Introduction

The Gaza Strip has a population density of 1961 persons per km². A high birth rate and a falling mortality rate produced an increase in the population from 457,000 in 1980 to 750,000 in 1992. Living standards in Gaza have risen over the past 20 years as a consequence of increased employment and an improved community infrastructure. The proportion of homes with electricity rose from 35% in 1972 to 98% in 1992, and that of homes with running water, from 14% to 93% over the same period. Overcrowding and poor sanitation are still problems, especially in the seven refugee camps located near urban centres.

Access to primary health care, which has been free since the early 1970s for pregnant women and children aged up to 3 years, is provided through 28 community health centres operated by the government health service (1). The refugee population attends nine health centres operated by the United Nations Relief and Works Agency for Palestinian Refugees in the Near East (UNRWA) (2). During the 1970s and 1980s a high degree of control of vaccine-preventable, childhood infectious diseases was achieved through a comprehensive programme that attained >90% immunization rates among infants (3–5). Another focus of primary care in the area has been an oral rehydration campaign, which sharply reduced the previously high levels of morbidity from diarrhoeal diseases (6). These efforts resulted in a decline in infant mortality rates from 76 per 1000 in 1978 to less than 40 per 1000 in 1990, while child mortality fell from 105 per 1000 to 52 per 1000 over the same period (7).
In 1986–88 the government health service initiated a programme to address high rates of anaemia and to improve infant growth patterns. This included the following elements:

- special training of health staff on nutritional issues;
- introduction of modern routine growth monitoring and standards;
- improved screening for and management of infants who failed to thrive, and a voluntary agency nutrition education service;
- teaching new mothers about breast-feeding and good supplementation practices; and
- routine provision of vitamin A and D to infants aged 1–12 months and of iron supplements to those aged 4–12 months, in accordance with recommendations of the American Academy of Pediatrics (8, 9) and the Israeli Ministry of Health (10).

The present article compares the growth and nutrition patterns of three cohorts of children aged up to 15 months who were born in 1987–88 (prior to the new nutrition-related initiatives), 1989, and 1990–92, with respect to sex, social class, feeding, and supplementation patterns.

Methods

Staff education, with emphasis on nutritional counselling, was introduced, and educational pamphlets on nutrition, written in Arabic, were widely distributed to mothers. Staff were also educated to encourage breast-feeding on demand, which is associated with decreased incidence and prevalence of infections (11). New child health records were designed, field-tested, and brought into routine use in all government community health centres. Included were the standard growth curves recommended by WHO and based on the reference population used by the United States National Center for Health Statistics (NCHS), with records of weight-for-age, length-for-age, weight-for-length, and head circumference (12–15). The records also included immunization states, intercurrent illness, developmental markers, feeding patterns, and risk assessment information, which permitted identification of children at nutritional or developmental risk and assessment of the overall health status of the child population (16).

The five community health centres selected for our study were all located in Gaza City and were categorized by social class, according to the general socioeconomic status of the neighbourhoods they served. The Sheikh Radwan and Rimal health centres served areas of comparatively high income, standards of sanitation and educational levels; many business and professional families lived here, together with people who had moved out of refugee camps. The Bandar Gaza, Shajaiya, and Jabaliya clinics served poorer socioeconomic neighbourhoods.


Observations on weight-for-age and length-for-age were recorded by public health nurses during visits made in connection with the routine immunization programme at 1, 3, 4.5, 6, 9, 12, and 15 months of age. For all cohorts the criteria for data collection were the same, as were the equipment, techniques, and 90% of the staff. For infants who visited a health centre more than once during the study intervals, one visit was selected randomly for data analysis. This was done to avoid over-representation by multiple attendees, who might have had more illnesses, more attentive parents, or other confounding factors (17, 18).

Each infant’s sex, date of birth, and visit date were recorded. Information on dietary intake, as reported by the mothers, was obtained from the children’s health records. Parents were asked whether their child was currently receiving breast milk, formula milk, cereal, fruit, vegetables, meat, and supplements of iron, vitamin A, and vitamin D.

