditions. These factors may interact with each other and sometimes produce unexpected health consequences.

Environmental influences on human health have predominantly been studied using reductionist approaches. Such approaches link individual factors to specific disease outcomes. However, these approaches have severe limitations because they ignore the complexity and interactions between the various factors, and how such interaction influences health and well being. Thus, there is a need for scientific analysis that considers the multiple factors of the problem. This can be accomplished by developing a systems approach that considers the complex, non-linear interactions between the different processes and factors.

Such a systems approach would build on the expertise of numerous scientific and engineering disciplines and interdisciplinary entities, and would be aimed at providing new insights that can effectively inform sociopolitical policies. It would also make an important contribution to help determine the future health research agenda.

An appropriate systems model allows for the integration of existing and new data and information that can lead to new insights as well as the identification of gaps in current knowledge. It also enables scenario projections, which cannot otherwise be tested experimentally. A complex system may be made up of several sub-systems, each of which is based on an understanding of sub-system interactions, and can give insights into the system as a

whole. The International Council for Science (ICSU) is developing such an interdisciplinary program whose purpose is to apply a systems approach to the analysis of health and well being in the urban environment. While the objective of the program is intended to focus on the urban environment, many of its features would be applicable in general to the non-urban environment as well.

One sub-system that makes up an important element of the overall systems approach is food security. The incorporation of food security as a component of the overall systems model is essential to the analysis and to understanding of its contribution to the overall health and well being of the individual as well as the population.

The Food and Agriculture Organization defines food security as a "situation that exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life".

---

**Corresponding Author:** Professor Dov Jaron, Calhoun Distinguished Professor of Engineering in Medicine, School of Biomedical Engineering, Science and Health Systems, Drexel University, 32nd and Chestnut Streets, Philadelphia, PA 19104, USA.

Tel: 215-895-2216; Fax: 215-895-1975

Email: Dov.Jaron@Drexel.EDU

Manuscript received 3 July 2009. Initial review completed 8 July 2009. Revision accepted 21 October 2009.

\* Some of the introductory material in this manuscript is based on a report by the Committee on Strategic Planning and Review of the International Council for Science (ICSU) and the ICSU Scoping Group on Human Health titled "Towards a Systems Analysis Approach to Health and Well being in the Changing Urban Environment".

Interruptions in food supply have immediate impact on human health and when they occur, constitute public health emergencies. Within-population disparities in food security represent one of the most dramatic indicators of economic and health disparities, and deserve priority for monitoring and amelioration to avoid health insecurity.<sup>1</sup>

Good health and well being, on the other hand, does not imply merely the absence of disease or infirmity, but presumes a state of physical, mental, and social well being. Several indicators, such as liveliness, alertness, good appetite, normal body temperature and pulse rate, normal height-for-age and weight-for-height can indicate health. In addition, a range of social, economic, and environmental factors determine the health status of an individual. An adequate and balanced diet is one of the most important contributing factors to achieve and maintain a good state of health.<sup>2,3</sup>

### ESSENTIAL NUTRIENTS

A sufficient supply of all essential nutrients and health promoting substances is the basis of any healthy diet. However, an adequate and balanced diet may vary from one individual to another and is influenced by lifestyles as well as the individual's cultural and social background. The energy and nutrient requirements of people suffering from certain diseases or of those during particular times in the life cycle such as pregnancy, lactation, infancy, or childhood differ considerably. Those population groups need diets adapted to their situation to keep them healthy.<sup>4,5</sup>

Essential nutrients that are necessary for life, growth, and tissue repair are chemical substances found in food but that cannot be synthesized at all or in sufficient amounts by the body. They belong to different groups of macronutrients as well as micronutrients. Water is the most important nutrient for survival. Of the 20 amino acids found in protein, eight have to be provided preformed in the diet of adults and are thus identified as being indispensable or essential. The fatty acids linoleic and linolenic acids are the second group of essential macronutrients. Furthermore, the human body depends on the dietary intake of 13 vitamins as well as of a variety of inorganic minerals such as calcium, magnesium, iron, iodine, and zinc.

There are additional groups of food components such as dietary fibers and phytochemicals, which are not considered to be essential but which are important for maintenance of health, and possibly also for reducing the risk of chronic disease.

