THE IMPACT OF MALNUTRITION ON THE LEARNING SITUATION

AIDS TO PROGRAMMING UNICEF & WFP ASSISTANCE TO EDUCATION

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INTRODUCTION

The purpose of this issue is to present a technical paper on the above subject which has direct relevance to the educational programmes assisted by UNICEF and WFP and, at the same time, to introduce a recent publication of Unesco on nutrition education which would interest our readers.

This paper by Sven Amcoff of the Department of Educational Research, Uppsala University, Sweden, is one of the 27 papers which have been very attractively presented in the following UNESCO-OXFORD University Press co-publication just released:

World Nutrition and Nutrition Education

EDITED BY
H. M. Sinclair and G. R. Howat

UNESCO
The twenty-seven papers (see Appendix I for titles and authors), arranged in three as:

Section I - The Nutritional Background
Section II - The Educational Background
Section III - Nutrition Education

were among the documents presented during the Oxford Conference on Nutrition Education, jointly organized by the International Union of Nutrition Societies (IUNS) and the United Nations Educational, Scientific and Cultural Organization (Unesco) and held in September 1977 - a meeting recognized as the first large international gathering devoted specifically to education in human nutrition.

The book gives the edited and updated proceedings of this Conference. An adaptation of the "Summary Notes" of the late Professor F. Aylward, who carried major responsibilities for the Conference - the notes being made available for use by the former Programme Specialist in Nutrition Education, Dr. Emmy Hookham - is in Appendix II.
Malnutrition can be defined as the lack of a sufficient quantity or quality of nutrients to maintain the body system at some definable level of functioning. It has been estimated that 37-80 per cent of all pre-school children in the developing countries suffer from protein-calorie malnutrition as assessed by the manifestation of syndromes, nutritional indexes, and weight deviations (Bengoa 1974). Mild to moderate malnutrition, also called chronic undernutrition, is much more common than severe forms, and is often difficult to recognize. The severe forms are either due to insufficient protein and calories (marasmus) or to an acute protein loss or deprivation (kwashiorkor). The consequences are somewhat different, but obviously there is a continuum between normality, marasmus, and kwashiorkor. In this short article it is not possible to go into details, and the term 'malnutrition' will be used in a broad sense. The consequences of early malnutrition depend on a complex pattern of factors such as its severity and timing (pre-and/or post-natal) and the psycho-social milieu.

Today when increasing investment is being made in educational programmes in the developing countries, it is especially important to study the effects of early malnutrition on the ability of children to profit from education. Does early malnutrition impair the learning ability and school performance? If it does, is the effect permanent or can it be reversed with adequate nutrition? Is the education of malnourished children meaningless, unless they are simultaneously provided with proper food? These are some of the questions I will discuss.

MALNUTRITION AND SCHOOL PERFORMANCE

Unfortunately very few studies have been made concerning the direct effect of early malnutrition on school performance. The findings in those that have been carried out indicate that both chronic undernutrition and severe clinical malnutrition in childhood are related to
There have been many investigations, however, regarding the effects of early malnutrition on variables that might be expected to be of significance for school performance.

From the beginning of the 1960s knowledge has accumulated about the way that different types of undernutrition, occurring during different phases of development and at varying times, have influenced the development of the central nervous system in animals. It has also been documented for a long time that the cognitive development is delayed in children who have suffered a serious lack of nutrition for a considerable length of time. Attempts have been made to correlate these findings, and - in somewhat simplified terms - it may be said that undernutrition in the foetus and young child causes disturbances in the morphological and functional development of the central nervous system. These in turn affect the cognitive and emotional development of the child. On the other hand, behaviour scientists have shown how an unstimulating society and psychological environment delays and disturbs a child's development. When undernutrition occurs, such an environment is almost always found, and to establish the existence of a causal relationship between undernutrition alone and cognitive development is very difficult. In the following I shall try to elucidate briefly the importance of good balance between adequate nutrition and a socially and psychologically stimulating environment for a normal development.

I shall deal firstly with biological effects of undernutrition and secondly with the way in which it is believed that these effects influence behaviour.

