# NUTRITION REVIEWS

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## GROWTH AND NUTRITION OF LEBANESE CHILDREN

During the three years that the author was privileged to spend in the Department of Pediatrics of the American University of Beirut, Lebanon, it was possible to make a few observations on the growth and health of the children coming under the care of this department. Although the quality of the medical care and the training of the staff of the department were comparable to those in other medical schools which are members of the American Association of Medical Colleges, the pattern of disease seen in the wards and in the outpatient department was much more similar to that seen in the United States about twenty-five years ago. Infantile diarrhea and lower respiratory infections were extremely common, and infectious bacterial disease was commonplace. Although malaria and hookworm were absent from this population, the incidence of other parasites such as the beef tapeworm and *Ascaris* was high. Congenital heart disease and other congenital malformations, particularly of the central nervous system, made up one-third of the hospitalized patients, and aggressive surgical programs had been developed in both of these areas. Although the American University Hospital is a private institution and patients are accepted on their ability to pay, it was possible to obtain funds for the admission of medically indigent patients that were seen in the outpatient department where a small fee was charged.

The assessment of the growth performance of those inpatients and outpatients on the growth charts of R. L. Jackson and H. Kelly (*J. Pediat.* **27,** *215 (1945)*) was instituted, but serious questions were raised as to whether these particular growth charts were pertinent for Lebanese infants. The height and weight observations made at the infirmary of the American University of Beirut on 775 Lebanese boys aged six to 18 years, attending International College, were plotted on the Iowa growth charts. The mean for height for this privileged group was almost identical with the Iowa standards, and the median weights were greater than the American school children on whom these standards were made.

Three hundred forty-seven girls at a private school were measured by S. Najjar and A. Jarrah. In this group acceleration in height appeared to occur at a slightly earlier age than the Iowa standards. The adult height was somewhat less, although the weight curves were almost identical to their American counterparts. The heights and weights of 80 infant boys and a similar number of infant girls receiving well-child care from three pediatricians in private practice were found to have growth patterns practically identical with the standards of Jackson and Kelly. Since the performance of a socially and economically privileged segment of the population had growth patterns comparable to the American standard used, it was felt justifiable to use these standards as a point of reference in studying the poorer growth of some of the children seen in the hospital and outpatient department.

Records of height and weight have been recorded at the American University of Beirut on incoming freshmen with a median age of 18 years on a routine basis. Among the male students from Lebanon, the mean height had increased from 169.9 to 173.5 cm. during this ten-year period. These observations would suggest that the secular trend in stature was proceeding more rapidly in Lebanon than in Europe and North America (T. E. Cone, *J. Pediat.* **59,** *736 (1961)*).

In collaboration with R. Y. Asfour, all

new admissions to the outpatient department between the ages of six months and six years were studied for a five-month period. This group consisted of 214 males and 125 females. It is worth noting that nearly twice as many males as females were admitted to the hospital and that this sex distribution occurred among both Moslems and Christians, which were nearly equally represented in the sick child population. The median weight curves of these children approximated the sixteenth percentile on the Iowa standards. Hemoglobin concentration, hematocrit, total serum protein and serum albumin were determined on all the individuals in this group. The incidence of anemia defined as a hemoglobin concentration of less than 10 g. per 100 ml. was 15 per cent in the males and 4 per cent in the females. The highest incidence was 30 per cent in the males in the second year of life. This anemia was probably due to iron deficiency since hypochromia existed in 90 per cent of the anemic children.

When the incidence of anemia was determined for those children lying above or below the sixteenth percentile of the Iowa growth charts, it was found that the smaller children were more frequently anemic than the larger ones. This association of hypochromic anemia and relative smallness within the population is probably associated with a low birth weight. The incidence of low birth weight in this group, defined as a birth weight of 2,500 g. or less, was 43 per cent in the small males in the second year of life, the same group having the highest incidence of anemia. The incidence of prematurity in children coming to the outpatient department for miscellaneous complaints between the ages of four and six years was 12 per cent for the females and 21 per cent for the males. These children were still found in the smaller half of their own group. The incidence of low birth weight on the comparable obstetrical service at the hospital was almost identical to the American textbook average of 7.5 per cent. It would appear that low birth weight was still contributing disproportionately to the occurrence of illness in children, even after the first three years of life.

