ORIGINAL ARTICLE

# Morbidity, Growth and Food Intake among the Underfives in Madura, Indonesia

*by*

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## Abstract

*The relation between common illnesses, growth and breast milk and food intake was assessed in a longitudinal population based study, covering 300 children, age 0-36 months. Morbidity was quite prevalent with a peak at age 4-24 months. It did, however, not affect the intake of breast milk and the consumption of additional foods in infancy. On the other hand, the daily intake of energy and protein was significantly reduced in older and particularly non-breastfed children. Morbidity explained about 28% of the variance in weight- and height-for-age in children, age 6-18 months. One can conclude that growth faltering early in infancy is primarily of nutritional origin, while at older age it is due to a synergistic effect of inadequate nutrition and morbidity. Anorexia rather than bad feeding habits is the main cause of poor dietary intake during and after illness.*

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## Introduction

Growth faltering is a major problem in infants and young children in Indonesia. One of the many causes is related to the weaning foods. It is of poor quality and voluminous, contributing to a low daily intake of energy. However, the nutritional factor inadequately explains the growth pattern observed [1a]. It is likely that in an unhygienic environment, morbidity is the primary cause of malnutrition [2].

Infectious diseases are known to impair physical growth of young children through a reduction in food intake and increased requirements during illness [3,4,5,6]. The interrelation of nutritional status and infectious diseases is complex. An infectious disease episodes may lead to a poorer nutritional status. On the other hand, a poor nutritional status may increase the likelihood of subsequently acquiring an infectious disease. Once malnutrition is established, an episode of infection may be more severe and/or of longer duration.

Most research has been carried out among children who were seriously ill and/or who were hospitalized [4]. Diarrhoea has been studied most extensively. There is evidence that diarrhoea episodes are associated with impaired growth [7,8,9], while diarrhoea is more severe and of longer duration in malnourished children. Most authors found little or no association with incidence [10,11,12,13].

Reductions in food intake during severe diarrhoea ranged from 10-40% but no negative effect on breast milk intake was reported [14,15,16,17]. Fewer studies have dealt with acute respiratory tract infections (ARI). The findings are not consistent with regard to incidence [4,18,] and the effect on growth faltering [9,19]. Food intake during ordinary illnesses are less extensively studied. The effects appeared to be less pronounced than in the case of diarrhoea [4]. It is not clear from these studies whether poor growth preceded and/or followed infection episodes. Furthermore, young children experience mild or moderate illnesses, recurrent at varying intervals, but not requiring hospitalization.

*What is the relation between this type of morbidity and nutritional status ? Does it affect breast milk and the consumption of additional foods ?*

This study was designed: (a) to assess the prevalence, incidence and duration of illness episodes among young children under village conditions; (b) to examine the association between minor illnesses and growth and (c) to determine the effect of minor illnesses on breast milk and food intake.

## Subjects and Methods

The study was conducted in two villages in Madura as part of a longitudinal research project on the process leading to child malnutrition [1a-b,20,21]. Since August 1981 all births had been recorded. About 50% of the birth cohorts 1985-87 were selected at the start of the study (n=300). Newborns were added to this sample.

Data collection started in January 1987 and continued to July 1988. The first 6 months were considered the pilot phase. Data from this period were not included in the analyses. Trained female fieldworkers visited the index children at home. They interviewed mothers on feeding pattern (24-hour recall) and morbidity in terms of symptoms as defined by the mothers. Healthy children were seen on a weekly basis, but sick children two times per week. To verify the fieldworker's report, a medicaldoctor visited a random sample of the children with more serious symptoms (fever, ARI, diarrhoea) who did not report to the project clinic on the same day or the following. Free treatment was offered to all sick children.



In the routine surveillance system of the project, all mother-child pairs were visited at home for growth monitoring at 4-week intervals. Data of weight and height for the morbidity sample were extracted from these forms. Weight was measured with Salter scales (to the nearest 100 g for infants and to the nearest 250 g for older children). Supine length or standing height were measured with a locally made length/height board and recorded in mm.

