

In: Practical approaches to combat malnutrition with special reference to mothers and children. Cairo, Egypt. May 25-29, 1977. N.S. Scrimshaw y M. Gabr (editors). Ministry of Health, Cairo, *Egypt, Arab World Printing House, Egypt*, p.134-144, 1979.

**INTERACTIONS OF MALNUTRITION
AND INFECTION** Leonardo Mata

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It is impossible and impracticable to separate health problems from their environmental causes. Thus, a quick glance at the present world distribution of famine and of severe and chronic malnutrition reveals a concentration in the tropics and subtropics. Undoubtedly, negative factors exist in tropical regions that make it more difficult for man to attain an adequate level of nutrition and development.

Figure¹ illustrates that deficiencies in both provision of food and environmental sanitation constitutes the primary factors in the causation of malnutrition⁽²⁾. The role of infection has been given increasing emphasis in recent times, because a close examination of food balance sheets, family dietary histories, and individual records of food intake by small children do not consistently reveal a limitation in food availability⁽³⁾

The ways in which infection affects the nutrition of the host are summarized in Table 1. Among all the mechanisms, reduction of food intake and stress-induced nutrient wastage, as outlined in Table 2⁽⁴⁾ seem to be the most important consequences of the infection in rural villages. The mother often lacks the knowledge and resources to rehydrate the child, particularly when he has diarrhea, or to provide an adequate diet during convalescence. Another important adverse effect of infection is calorie restriction and inadequate management of illness, which are often mediated by cultural beliefs and taboos.

Scientists and field workers have long suspected that malnutrition influences the immune response. Although it has been difficult to document, it is now known that certain components of the immune response are altered in severe and moderate malnutrition, Table 3⁽⁵⁾ It is worth noting that infection by itself may suppress some manifestations of the immune response.

Long-term prospective field studies conducted in poor rural communities demonstrated that malnutrition usually results from the combined actions of deficient diets and infections⁽⁶⁾. Such interactions interfere with nutrition and growth from the moment of conception; in preindus-

trial societies, the ratio of small-for-gestational age to premature infants ranges from 4:1 to 2:1, indicating the preponderance of intrauterine malnutrition⁽⁷⁾. It appears that fetal malnutrition results not only from inadequate maternal diet during pregnancy, but also from a history of malnutrition and infection in the mother during *her own childhood and adolescence*. Thus, supplementary feeding during pregnancy improves fetal growth, although the main determinants of fetal malnutrition are short maternal height, conception at an early age, and short birth intervals.

Low **birth weight infants** are often victims of early post-natal malnutrition, particularly of the marasmic type, and low birth weight is also one of the determinants of deficient growth and development later in life. However, postnatal malnutrition develops primarily as a result of poor child-rearing and hygienic practices, inadequate nourishment, and recurrent infection.

Recent evidence from community studies incriminates infection as a more important contributing factor than food availability in the genesis of malnutrition. Thus, malnutrition is commonly observed in homes where food supply does not appear to be limited. Detailed analysis of individual child histories often indicates that infection is the cause of significant caloric restriction because it is customary to feed the sick child watery gruels⁽³⁾. During convalescence, the mother does not always feed the child properly, partly because anorexia persists, and partly because she does not know how to care for the child recovering from illness. In such instances, an adequate food supply may be available in the home, but the child does not receive his share.

During the first year of life, respiratory infections and diarrhea diseases are the most common illnesses. While diarrhea, respiratory infections and the common communicable diseases of childhood (measles, whooping cough, and chicken pox) predominate during the second year. All of these have marked deleterious effects on host nutrition⁽⁹⁾.

Control and prevention of malnutrition cannot be discussed without considering the whole community's health and development. Table 4 outlines interventions that must be affected under any political system if nutrition and health are to be promoted, particularly among poor populations. These interventions are difficult to implement in most countries for lack of political decisions, limitations in human and material resources, and insufficient technological knowledge to implement mea-

asures where most needed. Table 5 describes general goals that must be fulfilled if the objective is to attain an adequate nutritional status for most of the population . In the past, individual actions have been implemented independently, often with beneficial outcomes; however, most scientists would agree that the holistic approach is the sensible means to reach the desired objectives. As table 6 illustrates, the interaction of two or more measures aimed at the correction of malnutrition and infection results in a greater beneficial effect than either intervention alone(t⁰). However, independent programs such as food fortification, immunization, and treatment of intestinal parasites have positive effects on nutritional status.

Oral rehydration of children with diarrhea is potentially one of the most important interventions in public health⁽¹¹⁾ Field studies supported by the World Health Organization indicate that it can be easily carried out by non-medical persons at a low cost and with dramatic results, as illustrated in Table 7. Children rehydrated by mouth were healthier and had better appetites than those who did not receive oral fluids. Furthermore, weight gains of orally rehydrated children were significantly greater than in those who did not receive oral therapy. In fact, rehydrated children exhibited weight increments comparable to those of well-nourished European children of the same age (12) .

It is difficult for countries in transition to diminish malnutrition and infant mortality with the resources available at present. Health planners and field workers meet with frustration when the appropriate resources to correct or solve a specific problem are not available. It seems evident that the application of existing knowledge and the accumulation of new knowledge hinge on a change in political and academic attitudes toward the kind of research needed, now commonly described as "health services research" (Table 8). This endeavor calls for a re-definition of specific problems, the establishment of priorities, the identification of measures to be applied, and the development of methods suitable for complete implementation where it is most needed.

