

# ECOLOGICAL FACTORS INFLUENCING THE GROWTH OF THE CHILD

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## INTRODUCTION

Soon after it is born, the human child is exposed to a hostile world where a world variety of hazards influence not only the growth of the child but also its very survival. Early infancy is associated with a very high mortality rate only equaled in old age. The physical growth of the child is perhaps one of the most sensitive indices of the effect of ecological stresses on the child.

The general course and pattern of growth of each child is genetically predetermined. However strongly acting ecological influences can alter the course of physical growth. Perhaps the two most important of the ecological factors are the dietary intake of the child and the influence of infections and disease. Increase in size is primarily dependent upon an adequate food intake both in terms of quantity and quality. This itself is dependent upon a wide range of ecological factors the most important of which includes factors that influence food production, the distribution and availability of foods, cultural preferences and taboos in relation to foods and cultural habits regarding the preparation of foods (Fig. 1).

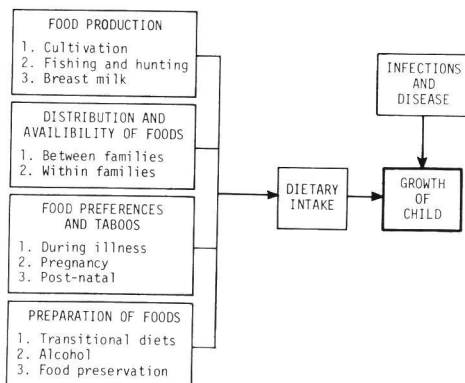


Fig. 1. Major ecological factors influencing the growth of the child.

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Aside from an adequate dietary intake, the single most important ecological factor influencing the course of growth of a child is the stress placed upon it by infections and disease. Further these two powerful factors of inadequate dietary intake as well as infections often act synergistically in a cyclic fashion with one factor reinforcing the undermining action of the other. In the paragraphs that follow the influence of these ecological factors on the growth of the child is examined and illustrations are drawn from studies conducted in Sabah, Sarawak and Peninsular Malaysia.

## FOOD PRODUCTION

### Cultivation

In settled rural communities, the cultivation of staple foods such as rice, millet, tapioca, maize, potatoes and yams is the principal means of food production and is consequently an important preoccupation of the community. For example, in one coastal Dusun community studied in 1979, it was noted that rice, tapioca, Italian millet, sweet potato and maize were grown and consumed by the community (Table I). The importance of such staple foods is underlined by the fact that the main events of the year coincide with events in the planting cycle. Thus ploughing, planting, weeding, irrigation and harvesting are all associated with rituals and ceremonies conducted by spiritual specialists. For example at the time of planting the *monogit* ceremony is carried by coastal Dusuns. It not only ensures a good harvest but also aims to bring good fortune and health to the household symbolically protected by the *monogit* ceremony (Fig. 2).

Most other foods including most fruits and vegetables (Table II and III) are locally cultivated by the majority of rural communities. The consequence is that many foods particularly fruits and vegetables are peculiar to a local community who, being unfamiliar with other foods such as the soya bean, do not have the taste for such foods not the knowledge of how these unfamiliar foods should be prepared for consumption. It is thus absolutely essential that new agricultural and other food products be introduced as a "total package" that incorporates not only agricultural "know-how" but also knowledge concerning storage, preservation, preparation and presentation of that food.

Table I

Proportion of households that produce cereals and starchy foods and that eat it at least once weekly.

(Coastal Dusun community, Tuaran)

Cereals and starchy foods	Proportion producing the food	Proportion consuming it at least once weekly
Rice	1.0	1.0
Sugar and sweets	0	1.0
Rice wine ( <i>tapai</i> )	0.8	0.8
Wheat flour	0	0.6
Biscuits	0	0.6
Glutinous rice	1.0	0.5
Italian millet	0.4	0.4
Tapioca	0.5	0.3
Honey	0.3	0.2
Sweet potato	0.4	0.2
Maize	0.3	0.1

Table II

Proportion of households that grow fruits and that eat it at least once weekly (Coastal Dusun community, Tuaran)

