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The Hazards of Malnutrition in Early Infancy

by

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Abstract

Severe protein calorie malnutrition is often accompanied by vitamin A deficiency and intercurrent infections. These three conditions have a synergistic action on each other. The younger the infant, the more severe are the hazards of nutritional deficiency.

Severe malnutrition in early infancy results in :

1. Direct hazards to the infant consisting of :

a. Retardation of physical development.

b. Retardation of brain development with subsequent impairment of learning ability.

c. Decreased resistence against infections.

d. PCM is a predisposing factor to diarrhoea, with aggravated the malnutrition.

e. Blindness due to vitamin A deficiency.

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II. Indirect hazards affecting :

A. Other siblings in the family.

Frequent illness and a high mortality rate of the malnourished infant necessitate more intensive care and increase expenses for treatment. This will be a cause of neglection of other children in the family.

B. The community :

1. *Health centres and pediatric wards are often overloaded by malnourished infants who often suffer from recurrent and chronic infectious diseases.*
2. *Rehabilitation centres and schools have to be set up for the blind.*
3. *The possibility of impairment of learning ability might inhibit technical development and progress.*

Regarding the many impacts and the complexity of this problem, it is important to discuss what can be done to improve prevention and treatment of malnutrition in early infancy. It is also important to stimulate teamwork among medical and nonmedical departments who are involved with nutritional problems, nutrition education, food production and distribution. Most probably periodic evaluation and comparison of results will improve the methods used to overcome this problem.

The most common nutritional deficiencies among Indonesian infants up to two years of age, are protein calorie malnutrition (PCM) and vitamin A deficiency (Trowell et al., 1954; Poey, 1957; Ten Doesschate, 1968; Monckeberg, 1971; Mc Laren, 1968). The younger the infant the more severe are its hazards. Prematures, small for dates and ill newborns require special attention. This group is prone to the development of malnutrition, since its nutritional reserves are less than in older children and adults (Heird, 1972). Severe protein calorie malnutrition results in physical growth retardation and histopathological changes in the brain (Stock, 1963; Cheeck, 1968, 1970; Drillien,1968; Scrimshaw, 1968, 1969; Darwin Karjadi, 1971; Monckeberg, 1971; Soewondo, 1971), the gastrointestinal tract (Bowie, 1967; Brabezat, 1967, 1968; Mendes, 1958; Montgomery, 1964; Hassen, 1971; Sunoto et al., 1974), the pancreas and other organs which may cause functional disturbances. The critical priod for brain development is the first six months of life (Winick, 1969).

In food restriction the ratio of calories to protein in the diet is important (Montgomery, 1964; Check, 1968). If protein intake is very low, while calories are not so radically restricted, the result will be a decrease in cellsize, but cell multiplication remains normal. Calorie restriction will distrub cell multiplication, while cell size is still normal (Mendes, 1958). A mixture of these two conditions is usually found in marasmus and kwashiorkor.

The hazards of severe malnutrition in early infancy are manifold. To discuss them all in detail would be impossible. This article is an attempt to discuss the most important aspects. Severe malnutrition in early infancy will not only effect the malnourished infant, but indirectly also its family and even the community as a whole.

1. *Direct Hazards to the Malnourished Infant*

The most important are:

1. Physical retardation
2. Retardation in brain growth and development
3. Decreased resistasce to infection
4. Predisposition to diarrhea
5. Blindness due to vitamin A deficiency.

1.1. Physical growth retardation

Body weight and body length are below normal in PCM. About 60% out of 181 infants admitted to the Pediatric Department of the Dr. Soetomo General Hospital, between January and June 1973, were underweight (body weights were below 80% of the Harvard stan-

dard). Twenty four per cent were severely underweight, with body weights less than 60% of the Harvard standard (M. Adnan, 1973). Body weight were significantly lower in 65 cases suffering from severe tuberculosis ($p < 0.01$), below 80% in 83.6% of the cases and less than 60% in about 49% (Boerhan Hidajat, 1973). Monckeberg (1971) stated an incidence of 90% of malnutrition among hospitalized patients in developing countries.

1.2. Retardation in brain growth

Severe PCM in early infancy will affect brain growth and development (Stock, 1963; Scrimshaw, 1969; Winick, 1969; Cheeck, 1970; Monckeberg, 1971; Soewondo, 1971). The critical period for brain development is the first 6 months of life (Winick, 1969).

In severe PCM :

— The number of braincells is decreased.

