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Growth and Malnutrition in Ethiopia

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A B S T R A C T

This article focuses on anthropometric parameters as height for age, weight for age and weight for height, which are among the most used tools for assessing well-being of infants and children. Such data have been collected between 1992–1993 from samples of infants and children aged between 2 and 10 years from urban and rural areas of Ethiopia. Similar to many other reports from developing countries the great amount of malnourished children is preoccupying as reflected by about 15% of children below the 5th centile of weight for height and about 53% of children below the 5th centile of height for age and about 45% below the 5th centile of weight for age.

***Key words**: growth, nutrition, Ethiopia*

Introduction

Although growth is known to be influenced by genetic as well as by environmental factors, the latter are of greater importance. For it is under optimal levels of environmental conditions that genetic factors become most effective.

The past decades have witnessed a proliferation of research on the interaction of nutrition and human development, unfortunately however the harnessing of this wealth of information to reduce the incidence of malnutrition has been less successful.

Thus notwithstanding massive efforts in developing countries with augmentation of annual food production by 2.8% and a dramatic increase of the prevalence of contraceptive practice has led to a reduction of annual population growth to 2.2%, children in 1984 still went to bed hungry[1,2], and still the prognosis for ending world hunger is not encouraging[3]. Sub-Saharan Africa has had an aggregate malnutrition rate of nearly 30% for the last decade. While malnutrition prevalence has decreased significantly in

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most other developing countries in the last years it has been nearly static for Sub-Saharan Africa[4]. Nutritional studies have shown that linear growth (height for age) and ponderal growth (weight for height) have different nutritional requirements. While inadequate energy intake is the main reason for wasting (low weight for height), stunting (low height for age) can be caused by numerous inadequacies. Thus growth as analyzed by the anthropometric indices as weight for age and height for age serves as a sensitive indicator of health and nutritional status of children[5].

As a reference population WHO[6] has recommended the use of National Center for Health Statistics[7] growth charts, curves and tables when local standards are not available. Currently, about one-fourth of African primary schoolchildren lie under the fifth centile of US NCHS Reference Standards for height and weight for age[8].

Study site, culture, socioeconomic and nutritional situation

Ethiopia is one of the largest and most populous countries in northeastern Africa. The Ethiopian population is of great diversity, with differences in cultural background and traits, methods of gaining a livelihood, languages, and religions[9–11]. Many languages and dialects are spoken, which may be grouped into two major language groups i.e. Semitic or Cushitic languages. Semitic includes Amharic, the official national language, Tigrigna, Tigre, and Guragigna, and Cushitic includes Oromigno, Somali, Sidama, and Afar[12,13].

Although there is often a great mix of religions in any given place, Muslims (47.5%) are the most numerous of the total Ethiopian population, Coptic Christians amount to 37.5% and the remainder include various indigenous reli- gions[14]. There does not exist any statistics on the distribution of religions amongst the various ethnic groups however the majority of the Amhara, who are mainly concentrated in the Center and the North of the highland are Coptic Christians. The Oromo who live in the South of the highland and in the Southern lowlands on the other hand are mainly Muslims, and indigenous religious groups are mainly represented in the Southeast and Southwest of the lowlands[15]. Ethiopia is most densely populated in the highland areas, and almost 90 percent of the people live outside cities[16]. For the year 1989, Minca[17] estimated the size of the total population of Ethiopia about 49 million with an increase of the mean population density from 23 to 38 inhabitants per km^2 during the last decade. More than 45 percent of the people are 15 years of age and younger, and both birth and death rates are high i.e. crude birth rate 45.13 and crude death rate 17.63 (as expressed per 1000 persons)[18].

With an average life expectancy at birth of about 45 years for males and 49 years for females it ranges among the lowest of the world[15,16].

Disease and malnutrition continue to be the major problem of Ethiopian children, and the present study was made possible by Italian efforts to improve the distressing medical and sanitary situation in Asela and surroundings, the capital of one of the most densely inhabited highland area. In cooperation with the Ethiopian sanitary authority and the Italian Ministry of Foreign Affairs it was decided to build a hospital in Asela and to set up a maternal and child health program.

The task of the present study to investigate and evaluate the nutritional status of infants and children in Amhara and Oromo was an integral part of this programme[19].