Fruits	Proportion growing the fruit	Proportion eating it at least once weekly
Bananas	1.0	0.7
Papaya	0	0.7
Pineapples	0.8	0.3
Jackfruit	0.4	0.2
<i>Anona muricata</i> ( <i>durian belanda</i> )	0.7	0.2
Rambutan	0.5	*
<i>Baccaurea motleyana</i> ( <i>rambai</i> )	0.5	*
Mangosteen	0.4	*
<i>Lansium domesticum</i> ( <i>langsai</i> )	0.4	*
<i>Putorius nudipes</i> ( <i>pulasan</i> )	0.3	*

\* Available irregularly



Fig. 2. At the start of the planting season, a Dusun family sit together on the floor during the *monogit* ceremony conducted by 4 sword-wielding *bobolian* [spirit specialists] who symbolically hold an inverted tray over their heads signifying protection against misfortune, ill-health and famine. A white cockerel, lying on the tray, has just been sacrificed as an offering to the spirits to ensure a plentiful harvest, good fortune and health.

Table III

Proportion of households that grow vegetables and that consume it at least once weekly (Coastal Dusun community, Tuaran)

Vegetables	Proportion growing the food	Proportion consuming it at least once weekly
Banana spadix ( <i>jantung pisang</i> )	1.0	0.9
Fern shoots ( <i>pucuk paku</i> )	0.6	0.4
Brinjal	0.5	0.4
Spinach	0.4	0.4
Long beans	0.4	0.3
Mushrooms	0.7	0.3
Ipomea leaves	0.3	0.3
Cucumber	0.1	0.3
Jackfruit pistil ( <i>pucuk nangka</i> )	0.4	0.2
Bamboo shoots	0.3	0.1
Mustard leaves ( <i>sawi</i> )	0.1	0.1
Cabbage	0	0.2
Carrots	0	0.1

## Domestic Animals

In considering the problem of food production, the place of domestic animals in the supply of foods should not be neglected (Table IV). Where there is sufficient land many of these animals are allowed to wander around foraging for their own food. This non-intensive method naturally results in a relatively low production of animal proteins. However it has the advantage that available cereals and other foods are not deliberately turned into animal fodder. In the process of converting cereals into animal meat, approximately 85% of the calories contained in the grain are lost in terms of human nutrition (Matze, 1979). Recently there have been moves by sanitarians to require for mainly aesthetic reasons, that domestic pigs be penned in an enclosure. This ill-conceived notion has not only removed the scavenger action of the pig but also resulted in either a greater loss of calories, in term of human nutrition in the form of grain lost as animal feed, or in a decrease in the number of pigs from lack of food supplies denied to pigs penned in an enclosure.

Table IV

Proportion of households that self-produce fish, meat and eggs and that consume it at least once a week (Coastal Dusun community, Tuaran)

Fish, meat and eggs	Proportion producing the food item	Proportion eating it at least once weekly
Fresh fish	@	0.9
Eggs	1.0	0.7
Salted fish	0	0.6
White bait ( <i>ikan bilis</i> )	0	0.2
Chicken	1.0	0.1
Ducks	0.2	0.03
Mutton	0.7	*
Beef	0.3	*
Pork	0.2	*
Deer	@	*
Wild boar	@	*
Bamboo rat	@	*
Squirrel	@	*
Monkey	@	*
Turtle	@	*
Snake	@	*
Iguana	@	*
Small birds	@	*

\* Available irregularly

@ fishing or hunting is carried out by 5-15% of the households

## Fishing and Hunting

Fishing and hunting for animal proteins can add valuable protein to supplement the diets of those who live close to sources of such foods. In many coastal communities the principal source of animal proteins is the fish. In the coastal Dusun community that was studied, it was noted that (Table IV) fish, in the form of fresh fish, salted fish and white bait, constituted the principal source of animal protein for all persons after infancy.

It should be noted that even though buffaloes, goats and pigs are reared, the consumption of these is relatively low and that these animals are often sold for cash or are slaughtered only at festivals and for rituals.

Hunting for wild animals and birds, particularly the small ones, is an important activity in jungle fringe communities that are in short supply of proteins. About 15% of all the families in the coastal Dusun community that was studied (Table IV), supplemented their diets by hunting for animals and birds. In jungle and jungle fringe communities almost all families hunt for food. Consequently, the hunting dog is an important member of the household in these communities.