The effect of morbidity on breast milk intake and the consumption of additional foods was assessed in a subsample (n=78). Eligible were children aged 1-36 months,reported sick with the symptoms of common cold, fever, diarrhoea and other diseases(skin, otitis media, conjunctivitis). Each child was observed twice with an interval of around three weeks. At the first visit all children were sick, at the second visit most children were recovered while others were convalescent. During these visits a female fieldworker stayed at the home of the child for 48 hours. Breast milk intake was measured by test-weighing method (SECA scale), while the amounts of additional foods were weighed with Soehnle scale. Nutrient intakes were estimated by converting the amounts of foods consumed into energy and protein, using the Indonesian Food Composition Table (1969). For breast milk the values of 70 kcal and 1.2 g protein were taken [22]. Details of the methodology were described in an earlier publication [23].

**Statistical analysis**

a. morbidity :
Symptoms by age groups were calculated from the total of 4-weekly examination records (n=5080 records from 353 children). The total number test periods with illness episodes were based on the longitudinal sample (n=300 children).

b. association between morbidity and growth :
Weight-for-age (WA), height-for-age (HA) and weight-for-height (WH) were expressed as percentage of the $50^{th}$ percentile and as Z-scores of the NCHS reference. Values were categorized into groups, corresponding with a level above the median of the reference (>100%), approximately between the median and minus 2 standard deviations (WA and WH 80-100%; HA 90-100%) and below 2 standard deviations (WA and WH <80%, HA<90%). A stepwise multiple regression analysis was done to assess the factors influencing Z-scores in WA, HA and WH and morbidity across 3 months examination periods by age cohorts.

c. The feeding pattern during illness was analysed from the 24-hour recalls of the whole sample studied for the relation of morbidity and growth. Descriptive statistical analysis was performed to compare feeding pattern and dietary intake when children were sick, convalescent or healthy. Differences were tested by the paired t-test.
Breast milk intakes were only reported for those children with accurate measurements for the 48 hours at both visits (N = 22).

## Results

A total of 353 children were enrolled. Of these, 300 children were seen regularly for morbidity, 194 children had complete weight measurement, 137 children had complete height measurements and 246 children had anthropometric measurements at the start and the end of the study.

*Morbidity*

Common cold occurred most frequently (38%), followed by diarrhoea, acute respiratory infections (ARI) and skin infection, ranging 10-12% (Table I). The peak prevalence of morbidity by age isillustrated in Table II. Even at age 0-3months already one third of the infants were sick. Age-group 4-18 monthswas most affected, i.e. over 50% having one or more symptoms at the time of examination. The prevalence dropped to 19% at age 37-42 months. The pattern was similar for each symptom. A negligible number of children were never sick over the year while the same children were very frequently sick, i.e. 48-53% at age 0-24 months had symptoms at 10 or more test periods (Table III) and the majority of children age 0-30 months were sick more than 90 days over the year (not shown in the Table).

*Growth*

Weight-for-age (WA), height-for-age (HA) and weight-for height (WH) in standard deviation or Z-scores of the NCHS reference is shown in Figure 1.

Children began at a fair level of WA. Because their lengths were already depressed at the age of 3 months, they were not wasted during the early months of life. Thereafter, the progressive decline in WA and HA, concomitant with a serious increase in wasting (WH) present a depressing picture of postnatal growth. By the age of 3 years WA and HA were about2.5 standard deviations below the reference. In other words, the average weight and height of these children (at 3 years age) were less than the expected value for the lightest 1.3% of the reference population.

*Nutritional status at concurrent illness*

Do sick children have a poorer nutritional status ? To answer this question a percentage frequency distribution of WA and HA by categories of % NCHS references was made. The differences between sick and healthy children in percentage underweight and stunted are summarized in Table IV.

