FOOD SECURITY, UNDER-NUTRITION & INFECTIOUS DISEASES

'The best cure for malaria is a full cooking pot'- an old Tuscan proverb.

The importance of food in health has been an intrinsic part of our cultural knowledge. Western science recognised the relationship between food and infectious disease only recently, with the association of famine with mortality due to infections. Better food supply has been associated with a decline in mortality, increase in longevity and the modern rise of the human population. In our country although acute starvation has been largely prevented, chronic hunger is a reality for the majority of our people. While people live longer, the burden of infectious diseases is still with us. This article attempts to ask the question whether the lack of food and chronic under-nutrition underlies out inability to solve infectious disease problems in India.

In the first part of the article, historical work based on the rise of the human population and the relationship between famine and infectious disease mortality are reviewed. In the second part of the article development of food self sufficiency is retraced; then the effect of structural adjustment policies and agri -exports in the nineties on shifting of cropping patterns and falling percapita food availability are outlined. In the third part of the article, the effect of changes in food supply on nutrition are discussed. In the fourth part of the article, the immunological links between under -nutrition and specific infectious diseases are discussed. In the fifth part of the article some of the problems of dealing with nutritional problems in clinical practice are elaborated.

I. HISTORICAL LINKS BETWEEN FOOD SUPPLY AND INFECTIOUS DISEASES

The increase in the human lifespan and the rise of the human population over the last century has been one of the most dramatic changes of our times. Mckeown in a seminal study of the mortality data from England and Wales, showed that the mortality decline due to major infectious diseases was a result of better availability of food, safe drinking water and sanitary reforms and preceded the use of specific medical treatments or preventive measures. Of these he suggested that food availability was the single most important factor in the mortality decline.

European land was typically of low productivity due to the shorter growing season, low seed to yeild ratio and less fodder availability. With the seizure of the colonies, the European countries were able to cultivate their tea, coffee, sugar and spices using indentured labour in the colonies and to accumulate capital. The accumulation of capital and largescale imports enabled a general improvement in the quality of nutrition and lifestyles.

The relationship between food supply and infectious disease mortality was demonstrated in studies of the major Indian famines of the nineteenth and the early part of the twentieth century. In each of these famines millions of people died. Maharatna studying, four famines of this period, showed that famine mortality correlated closely to the grain price index (which was a measure of the severity of famine and of economic hardship)(4). Mortality during famine was largely due to Malaria, Cholera, diarrhea and dyssentry, and malaria

was the single most important cause of death. Each disease had a particular temporal profile in relation to famine. Cholera deaths occurred during the period of drought, those due to diarrhea and dyssentry coincided with the rains, and the malaria mortality peaked in the post monsoon period maximally in the year following the drought. He suggested that death due to undernutrition was mediated through infectious diseases, but modified by environmental factors such as water scarcity, congregation in camps (in the case of cholera) and the monsoons in the case of malaria.

The major decline in mortality in India occurred after 1921 as documented by Kingsley David and Sumit Guha (3). Sheila Zurbrigg attempted to elucidate the reasons for this decline studying malaria mortality in Punjab between 1868 and 1940. She showed that till 1908, seasonal malaria mortality strongly correlated to the the degree of flooding and to the wheat prices. However in the post- 1908 period the malaria mortality decreased and ceased to be affected by wheat prices, without any change in the clinical rates of malaria, infected musquito rates or public health measures. She suggests that only explanation for the mortality decline was improved famine relief. Official relief after 1908 was sanctioned before frank famine took place, and based on increase in food grain prices and later also for flood induced harvest losses. Although chronic undernutrition was still very common, people plunged less often into acute starvation.Sumit Guha too suggests that the possible reason for the post -1921 mortality decline was a fairly stable level of moderate malnutrition.

In actual fact during the period between 1900 to 1947, there was a decline of per capita food availability of 25 %. Increasing exports and adverse terms of trade compromised food availbility. Patnaik suggests these policies resulted in the West Bengal famine of 1943 -44 during which 2-4 million people died. Therefore detailed study of food availability and food intakes are required before one can substantiate the claim that decline in mortality was due to improved famine releif and better food availbility.

