

During the entire period of undernutrition there was an average daily retention of 0.5 gm. of nitrogen (periods I through V). Although the retention of nitrogen increased as the calorific value of the diet approached maintenance, there was a significant and constant storage of nitrogen during the periods of the most severe undernutrition. The average of the 44 days, when 600 calories were being fed, (periods I, II, and III) was 0.5 gm. of nitrogen per day. On the other hand, with a constant calorific value of the diet, an increased nitrogen intake (period II) did not increase the nitrogen retained. Over the period of study the child lost 8 kg. of body weight while she retained 49 gm. of nitrogen.

Summary. An obese child, who was sharply underfed for 85 consecutive days, retained a large amount of nitrogen while losing 8 kg. of body weight. Although there was a significant and constant retention of nitrogen during the period of most severe undernutrition, the retention of nitrogen gradually increased as the calorific value of the diet approached maintenance. Increasing the nitrogen of the diet did not increase the retention of nitrogen while the subject was being severely underfed.

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Relationship Between Vitamin D Intake and Linear Growth in Infants.

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Over a 3-year period the Research Laboratory of the Children's Fund of Michigan, cooperating with the Children's Hospital of Michigan, has studied the effect of certain accessory food factors on nutrition, growth and development of infants during the first year of life. Data have been collected which appear to confirm the findings of Stearns, Jeans and Vandecar,¹ who, in an extensive individual study, demonstrated a close relationship between vitamin D intake and linear growth.

Over 500 infants* from urban families of indigent or near-indi-

¹ Stearns, Genevieve, Jeans, P. C., and Vandecar, Verva, *J. Pediat.*, 1936, **9**, 1.

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gent class have been observed. Infants whose family background predisposed to defect and infants presented for initial examination after reaching 10 weeks of age were rejected. The children were observed to the end of their first year of life.

A carefully balanced artificial diet was prescribed, based on evaporated milk, and the chief elements supplied gratis to the parents.† A daily supply of vitamin C considered adequate was supplied by commercial dehydrated lemon juice powder. Vitamin D was administered in the form of irradiated evaporated milk or standardized cod liver oil.‡ Carbohydrates were added in the form of Karo syrup. Solids were added to the diet at suitable ages.

During monthly visits to the clinic the infants received medical examinations, anthropometric measurements; x-rays of the extremities were taken to be used in appraisal of subclinical rickets, scurvy, or other physical defects. Hemoglobin determinations and red and white blood cell counts were made. Capillary resistance tests for the diagnosis of scurvy (Göthlin's method) were made on 112 of the infants, psychometric examinations on 127. Detailed records were maintained.

Two trained nurses assisted in the clinic and supervised the care of the child in the home. They made frequent visits to the home for this purpose, carrying necessary supplies, and checking the records of feeding and care kept by the mother.

After elimination of all infants who for any reason might militate against "average" quality of the group, 414 infants were eligible for statistical consideration. It was possible to divide the babies into 5 distinct groups on the basis of quantity and source of vitamin D. Racial factors are relatively constant for all groups. We concluded that the averages for our mixed groups are not unduly weighted by either sex, as the various diet groups retain the same relative ranking when the values for boys only are plotted or when the mixed group values are used. Due, however, to the smaller groups thus selected, the curves show greater variability, and for that reason are not presented. The largest group, containing 170 babies, was prescribed cod liver oil in dosages that gave each individual between 250 and 600 U.S.P. units of vitamin D daily. Sixty infants in the second group received an average of 810 units, and a third group of 51 children received 675 units per day. The 76 chil-

† The infants were obtained through the generous cooperation of the Detroit Department of Health, Harper Hospital, Florence Crittenton Hospital, Woman's Hospital, and private physicians in Detroit.

‡ Standardized cod liver oil was kindly furnished for some of the infants by the United States Children's Bureau.

dren in the fourth group received between 95 and 152 U.S.P. units per day from irradiated evaporated milk. Through a milk production error the fifth group of 57 infants received unirradiated evaporated milk until the age of eight lunar months. At this time some of the diagnosticians made an interpretation of rickets from several of the roentgen films.² Immediately, therapeutic doses of cod liver oil were prescribed. This corrected any slight rachitic condition before the termination of the study and no effect upon the rate of growth in length could be found.

