**ORIGINAL ARTICLE**

# The Preschool Child in Suka Village, North Sumatera

II Mixed longitudinal data of weight and height

*by*

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**Abstract**

*A mixed longitudinal study on growth was carried out during one year in a group of 398 children, age 0 - 5 years. A sharp drop of weight and height increments were observed at age 3 - 6 months.*

*Growth rates continued to be low until about 24 months of age, after which increments were approximately similar to British reference data.*

*Food intake, as published in the previous article, is not the only underlying factor of the situation recorded.*

*More longitudinal studies are needed to assess the pattern of growth of infants and young toddlers in relation to dietary intake and morbidity.*

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## Introduction

Anthropometric measurements are widely used to assess nutritional status. Weight and height are probably the most sensitive parameters. (Keller et al., 1976; Morley and Woodland, 1979).

A combination of weight-for-age, height-for-age and weight-for-height allow grouping of children into different categories of malnutrition, depicting a current and/or past episode (Seoane and Latham, 1971; Waterlow, 1976).

Published data from Indonesian children pertain mostly to results from cross-sectional surveys or studies. To know when growth retardation takes place, longitudinal studies are needed. The results of a one year follow-up of weight and height c.q. length of children, 0 - 5 years of age in Suka village are presented in this article.

The village characteristics, dietary pattern and food intake of preschool children have been covered in a previous publication (Kusin et al., 1981).

## Materials and methods

At the start of the study 501 children of 0 - 5 years of age were in the village. Of these, 398 children could be enrolled in the study.

Refusals were exclusively due to fear for blood drawings, needed for the biochemical part of the study. Different samples of children were used in the statistical analysis of data (Table 1).

TABLE 1 : *Distribution of children included for data analysis*

| Age, years | Total population | | Number enrolled | | Sample for calculation of mixed longitudinal growth | | Sample for calculation of increments | |
|---|---|---|---|---|---|---|---|---|
| | F | M | F | M | F | M | F | M |
| < 1 | 39 | 40 | 30 | 33 | 21 | 22 | 13 | 10 |
| 1 | 36 | 31 | 29 | 24 | 28 | 23 | 18 | 14 |
| 2 | 54 | 38 | 43 | 30 | 35 | 20 | 31 | 13 |
| 3 | 43 | 47 | 36 | 41 | 20 | 20 | 16 | 19 |
| 4 | 46 | 44 | 37 | 37 | 29 | 25 | 22 | 13 |
| 5 | 33 | 50 | 23 | 35 | 9 | 14 | — | — |
| 0-5 years | 251 | 250 | 198 | 200 | 141 | 124 | 100 | 69 |
| Total | 501 | | 398 | | 265 | | 169 | |
| | | | 80% of total population | | 67% of enrolled | | 42% of enrolled | |

Age was accurately known for about 80% of the children, age 0 - 24 months as baptismal cards were still available. When these cards were lost, viz. in most of the older siblings, we had to rely on the memory of the parents. In such cases mentioned age was cross-checked against the age of other siblings and a local calendar of events.

Weight and height were measured according to standardized techniques (Jelliffe, 1966). For age group 0 - 24 months a Unicef Detecto beam balance scale and a length board were used. Older children were weighed on the platform type of beam balance scale, height was recorded with a microtoise. The same trained nurse took the measurements, scheduled at monthly intervals, throughout the study period in the same manner.

The data were handled in several ways :

a. For the growth curves based on absolute figures only children, with at least 4 measurements taken during the year, were included (N = 265). The means and standard deviations of weight (kg) and length c.q. height (cm) were calculated per month of attained age for all cohorts combined.

b. Increments in weight and height were based on the sample of children with 5 successive monthly measurements with at most one missing measurement (N = 169).
The method used to calculate monthly increments in weight and length c.q. height is a modified version of the one proposed by van't Hof et al. (1976). For this method a second degree polynomial was fitted through each 5 successive monthly measurements. The overlapping second degree polynomials are used for estimating the increments per child.

c. The degree of malnutrition was based on the total sample seen at any time during the year (N = 398). Weight-for-age, height-for-age and weight-for-height were expressed as percentage of Harvard standard, which was suggested as a reference for Indonesian preschool children at the Nutrition Workshop on Anthropometry, Jakarta 1975.

d. To represent graphically the relation between height, weight and age per age-group linear regression on height-for-age with weight-for-age as the dependent variable was applied. Regression lines were plotted between the first and third quartile points of the weight-for-age frequency distribution. The medians of weight-for-age on these regression lines were connected to show the trajectory in height-weight of the children in the first five years of life.

## Results

In any fieldstudy with enrollment and follow-up on a voluntary basis, total coverage cannot be achieved and gaps in measurements are common.

