ORIGINAL ARTICLE

The Preschool Child in Suka Village, North Sumatra III. Upper arm Circumference and Skinfolds as Indicators of Nutritional Status

by

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Abstract

Upper arm circumference, triceps and subscapular skinfolds were measured at 6-monthly intervals during one year in a group of preschool children, age 0 - 5 years.

All 3 measurements decreased as compared with the reference in the age period 1 - 23 months followed by a catch-up at age 2 - 4 years.

The predictive value of upper arm circumference for the development of malnutrition was low. Age group 1 - 23 months should be considered "at risk" irrespectively of the nutritional state at the time of examination.

Absence of mortality may be attributed to the fact that children can eat to appetite, when they are healthy and to the simple medical treatment given.

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Introduction

Assessment of nutritional status is indispensable to planning, implementation and evaluation of nutrition intervention. The search for the most accurate, feasible and economical anthropometric measures therefore continues.

Weight-for-age and weight-for-height are considered valuable indicators of protein-energy malnutrition among preschool children (Seoane and Latham, 1971; Waterlow, 1976; Keller et al. 1976).

However under field conditions accurate scales are often not available, height is difficult to measure by untrained persons and exact age is usually unknown. Because of these practical problems the upper arm circumference, either alone or in relation to height or age has been proposed as an alternative measurement. (Jelliffe and Jelliffe, 1969; Shakir, 1975; Zerfas, 1975; Anderson, 1979; Trowbridge and Staehling, 1980).

Skinfolds are seldom used as routine measurements due to the technical skills needed. Yet they give valuable additional information with respect to body composition.

In combination with upper arm circumference subcutaneous fat thicknesses may differentiate between protein and energy deficiency (McFie and Welbourn 1962; Keet et al. 1970; Gurney and Omolulu, 1971; Frisancho, 1974; Crooke-Fry and Howard, 1980).

With the intention to assess the value of various nutritional status indicators in the preschool child population in Suka village, the data of upper arm circumference, triceps and subscapular skinfold thickness are compared with weight-for-age and weight-for-height.

Material and Methods

The sample consisted of children, 0 - 5 years of age from whom in the period July 1976 - August 1977 data on food consumption as well as serial measurements of weight and height were collected (Kusin et al., 1981 a, b).

Upper arm circumference (U.A.C.), triceps (T.S.) and subscapular skinfolds (S.S.) were measured at 6 - monthly intervals according to standardized techniques (Jelliffe, 1966; Tanner and Whitehouse, 1975). A flexible steel tape was used for U.A.C. a Harpenden skinfold caliper for T.S. and S.S. At each time, the measurements were taken by the medical nutritionist (J.A.K.).

Due to lack of local standards, the Wolanski standard was used as reference for U.A.C. and British data for T.S. and S.S. (Burgess and Burgess, 1969; Tanner and Whitehouse, 1975). As sample size was small, the data are presented for the sexes combined, but in comparison with the reference, the standard according to sex was used.

Results

From the total population of 501 children, 0 - 5 years of age present in the village at the start of the study, 389 children participated in the study. No differences in socio-economic characteristics have been recorded between households in the study and households who refused to participate.

The distribution of the children, according to number of measurements taken, is given in Table 1. From about 50% of the children, no skinfold measurements were taken at the start, as the Harpender caliper arrived a few days late. Over the one year period 62% of the children were measured 3 times. It was ascertained by home visits that children did not abscond because of sickness or death. Mothers simply forget the appointment date, were too busy or felt that the child should not give blood again (for the biochemical part of the study).

The mean and standard deviation of UAC and skinfolds as well as the mean as percentage of the reference are presented in Table 2, Figure 1. The trends in the 3 parameters were similar. A decline can be noted from the second half year of life until the second year after which a catch-up was recorded and another dip in the fifth year. Triceps skinfold deviated most from the reference. If UAC and sum of skinfolds are considered to be an indicator of muscle mass and fat reserves respectively, it can be concluded that the children were mainly energy deficient.