BRAIN DEVELOPMENT

If we first look at the effect of malnutrition on the central nervous system we find that a great deal of research has been done on animals but also that an increasing number of studies have been based on humans. In the former it has been shown that during periods when the brain is growing rapidly it is particularly sensitive to insult. This critical period theory has been applied to man, and as the neural cells multiply in the foetus during pregnancy, malnutrition of the pregnant woman can be dangerous to the foetus. But this critical-period theory seems to be too simple and is not easily proved in humans. It is complicated by the fact that different parts of the brain have their growth spurt during different periods, the time of which is difficult to settle. Thus damage occurring at one particular period will affect one part of the brain more than another. To make things even more difficult these periods differ between different animals and between animals and man. Generalizations from animal research to man thus cannot be made with certainty.

The parameters that have been used to indicate brain growth
include the total number of cells (neurons and glia cells), the proportion of cells in different parts of the brain, myelin formation, cell size, axon-dendrite connections, and certain biochemical processes. There may also be other indices that have not yet been considered.

Pre- and post-natal malnutrition has been shown to affect all these parameters.

The pre-natal multiplication of neural cells mentioned above is considered most important because these cells, which form the functioning cells of the nervous system, do not multiply after birth.

The glia cells are also pre-natal in multiplication, but they form connective tissue in the nervous system and may not be so vital. Stein and Susser (1976) recently argued that during the second trimester of pregnancy when neurons multiply rapidly, the nutritional needs of the foetus may be small enough for the mother to sustain under any conditions that support her own life. The third trimester is the phase of maximum brain growth and also the period when foetal growth is most sensitive to nutritional deprivation, but it may not be the period when the most critical brain development occurs. Hence the foetus may be protected from irreversible damage to the nervous system and cell growth can take place post-natally. Recent research has also shown that rapid brain growth may persist into the second year of life or even longer.

It is now supposed that a combination of pre- and post-natal malnutrition is necessary for irreversible damage to occur.

There is still a lot of confusion concerning this question, however, and very little seems to be known about the long-term effect of rehabilitation during different post-natal periods on the various brain parameters.

BEHAVIOURAL DISTURBANCES

Certain behavioural alterations are found in malnourished children. In his review of the knowledge concerning the impact of severe and moderate malnutrition on behaviour, Read (1973) finds that severe malnutrition during pre-natal life or infancy or both is accompanied by apathy, irritability, maladaptation in social situations, a low attention-span and reduced exploratory behaviour. Other changes in behaviour that have been reported to be associated with severe early malnutrition are hyperexcitability to aversive stimuli and phobic reactions instead of normal curiosity toward new objects (Barnes 1971),
as well as a decreased ability to focus on tasks and an increased emotionality (Thorp 1975). The behavioural disturbances found in hungry and moderately undernourished children include listlessness, apathy, and a lack of interest in the environment (Read 1973), as well as restlessness and a reduced ability to pay attention (Liggo 1969).

Mental Development

Now it might be asked "What are the relations between the brain parameters and mental development or intelligence?". So far, it has unfortunately been as impossible to establish any relationship between brain cell number and intelligence as to relate intelligence to chemical processes (Dobbing and Smart 1974).

But we know that early severe malnutrition is related to retardation in mental development, as measured by different psychological tests. The intelligence of malnourished children has been found to be significantly lower than that of normal children. Language retardation is particularly evident in previously severely malnourished children. Cravioto (1970) emphasizes, however, that since psychological tests are not culture-free, a better measurement of mental development is the ability for intersensory integration of the central nervous system. The results of his studies (Cravioto, Gaona, and Birch 1967) show that malnourished children have delayed development of the ability to integrate auditory and visual stimuli as well as visual and kinesthetic stimuli. This is probably not only a perceptual process but also a conceptual one, where language is involved. Pollit and Thomson (1977) have recently made a critical review of studies on the effect of protein-calorie malnutrition on mental development. They conclude that 'except for those cases of severe and chronic undernutrition with an onset during the prenatal period or early post-natal life, protein-calorie deficiency does not arrest development'. But they stress the fact that in areas where malnutrition is endemic the social and psychological milieu is unstimulating, which also affects cognitive variables.