A large percentage of healthy children were underweight (WA <80%), and stunted, viz. 45-77% and 48-56% respectively in age group above 4 months. There was a tendency of sick children being more frequently underweight, but the differences were only consistent at age 19-24 months. No clear pattern emerged for HA.

*Effect of morbidity on nutritional status*

This aspect was analysed per 3 months observation periods. WA and HA at the end or the start of the period were again categorized by % NCHS reference (Table V-VI). WA lessthan 80% was, with few exceptions, more prevalent following or before an illness episode, irrespective the symptoms, but acute respiratory infections appearred to be detrimental.

In an attempt to explain the deficit in growth reported, an analysis of variance (ANOVA) was done for 3 age-groups: 0-6, 6-18 and 18-36 months. Those 4 covariates used were counts of days with acute respiratory tract infections (ARI), fever, common cold and diarrhoea during the trimester preceding the anthropometric measurement in NCHS Z-scores. Days sick were collapsed to 3 levels: 0-2, 3-13 and 14 or more days.



In general, in this sample the greatest affect was from ARI and fever. The ANOVA for days sick with ARI by age showed a consistent effect of morbidity on the Z-scores for WA (F = 2.68, Df = 4.185 and P <0.03). It was highly significant in age-group 6-18 month (F = 6.91, Df = 2.81 and P <0.002). There were no significant effects of ARI in the Z-scores for HA, but in the middle age-group it reached significance as a simple effects contrast (F = 3.21, Df = 2.54 and P <0.048). Further, although again ARI was not significant for the overall Z-scores for WH, ANOVA significance was approached in the 6-18 month age-group (F = 1.89, Df = 6.113 and P 0.088).

Periods of fever longer than 14 days occurred only in the 2 youngest age-groups and hence the ANOVA analysis was made with days fever dichotomized at two. For the Z-score WA the 3 way interaction between age-group, time and fever approached significance (F = 2.01, Df = 5.563 and P <0.062). The same interaction was significant for both the Z-score for HA (F = 2.47, Df = 6.377 and P 0.023) and the Z-score for WH (F = 2.51, Df = 6.272 and P <0.022).

The multiple regression equations for the 4 trimesters and the 3 age-groups showed that predicting was acceptable forthe youngest age-group and poor for the olderage-groups. At 6-18 months about 28% of the variance in WA and HA and 22% of the variance in WH was explained by morbidity.

*Morbidity, feeding pattern and food intake*

At enrolment all children (n = 78) were sick. At the revisit 60 children were completely recovered and 18 were still convalescent. Duration of illness varied greatly by type of disease. On average the duration was 13 days in the "sick-healthy" and 20 days in "sick-convalescent" group.

Results of the 24-hour recalls from the whole morbidity sample indicate that morbidity did not influence feeding pattern during infancy, when special foods are offered (infant rice, rice and banana or banana). At the age when children are given the family diet (rice-maize as staple) viz. after the age of 9-12 months, sick children were given rice instead. This was particularly the case in children, suffering from diarrhoea.

Our impression that quite a large percentage of toddlers have a loss of appetite was confirmed by the in-depth study. While only a few healthy children had anorexia, the percentage of children who did not eat when sick increased with age. Except for common cold, anorexia started at age 4-6 months, reaching a peak at 10-15 months and falling off to a level of 3-5% atage16-24 months (Figure 2).

Breast feedingpatterns, nursing frequency and duration of nursing in infants and young children were virtually unchanged by illness. On average breast milk intake ranged from 515-610 g per 24 h at age 1-19 months (Table VII).

There was a wide variation in energy and protein intake from additionalfoods (breast milk excluded). Considering the total group of 78 children, there was a significant reduction in energy and protein intake when sick (P<0.01), both in absolute amounts per day as well as in amounts per kg body weight per day (Table VIII-IX). This reduction was consistent in all age-groups. It ranged from 10-24% of intakes when healthy. Due to the large variation in intakes and small number age-group, only in non-breastfed children at age 24-35 months the differences were significant (P < 0.05).

