Nutrition and Infection Field Study in Guatemalan Villages, 1959-1964

VII. Physical Growth and Development of Preschool Children

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The changes with age in height, weight, skinfold thickness, bone development, and head circumference of children from birth through the fifth year of life are reported for three Guatemalan villages for the five years, 1959 to 1964. The children were observed during a longitudinal prospective study of the villages in which a nutrition program with supplementary feeding was introduced in one, environmental sanitation and preventive and curative medical services were introduced in a second, and the third served as a control.

THIS paper evaluates and compares the growth and maturation of preschool children in three study villages. Children of Santa Catarina Barahona, the "feeding village," received a food supplement and their mothers were given advice on nutrition. In Santa María Cauqué, the "treatment village," a program of environmental sanitation, immunization, and medical care was introduced. Observations were made in Santa Cruz Balanyá, the "control village," without introducing either nutritional or health services. Anthropometric and other measurements were obtained periodically as part of long-term prospective field studies of children less than 5 years old in each village. The general objectives and study plan,[1] study area, population characteristics, organization of field studies,[2] field procedures, methods of collection of data,[3] and findings on mortality,[4] and incidence of disease[5,6] have all been described previously.

The most sensitive indicators of nutritional effects on preschool children are measurements of their growth and development. Because of the insidious onset and slow evolution of malnutrition, the disease is difficult to identify from the records of nonmedical field workers as was necessary in this study. However, periodic examinations by a physician for clinical signs of nutritional deficiencies added little information.

The specific objective of the present study was to determine the extent to which the observed growth responses could be attributed either to the nutrition program in the feeding village, or to the program of environmental sanitation and health services in the treatment village. Evaluation of anthropometric measurements by calculating conventional "means and standard deviation" could not take advantage of the longitudinal features of the study. Therefore, analysis was by rates and trends.

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Methods

Sequential measurements of height, weight, skinfold over the triceps, and head circumference were made for all preschool children. As described earlier[3] the measurements were taken in the three villages in regular rotation according to an established schedule during three days at three-month intervals. In addition, roentgenograms of the left hand of children over six months of age were taken annually to determine bone maturation.

The various measurements were first examined according to age, sex, and village to learn the general characteristics of physical growth in the populations studied. Owing to the greater inherent variability in measurements of skinfold (coefficient of variation [CV] = 30%), and because skinfold thickness and head circumference were determined only during the first 2½ years of the study, no further analyses of these data were made. Attention centered on measurements complete for the five years of the study, those of height and weight.

Growth in height and weight of children in the three villages was compared within sex and age groups for the first and second parts of the study (May 1959 through December 1961; January 1962 through April 1964) to determine whether changes during the study would require analysis by age-group cohorts. The comparisons between these periods showed no consistent pattern and thus the total data were used in subsequent analyses.

These preliminary examinations indicated further that gain in weight was linear after approximately the eighth month of age, while growth in height became so after approximately the tenth month. Therefore, a quadratic polynomial $(a + b_1 + b_2x^2)$ was used to fit the data on height and weight measurements before 12 months of age, while a simple linear function $(a + bx)$ was considered adequate for the period from 1 through 4 years of age.

A comment on the above models is appropriate since they are only approximations of the exact equations, and the estimate of the constants is meaningful only under certain assumptions. Thus, in the simple linear equation, the constant b is an estimate of the rate of gain in height or weight. This assumes the rate to be constant throughout the time period considered (that is, that the acceleration is 0), a reasonable assumption for the period from 1 through 4 years; b is therefore a good estimate of rate of growth. The constant a, on the other hand, has no real biological meaning. In a sense it represents initial height or weight if the estimated rate (b) of 1 through 4 years has been operative from birth. Since this is not the case, a can only be considered a convenient constant to adjust the scale of measurement.

During the first eight to ten months of life, the rate of growth in height and weight of Guatemalan village children decreases rapidly. If we assume that for short periods the decrease in rate of growth (that is, negative acceleration, or deceleration) remains constant, then b_2 in the quadratic polynomial is one half of the acceleration constant. A constant acceleration implies a linearly increasing or decreasing velocity (in this case estimated by the linear function $b_1 + 2b_2x$). Total growth achieved at a specific time may then be estimated by the quadratic polynomial.

Although the assumption of a constant acceleration is not valid over the total period of growth, it does give useful estimates under 1 year of age. For comparison of the different treatment groups in the three villages, the growth patterns observed under the established experimental conditions are sufficiently reliable. Since the fitted lines of graphs illustrating periods under one year and 1 through 4 years of age must be continuous, the total period from birth to age 5 years is obtained by joining the two graphs.

Bone development was assessed by actual count of the number of ossification centers present in the left wrist. A score for the bone maturation of each individual was obtained by comparison with corresponding normalized T scores[7] derived from the age-sex-specific distribution of the number of ossification centers present in well-nourished Ohio children studied at the Fels Research Center (S. M. Garn, written communication, July 1960). The distribution of the age-sex-specific T scores was then obtained for each yearly examination, and village differences were examined by the chi square test. The Institute of Nutrition of Central America and Panama (INCAP) computer was used for all calculations and data processing.