The prevalence of malnutrition according to weight-for-age (WFA), weight-for-height (WFH), UAC and sum of skinfolds are given in Table 3. The means minus 2 standard deviations as percentage of the reference are taken as cut-off points. Obviously each parameter measures a different aspect of growth c.q. nutritional status.

While WFA illustrates the impact of chronic malnutrition, the other 3 parameters are mainly parameters of the current nutritional state.

The prevalence of malnutrition according to WFA after infancy was so high that there is no need to search for a screening indicator.

Likewise, such a low prevalence of current malnutrition (WFH) cannot be sieved out by UAC without accepting many false positive c.q. low UAC but acceptable WFH.

If UAC was not sensitive enough to diagnose malnutrition at the time of examination, can it identify the child "at risk" to develop malnutrition of a more serious stage in the near future?

The changes in WFA and WFH, 6 months after the first examination in two UAC categories are presented in Table 4. "No change" means no shift in the respective growth channel, for instance WFA at first and following examination was 76% of the reference; "deterioration" or "improvement" denote a shift in the growth channel for instance from 80% to 76% or from 81% to 90% etc.

The results show that UAC does not have a predictive value either.

Discussion

In line with the trend in weight-and height-for-age published earlier (Kusin et al., 1981b), the critical period according to UAC and skinfolds was the first 2 years. This is mainly a reflection of an adverse environment as weight, height and UAC of well-nourished Indonesian children approximate reference curves (Husaini and Husaini, 1980). No data of skinfolds from healthy Indonesian children are available. In view of the similar trends for all indicators, it can be assumed that the impact of environment is more important than genetic potential with regard to skinfolds as well.

In the Suka child population, characterized by slow but proportional growth viz. low WFA but acceptable WFH, UAC appeared not useful as a screening indicator.

Ultimately, the value of an indicator in nutritional surveillance is its predictive value of undesirable outcome in terms of severe malnutrition and/or death. As mentioned earlier, only one case of kwashiorkor was diagnosed, none with severe marasmus and none died of disease in the years of observation. Assessment of the predictive value of UAC was, therefore, done in relation to changes in WFA and WFH, 6 months after examination. As born out by the results, UAC could not differentiate between children who will or will not deteriorate in nutritional status. The only distinctive criterion was age. Thus, irrespective its nutritional status at the time of measurement, children age 1 - 23 months were "at risk" for development of malnutrition.

The study design was such that the exact impact of morbidity on nutritional status and vice versa cannot be evaluated. As far as could be judged from observation, the absence of mortality in the child population studied may be attributed to the fact that children can eat to appetite after each insult of an infectious disease, allowing recuperation in nutritional status. On the other hand, in Suka at any month of the year 30 - 40% of the preschool children were sick, duration of sickness ranged from 2 - 18 days and about 60% had ascaris infestation. As an incentive, simple medical treatment was provided for all children during the year of the investigation. It did not prevent diseases, but possibly reduced the duration of fever, diarrhoea and anorexia.

Primary health care, if it includes only symptomatic treatment, may thus reduce the prevalence of severe malnutrition and child mortality. It will not prevent mild-moderate malnutrition of the chronic type if morbidity remains high.

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TABLE 1 : *Distribution of Children.*

Age in month at enrollment	Number at first measurement		Number of measurements over 1 year				
			UAC		Skinfolds		
	UAC	Skinfolds	2	3	1	2	3
1 — 11	65	33	15	33	2	15	16
12 — 23	66	51	11	40	4	29	18
24 — 35	72	69	12	48	6	48	15
36 — 47	79	71	15	49	5	47	19
48 — 59	72	55	9	50	2	32	21
60 — 71	35	37	8	20	3	22	12
Total	389	316	70 (18%)	240 (62%)	22 (6%)	193 (50%)	101 (26%)

Between parentheses: percentage of number of children at enroliment (N = 389)

TABLE 2 : *Upper arm circumference and skinfolds at first measurement: mean and standard deviation*