The following age categories were employed: 0–2.99, 3.0–5.99, 6.0–8.99, 9.0–11.99, and 12.0–14.99 months. Sex-specific length-for-age and weight-for-age data were converted to z-scores in accordance with the NCHS reference growth curves, using the Centers for Disease Control Anthropometric Software Package. Bivariate analysis by age, social class, feeding patterns and iron/vitamin supplementation was carried out as well as multiple regression analysis, using SAS statistical software. The significance of differences between z-scores was analysed using Student’s t-test.

Results

In all the cohorts, weight-for-age data showed inconsistent patterns. However, the overall weight-for-age was greater than the standard z-score for 3–8-month-olds, and fell below the standard for the 9–15-month-olds. Multiple regression analysis indicated that breast-feeding was positively correlated (P<0.05) with weight-for-age; birth order (P<0.05) and con-
consumption of vegetables ($P<0.005$) were negatively correlated with weight-for-age. Social class, and fruit, cereal, meat, iron and vitamin intake were not significantly correlated with weight-for-age in all three cohorts.

There was a significant increase ($P<0.001$) in length-for-age $z$-scores from the 1987–88 to the 1989 cohort, and a small change between the 1989 and 1990–92 cohorts (Fig. 1). Feeding patterns did not differ for boys and girls; this was true, for example, with regard to the proportions still breast-feeding at 10–15 months. The $z$-scores of boys and girls in the 1987–88 and 1990–92 cohorts indicated little difference between the sexes in terms of length-for-age.

Among the children of higher social class (Fig. 2) there was an improvement in length-for-age from the 1987–88 to the 1989 cohort, and, for infants aged up to 12 months, from the 1989 to the 1990–92 cohort. A similar pattern was observed for infants from lower social class areas.

The overall proportion of infants being breast-fed increased from 64% to 76% at 9–11 months, and from 48% to 71% for the 12–15-month age group between the 1987–88 and 1989 cohorts. With respect to breast-fed children, the 1989 and 1990–92 cohorts had far higher $z$-scores than the 1987–88 cohort (Fig. 3). Breast-fed infants in the 1990–92 cohort had higher $z$-scores than infants who were not breast-fed throughout the first 15 months of their life (Fig. 4).

The prevalence of iron supplementation increased from 40% to 86% among infants aged 6–12-months between the 1987–88 and 1989 cohorts. Iron had a highly positive effect on length-for-age among all three cohorts. Overall, the highest proportion of infants receiving iron supplementation were in the 1990–92 cohort, which most resembled the NCHS standard, although the other two cohorts were also relatively close to it. Children who were not fed iron in 1987–88, 1989, and 1990–92 had markedly low scores for length-for-age, especially those aged 9–15 months.

Throughout the 3–15-month period, the infants in the 1990–92 cohort who were fed iron supplements had $z$-scores that were 0.4–0.6 standard deviations greater than those of their counterparts who had not received iron (Fig. 5). The iron-fed infants were well above the NCHS length-for-age norm during the first 6 months, and were consistently close to the NCHS standards in the 6–15-month age group.

A multiple regression analysis (Table 1) showed that height-for-age was positively correlated with iron supplements ($P<0.0001$), cereals ($P<0.0001$), and breast-feeding ($P<0.001$). Negative factors relating to height-for-age were eating vegetables ($P<0.0001$) and birth order ($P<0.01$). Social class, vitamin supplements, and meat consumption were not significantly correlated with length-for-age.

**Fig. 2.** Length-for-age $z$-scores of higher social class children aged 3–15 months in the 1987 ($n = 540$), 1989 ($n = 994$), and 1990–92 ($n = 338$) study cohorts, Gaza. For the 6–8-month age group the data for 1990–92 were zero.