The average heights for each group were calculated for successive 28-day intervals, plotted, and the resulting curves compared by inspection. The curves demonstrated that the average heights of the 3 groups receiving the highest vitamin D intake were almost identical and that the values were noticeably higher than for the 2 groups receiving less vitamin D. Two of these groups received 675 units or more. The other, prescribed 250 to 600 units, undoubtedly received an average amount near to 600 units as the usual procedure was to start each infant at the low dosage and increase it as rapidly as possible to the maximum. Since the 2 groups receiving greater amounts did not increase in length at any greater rate than the third, it would seem that the optimum dosage for growth promotion is very near to 600 U.S.P. units daily.

The 3 groups mentioned included 271 infants who received between 250 and 810 U.S.P. units daily. Averages were obtained for a composite of these 3 groups. These were compared graphically with the averages of the other 2 groups (Chart I). It will be seen that the average heights at the beginning of observation are almost identical for the 3 groups, but thereafter the group receiving the greatest dosage increased most rapidly in length, the group on an intake of 95 to 162 units gained at a noticeably slower rate, and the group supplied with almost no vitamin D gained the slowest. The addition of vitamin D to the regimen of the group at an average age of 225 days apparently failed to increase the rate of growth appreciably, although the occurrence and severity of rickets were diminished.

It has been determined that the lower curve for these 2 groups is not due to the presence in them of infants with moderate rickets. Only 2 cases developed from the 76 in the group receiving 95 to 162 U.S.P. units. Averages for these 2 showed little variation from the averages for the balance of the group. The curve for "moderate" rachitic infants (8) of the "no D" group falls considerably

² Cooley, T. B., and Reynolds, L., *J. Pediat.*, 1937, **10**, 743.

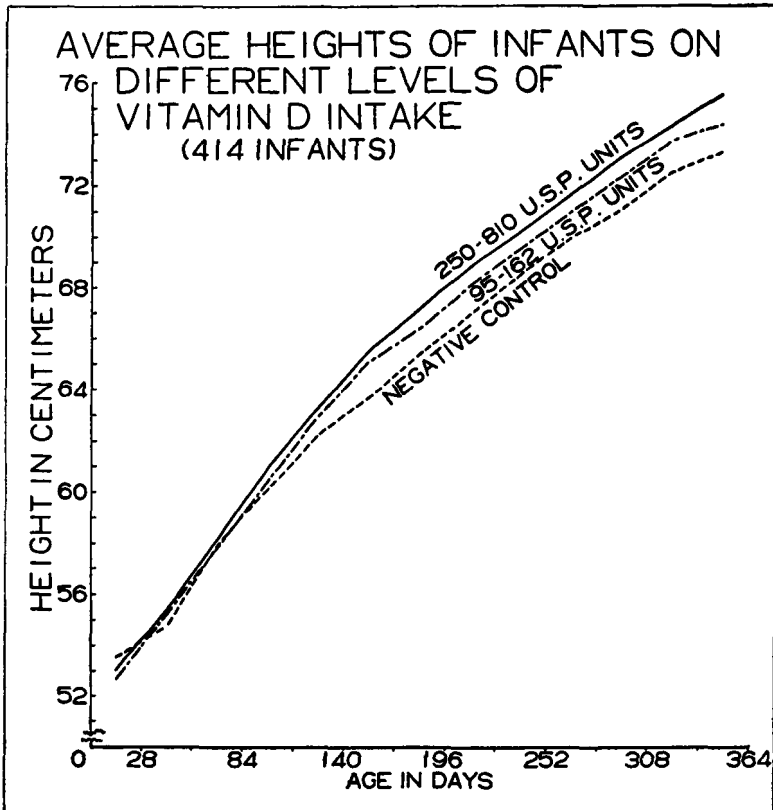


CHART 1.

below that of the remainder but, due to the small proportion of rachitic infants, the curve for the non-rachitic infants is not greatly higher than that of the group as a whole.

The average heights of the infants in this study compare favorably with accepted standards. These comparisons have been published from this laboratory.^{3, 4}

³ Poole, M. W., Hamil, B. M., Cooley, T. B., and Macy, I. G., *Am. J. Dis. Child.*, 1937, **54**, 726.

⁴ Poole, M. W., Hamil, B. M., Cooley, T. B., and Macy, I. G., *Am. J. Dis. Child.*, in press.