Results

The increase in head circumference by age and sex for children in each of the three villages is shown in Fig 1. Although equal at the start of the study, the head circumference of boys increased faster than that of girls in the three villages. In both sexes, the head circumference at birth was about 70% of the measurement at five years of age, and at 12 months, about 90%. Preschool children of both sexes in the feeding village

Table 1.—*Average* Increments in Height and Weight by Quarter Years for Preschool Children From Three Guatemalan Villages, 1959—1964*

Village		Age in Months 0-2	3-5	6-8	9-11	12-14	15-17	18-20	21-23
Height (cm)									
Feeding	Boys	6.42	4.29	3.20	2.44	2.04	2.11	1.98	2.09
	Girls	6.66	4.48	2.89	2.11	2.55	2.58	1.92	2.05
Treatment	Boys	5.98	4.23	2.92	1.95	2.02	1.87	1.61	1.83
	Girls	5.50	3.00	2.76	2.20	2.24	1.90	1.82	1.42
Control	Boys	6.90	4.30	2.81	1.93	1.94	2.03	1.84	1.60
	Girls	6.36	4.30	2.96	2.23	1.84	1.30	2.00	1.54
Weight (kg)									
Feeding	Boys	1.62	0.90	0.48	0.50	0.27	0.49	0.59	0.59
	Girls	1.88	1.02	0.48	0.40	0.50	0.45	0.43	0.65
Treatment	Boys	1.57	0.80	0.42	0.24	0.30	0.45	0.44	0.48
	Girls	1.61	0.46	0.26	0.24	0.44	0.32	0.36	0.42
Control	Boys	1.77	0.88	0.25	0.38	0.27	0.50	0.42	0.48
	Girls	1.54	0.86	0.40	0.30	0.35	0.37	0.53	0.40

*Each value is the average of 50 or more observations.

had greater head circumferences than their counterparts from either the treatment or control villages. For all three villages, however, these measurements were significantly smaller than the United States children of comparable ages.[8]

Skinfold measurements are presented in Fig 2. The increase in this measurement with age was similar for both girls and boys in all three villages. The usual initial rapid rate of gain reached a maximum around 6 months of age. The subsequently decreased rate was most marked in the control and least in the feeding village. In all three, decline in values for skinfold thickness ended around 30 months of age, after which a slow gain and eventual stabilization occurred. The variability in this measurement (30% CV) was so great that village differences are without meaning. The skinfold measurements of these Guatemalan children averaged slightly less than those of Canadian children[9] of the same age and sex.

Patterns of Growth.—The patterns of growth in height and weight are illustrated in Fig 3 and 4. In addition to differentiation by village and sex, the results obtained in the initial part of the study (1959 to 1961) are compared with corresponding information obtained during the final period (1962 to 1964). This provides an opportunity to detect cumulative effects incident to the program or to unrelated trends.

For gain in height with age (Fig 3), the general patterns in the three villages were similar, although the boys and girls of the feeding village tended to grow faster in height than those of either the treatment or control villages. This tendency was evident during the first part of the study and slightly more so during the second part, especially among boys. Although the observed differences between the early and late periods of the study were paralleled to a lesser extent in the control village, they were not significant in either control or treatment village. There were no differences in mean height between boys and girls of the ages observed.

Rates of gain in weight with age (Fig 4) followed a similar pattern to those for height. The gains were similar in all three villages, but again, children from the feeding village had a slight advantage. Only control village boys showed any significant difference in weight gain during the two time periods; initially, they weighed less than boys from the other two villages. No changes between the first and second parts of the study were seen in the pattern of weight gain among girls in any of the three villages. Girls of the feeding village gained more in both periods than those in either treatment or control villages.

Growth in weight and height during the first three months of life in each of the villages coincided with the corresponding patterns for well-nourished children,[8-10] or was only slightly less. Thereafter, the two curves of weight gain began to separate. The maximum divergence from the weight gain of the reference pattern occurred during the remainder of the first year and through the second year of life. Thereafter, children still weighed less but neither gained nor lost weight appreciably relative to children of the reference group.

Figure 5 presents the distribution of T scores during each year of the study for the number of age-sex-specific ossification centers in the left wrist of children. Low T scores predominate in all three villages, the