## Discussion

The results of the one year intensive follow-up of children age 0-36 months, showed that minor illnesses (not requiring hospitalization) occurred frequently. The peak prevalence was at age 4-24 months, when more than 40% of the age-groups were reported sick. The gradual decrease in prevalence in the third and fourth year of life indicated that in the course of time children adapt to the unhygienic environment and other external, detrimental factors. Rather unexpected was the obsevation that illness seemed to cluster. Further analysis is needed to identify families with relatively healthy and sick children.

The growth pattern in this subsample, covering about 50% of the total child population is similar to that of the population at large. Growth faltering, defined by weight or length velocities, started around the fourth month. The decline relative to the reference was progressive till 24 months of age. The coincidence of peak morbidity prevalence and deterioration in growth underlined the synergism between the two.

WA seemed to be a better indicator than WH for the effect of illness on subsequent nutritional status as well as a better predictor for morbidity. However, differences varied and age or symptom dependent. The ANOVA analysis confirmed the effect of morbidity on subsequent growth, but significance levels were only obtained for ARI and fever. It is important to note that about 25% of the variance in growth was explained by morbidity at the age-group 6-18 months.

Part of the effect of morbidity on growth was mediated through a reduced intake of energy and protein. However, the impact on the total intake was mainly limited to the non-breastfed, older child. At infancy approximately two-third of the total energy and protein intake was derived from breast milk, which was not affected by illnes of the child. Continued breast feeding during illness clearly protected a child againts a serious reduction of calorie and protein consumption.

At age 12-23 months the reduction in energy and protein intake due to illness was substantial and more so in non-breastfed than in partially breastfed children due to a large contribution of breast milk in the total intake. The total mean energy intake of healthy Madurese children ranged from 69-75% of the estimated average daily intakes of healthy well-nourished children (22). At times of illness the range was down to 56-62%, mainly because of anorexia of the children. This study identified anorexia as impedent to more adequate nutritional intake during illness.

It is noteworthy that there were no harmful dietary habits as Madurese mothers continued to breastfeed and did not withhold foods when children were sick. In fact, mothers took the effort to offer the sick child easily digestible food, for example banana or the foods he likes.

### What is the origin of malnutrition ?

In an early publication we have concluded that breastfeeding was good in duration, frequency of feeding and amounts produced per 24 hours. However, breast milk and additional foods provided less than the recommended intake in energy from the age of 5 months [23]. Morbidity also did not affect total food intake in infancy. Hence, growth faltering in early infancy is primarily nutritional in origin. In agreement with other studies, morbidity became increasingly prevalent from the age of 6 months. This study indicated that even minor illnesses such as



Table I. *Prevalence of symptoms observed in 4-week-periods over one year*

| | | |
|---|---|---|
| Common cold | 1331 | ( 37.9%) |
| ARI | 397 | ( 11.3%) |
| Fever | 294 | ( 8.4%) |
| Skin eczema & fungal | 417 | ( 11.9%) |
| Skin infections | 349 | ( 9.9%) |
| Diarrhoea | 421 | ( 12.0%) |
| Eye infection | 135 | ( 3.8%) |
| Ear infection | 85 | ( 2.4%) |
| Other | 84 | ( 2.4%) |
| Total episodes : | 3513 | (100.0%) |

Table II. *Number and percentage ill by age at time of examination*

| Age-months group | Number | % ill |
|---|---|---|
| 0-3 | 292 | 34 |
| 4-6 | 410 | 50 |
| 7-9 | 476 | 56 |
| 10-12 | 461 | 60 |
| 13-15 | 439 | 60 |
| 16-18 | 443 | 52 |
| 19-24 | 908 | 46 |
| 25-30 | 891 | 36 |
| 31-36 | 570 | 25 |
| 37-42 | 190 | 19 |
| All ages | 5080 | 44 |