— The headcircumference is small.

— Transillumination of the skull is strongly positive (Monckeberg, 1971). This indicates a discongruence between skull and brainvolume, the latter being relatively smaller. The remaining space is filled with fluid, which gives a stronger transillumination.

— EEG changes have been found.

In the first 6 months of life, a correlation has been found between the decrease in the number of braincells and the headcircumference in PCM (Winick, 1963). What is the functional significance of all these changes? There is evidence, that functional brain damage may result from early malnutrition.

Darwin Karjadi et al. (1971) examined 31 children between 9 - 15 years of age, with known malnutrition in the critical preschool period.

Bodyweight, bodylength and IQ were significantly lower in comparison with a healthy group of children.

Scrimshaw (1973) mentioned that results of recent investigations have shown that malnutrition in early infancy associated with decreased sensory stimulation from the environment may result in disturbances in learning and behaviour.

Small for dates were found to develop normally if stimulated by a favourable environment. On the other hand severe nutri-

tional deficiency after complete development of the central nervous system, will decrease the child's activity and indirectly affect learning ability and behaviour. This handicap will be felt if the malnourished infant has become an adult. It will indirectly also affect its family, the community as a whole and inhibit technological development of the country (Darwin Karjadi, 1971; Soewondo, 1971; Monckeberg, 1971).

Ignorance and a low IQ of the mothers will be a handicap in overcoming malnutrition in their children. This is one cause of the persistance of malnutrition in the succeeding generation.

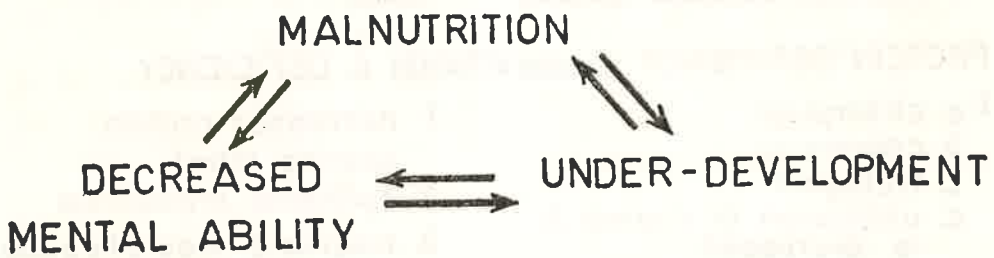
Technological progress of a country will also be inhibited, since this requires technical knowledge, which is difficult to achieve, if learning ability is impaired. This situation will secondarily inhibit economical development, so that it can be concluded that:

a. malnutrition

b. unfavourable environment which does not stimulate mental activity and development, leading to decreased mental ability and secondarily to underdevelopment

c. poor socio-economic conditions.

will act synergistically on each other and form a vicious circle.



Nutritional as well as environmental conditions should be improved to achieve optimal mental development.

1.3. Decreased resistance against infection

Nutritional deficiencies and infectious diseases are two major problems among infants in Indonesia. These two conditions often have a synergistic effect on each other.

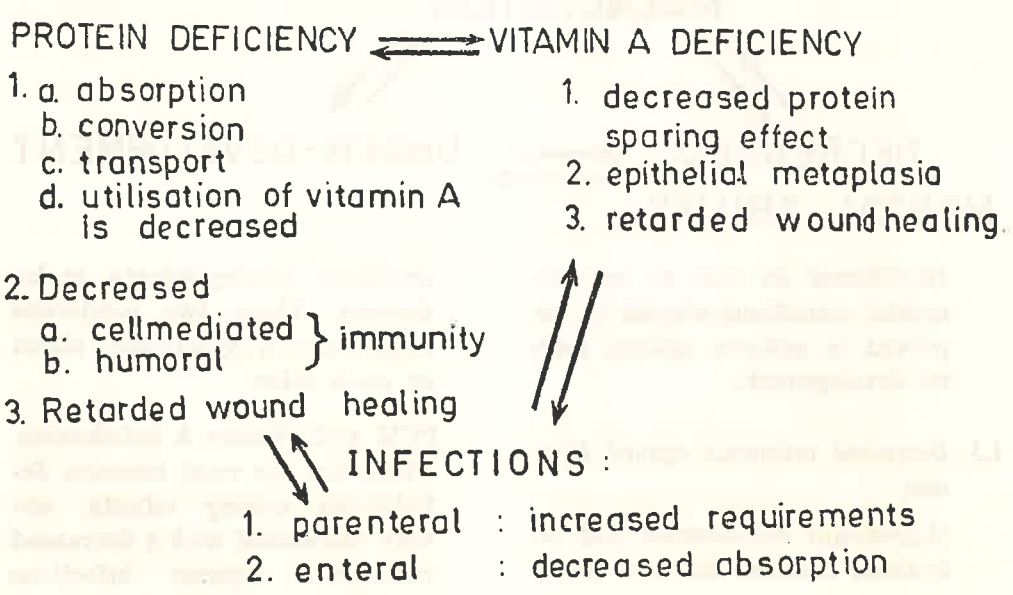
PCM and vitamin A deficiencies, which are the most common deficiencies among infants, are both associated with a decreased resistance against infections