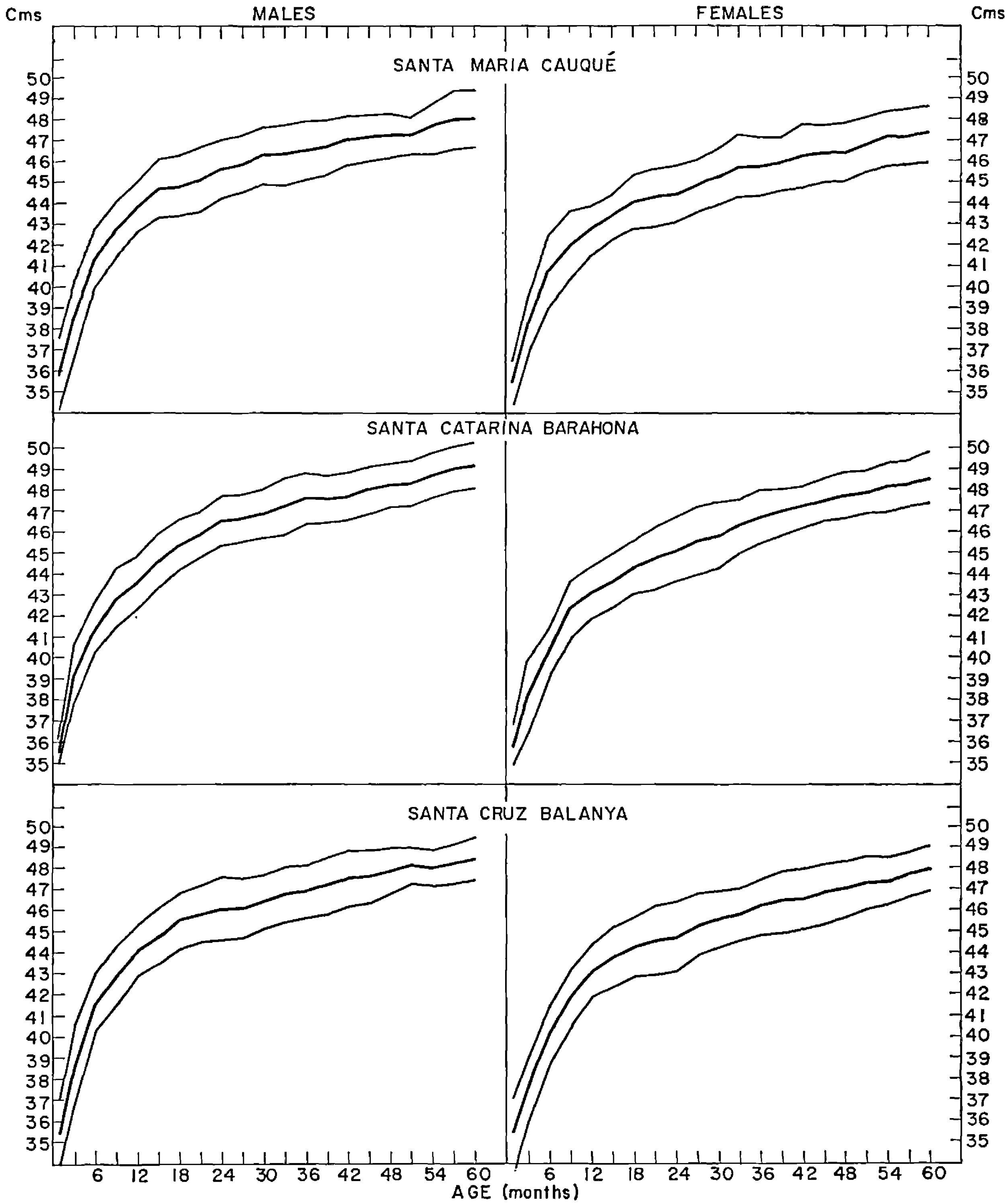

Fig 1.—Head circumference by age and sex, children of Santa María Cauqué (treatment village), Santa Catarina Barahona (feeding village), and Santa Cruz Balanyá (control village).

children having fewer ossification centers present at given ages than their counterparts of the reference population. Chi square tests indicate variation in T scores among the three villages at the beginning of the study, with greatest development for children in the feeding village. This difference steadily increased during the years of the study, with continued improvement in T score distributions of the children receiving supplementary food, and a lack of any such change in children of the treatment and control villages. These differences have been ascribed elsewhere[11] to a delay in mean age of appearance of the ossification centers and a reduction in the mean cortical