Although the incidence of hypochromic anemia was similar to that found in a number of indigent populations studied in the United States, it was surprising to find the incidence of hypoalbuminemia, defined as a serum albumin concentration of less than 3.5 g. per 100 ml., to be 11.6 per cent in the total group. The incidence was 18.4 per cent in the second year of life. There was no difference in sex incidence. Cases of full-blown kwashiorkor were rare in the population from which these children came, but the combination of growth failure and hypoalbuminemia in a significant percentage of this population in the second and third years of life demonstrated quite clearly the existence of a mild form of protein-calorie malnutrition. Justification for the use of a lower limit of normal of 3.5 g. of serum albumin per 100 ml. was amply demonstrated in concurrent studies in the Well Baby Clinic by J. K. Harfouche (*Thesis, Harvard School of Public Health, June, 1964*) in which the serial observations on over 300 children between birth and 18 months of age failed to show concentrations of albumin below 3.5 g. per 100 ml., except with detectable clinical evidence of poor health. Although routine hemoglobin determinations were done in this outpatient department, it was obviously equally as fruitful to consider routine determinations of the serum albumin.

In collaboration with I. Dabbous and A. Hanissian, analysis of all cases of infant diarrhea admitted to the hospital during a six-month period was made, and biochemical observations were performed on 54 cases seen during a five-month period. In common with other studies (J. E. Gordon, *Nutrition Reviews* **22,** *161 (1964)*), only one of these infants had bacillary dysentery, and 10 per cent had identifiable pathogenic coli in the stools. Growth failure in this group was common, with 55 per cent of the group falling under the third percentile on the Harvard growth charts for both length and

weight. All of the group were artificially fed at the time that they developed diarrhea. Careful attention in history-taking relating the cessation of breast feeding, or more correctly the initiation of artificial feeding to the episode of diarrhea, showed that the diarrhea began within a week following the introduction of artificial formulas in many instances and within four months in 62 per cent. It was quite clear that in the environment from which these infants came, the use of powdered milk, bottles, and nipples, carried a very great risk of gastroenteritis. Although no prospective studies were done, the staff of the department had developed the attitude that infant diarrhea was closely associated with unsanitary and crowded housing conditions and lack of suitable education in the use of bottles and nipples in infant feeding. By contrast, in urban children living in houses where an electric refrigerator was present (not an uncommon feature in low income groups in this country because of installment buying), the classical association between artificial feeding and gastroenteritis was much less common.

Biochemical studies made on these children with gastroenteritis showed that 9 per cent had anemia as defined above. Serum albumin concentrations were less than 3.5 g. per 100 ml. in 36.4 per cent of the cases and less than 3.0 g. per 100 ml. in 18.2 per cent. These findings indicate the close association of protein malnutrition and diarrhea.

Although vitamin A deficiency had not been recognized as more than a rarity in this pediatric population, and since the vitamin A status of the country as a whole did not show any areas of severe deficiency during the ICNND survey in 1961, it was a surprise to find that 40 infants in the first year of life from the outpatient department on whom vitamin A blood levels were determined, showed many instances of concentrations below 10 $\mu$g. per 100 ml. A further opportunity to study the fat soluble vitamins was offered at the Government Hospital in Sidon in 1962 when the pediatric residents rotated through this hospital. Observations were made on 38 infants coming into the hospital, usually for acute gastroenteritis or pneumonia. Their composite growth curve showed reasonably normal growth up to the age of four to six months, followed by a plateau in weight gain until 18 months and a very severe slowing of growth in length. This was followed by partial recovery in the infants nearing three years of age. The mean serum vitamin A of this group of infants was 8.9 $\mu$g. per 100 ml., with 59 per cent of the group having values in the "deficient" range of less than 10 $\mu$g. per 100 ml. Serum carotene concentrations averaged 25 $\mu$g. per 100 ml. with 94 per cent of them under 50 $\mu$g. per 100 ml. During the ensuing summer, three cases of xerophthalmia were discovered in this group of infants and confirmed by D. S. McLaren, suggesting that clinical vitamin A deficiency was indeed occurring in these depleted infants.