II. FOOD SECURITY IN INDIA (2, 3)

In the first two decades after independence the government increased food production by promoting fertilizer technology and high yeilding varieties (HYV) in irrigated areas. At the same time it set up two tiers of procurement of grain, by the central government through the food corporation of India (FCI) and by state government through various schemes, which would purchase unlimited amounts through a minimum support price. A public distribution system (PDS) consisting of a chain of fair price shops were set up to distribute procured grain at issue prices lower than the procurement and handling charges. This constituted the food subsidy which was on the average 10-12% of the final price.

The wheat revolution upto the 1970's in the north, especially in Punjab followed by growing of rice in the same region as a commercial crop constituted the growing intervention of the state in the food economy. By the late 1980's over 90% of the wheat procurement and 66% of the rice were supplied by the five states Punjab, Haryana, UP and Jammu and Kashmir. Green revolution provided adequate grain for the PDS. The economic gains however went to larger farmers in the absence

of land reforms, leaving behind the mass of peasants in poverty. The pre-independence trend of declining per head food availability was reversed with a 17 % rise in grain production. However the PDS has had problems of mismanagement, urban bias, lack of coverage of tribal areas and lack of correlation between food supply and level of poverty of the state. Studies show that the grain off-take was very low except in the states of Kerala, West Bengal, Tripura (all left governed states) and Jammmu and Kashmir. A number of regional parties which came to power between 1989 and 1991, instituted specific programmes to improve food availability such as the mid-day meal scheme in Tamilnadu and Gujarat and the Rs.2/kg of rice in Andhra Pradesh.

Upto mid 1991, national policy was geared to achieving higher food consumption levels for poorer segments of the population. By purchasing two fifths of the market supply, under the dual purchase and price system the government played a major role in controlling inflation of food grain prices. Even though socio-economic inequalities were widening, the price of grain was controlled and people could buy it.

From mid-1991 the government started instituting structural adjustment policies governed by the World Bank which included trade liberalisation and agro-export promotion. From the second half of the 1980's there was a declining trend of coarse grain production and growth of oilseeds. From 1990 -1996, the area under culivation for coarse grains and pulses declined whereas that under wheat cultivation remained stationary. Annual growth rates of food grain production have decreased and have not kept up with the requirement of the growing population, resulting in falling per capita food grain availability. In contrast the decline in area of food grain production has been made up by the increase in area under cultivation of cotton, oilseeds, sugarcane and horticultural crops. Of the oilseeds, soya bean production has increased the makimum and most of this is used for conversion to fodder cakes for export. The oil seeds are replacing course grains in the low rainfall areas such as Andhra Pradesh, Maharashtra, Madhya Pradesh, Gujarat and Rajasthan, threatening the staple food of poorer people in these regions.

Rapid growth of livestock production for the cities and middle east export has resulted in an increasing diversion of grain cultivated land into that for fodder food. Prawn cultivation for export, has resulted in takeover of coastal agricultural land from the farmers and irreparable salination of the soil.

The decrease in the food subsidy between 1992 to 1994 and the accompanying price rise led to a predictable fall in the off-take from the PDS. The mismanagement of PDS stocks in 1996 forced the government to import 1.25 milion tonnes of grain. India may become an even more substantial grain importer unless steps are undertaken to step up food grain production and protect the domestic producer.

B.WHY DO NORTHERN COUNTRIES PROMOTE AGRI-EXPORTS (2)

The high standard of living of northern households is maintained by a variety of imported products from tropical and subtropical countries. Some of the changes in consumption patterns are a result of increasing health consciousness such as the shifts to vegetable oils, lean meat, fish, fibre containing cereals, vegetables and fruits. Only a fraction of these demands can be met from the temperate countries.

TNC's have shifted beef production to warmer countries such as Mexico and El Salvador to increase lean meat production, displacing human foodgrains by fodder crops. Prawn culture is destroying agricultural land in India and Thailand. Foreign owned mechanised fishing fleets are displacing local fishing communities in the Indian Ocean. TNC's are also displacing food grain by contracting the production of fruits and vegetables.