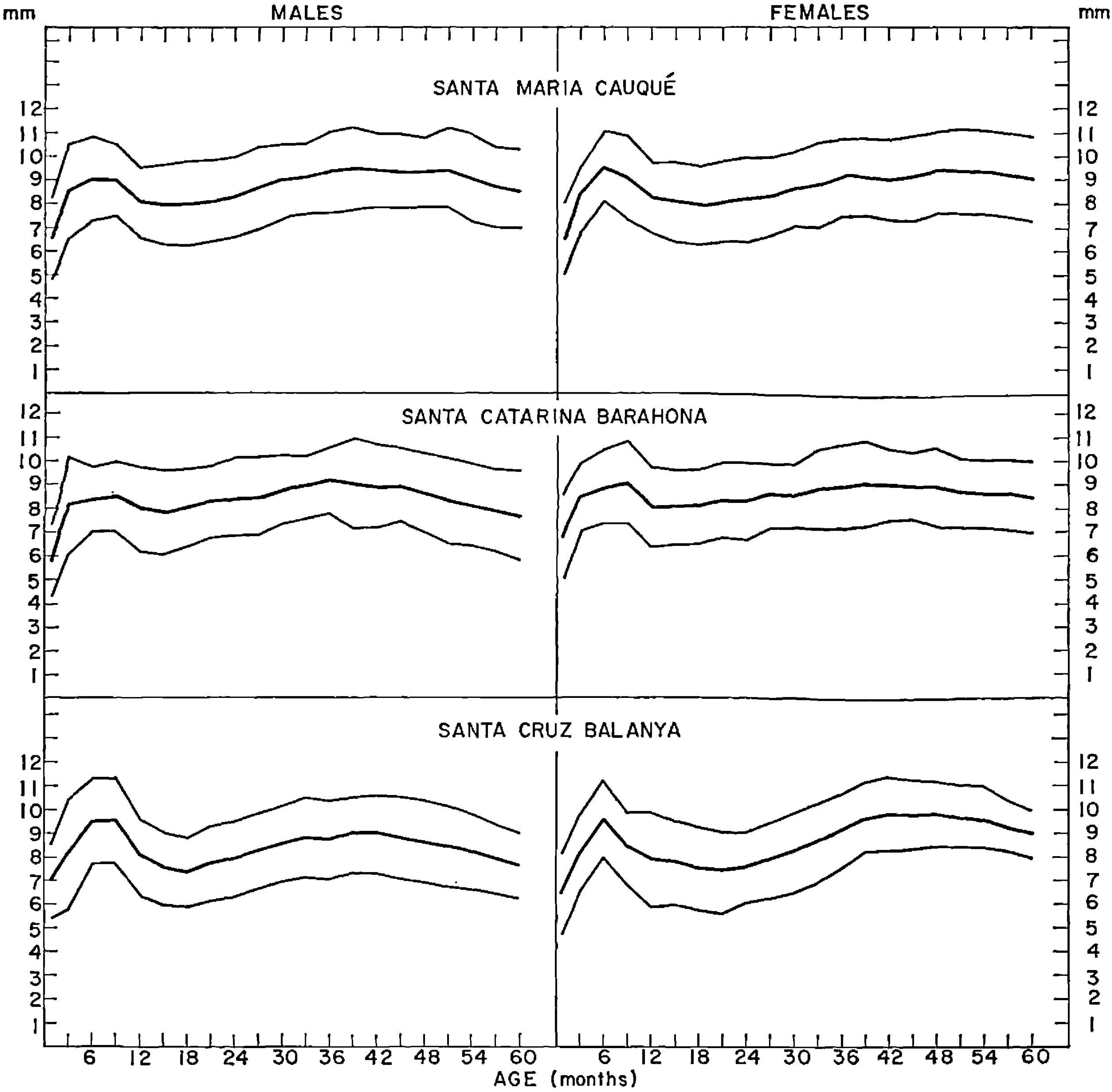

Fig 2.—Skinfold thickness (triceps) by age and sex, Santa María Cauqué (treatment village), Santa Catarina Barahona (feeding village), and Santa Cruz Balanyá (control village).

bone thickness as seen in roentgenograms of the second metacarpus.

Increments of Height and Weight.—Table 1 summarizes net increments of height and weight calculated individually for each child and averaged by sex for each year of age. Average age-specific gains in both height and weight are less among children of the treatment and the control villages than in the feeding village.

Once growth became essentially linear, absolute increments of height and weight were less for the children from these two villages than for the children of the feeding village. The larger increments for the feeding village were established by the second half of the first year of life, or early part of the second year. Increments in all three villages, although initially similar to those observed in well-nourished populations, progressively became smaller, suggesting an earlier slowing of the initial rapid growth for the children of all three villages.

Estimates of Constants

Estimates of the constants, obtained from fitting the quadratic function $y = a + b_1x + b_2x^2$ to the longitudinal individual observations, are presented in Tables 2 and 3 for