The characteristics of the families with children in the sample and those

TABLE 2 : *Mean and Standard Deviation of weight and height for the sexes combined*

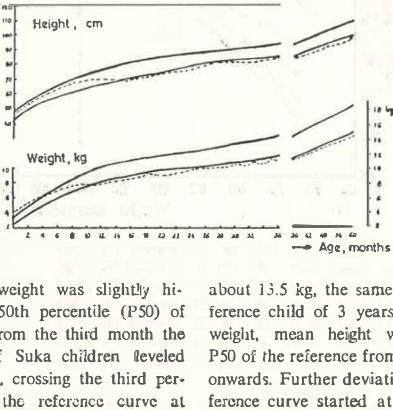
| Age in months | Number of measurements | Weight, kg | | Height, cm | |
|---|---|---|---|---|---|
| | | Mean | S.D. | Mean | S.D. |
| 1 | 4 | 4.1 | 0.33 | 52.1 | 1.95 |
| 2 | 4 | 5.1 | 0.59 | 56.4 | 2.80 |
| 3 | 7 | 5.3 | 0.60 | 58.0 | 1.77 |
| 4 | 9 | 6.2 | 0.66 | 60.3 | 1.30 |
| 5 | 9 | 6.5 | 0.77 | 61.0 | 1.54 |
| 6 | 13 | 6.9 | 0.93 | 62.5 | 2.26 |
| 7 | 12 | 7.2 | 0.95 | 64.8 | 1.70 |
| 8 | 17 | 7.3 | 0.66 | 66.0 | 2.71 |
| 9 | 24 | 7.6 | 0.77 | 66.8 | 1.85 |
| 10 | 24 | 7.6 | 0.92 | 68.0 | 2.26 |
| 11 | 24 | 7.7 | 1.02 | 69.2 | 2.52 |
| 12 | 25 | 7.7 | 1.01 | 69.5 | 2.10 |
| 13 | 28 | 7.8 | 0.94 | 70.1 | 2.05 |
| 14 | 24 | 7.9 | 1.18 | 70.8 | 3.00 |
| 15 | 22 | 8.0 | 1.09 | 71.1 | 2.03 |
| 16 | 32 | 8.3 | 1.10 | 71.2 | 2.31 |
| 17 | 24 | 8.4 | 1.15 | 72.8 | 3.26 |
| 18 | 38 | 8.6 | 0.86 | 72.9 | 2.13 |
| 19 | 28 | 9.0 | 0.99 | 74.3 | 2.20 |
| 20 | 39 | 8.8 | 1.08 | 74.0 | 2.96 |
| 21 | 37 | 9.0 | 0.84 | 75.4 | 1.98 |
| 22 | 35 | 9.1 | 1.07 | 75.4 | 2.56 |
| 23 | 28 | 9.1 | 1.16 | 75.6 | 3.18 |
| 24 | 40 | 9.4 | 0.94 | 77.3 | 2.86 |
| 25 | 30 | 9.6 | 0.97 | 77.2 | 3.14 |
| 26 | 34 | 9.6 | 1.08 | 78.0 | 3.67 |
| 27 | 42 | 10.0 | 0.83 | 78.6 | 2.91 |
| 28 | 28 | 10.2 | 1.06 | 80..0 | 3.88 |
| 29 | 26 | 10.2 | 0.94 | 79.5 | 3.19 |
| 30 | 54 | 10.5 | 0.95 | 80.5 | 2.76 |
| 31 | 23 | 10.9 | 0.80 | 82.3 | 3.52 |
| 32 | 47 | 10.7 | 0.94 | 81.5 | 3.16 |
| 33 | 39 | 11.2 | 0.93 | 82.4 | 3.00 |
| 34 | 28 | 11.0 | 1.06 | 83.8 | 3.13 |
| 35 | 36 | 11.5 | 1.12 | 83.6 | 3.35 |
| 36 | 68 | 11.4 | 1.20 | 84.6 | 3.82 |
| 37 — 42 | 169 | 11.9 | 1.56 | 86.5 | 4.55 |
| 43 — 48 | 142 | 12.6 | 1.65 | 89.2 | 4.76 |
| 49 — 60 | 279 | 13.4 | 1.57 | 92.4 | 4.86 |
| 61 — 72 | 180 | 14.4 | 1.65 | 96.7 | 4.56 |

who refused to take part in the study were not different.

Through home visits we have ascertained that children who failed to come at an appointed data were not sick at that time. One child of 2 years died of kwashiorkor on the first day of the study, 3 children died of accidents in the course of the year. One may thus assume that the growth pattern of the sample followed, reflects that of the preschool child population in Suka.