(Raffel, 1961; Zucker, 1964; Scrimshaw, 1968; Olson, 1968; Smyth, 1971; Monckeberg, 1971). In severe PCM cellmediated as well as humoral defense mechanisms are impaired. In vitamin A deficiency formation of epithelium is disturbed and woundhealing, like in deficiency is retarded. This will predispose to infections. Infection on the other hand, will often aggravate or precipitate malnutrition. The more prolonged the infectious disease, the more severe is the malnutrition.

Malnutrition was more frequent and more severe among infants suffering from severe tuberculosis (meningitis, miliary tbc.), compared to a group suffering from acute infections (pneumonia) in the Pediatric Department of the Dr. Soetomo General Hospital, Surabaya (Ismoedijanto et al., 1974).

Vitamin A deficiency was found in 20% of the infants suffering from PCM in the Pediatric Department of the Dr. Soetomo General Hospital. The incidence was 30% in cases complicated diarrhea (Ratna Indrawati et al., 1974). Almost all cases were complicated by an intercurrent infection, mostly respiratory infections.

A combination of PCM, vitamin A deficiency and infection will form a viccious circle (Pudjiadi and Harmanses, 1968; Roels, 1961; Olson, 1968; Scrimshaw, 1968).



Simultaneous treatment of all 3 conditions is necessary to obtain satisfactory results.

1.4. Predisposition to diarrhea

The majority of infants admitted in the Pediatric Department of the Dr. Soetomo General Hospital suffer from diarrhea. Diarrhea, particularly if prolonged, will aggravate or precipitate the state of malnutrition. Protein calorie malnutrition on the other hand is a predisposing factor for diarrhea. Atrophy of the intestinal mucosa and associated glands and pancreas have been found in severe PCM (Herbst et al., 1969; Trowell et al., 1954; Brunser, 1966).

1. Crypts and villi of the small intestine show atrophy.
2. The mitotic index of intestinal crypt cells is decreased (Brunser, 1966).
3. The migration rate of jejunal epithelial cells is decreased (Deo and Ramalingaswami, 1965).
4. DNA replication in the intestinal mucosa is slowed down (Cheeck, 1968).
5. Digestive enzymes in the brushborder cells are decreased, particularly the disaccharidases (Bowie, 1965; Burke, 1966; Sunoto et al., 1973).
6. Acinar cells in the pancreas are atrophic and the number of zymogen granules is decreased (Poey, 1957).
7. Pancreas enzymes are decreased (Barbezat and Hansen, 1968).

Gastro intestinal dysfunction may result, leading to intolerance against fat, in protein and carbohydrates. PCM and diarrhea have a synergistic effect on each other. Diarrhea was found in 20% of the infants admitted for severe PCM in the Pediatric Department of the Dr. Soetomo General Hospital. Twenty nine out of 50 cases (= 58%) with bodyweights less than 60% of the Harvard standard, were intolerant against lactose. This was determined with the clinitest, after loading with 2 grams lactose per kg. bodyweight administered as an 8% solution.

Stoolcultures were positive in 23 out of 50 cases (= 46%).
The following micro organisms were found :

staphylococcus aureus (anticoagulans positive)	12 cases
vibrio cholera	9 cases
escherichia coli	4 cases
shigella	1 case.

Three cases showed a combined infection with E. coli and staphylococcus aureus (Ratna et al., 1974). The mortality rate of

PCM complicated by diarrhea among our patients was 14%, whereas in PCM without diarrhea it was about 10%.

1.5. Blindness due to vitamin A deficiancy

Vitamin A deficiency is one of the most serious complications of PCM (Mc Laren, 1968). Both conditions have a synergistic effect on each other (Olson, 1968). Vitamin A has a protein-sparing effect. One of the first symptoms of vitamin A deficiency is growth retardation (Roels, 1961; Guthrie, 1967; Ten Doesschate, 1968).