## Breast Milk

The importance of breast milk as a source of food for the young child cannot be overemphasised. There is no doubt at all that breast milk is the safest and best food for the young infant. Studies have demonstrated that breast milk has specific nutritional and anti-infective properties and that breast-feeding is associated with lower rates of attack and death from infectious disease. In one study, it was noted (Kanaaneth, 1972) that malnutrition was practically absent among breast-fed infants while about 30% of bottle-fed infants were found to be malnourished. Plank and Milanese (1973) noted that bottle-feeding is associated with three times as many death as compared with infants who have been wholly breast-fed.

The irony of it is that in developing countries such as Malaysia where breast-feeding is most needed, there are indications that there is a decline in the proportion of women who breast-feed their infants. The decline is most marked among urban women particularly urban Chinese women. About half the urban Malay and Indian women and two-thirds of urban Chinese women who began breast-feeding their infants had ceased to do so within three months of childbirth (Pathmanathan, 1979). Although the decline of breast-feeding is less marked among rural women, it was found that nine months after childbirth only 50% of rural Malay women, 21% of rural Indian women and 19% of rural Chinese women were still breast-feeding their infants.

The high cost of packaged milks, set against the low incomes characteristic of the developing countries, leads mothers to use dilute preparations far below those recommended by the manufacturers. Thus in the economically poorer areas of the world, the use of anything other than breast milk often amounts to a death sentence for the young infant.

## **DISTRIBUTION AND AVAILABILITY OF FOODS**

### **Between Families**

The wide differences in the availability of foods between different countries and between different communities in the same country have been well documented. For example, it has been estimated (Matze, 1979) that the average annual per capita consumption of animal protein is about 20-25 kg. in the industrial countries as opposed to only about 1 kg. in the Asian and African countries.

Malnutrition is not always due to insufficient food production. Unemployment, poverty and the lack of purchasing power can lead to low food production. Only those who have income (and employment) have purchasing power. In other words, socio-economic conditions are of paramount importance. The National Household Expenditure Survey, Malaysia has shown that rural households with an income of less than M\$200.00 spent 52.6% of their income on food of which 45% was spent on rice, bread and other cereals and 19% on fish and meat, while higher income rural households with an income of M\$600.00 or more spent 26.7% on their income on food of which 28% was spent on rice, bread and other cereals while 33% was spent on meat and fish. On the other hand, the urban poor with an income of less than M\$200.00 spent 39.5% of the income on food of which 33% was spent on rice, bread and other cereals and 30% on fish and meat, indicating that unlike the rural poor, the urban poor spent more on protein foods. However since urban prices are higher it is not clear whether they finally ended with a more nutritious diet, although this may seem to be the case. The problem of hunger cannot be solved in the long run without the creation of jobs and the resultant increase in the purchasing power of the poor.

### **Within Families**

In many communities, adult men are served first while women and children eat only after the men have finished. When there is a shortage of food, it is the women and children who go hungry.

In some Orang Asli communities, when a large animal such as a deer is caught, the flesh is usually taboo to the children and women of childbearing age. Thus only the men and elderly women benefit from this protein boost. Among the deep jungle Semai young children are allowed to eat small animals and fishes including small birds, water snails,

toads, and frogs. However all larger animals and birds are taboo. It is believed that the flesh of these animals will cause *sawan* (convulsions) if eaten by children. After they are over 4 years of age, wild pigs and the meat of animals with "stronger spirits" may be added. Between the ages of 10 years and 20 years the list begins to grow larger and the leaf monkey, bats, civets, anteater, deer, turtle, tortoise, bear and the larger birds such as owls, hawks and hornbills are added. By the age of 25 years, almost all animals may be eaten. Elderly men and postmenopausal women have the minimum of restrictions. Pregnant and lactating women have numerous food taboos (Bolton, 1972). Consequently, it is the growing child and the pregnant and lactating women who are least likely to receive the foods that they so very much require. Bolton (1972) reports that the plasma albumin levels of women are lower than those of men and that women of childbearing age have the lowest plasma albumin levels among the adults.