The mean and standard deviation of weight and height for the sexes combined are presented in Table 2, the Suka growth curves and the 3rd and 50th percentile (P3 and P50) of the Harvard reference curve in Figure 1. At 1 - 2

FIG. 1 : *Weight and height for age compared with P 50 and P 3 Harvard standard (semi-longitudinal data)*

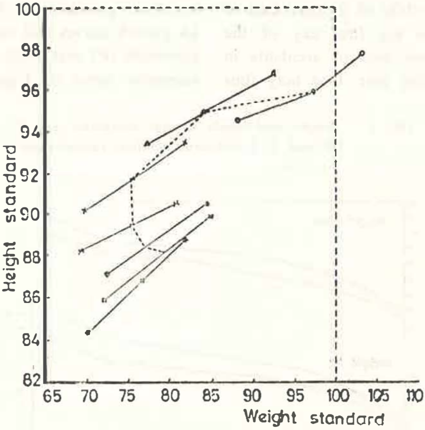



months mean weight was slightly higher than the 50th percentile (P50) of the reference. From the third month the height curve of Suka children leveled off dramatically, crossing the third percentile (P3) of the reference curve at age 11 months.

In the period 18 - 36 months growth was irregular, with episodes of weight-gains and losses. From the age of 3 years onwards growth has stabilized but never catch-up

Weight at 5 years of age in Suka was about 13.5 kg, the same weight as a reference child of 3 years. In contrast to weight, mean height was lower than P50 of the reference from the first month onwards. Further deviation from the reference curve started at 4 months. The separation was progressive after 8 months of age, leading to a larger absolute difference with age 12 - 18 months. Departure from reference curve in height thus occurred about 6 months later than in weight. In line with the weight curve, an irregular period of growth in height

FIG. 2 : *Weight-for-age and height-for-age as percentage of Harvard standard (mixed longitudinal data) : regresion lines 25th, 50th and 75th percentile (mixed longitudinal data) N = number of measurements*




o age from 0 to 5 months (N = 35)
Δ age from 6 to 11 months (N = 78)
+ age from 12 to 17 months (N = 111)
x age from 18 to 23 months (N = 132)
◇ age from 24 to 35 months (N = 281)
□ age from 36 to 47 months (N = 307)
☆ age from 48 to 71 months (N = 489)

was observed in the period 18 - 36 months of age. At 5 years of age the growth retardation in height among Suka children was similar to that in weight, viz, 2 years.

In figure 2 the regression lines of weight-for-age (WFA) and height-for-age (HFA) as percentage of the Harvard reference as well as the P25, P50 and P75 of WFA for Suka children are given for 6 months age periods. It illustrates in a more clear way than the growth curves, the pattern of weight and height changes as children grew older. The median WFA dropped from

FIG. 3 : *Comparison of age-cohorts with Harvard standards for weight-for-age, height-for-age and weight-for-height (percentages).*

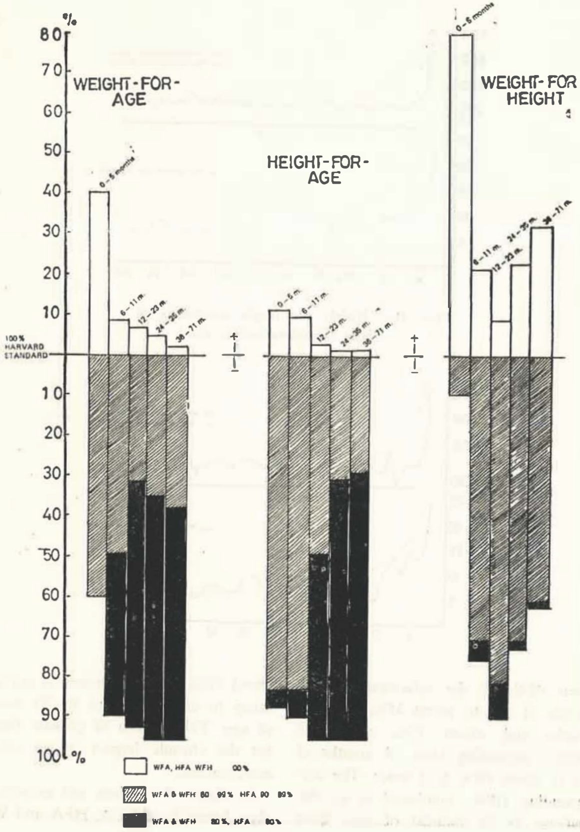


FIG 4a : *Weight and height increments of girls (semi-longitudinal data)*

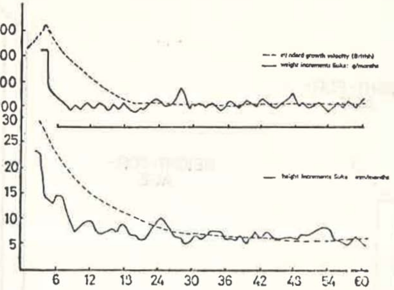
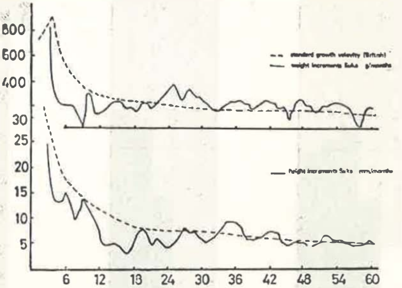