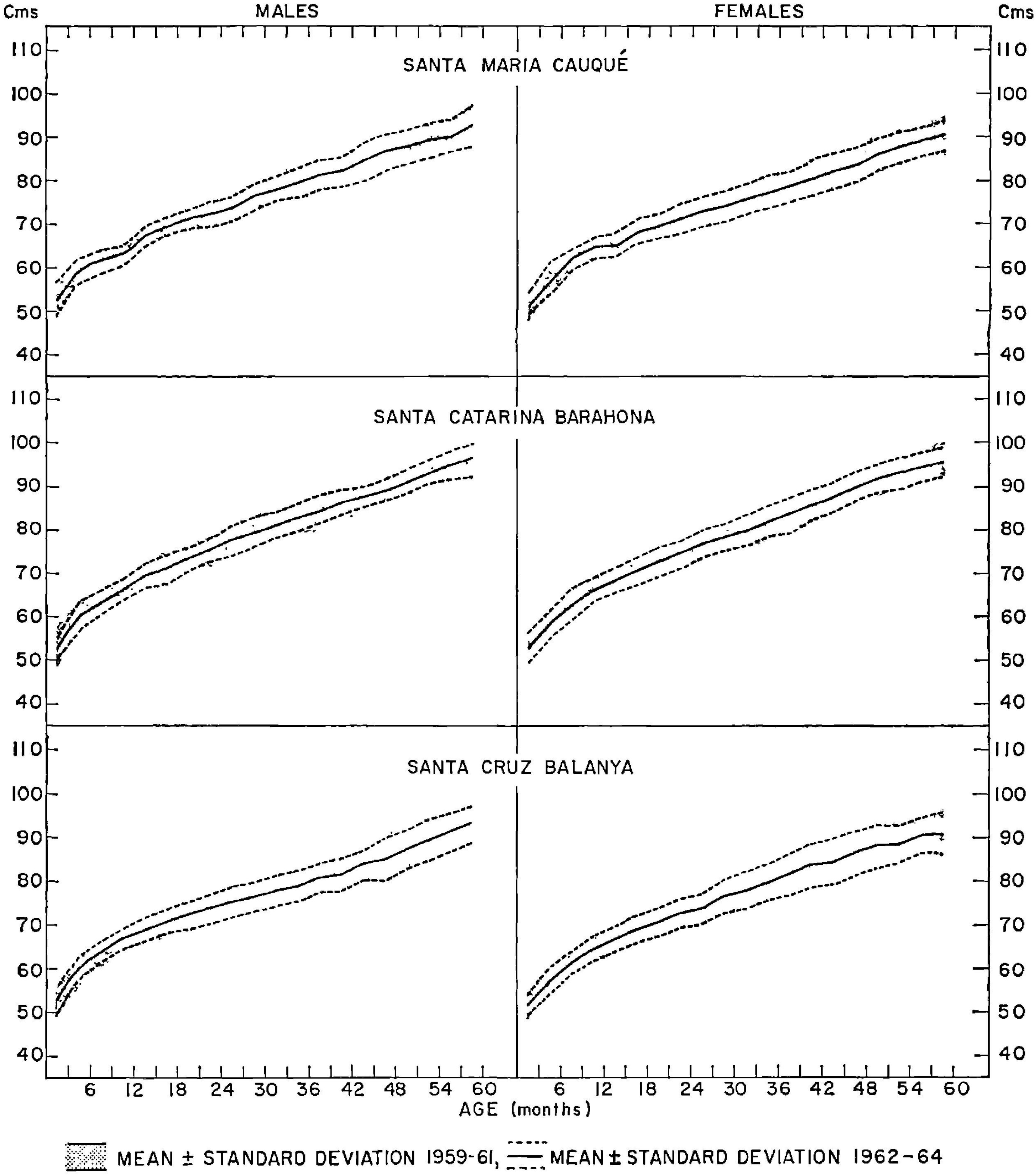

Fig 3.—Growth in height (cm) by age and sex, children of Santa María Cauqué (treatment village), Santa Catarina Barahona (feeding village), and Santa Cruz Balanyá (control village).

height and weight, respectively. In each case, the constant b_1 can be considered as an estimate of the maximal growth potential and the constant b_2 as an estimate proportional to the acceleration in growth.

Gain in Height.—The estimates in Table 2 for the two constants describing approximate rates of gain in height for children under 1 year of age indicate that the maximum growth potential (b_1) was generally greater for boys than for girls, although the differences were not significant. The acceleration constants (b_2) are all negative and also generally greater for boys than for girls, although again, the differences are not significant. The estimates of maximum growth potential (b_1) for both sexes do not differ among the villages. On the contrary, the