## **FOOD PREFERENCES AND TABOOS**

### **During illness**

Many foods, whether they be classified culturally as foods that are "cooling" or that "carry wind", may be eaten with impunity during good health. However the same foods are carefully avoided when the individual becomes ill (Chen, 1977). Thus beef is ordinarily harmless but becomes *bisa* (poisonous) when one has any cuts or skin rashes. Wilson (1971) notes that among Trengganu Malays peanuts and eggs are *bisa* for people with open sores; cashew nuts should not be eaten if one has scabies; egg plant, chicken or fried bananas are *bisa* for people with stomach troubles; mutton is not good for a cough; soursop is bad for influenza; beef, mutton, mackerel, cucumbers and watermelon are bad for boils; vinegar and soya sauce are bad for asthma; and that fish soya sauce, peanuts, ducks and prawns are dangerous for *seduan* (a Malay defined disease resembling sinus trouble). McKay (1971) records that in Trengganu *langsats* (*Lansium domesticum*) together with other sour-tasting fruits are bad for malaria and that *langsats* and fern shoots are bad for worms. It has also been noted (Chen, 1972) that papaya, and other carotene-rich foods are believed to be bad when a child develops night-blindness due to vitamin A deficiency. The child is thus deprived of carotene-rich foods when he most needs it.

### **During Pregnancy and the Postnatal Period**

The WHO Expert Committee on Nutrition in Pregnancy and Lactation (1965) notes that "It seems reasonable to conclude that under-nutrition and malnutrition among mothers, especially in the developing countries, contribute towards impaired maternal, foetal and infant health and vitality".

Undernourished women produce smaller babies which have a higher death rate. Chong *et al.* (1968) investigating the nutritional status of one hundred pregnant mothers from lower-income urban groups, noted that their diets were most deficient in thiamine, iron and riboflavine, and that niacin, ascorbic acid and calcium were also inadequate. The situation among rural pregnant women would be even worse.

Among the Dusun of Tuaran it is believed that a pregnant woman should not eat too much rice or she will have difficulty at childbirth; she should not take alcohol, fruits with a flaw in the skin or flesh and the flesh of animals that have not been slaughtered or the child will be born with a congenital defect; she should not take alcohol or pineapples lest she abort; she should not eat paired fruits or she will have twins; she should avoid turtle eggs or the child will be born with "flat feet" and a "soft head"; she should not eat small white fish or the newborn will suffer from convulsions and epilepsy; and she should avoid most fruits as these are "cooling" and she will be ill.

After childbirth, dietary restrictions are far more severe than during pregnancy when there are in fact very few restrictions. For example, among rural Malays during the first forty-four days after childbirth, it is believed that the mother's body is especially vulnerable to "cooling" foods (Chen, 1973) such as pineapple, citrus fruits, cucumbers, papayas and most green leafy vegetables which are in effect good sources of carotene (Chong and Soh, 1969). In addition, foods that are said to be *bisa* (poisonous) such as prawns, catfish, cuttlefish, cockles, *belachan* (anchovy paste) and certain types of fish, as well as foods that are reputed to "carry wind" such as cassava, cassava tips, sweet potatoes, pumpkin, taro, maize and jack-fruit are avoided. On the other hand, "heating" foods such as pepper, chillies, smoked or salted fish, eggs, and coffees are advocated.

In practice, the resulting diet, especially in remoter areas of the east coast of Peninsular Malaysia, consists of rice, pepper, chillies, dried or salted fish, and coffee. Such a restricted diet has been found to result in low serum levels for folic acid, carotene and iron (Wilson *et al.*, 1970). This is not surprising in view of the generally deficient diet even without these taboos (Chen, 1973).

Wilson (1973) compared the nutrient composition of food consumed by a rural Malay woman 28 days after confinement and noted that the intake of calcium, thiamine, riboflavine, vitamin A and ascorbic acid was low and a cause of concern.

Among the coastal Dusun of Tuaran, it is believed that post-natal women should not eat cold left-overs, gourds, pumpkin, cucumber, most fruits and all sour foods as these carry "wind" and

may be "cooling" and cause varicose veins. Large fishes, prawns and crabs are also taboo as they are "poisonous" and cause skin reactions. "Hanging" vegetables such as gourds and long beans have to be avoided since they are believed to cause uterine prolapse, while maize is believed to cause the teeth to fall out, mushrooms to be associated with rapid aging and eels and catfish are thought to change the sexual organs of the woman into male organs. Green leafy vegetables are taboo to mothers as these are believed to be responsible for the green colour seen in the stools of some newborns.

## PREPARATION OF FOODS

### Transitional Diets

The toddler is perhaps the most vulnerable of the whole family. He is the subject of a dietary transition when the breast is to be denied to him while he is expected to fully participate in adult meals. The toddler, during this transition phase, is often mistaken to be a "mini-adult", and is served small portions of the adult diet which is usually too spicy and too tough for him. He needs his foods sufficiently ground up to be digestible. He also needs to be introduced to spices in a slow and staggered fashion.