### ADEQUATE DIET

A healthy diet, therefore, means different things to different people. In children, an adequate diet aims to promote health, growth and development. In adult nutrition, it focuses on attaining or maintaining optimal health and preventing chronic degenerative diseases.

Although the basic needs of people are similar worldwide, the individual lifestyle determines which diet is adequate. In societies where physical labor is common, foods of plant and animal origin that meet the energy requirements will almost inevitably constitute an adequate diet. In highly industrialized societies where foods are

usually highly processed, a nutrient-dense diet with a limited energy content is considered adequate.

Plant food forms the basis of adequate diets. Foods of animal origin, particularly meat and fish are not essential for an adequate diet, but they are useful complement to most diets. Societies that have adopted vegetarian diets do not show evidence of malnutrition when the supply of total food is adequate. They rather have a lower risk of nutrition related diseases such as high blood pressure or obesity. In addition, sufficient fluid intake is important to an adequate diet. A prolonged consumption of an inadequate diet is likely to lead to malnutrition, over- or under nutrition and enhancement of degenerative diseases.<sup>5</sup>

### GLOBAL FOOD SUPPLY

In general, the world has ample food. The growth of global food production has so far been equal to the population growth. However, many of the world's people do not live where much of the world's food is produced. Industrial countries produce half of the world's grain, but they have less than a fourth of the world's population. Thus, many poor countries and hundreds of million of poor people do not share in this abundance. They suffer from a lack of food security caused mainly by a lack of purchasing power. Many countries have a fragile food supplies because of chronic food shortages due to unfavorable growing or harvesting conditions or political turbulence. Only a few countries are self-sufficient in food supply. The rest rely for their food imports on the world market.<sup>6</sup>

Even though on all continents - except Africa south of the Sahara - the nutritional situation of the population has improved during the last ten years, there are still 78 countries classified as food-deficit, low-income countries. Worldwide, 29 percent of all children under five years of age suffer from underweight and 36 percent suffer from growth retardation. About two billion people suffer from iron deficiency or anemia, a significant proportion of whom are in industrialized countries, too. Iodine deficiency is another worldwide problem. Especially in Africa south of the Sahara, in South East Asia and in least developed countries, the nutritional situation is still problematic.

The House of Representatives of the United States recently (2007) produced a report that provides the following comprehensive statistics as well as recommendations regarding food insecurity around the globe.<sup>7</sup>

Based on data collected in 2006, an estimated 850 million people in the world, with 824 million in developing countries, were chronically hungry. The largest concentrations of the chronically hungry—an estimated 298 million individuals—are in South Asia, with most of those individuals concentrated in India, where there are an estimated 212 million undernourished individuals, and in sub-Saharan Africa, where there are an estimated 206 million hungry people.<sup>8,9</sup>

The number of food and humanitarian emergencies has doubled from an average of about 15 per year in the 1980s to more than 30 per year since 2000, due in large part to increasing conflicts, poverty, and natural disasters around the world. Some emergencies are exacerbated by multiple shocks, such as civil wars, recurring droughts, and endemic disease, adding to their complexity and pro-

tracting the crises for many years. In 1990, the proportion of people in the developing countries living with insufficient food was estimated to be 20 percent. By 2003, that percentage declined to 17 percent. However, from 1996 to 2006, the absolute number of hungry people increased by almost 8 percent. The number of hungry people in the most seriously affected regions of the world, namely South Asia and sub-Saharan Africa, is continuing to increase. In sub-Saharan Africa, in 1990, there were an estimated 169 million chronically hungry people; in 2003, the number of chronically hungry people increased by 22 percent.

A critical conclusion of the report, supported by food assistance experts, advocates, and implementers was that distributing food commodities alone would not reduce food insecurity. Food assistance needs to be combined with other non-food resources, such as assistance to promote agricultural development, economic growth, and assistance to support education, water, and health programs, in order to mitigate the underlying causes of chronic hunger.