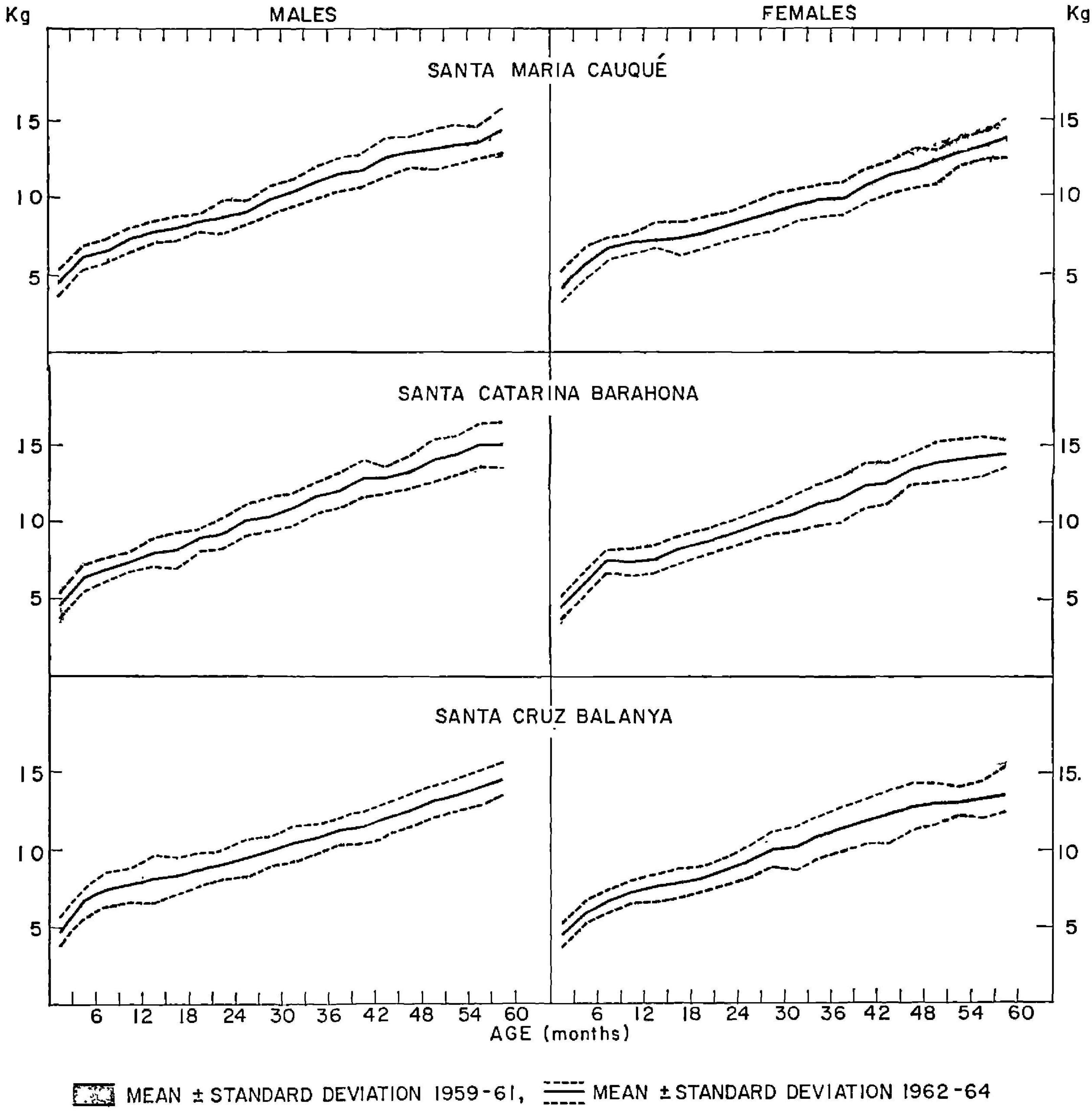

Fig 4.—Growth in weight (kg) by age and sex, children of Santa María Cauqué (treatment village), Santa Catarina Barahona (feeding village), and Santa Cruz Balanyá (control village).

negative acceleration estimates (b_2) are larger for the control village. The correlation values (r^2) indicate that the fit of the quadratic function is good in that it explains about 80% of the individual variations in height.

Gain in Weight.—The constants characterizing rates of gain in weight for children under 1 year of age (Table 3) again show no significant differences between the sexes or among the three villages in terms of either maximum growth potential (b_1) or growth acceleration (b_2). The adequacy of the fit of the quadratic equation to the weight data, as judged by the values of r^2, is not as good as for height; only about 50% to 60% of the individual variations in weight measurements are explained. It is significant, however, that the r^2 values are higher for the feeding village, suggesting a slightly more uniform rate of gain in weight for age in children of this village.

The values of the fitted constant b, which estimates the rate of gain for the period from 1 through 4 years of age, are given for height (Table 4) and weight (Table 5) for each village by sex.

Both boys and girls of the feeding village have significantly higher rates of gain in height and weight. Sex differences are not apparent for either measurement. The values of r^2 calculated for the constant fitted to the height progression are all over 80% and somewhat better in the case of feeding and treatment villages than in the control village. The r^2 values calculated from the fitting of the rates of weight gain to the linear equation are lower than those for height, and largest for the feeding village.

Differences in Growth.—The curves fitted to the data for height and weight of children from birth through the fifth year of life are presented in Fig 6. These show clearly the more rapid growth in both height and weight for both girls and boys of the feeding village. The children from treatment and control villages did not differ in patterns of growth for either height or weight. The differences in growth between the feeding and the other two villages resulted in a net difference of approximately 3 cm in height and 1 kg in weight by the end of the fifth year of life.

The findings were also examined for an association between physical growth and the nature and amount of illness. The study population of each village was divided into upper, middle, and lower thirds according to rates of gain in weight and in height. For each tercile, incidence was compared for diarrheal disease, respiratory disease, and all other cases of disease. In the same manner, a possible relationship was sought between tercile of gain in height or weight and number of days ill with each type of disease. Neither analysis gave evidence of a consistent association between terciles of growth and frequency or extent of illness.

The reverse relationship was examined in a more selective manner. Children were grouped into upper, middle, and lower thirds according to number of days of illness from diarrheal disease, respiratory disease, and total disease. Growth rates were then calculated for each tercile of the age groups 0 to 12 months and 6 to 23 months, separately for boys and girls. These overlapping age groups were selected as the two most likely to be influenced by days of illness. No significant relationship was found by this procedure between days of illness and gain in either height or weight.

Comment

The present results leave little doubt of the superior nutritional status of the children in the feeding village after their participation in the supplementary food program, as judged by anthropometric measurements. This is evident from the growth curves for height and weight and the data on bone maturation as well as the information on head circumferences. Nevertheless, the medians in height and weight for the feeding village were still below the tenth percentile for well-nourished children.[8,10] In other words, the children of the feeding village were still markedly retarded in growth and development, and the margin of their superiority over the treatment and control villages was quantitatively small.