The high standard of living is maintained by the low cost of imported products. The costs are kept down by low wages and controlled pricing. However the ultimate cost is borne by steady lowering of food consumption and nutrition for large segments of poor people.

C. EXPERIENCE OF SAP-IMPLEMENTING COUNTRIES :

Mexico which had achieved food self-sufficiency in the 1960's. is now an importer of maize, beans and wheat as a result of structural adjustment policies. In the sub-Saharan African countries (all of which have liberalised and engaged instrong export oriented drives in the early 1980's) there has been a decline of cereal output and per capita food availbility. In these countries most of the agricultural land is us used for cultivation of exported crops. By 1989 a substantial part of sub- saharan Africa was in the midst of pre-famine conditions, and actual famine was averted in 1992-93 by massive foreign aid. Wage cuts, rising prices and elemination of food subsidies have forced people to shift to poor quality high bulk foods leading to increasing ill-health, nutritional deficiencies and mortality. All these countries have seen rising rates of ill health and mortality (7). Yaws and Yellow fever which were eleminated from Ghana, have reappeared. The policies have ignored the profound societal impact of AIDS on the community.

In many African countries the infant mortality rate during 1980-1985 (the SAP period) rose by 4-54 %, and the under 5 mortality by 3.1-90.9%. A 10 country study concluded that the nutritional status of children had declined in all but two countries. Various studies showed that at the end of the SAP period, the majority of deaths in children were due to malnutrition. In 1988 it was estimated that one-million African children had died in the 'debt war'.

III. HOW MUCH HAVE OUR IMPROVEMENTS IN FOOD SECURITY IMPACTED ON HUNGER AND UNDERNUTRITION :

In the post-independence period only 3 major famines have been described. In the 1966-67, Andhra Pradesh, Maharashtra and Bihar suffered famine, resulting in an average calorie intake of 1100-1400 Kcal and many households subsisted on wild leaves and tubers. 60 shiploads of grain from the U.S. containing 7 million tonnes of wheat were sent but could not prevent 36% of families subsisting on a starvation diet. In 1987 the worst drought of the century occurred affecting 15 states and 6 union territories. While the calorie intake did not fall, the quality of food deteriorated but did not result in starvation deaths. The successful prevention and management of recent droughts has been due to increased food production, the PDS and controlled food pricing.

While we have been able to prevent famine, the increased food production has not been equitable. NNMB-NSSO survey in 1983-84 showed that average food expenditure of families ranged from Rs.73-80 per month, which was 70 % of the total household expenditure (8). In 1989, the NNMB survey showed that the monthly household income was

Rs.60. Therefore, it is likely that household expenditure on food actually declined.

Comparison of dietary surveys in rural areas conducted between 1960-69 (Diet Atlas of India, 1969), NNMB Surveys 1975-79 and NNMB survey 1988-89, show the calorie intake increased statistically by 300 kcal, from 1960's to 1975, but have failed to register further increase from 1979-1989. While the average diets are marginally adequate, based on the low cost diet recommended by ICMR, they are deficient in vitamin A and Riboflavin. However if one compares the composition of food stuffs to that of a balanced diet, the diet is deficient in pulses, green leafy and other vegetables, roots, tubers, fats, oils, milk and milk products. In fact the intake of pulses, roots and tubers have declined from 1979-1989. Comparable studies with similar sampling methods are not available before 1960.

The weight-for-age status of pre-school children according to Gomez's criteria showed a decline in the proportion of severe and moderate malnutrition and corresponding increase in normal and mildly malnourished children. The prevalence of severe malnutrition declined from 15 % in the seventies to 8.7% in 1988-90, while the normals increased only from 5.9 to 9.9%. Clinical assessment showed that prevalence of severe PEM, Bitot's spots and angular stomatis had declined. Still, 90 % of children are suffering from undernutrition. In adults in rural areas, the same survey showed than more than 55 % had a BMI < 18.5 which indicates chronic energy deficiency. While there was marginal shifts of the adult BMI and mean heights and weights between 1975-79 and 1988-90, these are of questionable significance.

The extent of chronic hunger is sharply debated. Whatever estimate is used, the conclusion that the problem of chronic hunger is all-pervasive cannot be escaped.