**Fig. 3.** Length-for-age $z$-scores of breast-fed children aged 3–15 months in the 1987 ($n = 675$; % breast-fed at 9–12 months = 68%), 1989 ($n = 1099$; % breast-fed at 9–12 months = 64%) and 1990–92 ($n = 729$; % breast-fed at 9–12 months = 70%) study cohorts, Gaza.
Discussion

Growth monitoring enables providers of primary health care to document an individual child’s progress for the benefit of both the mother and the caregiver. The use of standard growth charts provides a comparative measure of the health status of infants, and, implicitly, of the effectiveness of the health care system. Growth monitoring therefore serves both an educational and evaluation function (7, 10, 14, 18–21).

The present study was undertaken as part of the new nutrition intervention promotion programme in Gaza and consisted of a serial cross-sectional analysis of three cohorts of children attending the same primary health centres for routine care between 1987 and 1992. There was no control group, but growth patterns were examined before and during the programme in the same centres and by the same staff.

Fig. 4. Length-for-age z-scores of breast-fed (n = 1028; 72%) and non-breast-fed (n = 406; 28%) children aged 3–15 months in the 1990–92 cohort, Gaza.

Fig. 5. Length-for-age z-scores of iron-fed (n = 158–484) and non-iron-fed (n = 27–133) children aged 3–15 months in the 1990–92 cohort, Gaza.

Overall, the study shows a marked upward shift from the 1987–88 cohort towards the WHO/NCHS growth patterns, particularly in length-for-age. There was, however, little difference between the 1989 and 1990–92 cohorts, who were better nourished in terms of supplementation and feeding patterns than the 1987–88 group.

The 1990–92 cohort’s z-scores were very close to those of the reference population up to the age of 12 months. A fall-off was observed between 12 and 15 months for all cohorts, but was particularly marked for the 1990–92 cohort. This may indicate reduced attention to the nutrition of over-1-year-olds both in the counselling programme and at home, especially during the economic decline that occurred in 1990–92. The narrowing of social gaps in the area is reflected by the reduced difference in children of high and low socioeconomic status that occurred between 1987 and 1989.

No significant differences were observed between the growth patterns of male and female children up to 15 months of age in either the upper or lower socioeconomic status groups. It has been commonly held by health care workers in the area that there is a sex bias in feeding, favouring male children, but this is not reflected in the overall growth or feeding patterns found in this study.

Multiple regression analysis indicated that there were highly significant positive correlations between length-for-age and both iron supplementation and cereal feeding. Iron deficiency is the commonest nutritional deprivation state and is especially important because of its deleterious effects on the psychomotor development of infants. Exclusive breast-feed-
ing after 6 months of age causes iron deprivation thereby negating some of the advantages of breast-feeding (9, 22–24). Iron supplementation therefore appears to be justified in developing areas as a low-cost, effective method not only of preventing iron-deficiency anaemia but also of giving improved physical growth in terms of length-for-age.

Current nutrition guidelines encourage breast-feeding and the addition of cereal, fruit, vegetables and meat beginning at 4–6 months of age. During weaning, particularly in developing areas, infants are particularly exposed to enteric infectious diseases as a consequence of suboptimal sanitation and food preparation methods. Children in developing countries frequently experience severe bouts of diarrhoeal disease, which have deleterious effects on their growth patterns. Repeated illness and depressed food intake adversely affect the growth of children (11), who are thus at increased risk of a continuing cycle of malnutrition, infection, and growth impairment. While it is vital to stress the importance of breast-feeding for an appropriate period in order to avoid premature weaning, it is equally necessary to give adequate supplementary foods during the second half of the first year of life and to ensure proper food intake in the second year.

Birth order and vegetable feeding contributed negatively to length-for-age. Children of higher birth order may suffer in competition for food in the household. The reason for the negative role of vegetable feeding is unclear.