Analysis of Growth Constants.—Further evidence of the better growth performance

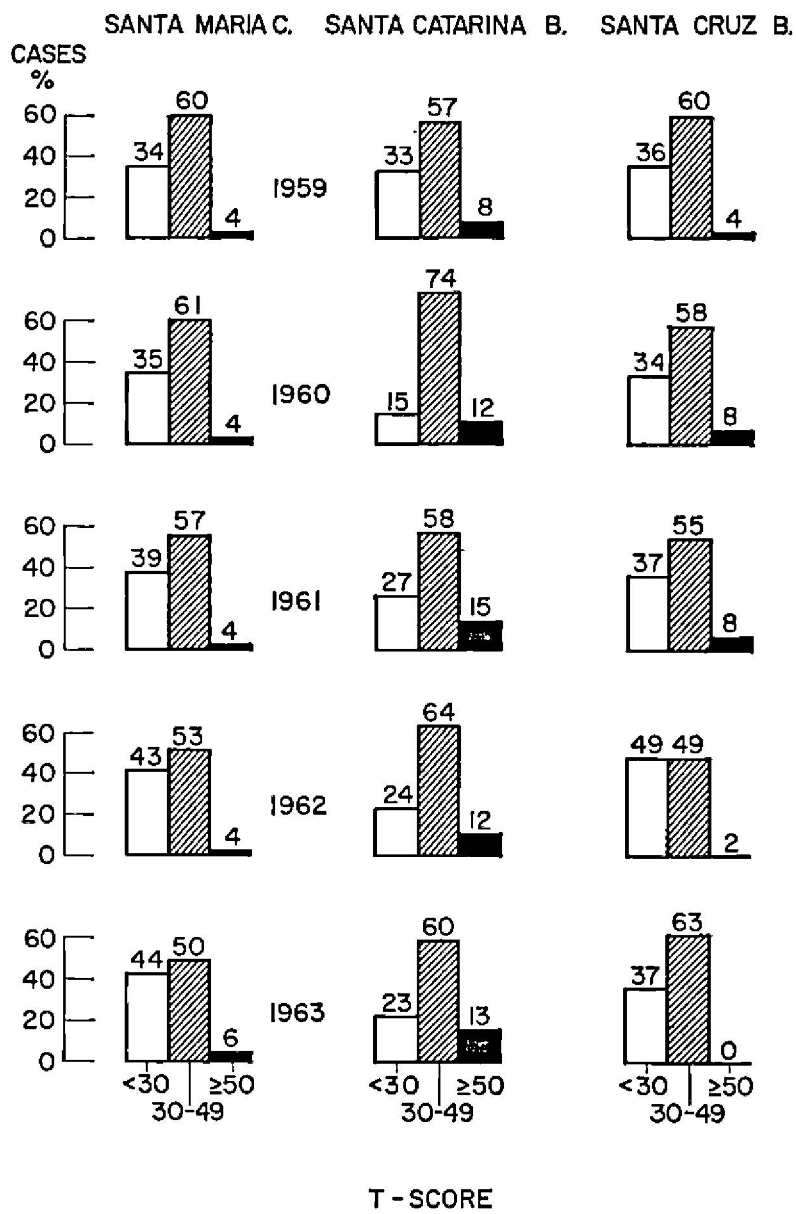

Fig 5.—Age-sex-specific numbers of ossification centers (left wrist), percent of cases, and T scores, by years of study (1959-1964), Santa María Cauqué (treatment village), Santa Catarina Barahona (feeding village), and Santa Cruz Balanyá (control village).

Table 2.—Gain in Height of Children Less than One Year Old
$Y = a + b_1x + b_2x^2$

Village	No. of Observations	b_1* (cm/mo)	b_2* (cm/mo)	r^2
Feeding				
Boys	259	2.233 ± .152	.063 ± .008	.802
Girls	290	2.113 ± .119	.055 ± .007	.843
Total	549	2.165 ± .095	.058 ± .005	.823
Treatment				
Boys	625	2.130 ± .082	.059 ± .004	.833
Girls	607	2.176 ± .078	.063 ± .004	.844
Total	1232	2.152 ± .058	.061 ± .003	.833
Control				
Boys	543	2.358 ± .091	.071 ± .005	.831
Girls	565	2.150 ± .100	.059 ± .005	.794
Total	1108	2.232 ± .070	.064 ± .004	.800

*The growth constants b_1 and b_2 are explained in the text.

Table 3.—Gain in Weight of Children Less than One Year Old
$y = a + b_1x + b_2x^2$

Village	No. of Observations	b_1* (kg/mo)	b_2* (kg/mo)	R^2
Feeding				
Boys	259	0.562 ± .046	−.019 ± .002	.646
Girls	290	0.528 ± .038	.017 ± .002	.698
Total	549	0.544 ± .030	.018 ± .002	.673
Treatment				
Boys	625	0.502 ± .028	−.017 ± .002	.611
Girls	607	0.501 ± .026	.017 ± .001	.648
Total	1232	0.501 ± .019	.017 ± .001	.622
Control				
Boys	543	0.541 ± .034	.019 ± .002	.560
Girls	565	0.485 ± .032	.016 ± .002	.557
Total	1108	0.507 ± .024	−.017 ± .001	.546

*The growth constants b_1 and b_2 are explained in the text.