Table III. *Number of observation periods sick over one year*

| | Age-months groups | | | | |
|---|---|---|---|---|---|
| | 0-6 | 6-18 | 18-24 | 24-36 | Al |
| N<br>mean<br>SD | 64<br>4.03<br>1.36 | 94<br>4.14<br>1.31 | 31<br>3.77<br>1.45 | 111<br>2.77<br>1.54 | 300<br>3.57<br>1.52 |
| Number of observation Periods<br><br>Sick** | | | | | |
| 0 | 3% | 2% | 3% | 11% | 6% |
| 1 - 3 | 11 | 5 | 19 | 34 | 18 |
| 4 - 6 | 11 | 18 | 16 | 20 | 8 |
| 7 - 9 | 22 | 19 | 13 | 19 | 19 |
| 10 - 14 | 53 | 55 | 48 | 16 | 40 |

* age at enrolment
total number of observation periods = 14

Table IV. *Are sick children more malnourished ?*
*Weight-for-age less than 80% :*

| Age groups month | cc | ARI | Fever | Diarrhoea | not ill % <80% |
|---|---|---|---|---|---|
| 0 - 3 | 0 | + 13% | + 13% | + 3% | 18% |
| 4 - 6 | + 6 | 0 | - 6 | + 9 | 45% |
| 7 - 12 | - 10 | + 11 | + 19 | + 10 | 48% |
| 13 - 18 | + 1 | 0 | 4 | + 2 | 76% |
| 19 - 24 | + 15 | + 26 | + 17 | + 32 | 42% |
| ≥ 25 | + 3 | - 4 | + 6 | + 12 | 77% |



*Height-for-age less than 90% :*

| Age groups months | cc | ARI | Fever | Diarrhoea | not ill |
|---|---|---|---|---|---|
| 0 - 3 | - 1% | + 1 | + 16 | + 8 | 29% |
| 4 - 6 | - 3 | - 5 | 0 | - 10 | 48% |
| 7 - 12 | - 6 | + 6 | - 14 | + 3 | 56% |
| 13 - 18 | - 0 | + 9 | - 1 | - 12 | 45% |
| 19 - 24 | 0 | + 3 | - 15 | + 15 | 50% |
| >25 | + 3 | + 12 | + 2 | - 9 | 42% |

* prevalence in sick children minus prevalence in healthy children at time of examination, i.e. positive sign denotes higher prevalence among sick children

Table V. *Does nutritional status deteriorate after illness ? **

*Weight-for-age less than 80% :*

| Age groups months | cc | ARI | Fever | Diarrhoea |
|---|---|---|---|---|
| 0 - 6 | + 6 | + 9 | - 10 | + 13 |
| 7 - 12 | + 16 | + 2 | + 8 | + 6 |
| 13 - 18 | + 14 | + 16 | + 6 | + 8 |
| 19 - 24 | + 19 | + 19 | + 5 | + 10 |
| ≥ 25 | - 8 | + 5 | + 4 | 0 |

*Height-for-age less than 90% :*

| Age groups month | cc | ARI | Fever | Diarrhoea |
|---|---|---|---|---|
| 0 - 6 | - 5 | - 16 | + 20 | - 5 |
| 7 - 12 | - 5 | - 8 | + 2 | - 1 |
| 13 - 18 | + 4 | + 6 | + 5 | - 8 |
| 19 - 24 | - 1 | - 4 | - 6 | + 15 |
| ≥ 25+ | - 3 | - 20 | - 2 | - 7 |

* longitudinal analysis :
Prevalence of malnourished at the end of 3-month-interval, i.e. % with symptom minus % without symptom -positive sign denotes deterioration after illness episode.