Materials and Methods

Two hundred and forty nine female and 246 male infants and children aged between 2 and 10 years (Table 1) have been investigated between 1992 and 1993 in urban and rural areas of Ethiopia. The age of children was recorded by interviews with the parents, which consisted primarily of their mothers. Interviews were conducted by a medical doctor and a nurse. All participants were examined by a physician, and were free from overt disease at the time of the study. All study protocols were approved by the Regional Sanitary Center of Asella (the capital of the region formerly named ARSSI) and informed consent was obtained from the participants' parents, predominantly the mothers. Both interviews and measurements were performed in health centers, schools and in the hospital in Asella and in six neighboring villages situated at an altitude of about 2200 meters. Figure 1 shows localization of the areas investigated.

The measurements were standardized by assessment of intra- and inter-observer variability and regular calibration of the measuring equipment was performed. The measurements included body height (measured to the nearest 0.1 cm with a Martin metal anthropometer), body weight (measured to the nearest 0.1 kg with a portable mechanical scale), triceps skinfold (measured with a Harpenden caliper) and upper arm circumference. (measured with a metric steel tape with a graduation in millimeters). These measurements have been selected according to WHO[6] recommendations on the principle of their maximal informative value for nutritional state of infants and children.

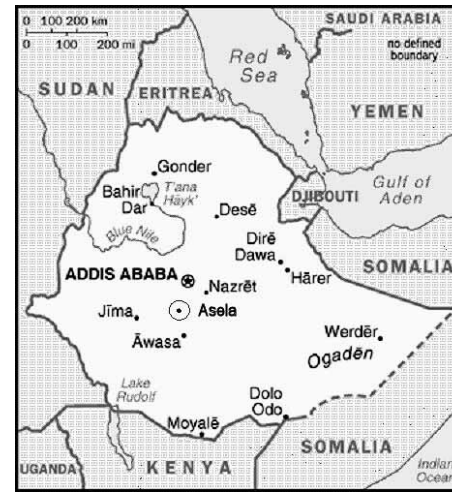

Fig. 1. Map of Ethiopia (modified from Wolde[15]), Asela and surroundings the area where the infants and children have been investigated are marked by a circle.

Consequently the means and standard deviations of the following parameters have been calculated: weight for age, height for age, upper arm circumference for age, triceps skinfold for age and the indices weight for height and muscular upper arm area (cm^2) (UAMA)[20,21].

TABLE 1
AGE DISTRIBUTION (YEARS) OF THE 249 FEMALE AND 246 MALE INFANTS AND CHILDREN INVESTIGATED IN ASELA, ETHIOPIA

Ages in years	2	3	4	5	6	7	8	9	10	Total
Males	17	26	43	39	25	27	32	23	14	246
Females	18	22	35	35	21	35	35	24	24	249
Total	35	48	78	74	46	62	67	47	38	495

UAMA (cm^2) = (Upper arm circumference – triceps skinfold x pi)^2 / 4 pi

These parameters and indices correspond to those used to set up global reference values.

The reference values used for comparison with the Ethiopian children were: NCHS[7] reference standards for height for age, weight for age and weight for height; NHANES I and II reference standards for muscular area by age and height[20, 21]. In view of the fact that Ethiopian reference standards do not exist, the National Center for Health Statistics[7] growth charts, curves and tables were used as reference standards in accordance with the WHO[6] recommendation.

Data analysis includes calculation of distributions and a normality check of each auxometric parameter by Kolmogorow-Smirnof non-parametric test; calculation of centiles and comparison with International reference standards.

Results

All the auxometric parameters were normally distributed. The only exceptions were weight of five-year-old males and upper arm circumference of eight-year-old females.

The auxometric parameters height for age and weight for age (Figures 2a, 2b) do not differ significantly between females and males at any age. This is also the

