Community diagnosis of physical growth of infants based on monitoring in a routine preventive service

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SUMMARY The physical growth pattern of infants aged from one month to two years was studied in a lower middle class community in Jerusalem. Weight and length were measured at one month and at three, six, 12, and 24 months. In each age and sex group there were at least 200 children. At one month and 24 months the percentage of children below the 10th percentile for weight and also for length was higher than expected, although severely impaired linear growth was observed in only 0.5% of males and 1.3% of females at 24 months. The percentage of overweight infants was highest at three months (6.2% of males and 5.2% females). In the light of these findings, we discuss the feasibility of accurate monitoring of physical growth in maternal and child health clinics; the possibility of an association between maternal stature and the high percentage of children below the 10th percentile for length; and the association between food intake and growth pattern.

Surveillance of physical growth has been made an integral part of the mother and child health services of the Department of Social Medicine, serving a defined neighbourhood of the city of Jerusalem (Kark, 1974). The aim of this surveillance is to assess the growth pattern of the population of children through collection of anthropometric measurements by standardised technique.

The purpose of this paper is to present the growth pattern from one month to two years of age and to assess the nutritional status of this population. For this, reference was made to the National Center of Health Statistics growth charts constructed recently, based on a sample of the child population of the United States of America (National Center for Health Statistics, 1976b; 1977).

Previous reports of studies of physical growth of Israeli children were concerned with the newborn (Handlesman and Davies, 1975; Palti *et al.*, 1977); with infants at twelve months of age (Nichaman and Reshef, 1978); and with schoolchildren (Shiloh and Yekutieli, 1958; Nichaman and Reshef, 1978). The studies were observations of selected groups of children at one time and none of them described a total community at various ages.

Material and methods

The surveillance was carried out in Kiryat Yovel, a neighbourhood in the western part of Jerusalem. The population of the neighbourhood is entirely Jewish. Fifty-seven per cent of the women of childbearing age are immigrants who came to Israel after the establishment of the State of Israel in 1948. Forty-three per cent are from Asia and North Africa, 14% from Europe and America, and 43% of mothers were born in Israel. The social class distribution of the children by fathers' occupations is 31% in Social Classes I and II (upper); 29% in III₁ (white collar or clerical); 30% in III₂ (blue collar or skilled manual); and 10% in IV and V (lower). The social class scale is an adaptation of the one used by the British Registrar General for many years (Kark *et al.*, 1964).

All babies born to families living in the defined neighbourhood, or babies of families who moved into the area, are included in the surveillance. This report is concerned with children born during the two-year period 1st June 1971 to 31st May 1973, at different ages in the first two years of their lives. During that period the total number of children was 765, of whom 379 were males and 386 females. The permissible age

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range for examination at one month was defined as minus one, plus two weeks; at three and six months it was ± 2 weeks; at 12 months ± 4 weeks; and at 24 months ± 10 weeks. The median age at examination was 4.0 weeks at one month, 12.8 weeks at three months, 25.8 weeks at six months, 52.7 weeks at 12 months, and 104.5 weeks at 24 months. The percentage of low-birthweight babies (2500 g and below) was 8.1% and the twinning rate 1%. There was a decline in the number of children aged from one month to two years because of population mobility, and the proportion of children who were examined also declined, from 90% at one month to 69% at two years (Table 1). This was because attendance at clinics tends to decline as children grow older; or the infants attending were outside the permissible age range for surveillance.

Weight and length were measured by specially trained public health nurses. Intra- and inter-observer variation was checked. Standard equipment as used in international growth studies was introduced (Falkner, 1960). Weights were recorded to an accuracy of 0.01 kg. Crown heel length was measured as described by Falkner (1960). Length was recorded to an accuracy of 0.1 cm. The National Center for Health Statistics weight and length percentiles (National Center for Health Statistics, 1977) were interpolated by us into weekly age intervals and into 10 percentile categories. On the basis of these tables the percentile for each weight and length measurement was calculated. Age-independent weight-by-length percentiles were also calculated. The reference median of height for age and weight by length was calculated as a percentage of the median. Only the extreme categories were calculated, 90% or less of the median length by age indicating stunted growth, 80% or less of weight by length indicating wasting, and above 120% of weight by length indicating overweight (Nichaman and Reshef, 1978). The presentation of the histograms follows the recommendations of Waterlow *et al.* (1977).

Results

Fig. 1 shows the percentage distribution of weight for age percentiles at one, three, six, 12 and 24 months of age by sex. The broken line indicates the expected frequency according to the reference population (10% of the population in each 10-centile category).

The distribution of attained weight at one month is significantly less than the reference population, for males especially, whereas at three months of age considerably fewer children than expected are below the 10th percentile (males 6%, females 4%). At subsequent ages, six, 12, and 24 months, the

Fig. 1 Percentage distribution of weight for age percentiles.

percentage of low weight infants increases; at 12 months 16% of males and 14% of females are below the 10th percentile. The percentage of infants above the 90th centile is less than expected at all ages for males, and at one, six, and 12 months for females.