The abilities mentioned above are of great importance in learning situations. Language is the instrument by which new concepts are learned, as well as being the means of communication, the transmission of knowledge, thought, and the expression of thought. Language retardation is therefore a serious handicap at
school and has a close impact on the ability to learn, to read, and to write. And visual-kinaesthetic intersensory integration is of great importance in learning to write. Consequently, delayed development in these areas predisposes to school failure.

LEARNING ABILITY

A more direct study of the learning ability of malnourished children has been made at the Tulane University Early Childhood Research Center in New Orleans ('Hungry children lag in learning' 1971). Learning ability was measured by practical learning tests, and a significant relationship was found between malnutrition and impaired learning ability. It is proposed that the difficulties of the malnourished children in maintaining attentiveness may be the key factor underlying the results.

INTERACTION BETWEEN EARLY ENVIRONMENT AND EARLY MALNUTRITION

Thus, early malnutrition is associated with abnormalities in brain development, behavioural disturbances, mental retardation (as measured by IQ tests or tests of intersensory integration), and impaired learning ability. There is no evidence, however, that early malnutrition is the direct cause of these disturbances (Barnes 1969) except in certain severe cases (Thomson and Pollit 1977). Malnutrition is generally found in poverty areas where there is also serious deprivation of environmental stimulation, a condition that could per se cause poor psychological development. To determine whether a causal relationship exists between two variables (in this case early malnutrition and mental disturbances), and not merely an association, the investigation must be designed as an experiment with controls. For ethical reasons this is not possible in the study of early malnutrition in humans. The researcher is thus restricted to survey studies or animal experiments, the results of which cannot be directly extrapolated to humans.

But sometimes such investigations can be made. The Dutch famine of 1944-5 in the Second World War is an example. Data from this situation have been treated as if an experiment had been performed. Large groups of children suffered this famine during different stages of development. The famine lasted from October 1944 to May 1945 and the effect has been carefully investigated by Stein and Susser (1976). They concluded, using data from the famine and from later examination for military service, that no relationship could be established between poor pre-natal nutrition and mental competence.

In developing countries where malnutrition occurs during both pre- and post-natal periods, the conclusion drawn by many scientists (Pollit 1970; Cravioto 1970, and others) is that the impairments are probably caused by malnutrition in complex combination with other
factors found in poverty areas, e.g. socio-economic factors such as deprivation of environmental, social, and emotional stimulation, cultural factors, such as ignorance and illiteracy of the parents, and biological factors, such as infections (caused by poor hygiene), multiparity, closely spaced pregnancies, and prematurity. Cravioto (1970) presents several series of flow diagrams showing possible interrelations among these factors.

ARE THE EFFECTS PERMANENT OR REVERSIBLE?

As to the permanency of the effects of malnutrition, there seems to be a critical dividing-line at 6 months of age. In children who were less than 6 months when malnourished, changes in the central nervous system, mental retardation, and the impairment of the learning ability have been found to be permanent, whereas re-feeding has resulted in recovery in all these areas in children who were older than 6 months at the time of malnutrition (Winick and Rosso 1974). Both enrichment of the environment and provision of food lead to an improvement in mental performance in these children. But the data on this matter are far from sufficient to draw definite conclusions.

PROGRAMMES FOR COMBATING MALNUTRITION IN YOUNG CHILDREN

Several studies have shown that in order to greatly improve the psychological behaviour and learning abilities of malnourished children, both better nutrition and stimulation for education must be provided.

In a report on a Mexican study, Chavez, Martinez, and Yaschine (1975) described how supplements to the diet of the mother-child dyad had a positive effect on the child's behaviour and how, as a result, the child received more attention not only from its mother but also from other family members. The children slept less, played more, and were also more demanding and disobedient, all of which contributed to a normal development.