IV.MALNUTRITION, IMMUNE RESPONSE AND INFECTION

The synergistic interaction between nutrition and infection was described by Scrimshaw in 1968. Infectious diseases are associated with reduced food intake, increased requirements and this adversely affects the nutritional status. Deteriorating nutritional status impairs immune function and modifies disease course and outcome.

A.IMMUNE RESPONSE IN PEM, VITAMIN A AND IRON DEFICIENCY

The adverse effects of PEM (Protein energy malnutrition) on the immune system are well documented (9). Cellular immune response is particularly affected. The total number of T Cells, especially CD4 (T helper) cells are reduced. In response to mitogens, T cells show reduced proliferation and lymphokine production. There is decreased macrophage mobilisation, phagocytosis and interleukin-1 (IL-1) production.

Malnourished children show impaired bactericidal activity and peroxide production by neutrophils. The humoral immunity is less affected by PEM. The levels of immunoglobulins are normal or elevated. Antibody response to immunistion with diptheria, tetanus toxoid and measles vaccine has been shown to be adequate in PEM but reduced in response to typhoid antigen . Total complement and C3 levels are reduced. Many of these changes increase with the severity of malnutrition and reverse after treatment.

The role of vitamin A in maintaining mucosal integrity is well known. In vitamin A deficiency immunological studies show fairly normal humoral and cell mediated immune response. However in vitro studies of nasopharyngeal cells show increased bacterial binding and

decreased lysosomal enzymes levels in leucocytes. Immunological studies of iron deficiency have shown impaired batericidal activity of leucocytes, reduced cell mediated immune response and lowered complement levels.

Immunological studies specifically on malnourished patients with tuberculosis have shown low total-T cells counts, CD4 counts, reduced T cell response to mitogen stimulation (PHA), reduced macrophage phagocytosis and bactericidal killing in comparison to patients with TB who were not malnourished and normal controls (10).The immunological changes were more severe in malnourished children with advanced TB disease reflecting their synergistic interaction. However it has to be noted that children with advanced disease were mostly malnourished, compared to patients with localised disease who were better nourished.

B. CLINICAL STUDIES OF MALNUTRITION AND TB (10)

There have been documented increases in tuberculosis deaths during situations of acute food scarcity, either natural or man-made. Reversal of these effects following food availability, supports this association. Radiological evidence of tuberculosis was seen in 30.5 % of children with Kwashiokor in India and several parts of Africa. Others have noted a close correlation between the age of distribution of tuberculosis and Kwashiokor in children. In an important study from Hyderabad, it was found that children of normal, mild and moderate malnutrition had higher rates of localised tuberculous disease whereas those with severe malnutrition mostly had advanced TB disease. Animal studies too have shown that food deprivation increases succeptibility to Mycobacterium tuberculosis. Other studies have shown that protective efficacy of BCG occurs in malnourished children also.

In summary, recent studies show that malnutrition plays a contributory role in the development of severe forms of TB. Better nutritional status propably prevents the the progression of the disease.

C.MEASLES AND MALNUTRITION

Measles places an unusual nutritional stress on children. The nutritional state of the child at the time of development of measles plays a subtle role in determining post-measles morbidity and mortality.

Hospital studies show that upto one-fourth of children who present with marasmus and kwashiokor have a recent history of measles. Prospective studies have shown that children lose 2-12% of their original body weight during the acute phase of measles and that the weight gain in the post-measles period is slower than for normal children. Marasmus and kwashiokor develop in 4% of children in the 6 months following measles. While all children who develop measles have an acute loss of weight and delay in weight gain following the illness, it is only children whose nutritional status is already compromised who develop severe protein energy malnutrition.

Studies in Africa by Morley in the sixties showed that measles in malnourished children was more severe and associated with higher mortality. While hospitals have reported complicated measles, community studies in India show that measles is a less severe illness. Prospective community based studies in India have demonstrated that the nutritional status at the time of development of measles does not influence measles related morbidity or mortality.

In studies conducted at Vellore, the rate and type of complication of measles was different in well fed children of lower and upper socioeconomic background. It was suggested that other factors such as personal hygeine, feeding practices during the illness and poor environmental condition which are related but seperate from malnutrition could influence the severity of measles.