Fig. 2 shows the percentage distribution of length for age by sex. The distribution of attained length of

Fig. 2 Percentage distribution of length for age percentiles.

Table 1 Study population: number and percentages of children examined by age and sex

Age (months)	MALE			FEMALE		
	Population	Children examined		Population	Children examined	
		No.	%		No.	%
1	379	339	89	386	346	90
3	376	323	86	385	321	83
6	355	264	74	378	278	73
12	351	234	67	371	256	69
24	307	208	68	330	232	70

Table 2 Percentage of infants stunted, wasted, or overweight at three, six, 12 and 24 months of age by sex

% of median	Stunted		Wasted		Overweight	
	< 90% length		< 80% weight by length		120% + weight by length	
	M	F	M	F	M	F
3	0	0	0	0.2	6.2	5.2
6	1.4	0.9	0	0.9	1.4	1.7
12	0.9	0	0	0	1.4	2.5
24	0.5	1.3	0.5	0.4	2.0	2.7

this Jerusalem population of infants at one month is significantly less than that of the reference population. The difference is more pronounced for males than for females. At three and six months the distribution of attained length is similar to that of the reference population. At 12 and at 24 months a high proportion of children fall below the 10th percentile (22% of males and 19% of females). Severely impaired linear growth (that is, stunted growth defined as 90% or less of the medium length for age) was observed in 0–1.4% males and 0–1.3% females (Table 2). There are fewer children than expected above the 90th centile for length, at all ages and of both sexes (males 1–4%, females 3–5%).

The distribution indicates that both sex groups are light for length at one month of age; at three and six months a considerable shift above the 50th centile is observed (Fig. 3). The percentage of those overweight at three months (+120% of median weight by length) is 6.2% for males and 5.2% for females. At subsequent ages the proportion of overweight children decreased (males 1.4–2%, females 1.7–2.7%) (Table 2). Severe wasting (less than 80% of median weight by length) was rare: 0–0.5% in males and 0–0.9% in females.

Discussion

The surveillance of our study population was built into the routine of the mother and child health services. Our experience since 1971 allows us to conclude that community surveillance of physical

Fig. 3 Percentage distribution of weight by length percentiles.

growth is feasible in a primary child health care service. However, it requires standardisation of methods of follow-up, measurements, and records. The results of this study are based on this inbuilt surveillance. Adequate size of the study population, at least 200 children in each age and sex group, and

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similarity of procedures to those used for the reference population, allow for comparison of this group of children in Jerusalem with the reference population in the growth charts of the National Center for Health Statistics, recommended as a standard for international comparisons of physical growth of children and assessment of the nutritional state of population groups (Waterlow *et al.*, 1977).

The comparison with the reference population indicates that the pattern of weight growth in our study population is somewhat different. The infants are lighter at one month, whereas at three months there are less than the expected percentages of infants below the 10th percentile or the 50th centile. The same trend is observed in the weight-by-length distribution. At one month, the infants are light for length, whereas at three and six months they become heavy for length. The prevalence of overweight was 5.2% for males and 6.2% for females. The infant population of this community is mainly artificially fed. At three months, only 13% are breast-fed, 1% of them exclusively (Palti *et al.*, 1977). The excessive weight gain from one month to three months is possibly due to overfeeding with milk and cereals. In England (Taitz, 1971) and Sweden (Sveger *et al.*, 1975) even higher percentages of the overweight and obese were observed in artificially fed infants at three months. At 12 and 24 months the percentage of infants who were light in weight was greater than at three and six months. The reduction in the numbers of overweight infants at these ages is possibly due to their own ability to regulate food intake and thereby avoid overfeeding by excess intake through bottle-feeding. Although the percentage of infants of light weight increased, wasting, defined as less than 80% of median weight by length, is not a problem in this population during the first two years of life. The infants of this community are shorter than the reference population at all ages observed, but the percentage of children stunted (less than 90% of median length for age, indicating chronic malnutrition) is very small (0–1.4%). In a previous study of a sample of the same children we have shown that dietary intake was adequate for all ages from six to 24 months (Palti *et al.*, 1977). If nutritional intake is adequate and infection rate is similar in this community (Palti *et al.*, 1979) to that in other healthy infant populations (Monto, 1974) possible genetic and other maternal factors have to be considered as determinants of low stature. The height of mothers of the study population is not known, but mothers' height of the 1974–76 cohorts of the same community is known. The median was 158.7 cm, indicating lower stature in comparison with a sample of Caucasian US women of childbearing age (National Center for Health Statistics, 1976a). The

reference population is from a middle class community of Ohio, where studies of secular trends have shown that the children had attained their maximum growth potential (National Center for Health Statistics, 1977). Our study population is heterogeneous in several important respects—namely, social class, ethnic group, and length of residence in Israel. We can assume that they have not yet reached their maximum growth potential. In a subsequent paper the effects on growth of ethnic, social, and cultural backgrounds will be discussed.

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