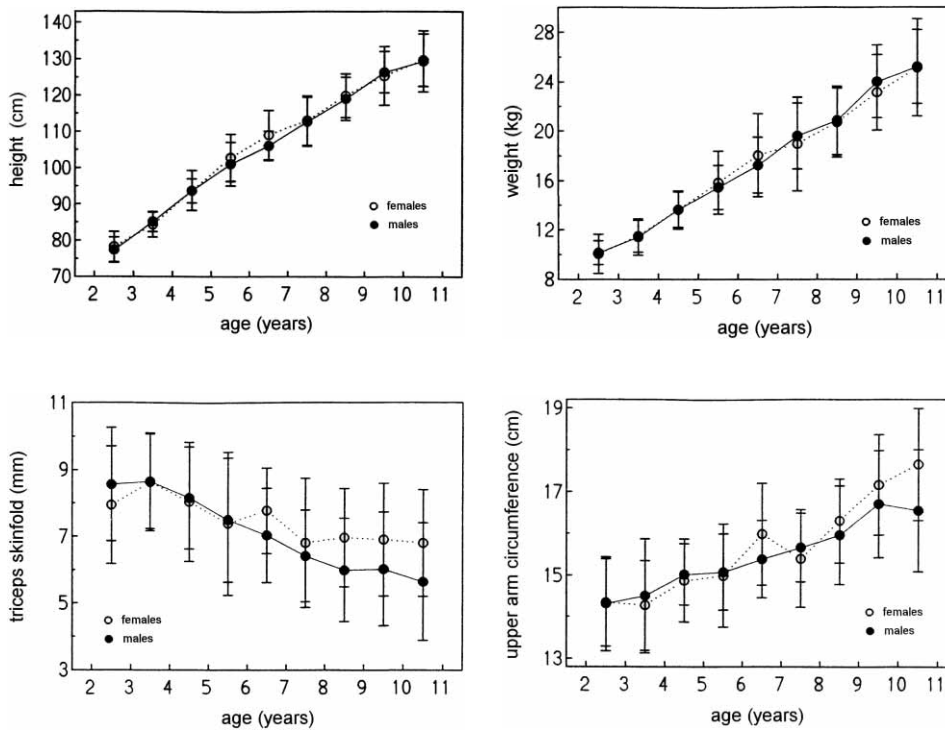

Fig. 2. Means and standard deviations of: a) height (cm) for age; b) weight (kg) for age; c) triceps skinfold (mm) for age; d) upper arm circumference (cm) for age in 249 Ethiopian female and 246 male infants and children.

case with triceps skinfold for age, however the values of six to 10 years old girls tend to be constantly higher than those of the boys of the same ages (Figure 2c). A similar tendency with the exception of 7 years old girls is also visible with upper arm circumference for age (Figure 2d). Table 2 sets out the frequencies of those children within the complete sample investigated who we situated below or equal the fifth centiles of the NCHS[7] and NHANES[20,21] International reference values for all the parameters and indices calculated. The ranges used correspond to the standard International percentiles. These distinguish between severe malnutrition i.e. below the 5th percentile (weight by height, height by age – NCHS growth charts[6,7] upper arm circumference by age, upper arm muscular area by age – NHANES I[20] and muscular area by height – NHANES II[21] and moderate malnutrition, i.e. between the 5th and the 10th percentile of these International reference standards. Undernourishment is more frequently observed with boys than with girls and this is evident from upper arm muscular area by age, weight by age and height by age. However altogether there is an overall high percentage of children who are too small for their age with weights much too low for their age and too little muscular development for their age. This is particularly striking in Figure 3 where the highest numbers of children who are extremely small for their age (below the third centile) and between the third and the fifth centile) are those 2, 3 and 4 years old (Figure 3a), and similarly so those whose weights are extremely low for their age (Figure 3b).

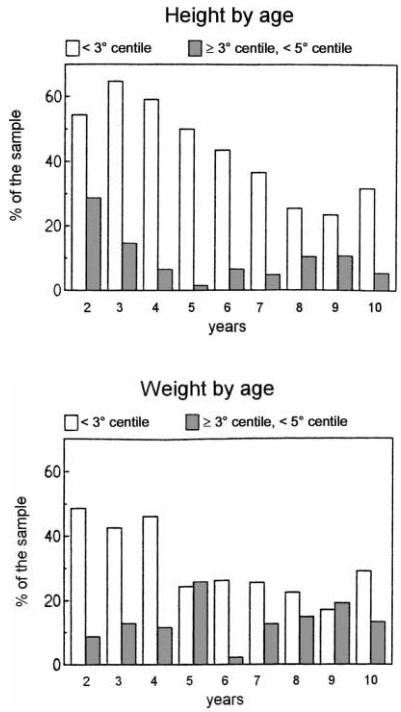

Fig. 3. Percentages of 495 Ethiopian infants and children, age ranges from 2 to 10 years situated below the third and between the third and the fifth centiles of the NCHS International Reference values for: a) height (cm) for age; b) weight (kg) for age.