Another interesting observation in these infants was that their serum tocopherol concentration averaged 0.33 mg. per 100 ml., and that 78 per cent of the group had values less than 0.5 mg. per 100 ml., levels at which increased peroxide hemolysis occurs frequently. The incidence of anemia in this group was 24 per cent. The presence of protein malnutrition was confirmed biochemically by an average serum albumin concentration of 3.98 g. per 100 ml., with one-quarter of the group having values less than 3.5 g. per 100 ml., and probably more since dehydration may have been present in many of the infants at the time they were studied. In striking contrast to these observations, the average ascorbic acid concentration in the serum was 0.9 mg. per 100 ml., with only 3 per cent of the population having ascorbic concentrations less than 0.2 mg. per 100 ml. Although the source of ascorbic acid available to these infants, who were almost entirely artificially fed using powdered milk formulas that were overdiluted and who rarely received other food, was not documented, it should be noted that infantile scurvy is essentially unknown in Lebanon, and that the frequent consumption

of citrus fruits by all segments of the population has been a time-honored practice.

At the time that A. Majaj, J. S. Dinning, S. A. Azzam, and W. J. Darby (*Am. J. Clin. Nutrition* **12,** *374 (1963)*) were observing megaloblastic anemias in Jerusalem which responded to tocopherol administration, a search was made for similar patients in Lebanon. Since some of the patients in Jordan had hypochromic as well as macrocytic anemia, it was decided to examine the bone marrow of all anemic patients coming on the service, whether they were hypochromic or not. This was done despite the previously common teaching that hypochromic anemia in infants that is not due to thalassemia is almost certainly due to iron deficiency. During a period of four weeks, five patients aged eight to 18 months with megaloblastic changes in the marrow were found. They all had very mild degrees of anemia, with hemoglobin concentrations ranging between 6.9 and 10.3 g. per 100 ml., and red blood counts between 2.64 and 4.90 million per cu. mm. Only three had macrocytosis (MCV above 100 cubic micra), and two were normocytic. The serum iron saturation was between 18 and 31 per cent in four, and 80 per cent in the fifth. Serum vitamin $B_{12}$ concentrations were in the normal range. Serum tocopherol concentrations on admission were 0.5 mg. per 100 ml. or less in three of the five patients. One patient had typical kwashiorkor, three had albumin concentrations between 3.0 and 3.6 g. per 100 ml., which rose 1 g. or more in ten days, and one had a normal serum albumin on admission.

In two of these patients, the megaloblastic changes disappeared in two weeks with full feedings and treatment of their concurrent otitis media and pneumonia. Three were placed on a diet of whole cows' milk supplemented with vitamins A, C, and D and studied further. The one with kwashiorkor lost his edema and regenerated his serum albumin without any hematologic response. He had an increased FIGLU excretion following a histidine load. However, he failed to respond to 25 μg. of folic acid by mouth daily for ten days or to 200 μg. daily for a subsequent two weeks. The FIGLU excretion became normal after ten days on 5 mg. of folic acid daily without hematologic response. The administration of 400 mg. of tocopherol acetate by mouth daily raised the serum concentration from 0.25 mg. to 3.43 mg. per 100 ml. Three weeks later he had a maximal reticulocytosis, a normal bone marrow and a rise in hemoglobin and red cell count. Since this occurred at the time a variety of soft foods were added to his diet, the specificity of the response is not clear. In two other patients studied in a similar manner, the disappearance of the maturation arrest which occurred after six and eight weeks of observation could not be related to specific therapy with either tocopherol or folic acid, but was associated with a gain in weight and clinical improvement.

Mild degrees of anemia with megaloblastic arrest in the marrow were apparently very frequent in the population receiving care and, since these anemias were almost always either so mild that they were disregarded or were mistaken for iron deficiency because of the accompanying hypochromia, their existence had not been appreciated. There was no hematologic response to high protein intakes. With recovery, the serum iron saturation fell, and microcytosis and hypochromia developed. This type of mild megaloblastic change in infants between eight and 18 months of age does not respond specifically to folic acid, and its relationship to tocopherol administration was not clear in these patients who were not as anemic as those reported elsewhere. Certainly the coexistence of hypochromia and macrocytosis with maturation arrest in the marrow was frequently found once it was looked for in these poorly nourished infants.

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