A survey conducted in 1990 among the Palestinian population resident in refugee camps in Gaza (and the West Bank, Jordan, and Syria) indicated that although the nutritional status of infants and young children, as assessed by length-for-age and weight-for-age, was below the international reference it appeared to be satisfactory. However, the length-for-age of these infants and young children improved significantly between 1984 and 1990, possibly reflecting improved socioeconomic conditions.\(^a\)

The improvement in growth patterns of infants in Gaza between 1987–88 and 1990–92 was undoubtedly attributable to a range of factors, including socioeconomic and environmental conditions. However, it is also an encouraging indicator of the probable effectiveness of a programme combining elements of nutrition monitoring and education (25) with vitamin and iron supplementation in a developing area. The emphasis on education and monitoring appears to have had a positive impact on maternal behaviour related to child nutrition.

Although cause and effect were not clearly demonstrated in this study, the comparisons made with baseline growth data indicate that the nutritional status of children aged up to 15 months in Gaza improved in recent years. Iron and vitamin supplementation and nutrition education, as part of routine preventive care services for infants, probably contributed to the improvement seen in the growth patterns of the cohorts studied.

Growth monitoring is vital to the health care of individual children and to the assessment of the growth and health status of the child population and should be continued and supplemented by studies on anaemia and iron deficiency among infants and older children. As an integral part of primary care services, growth monitoring should include regular measurement of weight, length/height, weight-for-height, and head circumference using the accepted international standards based on the NCHS growth curves, as recommended by WHO.

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Résumé

Effet d’un programme d’éducation nutritionnelle et de distribution de suppléments sur la croissance et la nutrition des nourrissons à Gaza, de 1987 à 1992

La bande de Gaza est une zone en développement qui compte environ 750 000 habitants et qui bénéficie d’un système de soins de santé primaires élabord. La vaccination complète de plus de 90% des nourrissons, grâce à laquelle les maladies évitables par ce moyen ont pu être maîtrisées ou éliminées, ainsi que les améliorations apportées à d’autres facteurs de santé, ont contribué à une réduction importante de la morbidité et de la mortalité infantiles et juvéniles au cours des deux dernières décennies. Depuis 1986, les services de soins de santé primaires, assurés par 28 centres communautaires, ont été étendus et leur mission englobe maintenant le suivi de la crois-

sance des enfants, l'éducation nutritionnelle et la distribution régulière de suppléments de vitamines et de fer aux nourrissons. Le personnel infirmier de cinq des centres de santé communautaires de la ville de Gaza a observé le profil de croissance et le mode d'alimentation des enfants âgés de 0 à 15 mois en 1987–1988, 1989 et 1990–1992. Les données relatives au poids et à la taille en fonction de l'âge ont été extraites des dossiers médicaux des enfants lors des visites régulières de vaccination et ont été comparées aux fiches de croissance de l'OMS et de l'USNCHS (U.S. National Center for Health Statistics). Les profils de croissance étaient semblables à ceux du NCHS jusqu'à l'âge de six mois, mais ils se dégradaient par la suite. Des améliorations ont été constatées dans le profil de croissance et le mode d'alimentation des cohortes de 1989 et 1990–1992 par rapport à la cohorte de 1987–1988 et aux normes du NCHS. Selon les renseignements fournis par les mères en ce qui concerne l'allaitement au sein et l'administration de suppléments alimentaires, de fer et de vitamines, les conseils nutritionnels donnés par les infirmières ont été mieux suivis. Aucune différence n'a été observée entre les sexes pour ce qui est du profil de croissance; une analyse multivariée a montré que les différences entre groupes socio-économiques n'étaient pas significatives et qu'elles étaient dues à des différences de régime alimentaire. Les principaux facteurs de l'augmentation de la taille en fonction de l'âge observée dans les deuxième et troisième cohortes, identifiés grâce à l'analyse multivariée, sont la consommation de suppléments de fer (P<0,0001) et de céréales (P<0,0001) et l'allaitement au sein (P<0,001). Un programme portant sur le suivi de la croissance, l'éducation du personnel de santé et des mères, ainsi que la distribution de suppléments de vitamines et surtout de fer, s'est accompagné d'une amélioration importante de l'alimentation et de la croissance des enfants âgés de 0 à 15 mois. Un programme d'intervention nutritionnel garantissant également le suivi de la croissance est un élément essentiel des soins de santé primaires.

References