Severe protein deficiency may aggravate or precipitate a state of vitamin A deficiency, due to disturbance of :

a. Vitamin A absorption.

Fat absorption is disturbed in severe PCM. Besides PCM is a predisposing factor to diarrhea. Histopathologic changes and dysfunction of the gastrointestinal tract and associated glands, like the pancreas, may be found. This may cause an intolerance against fat, protein and carbohydrates (Poey, 1957; Bowie, 1967; Barbezat, 1967, 1968; Herbst, 1969; Sunoto et al., 1973).

b. Conversion of carotenoids into vitamin A.

c. Vitamin A transport, because the concentration of carrier protein is decreased.

d. Uptake and utilization of vitamin A in the tissues is decreased (Olson, 1968).

Since protein as well as vitamin A deficiency are associated with decreased resistance against infections (Raffel, 1961; Zucker, 1964; Olson, 1968; Scrimshaw, 1968; Monckeberg, 1971; Smyth, 1971; WHO Chronicle 1973), a combination of these three conditions will result in a vicious circle. To achieve satisfactory results, all three conditions should be treated simultaneously.

The lower the bodyweight the higher the incidence and the more severe are the ophthalmologic symptoms of vitamin A deficiency (Ratna Indrawati and Bing Rudyanto, 1974). The incidence increases with the presence of diarrhea (Ten Doesschate, 1968; Teng, 1968) 20% in PCM without diarrhea and 30% in PCM with diarrhea (Ratna and Rudyanto, 1974).

Vitamin A deficiency is the most important cause of blindness in Surabaya and East Java in the age group under 16 years of age (Ten Doesschate, 1968). It

has been declared as a public health problem and the primary cause of blindness in Indonesia (Seminar on blindness, Bandung 1964).

Xerophthalmia was found to be a cause of blindness in :

31.7% of all causes of blindness in Ophthalmologic Department, Dr. Soetomo General Hospital (Tamin Radjiman and Oka, 1972).

40 % in Ophthalmologic Hospital Undaan (Ten Doesschate, 1968).

17 % in Ophthalmologic Hospital Undaan (Basuki, 1973).

The significant decrease in incidence, found by Basuki (1973), after a period of 11 years, is probably due to intensification of prophylactic admnistration of vitamin A and nutrition education. Addition of green leafy vegetables, which belong to the cheapest foodstuffs, to traditional infant food, like rice and banana, should be encouraged. Often eggs are sold instead of given to the infant.

2. *Indirect Hazards:*

These arise as a consequence of the direct hazards to the malnourished infant and affect:

a. Its family

b. The society.

Impairment of learning ability and behaviour will be felt when the malnourished child has grown up. Its effect on the family and on progress and development of the country has been discussed.

Decreased resistance to infection and a predisposition to diarrhea combined with poor hygienic conditions among the low socio-economic group, will cause recurrent often chronic infections. This necessitates frequent visits to the clinic or even hospitalization in already crowded outpatient departments and pediatric wards. It also means expenses for treatment and special care, leading to neglection of other children in the family. The mortality rate is high. Among infants admitted with PCM in the Pediatric Department of the Dr. Soetomo General Hospital, 11% died.

Vitamin A deficiency is an important cause of blindness among children up to 16 years of age (Ten Doesschate, 1968; Tamin Radjamin and Oka, 1972).

Blindness will handicap the infant for the rest of his life. The burden is also felt by the family and by the society. Special schools for the blind and reha-

bilitation centres have to be set up to educate these children and to find a way for them to earn their own living in the future.

Surabaya has one special school and one rehabilitation centre. Facilities are still limited due to lack of funds, space and personnel.

Th problem of malnutrition in early infancy is a very complex one.

Regarding its many impacts, it deserves special attention. To overcome this problem, I would like to suggest the foundation of a national nutrition club, consisting of all medical and non-medical departments involved with various aspects of nutrition. This would include nutrition science, prevention and treatment of malnutrition, nutrition education, food production and distribution, infant feeding practices in various parts in Indonesia, food preservation etc. The purpose of this nutrition club is to improve cooperation and to achieve better understanding of the many factors, which play a role in malnutrition. It could also help us to keep informed of recent problems, progress and activities in the field of malnutrition. Another sugestion is intensification of nutrition education in the medical schools.

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