In addition to strategies at the national level to improve the nutritional situation of a country's population there are a number of possibilities for joint international action. Some of the current regulations and rules of commercial trade put many poor countries at a disadvantage. Effective international markets with fair trade relations and policies would stabilize or even increase food availability for many countries. The global food support system includes the networks of commercial trade and food aid. As part of this, early warning systems could play a vital role in mobilizing world food reserves and distributing assistance to countries facing famine or other food emergencies.<sup>4</sup>

Food aid, mainly provided by international organizations, can help bridge the gap in situations of food unavailability and famine. Food aid programs support mostly vulnerable groups such as children by providing supplementary food. Whereas agricultural research contributes to increasing food supply and expanding food production, it does not solve the worldwide problem of unequal distribution of food.<sup>8</sup>

#### **FOOD AND HEALTH SECURITY**

Health and well being has always been focused on the type of health care system that a country is utilizing. Theoretically, it should create equal access to all individuals in a population with an affordable cost. Most of the global systems give little concern to the need of using healthy diets and avoiding food insecurity. The main focus of the health care system should be to reduce the cur-

rent disease-oriented treatment approach by encouraging significant changes in provider and consumer attitudes toward health promotion and health maintenance. The role of diet as a major component for health security has, unfortunately, always been minimized, although our knowledge about the role of food in prevention of chronic diseases has increased significantly.

As an example, the United States Institute of Medicine's Food and Nutrition Board has recently expanded the basis for nutrient recommendations to accommodate the link between diet and health and include the concept of chronic disease prevention in the development of nutrient allowances. There is presently considerable evidence demonstrating that diet and disease, particularly the chronic degenerative diseases, are closely linked. This has led to an expansion of the focus of nutrition recommendations. When food security is integrated with other factors into the overall system, it will improve our understanding of health and well being and at the same time strengthen our knowledge of the close link between food security and quality of life.

#### **AUTHOR DISCLOSURES**

None

#### **REFERENCES**

1. Food and Agriculture Organization of the United Nations. *The State of Food Insecurity in the World 2001*.
2. Schmidhuber J, Tubiello FN. Global food security under climate change. *Proc Natl Acad Sci. USA.* 2007;104:19703-8.
3. *Climate Change 2007: Impacts, adaptation and vulnerability. Summary for policy makers.* Intergovernmental Panel on Climate Change. Cambridge; 2007.
4. Factsheet: HIV/AIDS, Livelihoods & Food Security. Food in the Global AIDS Response. World Food Programme, June 2008.
5. Women and children getting by in urban Accra. International Food Policy Research Institute City Profiles; 2003
6. Dugger, Cecelia, 'U.N. Predicts Urban Population Explosion', *The New York Times*; June 28, 2007.
7. Food security and agricultural development. A report of the House of Representatives of the United States (Act of 2007)
8. Brouckerhoff M. *An Urbanizing World, (Achieving Urban Food and Nutrition Security in the Developing World - A 2020 Vision for Food, Agriculture, and the Environment - Focus 3)*; 2000.
9. Satterthwaite D, McGranahan G, Mitlin D. Community-driven development for water and sanitation in urban areas: its contribution to meeting the Millennium Development Goal targets. Water Supply and Sanitation Collaborative Council (WSSCC). Geneva, Switzerland; August 2005.

## Review

# Food security and population health and well being\*

Dov Jaron PhD<sup>1</sup> and Osman Galal MD, PhD<sup>2</sup>

<sup>1</sup>*School of Biomedical Engineering, Science and Health Systems, Drexel University, Philadelphia, Pennsylvania, USA*

<sup>2</sup>*School of Public Health Center for Health Sciences, Center for Global and Immigrant Health, University of California Los Angeles, California, USA*

## 糧食安全性與人口健康及安適

糧食安全性是健康和安樂的多因素系統分析中的重要因子。糧食供應及其他構成系統重要因素間的交互作用闡明了個體與人口的健康。一個衛生系統的重要分析應包含糧食安全性差異的考量，因為它代表經濟及健康不平等的顯要指標。世界人口中的一大部分—特別是在非洲下撒哈拉地區及東南亞—是處於長期飢餓的狀況。僅賴食物必需品的配給無法顯著地降低全球糧食不安全性。此外，為了減少長期飢荒的根本致因，促進農業發展、經濟成長及教育支援是必要的，進而以此提昇健康及安適。

**關鍵字：**飲食、糧食供應、糧食安全性、健康、安適