Freeman, Klein, Kagan, and Yarbrough (1977) also report successful results of a nutrition intervention programme in rural Guatemala. They stress that such programmes are relatively easy to implement in comparison with most other social action efforts, but they limit their conclusions to the area studied, probably being aware of the possible influence of cultural habits and factors in the environment.

In a recent article by Guthrie, Masangkay, and Guthrie (1977) the social aspects of malnutrition are stressed. They have worked in Sagada Mountain Province in the Philippines and have studied a group of severely malnourished children. The children were breast-fed during the first critical six months of life and had thus received
adequate nutrition during that time, but during the post-weaning period they did not receive sufficient nutrients, partly due to the fact that they suffered from diarrhoea.

The authors stress, however, the constraints of the cultural milieu, which, via the parents, teaches the children a pattern of passive resistance. This leads not only to resistance to nutritious foods when offered, but also to cessation of activities and refusal to respond to others. The result is a child cut off from what he needs for both cognitive development and physical growth.

**CONCLUSION**

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APPENDIX II

The proceedings of the International Conference on Nutrition Education were held in Oxford from 31 August to 7 September 1977 and are now available in book-form. The Conference was attended by 330 people from 70 countries and from different international organizations. About one-third of the participants came from developing countries in Africa, Asia and Latin America.

The Conference was the first international gathering devoted to nutrition education and one of the main conclusions of the Conference was that greater efforts should be made to promote and improve the quality of nutrition education and to encourage contacts between people in different countries concerned with different facets of food and nutrition education and training.

- the Content of food and nutrition education in the light of recent developments in our knowledge of nutritional sciences, and the application of these sciences in practical problems in developing and industrialized countries;

- the Pedagogical Implications for the planning and teaching of food and nutrition sciences at all educational levels with regard to relevance, curricula, techniques and methods and the problem of change.

In-depth discussion took place in working parties and discussion groups on:

- formal education and training within the tertiary education system - in universities and other institutions;
- formal education within the school system;
- adult education and extension - the diffusion of nutritional ideas and practices among the general public.

The members of the Conference came from different professional and educational backgrounds with qualifications in nutrition and in subjects such as natural science, medicine, agriculture, home economics, education, psychology and the social sciences.

All had a common interest in some aspects of nutrition and of education. Some were concerned primarily with formal education in primary and secondary schools; others in universities and associated institutions, such as colleges of education for teacher-training or colleges of agriculture; others were primarily involved in some form of adult education. A number were practising as nutritionists/dieticians in hospitals or in organizations concerned with special programmes (e.g. for children, or for the aged); several were involved in programmes of general adult education sponsored by voluntary or governmental bodies.
The discussions ranged over:

- formal education at the tertiary level in universities and other institutions in industrialised countries
- formal education within the school system in developing countries
- adult education, extension and non-formal education in countries

The major conclusions of the Conference were that if the quality of the teaching of nutrition and food sciences is to be improved, a core of qualified personnel (in nutrition and education) must be educated at national, regional and international levels; an international network for such education must be established to provide effective educational leadership. A second major conclusion was that, in order to promote and improve nutrition education, personnel concerned must become aware of and utilize existing educational structures and networks for this purpose.

More specific points that emerged were:

(a) the importance of follow-up meetings on a national, regional or international basis;

(b) the importance of devising machinery for the exchange of information among those concerned with different aspects of nutrition education;

(c) the special needs for the exchange of information to assist individuals and groups in developing countries;

(d) the need for a greater integration of current scientific ideas into nutrition and food science education, and the necessity of increasing the numbers of people who have qualifications in both education and in nutrition through special postgraduate courses and in other ways.

Among the points arising in respect to education at the tertiary level were:

(i) the importance in many countries of establishing or strengthening science-based courses leading to degrees in human nutrition and of linking these with other appropriate areas, and especially with food science;

(ii) the importance of strengthening nutritional curricula in schools of medicine and in schools of agriculture, as well as in other areas (such as home economics).
In respect to schools, it was clear from the discussions that in many countries special efforts were required to introduce nutrition education for both boys and girls, with links with different school subjects.

Discussions on adult education and extension revealed that there was ample scope in most countries for new initiatives among different population groups.