Age in months	Upper arm circ. (cm)			Skinfolds (mm)				
					Triceps		Subscapular	
	N	Mean	S.D.	N	Mean	S.D.	Mean	S.D.
1 - 5	27	12.9	0.9	11	7.6	2.0	6.5	1.2
6 11	38	13.8	1.1	22	6.2	1.5	5.4	1.4
12 - 23	66	13.6	1.1	51	5.8	1.2	4.2	0.8
25 - 35	72	14.5	1.2	69	7.0	1.3	4.8	1.0
36 - 47	79	14.9	1.1	71	7.4	1.5	5.0	1.1
48 - 59	72	15.4	0.9	55	7.4	1.5	4.7	0.9
60 - 71	35	15.1	1.0	37	6.9	1.5	4.5	1.1

TABLE 3 : *Prevalence of malnutrition according to different indicators.*

Age in months	1 — 11	12 — 23	24 — 35	36 — 71
N for UAC, weight, height	66	134	182	465
N for skinfolds	44	109	145	391
Prevalence : %				
WFA < 80%	24	71	61	68
WFH < 80%	3	8	2	1
UAC < 85%	26	50	36	17
TS + SS < 80%	82	94	88	60

N = number of measurements

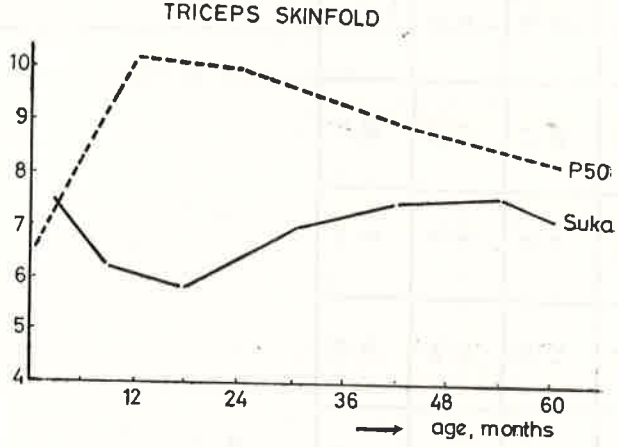
TABLE 4 : *Changes in weight for age and weight for height over a 6 months period : percentages (grouping according to upperarm circumference at initial examination*

Age (months)	N	UAC	Weight-for-age *					Weight-for-height *				
			No change	Improved		Deteriorated		No change	Improved		Deteriorated	
				1-5%	> 5%	1-5%	> 5%		1-5%	> 5%	1-5%	> 5%
1 — 11	43	⩾ 85%	9	2	2	21	65	14	14	7	21	44
	13	< 85%	15	8	—	25	54	23	15	8	—	54
12 — 23	46	⩾ 85%	52	15	4	20	9	30	28	9	20	13
	46	< 85%	20	52	13	13	2	13	35	30	20	2
24 — 35	79	⩾ 85%	49	22	4	23	5	35	34	6	18	6
	44	< 85%	39	36	9	14	2	34	34	18	11	2
36 — 71	215	⩾ 85%	47	30	3	20	1	40	31	6	20	4
	42	< 85%	60	33	—	7	—	43	40	5	7	5

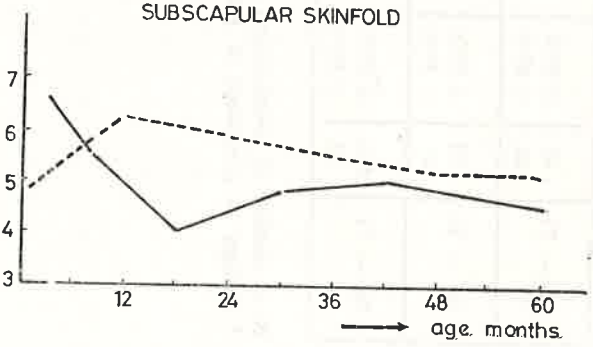
N = number of measurement
* changes in percentage of reference

FIG. 1 : *Upper arm circumference and skinfolds plotted against reference : cross-sectional data*

upper arm circumference



Triceps skinfold



Subscapular skinfold