Regarding malnutrition, a great deal needs to be done in relation to:

- a) understanding causality (particularly the significance of social factors),
- b) stimulation of "mothering" (proper child care),
- c) formclation of simple weaning foods, and
- d} development of systems to deliver clean water to rural areas, and to improve agriculture.

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PESTILENCE-FAMINE

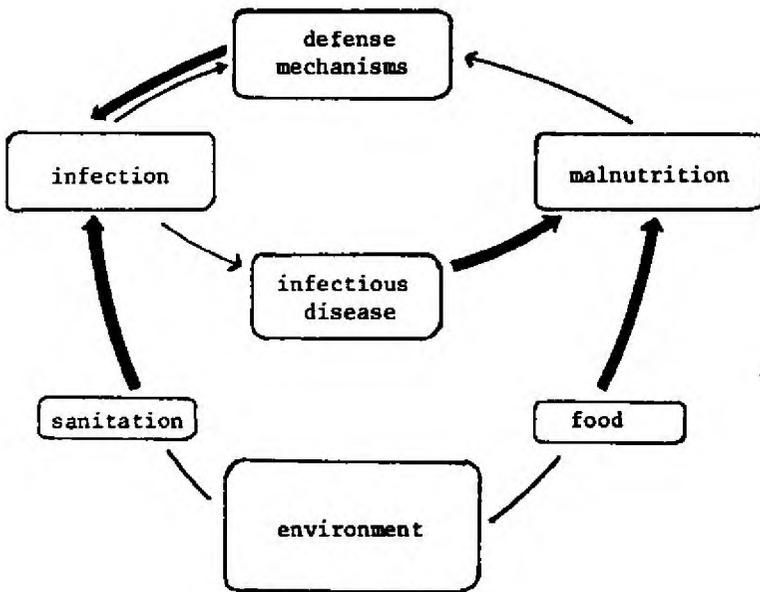


Fig 1.

Environmental determinants of malnutrition and infection, and their interaction.

Table 1. Effect of Infection in Nutrition

A. Direct

Decreased food intake, digestion and absorption
anorexia, vomiting, alteration of peristalsis
impaired digestion
nutrient depletion
impaired absorption

Wasting effect

loss of tissue (muscle, epithelia, blood)
loss of body nutrients
(N, AA, vitamins, minerals)

B. Indirect (culture-mediated)

Decreased food intake
alteration of diet
restriction of diet
inappropriate treatment

Table 2 Nutrient Wastage

A. Nutrient over-utilization

Increased expenditure of sources of energy
Increased synthesis of cholesterol and triglycerides
Overutilization of vitamins

B. Nutrient sequestration

Sequestration of iron in liver
Increased intake of zinc by hepatic cells.

C. Nutrient diversion

Uptake of plasma AA for newly synthesized "acute reactants"
Increased enzyme synthesis by liver
Synthesis of foreign protein, lipids and carbohydrates (as in viral replication)

After Beisel (4)

Table 3 Effect of Malnutrition on Immune response

Diminished Immune Response
Reduced antibody synthesis
Impaired cellular immunity
Impaired amplification phenomena
Alteration of Natural Barriers
Alteration or Reducton of non-Specific Factors
Alteration of Endocrine Balance
Changes in Composition of Indigenous Flora

Table 4 Interventions that will improve Nutrition and Health

Intervention	Effects
Water supply and excreta control	Prevention of diarrhea and parasitism
Immunoprophylaxis	Prevention of anorexia and nutrient wastage and nutrient loss due to infectious disease
Maternal education	Reduction of maternal and child infection, improved child feeding, feeding in convalescence and oral rehydration
Family planning	Delayed coneption, increased child-spacing and improved maternal and fetal nutrition
Agricultural measures Social legislation	Increased food supply Better distribution of resources and benefits

Table 5. Prevention of Maternal and Child Mainutrition in Countries in Transition

A. Promotion of optimal reproduction

- Promotion of optimal age for conception
- Increase in birth interval
- Prevention of unwanted pregnancies

B. Antenatal care

- Promotion of maternal nutrition and hygiene
- Prevention and treatment of infectious disease in the mother
- Identification of "high risk" factors
- Perinatal care

C. Care child and adolescent

- Promotion of nutrition and hygiene
- Prevention and treatment of infectious disease
- Education in health and reproduction attitudes
- Promotion of mental health and well-being

Table 6. Synergistic Effect on Child Mortality, of Feeding, Immunizations and Health Care*

Age, years	Intervention			
	None	Food program (1)	Control and prevention of infection (2)	(1)(2)
<1	107	92	80	81
1 - 4	23	16	14	11

* Mortality rates per 1000

Data from Taylor & Singh (10)

Table 7. Effect of Oral Rehydration on Weight Gain

Monthly weight (grams), Diarrheic children rehydrated in home				
Age in months	Philippines*		Turkey**	
	OR***	C***	OR	C
0 - 5	419	288	413	327
6 - 11	219	159	247	195
12 - 23	243	189	221	166
24 - 35	225	191	205	161
36 - 47	234	97	188	157
48 - 59	247	148	211	174

* 7 - month study

** 16-month study

*** OR = rehydration group; C = group not receiving oral rehydration

Studies conducted by Philippino and Turkish workers, coordinated by WHO staff and consultants. Original data furnished by Dr. D. Barua, WHO, Geneva.

Table 8. Health Services Research in Developing Nations

Definition of problems

Establishment of priorities

Identification of measures that need to be applied

Search for the "appropriate technology":

 mothering

 food production

 food supply

 primary health services

 housing

 education

 leisure

 other aspects of culture

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