During this transition state, malnutrition is often enhanced by the fact that the toddler may be allowed to replace many of his meals with snacks and cakes which are generally high in carbohydrates but low in protein and vitamins. McArthur (1962) noted that many Malay school children went to school without breakfast and that virtually all the children spent pocket money on snacks. Rosemary Firth (1966) noted that children ate a great quantity of snacks, and that the Malay parent often realised that he was extravagant in spending money on sweet meats. "If I am hungry, and there is no money, I keep quiet. But Mahmat, he must have his every day." "Every now and again I am presented with a bill for our son." Wilson (1971) notes that in Trengganu some women makes cakes and carry them from house to house to sell, especially in the morning and that all these snacks provide a considerable amount of food energy.

Added to this, environmental conditions tend to expose the child to large doses of organisms. It has been noted that feeding utensils as well as prepared foods are often contaminated with faecal organisms indicating the difficulty in preparing a clean feed for children particularly bottle-fed infants.

### Alcohol

In many communities in Sarawak and Sabah home brewed rice wine known as *tuak* or *tapai* is regularly consumed. In one coastal Dusun community it was found that 80% of the households produce rice wine for their own consumption and



drank this wine at least once a week. The principal drinkers are of course the adults. However it was noted that children of 3 to 4 years of age begin to share and drink small quantities from the glasses of their parents. In one unusual instance, a young child of 8 years presented with cirrhosis of the liver after he had been regularly fed on the residues of discarded rice salvaged from the wine jars.

### Food Preservation

Many rural communities living in deep jungle or on jungle fringes supplement their diet with animals and fishes that they have hunted. Small quantities are normally eaten that same day and usually present few problems. Larger catches of fish and larger animals cannot be consumed by the family on the same day and may be preserved by salting and fermentation to form *jarok*. Salted fish is extremely popular among the rural people, many of whom have found their own ways to pickle fruits and vegetables.

However, the nomadic Punans of Sarawak, who are hunter-gatherers, have neither the skills nor the materials such as salt to preserve surplus foods for the lean days. Once a large animal such as wild boar has been caught it is immediately cooked and all members of the group gorge themselves until they become sick. Within a day or two most members have developed gastroenteritis. In between these episodes of over-eating, there are the usual lean days when there is almost no food other than a few roots and small creatures found by the women and children. To overcome their hunger, they fill their bellies with water. As they are nomadic, there is not staple grain or crop that they can depend on. Toddler mortality is extremely high. Attempts to settle them in fixed localities have so far been unsuccessful as these Punans have no knowledge or skills for a settled agricultural life.

### INFECTIONS AND DISEASE

The effects of infections on the growth of the child differ according to the nature of the agent, the site affected and the age or physiologic state of the host. Children in the developing world not only carry a much heavier and more varied burden of infections but are also nutritionally in a more precarious state. Thus an infection which would have little or no effect of itself particularly in well nourished children in economically advantaged countries, is often sufficient to precipitate acute malnutrition in the children or the poorer areas of the developing world. For example in 1971, in the University Hospital, Kuala Lumpur, it was noted (Chen, 1974) that 66% of children aged 1 to 4 years admitted for infections could be classified as underweight and that 13% could be classified as suffering from severe protein calorie malnutrition. The two most common intercurrent infections were

gastroenteritis and respiratory tract infections.

Where infection and malnutrition interact for any length of time, growth may be severely retarded. Where infections precipitate kwashiorkor, damage may be serious. Infections alter not only the absorption, metabolism, and the excretion of various nutrients, but they also interfere with food intake as a consequence of the loss of appetite. In addition, it is often customary for solid foods to be withdrawn and for many foods to become taboo, so that nutrients are often reduced. Further it is often customary to prescribe purgatives which interfere with absorption and the utilisation of nutrients. Consequently, unless efforts are directed at both dietary intake as well as infections, the two act in a synergistically supportive fashion reinforcing each other while the health of the child spirals down-hill towards death.

### SUMMARY

The general course and pattern of growth of each child is genetically predetermined. However strongly acting ecological forces can alter this course of physical growth. The two most important ecological factors are the dietary intake of the child and the influence of infections and disease on the child. Dietary intake itself is dependant upon food production, the distribution and availability of foods, cultural preferences and taboos, and the customary ways in which foods are prepared and presented.

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