Cell mediated response is important in protection against measles. Severe and fatal measles has been reported in immunosuppressed children. Protective cell mediated and humoral responses develop during measles, irrespective of the nutritional status of the child. Although the specific immune response develops rapidly , measles is associated with a general immunosuppression especially affecting cell mediated immune functions lasting for upto 3-6 months following the episode. This is thought to be responsible for the complications that take place.

While there has been concern about the use of live attenuated measles vaccine in malnourished children, studies do not show any ill effect. Malnourished children mount a good immune response to the vaccine and this infection is not associated with the immunosuppression that occurs with actual measles.

Blindness is a well known complication of measles. During the acute phase of the illness children develop a superficial punctate keratitis which is due to active viral proliferation in the cornea. However following the acute episode, children develop keratomalacia which is thought to be due to vitamin A deficiency. Therefore the nutritional status of the child may determine the development of eye complications.

D. The relationship between PEM and diarrheal disease (9)

Hospital based studies show that marasmus and Kwashiokor as freqently associated with diarrhea and respiratory infection. Most community studies however show that the frequency of diarrhea is not different in malnourished compared to normal children. However all studies consistently show that diarrhea in all grades of malnutrition is of greater severity and duration and is associated with higher mortality.

E. The effects of vitamin A and iron deficiency on infections (9)

Several reports show increased mortality in children with xeropthalmia. However it it is not clear whether this effect is due to Vitamin A deficiency or the general nutritional status. Othes have noted that there is a higher prevalence of infections in children with xeropthalmia. Two studies have showed that vitamin A supplementation to children in the community could reduce mortality, but this was not substantiated in a third study conducted in Hyderabad.

Some studies of iron deficient children have shown higher rates of infections, but others have not demonstrated the findings. Similarly a community intervention could not demonstrate a change in morbidity in response to iron supplementation. Another study in iron deficient rubber plantation workers showed higher prevalence of diarrhea and respiratory diseases. A conflicting report by Murray reported reactivation of malaria, brucellosis and TB among Somali tribes in response to iron therapy. Thus iron may have a variable effect depending on the nutritional state and the environment.

Review of the studies shows the limited nature of the data that is available especially in the adult population on the relationship of under nutrition and infectious diseases. The relationship between the two is clearly complex and varies from disease to disease. While there does not seem to be a straight forward etiological link between nutri tion and infection, malnutrition clearly modifies the severity of illness, increasing morbidity and sometimes mortality.

V. NUTRITION IN CLINICAL PRACTICE

The emphasis in clinical nutrition has been on diseases of western society,diabetes, hypertension, hyperlipidemias, obesity and atherosclerotic vascular disease which are diseases of dietary excess. In contrast, in non-western societies where undernutrition and infectious diseases are the most important problems, dietary advise is rarely given except for gross nutritional deficiency. There is no infectious disease in the world whose treatment includes a specific dietary reccomendation. In contrast, in Ayurveda and Siddha every treatment includes specific dietary therapies.

In western medicine nutritional treatment involves restriction of calories, proteins, fat and salt. These recommendations do not include improvements in the quality of food. Critically ill patients in the intensive care unit are often deprived of feeding, surviving on less than 500 kcal/day supplied by intravenous fluids. The supposed reason for this is that studies in the ICU do not show clear benefit of feeding in critically ill patients. However this is against our instinctive reasoning that food is an intrinsic part of getting better. Traditional sanatorium treatment for TB included milk, eggs and meat. These recommendations are no longer advised as they have not shown to be efficacious . In the TB research centre trials comparing domiciallary and sanatorium treatment, women fared better with sanatorium treatment possibly because they could rest and have better food, than had they been at home. However this fact is ignored and domiciallary treatment is interpreted to be as effective as sanatorium treatment. The majority of the patients who visit our hospitals are deficient in calories , proteins, vitamins, calcium or iron. Most of the time we ignore these deficiencies prefering to diagnose the "disease" and to treat with specific drugs.