FIG 4b : *Weight and height increments of boys (semi-longitudinal data).*




about 98% of the reference at 1 - 5 months of age to about 85% at 6 - 11 months and about 75% at 12 - 23 months, improving after 24 months of age to about 78% at 5 years. The corresponding HFA, continued to lay behind up to 36 months of age, from about 96% of the reference at early infancy to about 87% at 49 - 71 months of age. This pattern of growth illustrates the chronic impact of an adverse environment.

In figure 3 children are grouped in class intervals of WFA, HFA and WFH (weight-for-height) as percentage of the Harvard reference.

For WFA only in age group 0 - 5 months an appreciable percentage of infants were above the Harvard reference. With increasing age, the percentage below 80% of the reference increased and ranges from 55 - 69% at age 12 - 71 months. Since growth retardation in height was even more pronounced, WFH was acceptable throughout the age period.

What actually happened, is shown by the growth velocities c.q. increments in weight and length/height (Figure 4a-b). Due to the small sample per months of age the curves are irregular. The trend was, however, very illustrative and did not differ for the sexes.

Clearly there was nothing gradual about the fall off in growth rate in the first 6 - 12 months of life, both in weight as well as in length. After 12 months of age growth velocity of both parameters remained lower than the standard until 24 months of age when it approached that of the reference group. In the age-period 36 - 60 months weight and height velocity were approximately similar to that of the reference group.

## Discussion

In this study weight and height of children, 0 - 5 years of age were followed and the results were compared with Harvard data, in the case of growth velocity with British data. There are good reasons to believe that these data can be used as a reference for Indonesian children. The growth curves of young children belonging to high socio-economic strata of the population in developing countries in general and in Indonesia parallel in that of the reference groups mentioned (Habicht et al. 1974; Keller et al., 1976; Djumadias 1978; Husaini and Husaini, 1980).

Results from cross-sectional surveys in Indonesia show that the nutritional status of infants is generally "acceptable", particularly during the first 6 months of life. Protein-energy malnutrition is most prevalent in the second year of life (Sayogyo. 1975; Kardjati et al. 1978). The incremental data of this study brings out one important fact: although the highest prevalence of malnutrition was diagnosed in age-group 12 - 23 months, the sharpest fall in weight and height velocity occurred at 3-6 months of life, followed by the second half year of infancy.

In fact the growth rates were also low in the second year but approximately similar to the reference in the third year.

Why was growth rate so affected during early infancy? At this age (0 - 5 months) they were exclusively breastfed, morbidity was low and child care optimal. The views on the proper time of introduction of supplementary foods are still controversial. WHO/Unicef stated (1979) that breastmilk alone is sufficient for adequate growth during the first 4 - 6 months of life. There is evidence to support this statement (Lauber and Reinhard, 1979; Ashabai et al., 1980; Ahn et al., 1980). Other workers oppose such a recommendation as faltering of growth among exclusively breastfed infants was observed in a number of developing countries between 3 - 4 months of age and in many cases earlier. (Waterlow and Thomson, 1979; Waterlow et al. 1980; Whitehead, 1980).

It should, however, be realized that some faltering of growth may be acceptable in view of the risk of introducing infections, notably weanling diarrhoea with the supplementary foods (Mata, 1978; Surjono et al., 1980). On the other hand, most workers agree that a well-nourished child has a better resistance to infection. No definite conclusions can be drawn at this stage for the Indonesian setting as our sample was very small, but early supplementation may be necessary.

In the second half year of life mothers in Suka supplemented their milk with mainly rice (Kusin et al., 1981). No data are available of amounts consumed. It is likely that the bulky food supplied too little energy and protein. Infections do start to take their toll at this age. Both factors may explain the low rate of growth in the period 6 - 11 months.

Measured food consumption of toddlers, age 1 - 5 years was slightly below recommended daily intake in energy and more than adequate in protein. The lower growth rates at 12 - 23 months can, therefore, not be attributed to food consumption alone.

Other factors, which are more detrimental at age 12 - 23 months such as infectious diseases, should be held responsible for the observation made. It may be assumed that at an older age children have acquired a better immunity.

The growth pattern of preschool children in Suka village demonstrates that malnutrition of the chronic type occurs even when food availability is not a constraint. In such areas the impact of supplementary feeding programmes are limited. More positive results with respect to nutritional status may be expected from improvemental sanitation, prevention of infectious diseases and simple treatment.

Nutrition education should focus on the time of introduction and the type of weaning foods.

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