Discussion

Auxology, originally a pediatric term for growth of infants, children and adolescents, today reflects interdisciplinary investigation by a wide range of disciplines as Anthropology, Physiology, Neurology, Psychology and Pathology. The anthropometric measurements used in this study have been recommended for various pediatric purposes, i.e. to assess growth patterns, maturation, and state of nutrition[22,23].Thus low height for age is considered an indicator for stunting, a marker for chronic undernutrition; low weight for height indicates wasting or temporary undernutrition; and weight for age indicates underweight, a combination of the former two[24].

It is obvious that all the data collected for this study clearly confirm that undernourishment, one of the known major

TABLE 2
PERCENTAGES OF ETHIOPIAN CHILDREN BELOW THE 5TH CENTILES (CONSIDERED THE CUT OFF POINT FOR UNDERNUTRITION) OF THE REFERENCE VALUES (NCHS[7], NHANES I and II[20,21])

		N	%
Height x age (*) (1)	Females	120	48.2
	Males	139	56.3
	Total	259	52.3
Weight x age (*) (1)	Females	99	39.8
	Males	124	50.4
	Total	223	45.1
Weight x height (*)	Females	37	15.0
	Males	38	15.4
	Total	75	15.2
Upper arm circumference x age (§)	Females	151	60.6
	Males	155	62.8
	Total	306	61.7
Upper arm muscular area x age (§)	Females	98	34.9
	Males	137	55.5
	Total	235	47.4
Upper arm muscular area x height (§)	Females	52	23.6
	Males	69	31.5
	Total	121	27.6

(*) On the basis of the NCHS[7] reference values; (1) include subjects ≤ the 3rd centile;
(§) NHANES reference value I[20] and II[21]

problems of Africa's children[25–27] also occurs within and in the environs of Asela in Ethiopia. Thus the frequencies of about 50% of infants and children from Asela and surrounding areas with height for age and weight for age below the 5th centile match those reported for children in Somalia[25,28], Turkana[29], Gambia and Uganda[30] and South Africa[31,32]. However there is much more information to be gained from these data in that they may also serve as pointers to effects on growth and maturation. Thus for example the constant absence of sex difference with the parameters height for age and weight for age may be taken as indicators of either retarded maturation or much reduced prepubertal growth spurt of girls. Prepubertal growth spurt in girls usually occurs at ages ten to eleven in European populations[26]. Another indicator for the above consideration comes from triceps skinfold measures by age (Figure 2d) and upper arm circumference measures by age (Figure 2c). While age pattern and sex difference of triceps skinfold measures in this sample are in accordance with the findings reported for European children[26], in six to ten year old girls they tend to surmount those of the same aged boys, the upper arm circumference measures expected to be higher in boys constantly remains to be higher in girls. This observation may in addition be inter-

preted to reflect reduced muscularity in Ethiopian boys, in that values of upper arm muscular area x age below the fifth percentile of the NHANES International reference standards reflect severe malnutrition, which applies to 55.5% of boys as compared to only 34.9% of girls (Table 2).

The reference values used for assessing well-being of the Ethiopian children are of International standing (NCHS[7], NHANES I and II[20,21]), and the results obtained without doubt give reason for concern. It may be of interest here that there is ongoing discussion on the adequacy of using these reference values for countries with different ethnic composition, living conditions including sanitary situation, nutrition and family income, and life style[33–36]. Others[37–40] on the other hand have confirmed their adequacy for privileged children in Ethiopia and India In conclusion the authors stress that notwithstanding the proven global usefulness of the NCHS[7]; NHANES I and II[20,21] reference standards it may be worthwhile that regional or National standards be developed as already pointed out by others[33–36].

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RAST I POTHRANJENOST U ETIOPIJI

S A Ž E T A K

Cilj je ovog rada prikazati antropometrijske parametre, kao što su visina i težina u odnosu na dob te težina u odnosu na visinu, kao najčešće upotrebljavanih pokazatelja rasta i stanja uhranjenosti djece. Podaci su prikupljani u Etiopiji, od 1992.–1993. godine na uzorku urbane i ruralne djece dobi od 2 do 10 godina. Kao što je to slučaj u mnogim drugim zemljama u razvoju, veliki broj pothranjene djece svoj odraz nalazi u činjenici da 15% djece se nalazi ispod 5. centila za težinu u odnosu na visinu, te oko 53% djece nalazi se ispod 5. centila za visinu u odnosu na dob, te 45% je ispod 5. centila težine u odnosu na dob.