Table VI. *Are malnourished children more prone to become sick ?**

*Weight-for-age less than 80% :*

| Age groups month | cc | ARI | Fever | Diarrhoea |
|---|---|---|---|---|
| 0 - 6 | - 1 | + 2 | - 15 | - 10 |
| 7 - 12 | + 2 | + 4 | 0 | + 3 |
| 13 - 18 | + 11 | + 33 | - 2 | + 7 |
| 19 - 24 | + 15 | + 16 | + 1 | + 16 |
| ≥ 25 | - 5 | - 14 | + 4 | - 5 |

*Height-for-age less than 90% :*

| Age groups months | cc | ARI | Fever | Diarrhoea |
|---|---|---|---|---|
| 0 - 6 | + 10 | 0 | + 11 | + 2 |
| 7 - 12 | + 9 | + 5 | + 5 | - 2 |
| 13 - 18 | + 1 | - 1 | + 3 | - 2 |
| 19 - 24 | - 8 | - 6 | + 2 | + 10 |
| ≥ 25 | + 1 | - 13 | + 5 | - 4 |

* longitudinal analysis :
Prevalence of malnutrition 3 months preceding illness episode, % with symptom minus % without symptom : i.e. positive sign denotes more malnourished children become sick.

Table VII. *Breast milk intake by age and visit (grammesper12 hours)*

| Visit | age - group months | n | day time, 12 hrs | | nigth time, 12 hrs | |
|---|---|---|---|---|---|---|
| | | | mean | SD | mean | SD |
| First, sick | 0 - 5 | 10 | 399 | 96 | 208 | 43 |
| | 6 - 11 | 7 | 339 | 75 | 197 | 72 |
| | 12 - 19 | 5 | 345 | 87 | 181 | 92 |
| Second, healthy or con-valescent | 0 - 5 | 10 | 396 | 108 | 187 | 63 |
| | 6 - 11 | 7 | 323 | 73 | 195 | 61 |
| | 12 - 19 | 5 | 388 | 168 | 126 | 114 |



Table VIII. *Energy intake from additional foods by age and visit*

| Age months groups | n | intake, kcal per 24 hours | | | |
|---|---|---|---|---|---|
| | | sick | | re-visit (*) | |
| | | mean | SD | mean | SD |
| 0 - 5, BF | 21 | 224 | 148 | 256 | 133 |
| 6 - 11, BF | 17 | 272 | 192 | 304 | 171 |
| 12 - 23, BF | 10 | 350 | 277 | 462 | 253 |
| 12 - 23, NBF | 12 | 642 | 359 | 787 | 274 |
| 23 - 35 NBF | 18 | 836 | 265 | 1015** | 252 |
| All children | 78 | 456 | 345 | 550*** | 374 |

* re-visit = healthy or convalescent

BF = breastfed; NBF = not breastfed

** paired t-test P 0.05
*** paired t-test P 0.01

Table IX. *Protein intake from additional foods by age and visit*

| age groups months | n | Protein intake, g per 24 hours | | | |
|---|---|---|---|---|---|
| | | sick | | re-visit (*) | |
| | | mean | SD | mean | SD |
| 0 - 5, BF | 21 | 4.1 | 2.7 | 5.0 | 3.6 |
| 6 - 11, BF | 17 | 5.4 | 4.1 | 7.2 | 5.4 |
| 12 - 23, BF | 10 | 8.5 | 7.6 | 10.9 | 5.6 |
| 12 - 23, NBF | 12 | 14.5 | 8.7 | 17.6 | 4.8 |
| 24 - 35, NBF | 18 | 20.0 | 6.1 | 24.2** | 5.0 |
| All children | 78 | 10.2 | 8.4 | 12.6*** | 8.9 |

* re-visit = healthy or convalescent
** paired t-test P 0.05
*** paires t-test P 0.01