During bedside rounds or in the clinic, doctors rarely ask patients about their food habits; have you eaten this morning or what did you eat today? The focus is on the "disease" and diet is an unimportant part of care relegated to the nurse, dietitian or the family. Doctors often prefer to give a drug than to spend time explaining a diet or relying on dietary restrictions to acheive the same effect. On the other hand for patients, food and rest are as if not more important than the drugs. This kind of difference in perception of dietary treatment is an aspect of the doctor-patient relationship of western medicine.

Very often patients have to starve in order to buy their medicines and then have to take them on an empty stomach. Diabetics who have to struggle to buy insulin suffer from hypoglycemia for lack of food. Patients who are admitted to hospitals may find the hospital diet too expensive and have to buy food from hotels that is not nutritious or hygenic, making them prone to other infections.

The place relegated to nutrition intreatment is reflected in curriculum development and the importance given to the nutritionist in the hospital. Medical undergraduates have little exposure to nutrition as a science. In the hospital the nutritionist is seen as someone who looks after the dietary department and not as a member of the treating team. Clinicians rarely have discussions with the nutritionist regarding the care of their patients.

Why is it that despite the existing knowled
ge demonstrating the links between undernutrition and infecton, dietary advise has not entered the paradigm of infectious disease management. Are we waiting for randomised clinical trials demonstrating the benefit of improvements in the diet in preventing and treating infectious diseases. Or is it that vaccines and antibiotics are seen as an easier method of dealing with the harshness of our socio-economic realities.

VI. CONCLUSION :

This article attempts to review the relationship between food supply, under nutrition and infectious diseases. Review of historical studies suggest that increase in longevity of life and reduction of infectious diseases has been related to improvement in food security. In India, while the green revolution and PDS system have improved per capita food production and famine averted, the average daily food intake remains marginally adequate and qualitatively inferior. Although severe forms of malnutrition have been replaced by mild to moderate forms, 90 % of under 5 children are still malnourished and more than half of adults are chronically energy deficient. Structural adjustment policies in India have seen rising agri-exports and food prices and falling per capita grain production. The experience of other structurally adjusting countries suggests that these changes are harbingers of falling food intake, undernutrition ill health and pre-famine situations.

Analysis of immunological studies show that nutrition is a critical determinant of host immune response in specific infectious diseases, especially the cell immediated immune response. Clinical data on the relationship between under nutrition and infectious diseases is scanty, especially for adults illnesses. The available evidence does not support, a causative relationship between undernutrition and infectious disease. However malnutrition clearly results in increased severity and rising mortality from infectious diseases. It is therefore likely that a large amount of morbidity and mortality can be avoided with better nutrition.

Clinical nutrition has focussed on diseases of western society and this is reflected in the absence of dietary therapies for infectious diseases. Dietary treatments are restrictive and not aimed at improving the quality of food. The relative lack of importance given to nutrition is reflected in curriculum development, the role of the nutritionist in the hospital,in the day to day care of the patient and the emphasis given to drug versus dietary treatments.

A variety of issues emerge from the foregoing discussion. If people were better nourished, would less amount of TB reactivation take place, would treatment response be better, relapse rates lower, would malaria mortality be less, would suffering and death due to

diarrhea and respiratory infections be less. Since the links between nutrition, infection and childhood mortality are obvious, the focus of nutritional research and intervention has been in this age group. But what about adults, most of whom are chronically energy deficient.

Despite the overwhelming evidence in favour of a nutrition-infection relationship, the importance of nutrition in adult infectious diseases is down played. If our economic policies are resulting in falling food intake and poorer nutritional status, what are the likely infectious disease consequences? If nutrition is an important determinant of infections, should we not incorporate demands for better quality and equitable distribution of food in our strategy for control of infectious diseases? Should we not lobby for increased jobs, better earning capacity, land reforms , protection of ordinary workers from the effects of inflation of food prices and small farmers from multi-nationals? Are the nutritional recommendations of western medicine changing food tastes in such a way as to alter food security in poorer nations thereby having adverse effects on infectious disease.

Unless we have the courage to effect changes in the primary determinants of health such as nutrition, we may not be able to impact significantly on the infectious disease problems of our country.

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