BF = breastfed; NBF = not breastfed



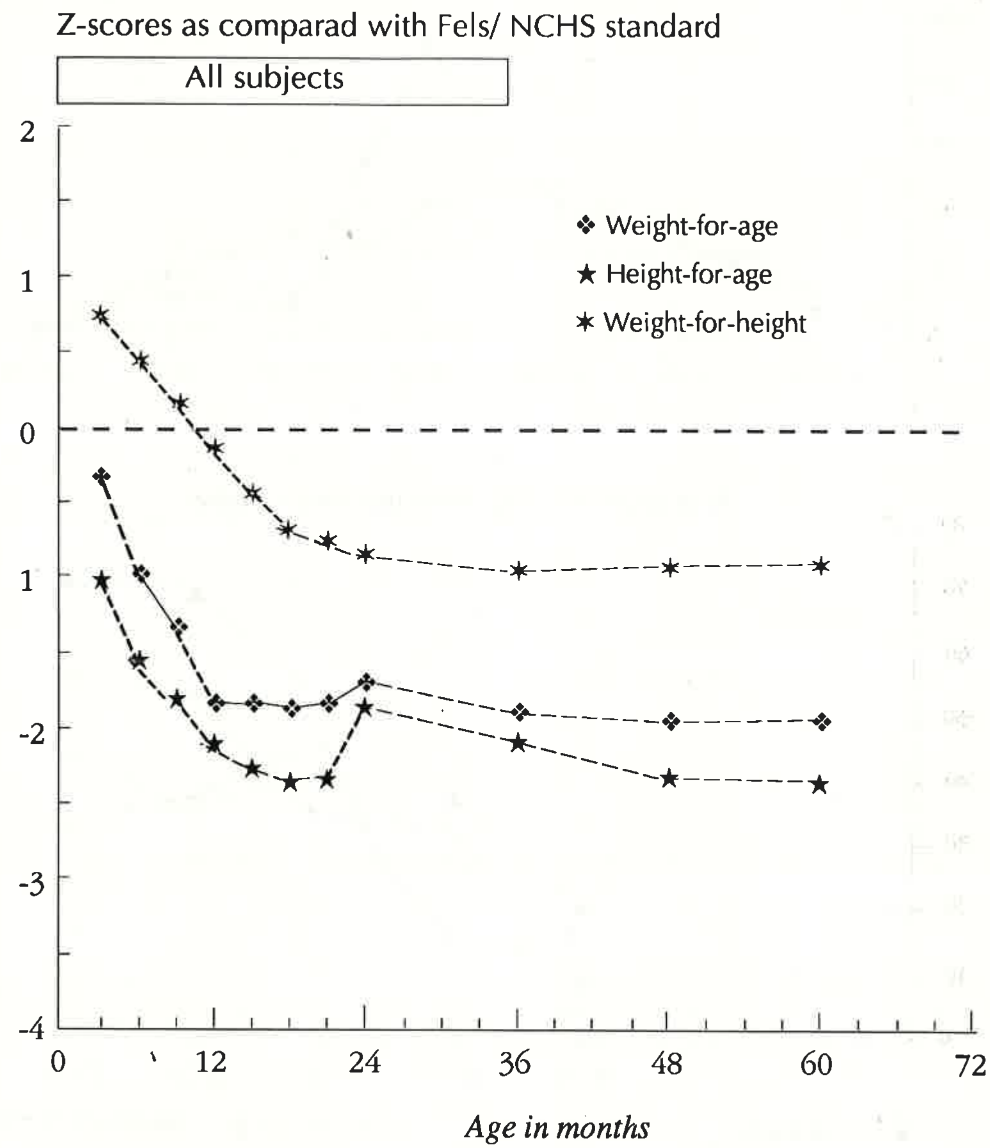
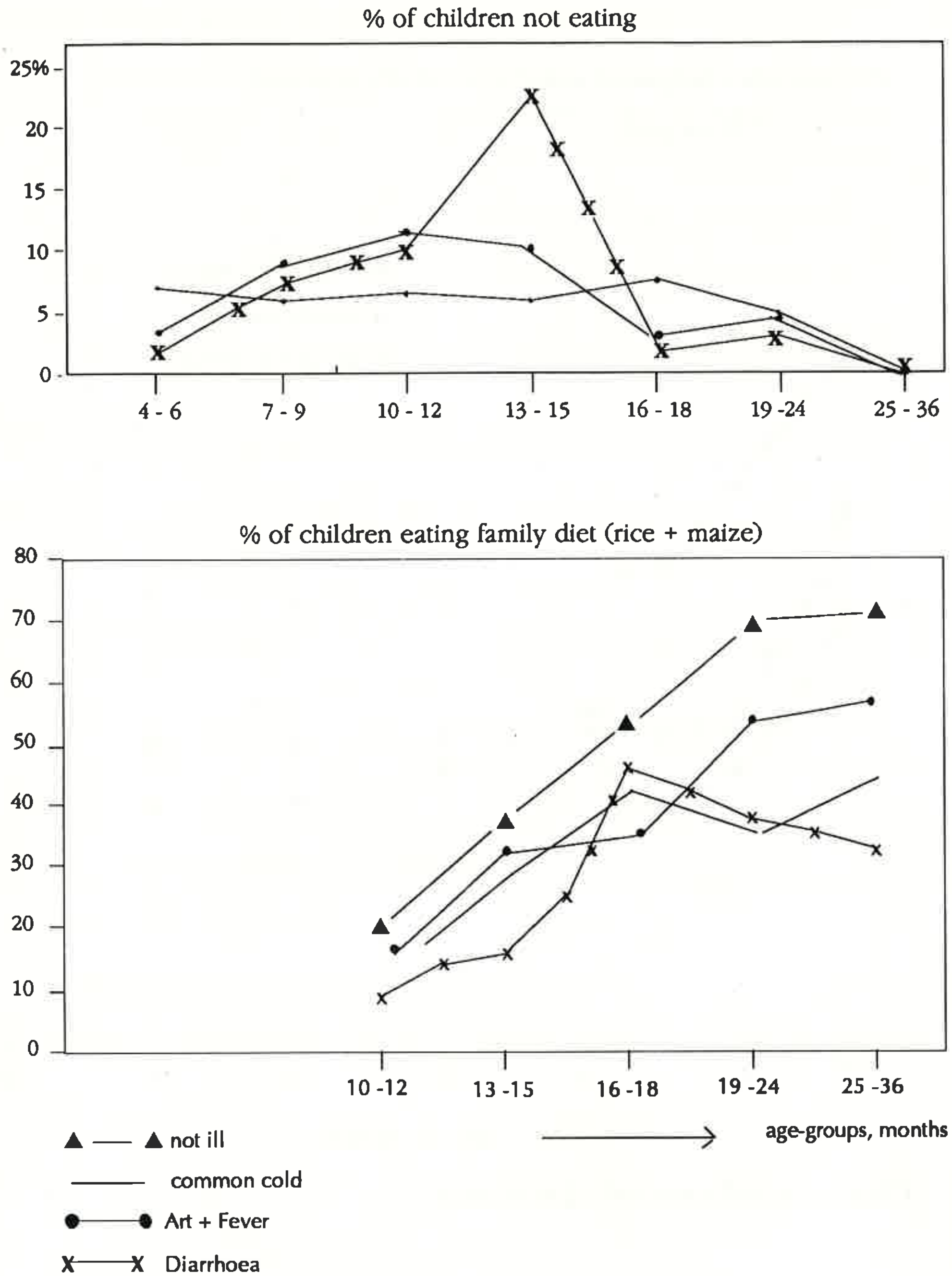



Figure 1: *Growth curve date : 3 to 60 months*




Figur 2 : *Feeding pattern by symptom*



ARI and fever had a negative effect on growth, among others through reduced food intake. Once set in motion by inadequate energy and nutrient intakes, impaired growth follows a downward spiral due to both inadequate weaning foods and morbidity.

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