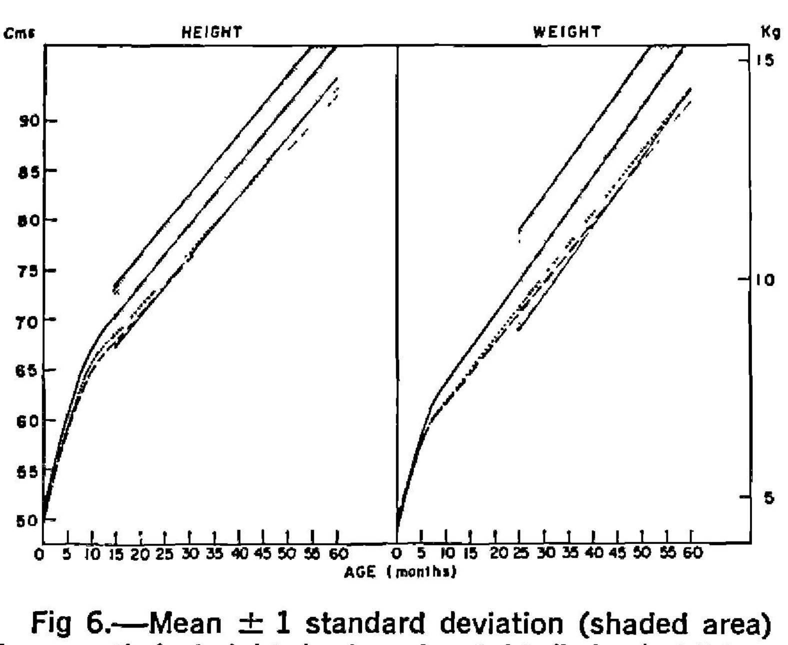

Fig 6.—Mean ± 1 standard deviation (shaded area) for growth in height (cm) and weight (kg) of children of Santa Catarina Barahona (feeding village) compared with mean for children of Santa María Cauqué (treatment village) (dotted line), and mean for children of Santa Cruz Balanyá (control village) (dashed line), by age in months.

of children in the feeding village comes from a detailed analysis of growth constants for the three villages. For the first 3 to 4 months, the initial rate of growth did not differ appreciably either among villages or from that of well-nourished children in Central America or the United States. This is the period when breast milk alone is generally adequate as a source of food and when infectious disease is less frequent because of maternally acquired passive immunity, good nutrition, and fewer opportunities for infection.

Well before the sixth month, conditions begin to change. Breast milk is less adequate as the sole source of food, and infection becomes more of a problem. The effectiveness of passive immunity decreases and exposure to infection is greater due to a more highly contaminated environment, more exposure to people, and food far less safe than breast milk. Not surprisingly, growth rates decline. The age at which this slowing in rate of growth occurred was somewhat later and of smaller magnitude in the feeding village than in the other two.

From 1 to 4 years of age, a constant rate of gain in height and weight is assumed; lower rates are attributed mainly to environmental factors. For both height and weight, the growth rates after one year of age were significantly less impaired in the feeding village than in the treatment and control villages. On the other hand, no significant differences in anthropometric measurements were observed between children of these two villages at any age studied.

Assessment of Growth Differences.—Assessment of the physiological significance of better growth and development of children in the feeding village may focus on either of two findings: the small differences among villages compared with the large departures from similar measurements in well-nourished children, or the better growth of children in the feeding village than in the treatment and control populations. It is true that the superiority of growth and development of children in the feeding village was small relative to the other two, and grossly inferior to similar measurements of well-nourished children. Nevertheless, a difference in growth increments in height of 0.06 cm for each month during ages 1 through 4 years between children in the feeding village and those in the other two means a difference in height of approximately 3 cm at the end of the five years of observation. To this must be added the net difference at 1 year of age between children of the feeding and treatment villages (about 0.7 cm) and those of the feeding and control villages (about 0.5 cm). The total difference is sufficient to be physiologically meaningful.

Nutrition.—The nutritional status of children even in the feeding village was far from optimal at the end of the study due to irregular consumption of the food supplement. This may account for the lack of a statistically significant association in any of the study villages between disease incidence and growth. The failure to demonstrate statistically more disease in the lowest terciles for height and weight was presumably due to the generally small improvement in growth rates.

The superior growth performance of the children in the feeding village may have been due more to the nutrition education program than to the supplementary feeding. There is some suggestion that the children participating most in the feeding program tended to receive less food at home. This was a likely factor in the lack of a significant correlation between total days of consuming the food supplement and growth rates. Moreover, total days of supplementary food intake is a relatively poor measure of the possible effect of the supplement because it does not take into account the distribution of the days of participation, the quantities consumed, or their relationship to breast feeding and food in the home. For example, a child receiving the supplement daily for only three months of the year would be credited with 25% participation for that year. Unfortunately, it is not practical to analyze growth rates by supplement consumption over periods of time as short as three to six months. Growth increments during such short periods are small, and technical difficulties in measurement are sufficiently great to make the results unreliable. Also, an acute infectious disease often influences sharply and unfavorably both food consumption and growth.

Direct evidence exists that the nutrition program rather than preexisting differences accounted for improved performance in growth and development of preschool children in the feeding village. Comparison of

Table 4.—*Gain in Height of Children From 1 to 4 Years of Age $y = a + bx$*

Village	No. of Observations	a* (cm)	b* (cm/mo)	R
Feeding				
Boys	733	61.782	0.604	.868
Girls	817	61.003	0.613	.902
Total	1550	61.346	0.610	.886
Treatment				
Boys	1427	60.218	0.553	.874
Girls	1602	59.058	0.543	.840
Total	3029	59.664	0.547	.851
Control				
Boys	1366	61.413	0.525	.824
Girls	1611	59.506	0.576	.819
Total	2977	60.402	0.552	.821

*The growth constants a and b are explained in the text. Least significant difference for sex comparisons (P - .05), approximately 0.02. Least significant difference (P = .05) for village comparisons (pooled sexes), approximately 0.01.

Table 5.—*Gain in Weight of Children From 1 to 4 Years of Age $y = a + bx$*

Village	No. of Observations	a* (kg)	b* (kg/mo)	R:
Feeding				
Boys	733	6.047	0.161	.811
Girls	818	5.976	0.157	.820
Total	1551	6.006	0.159	.814
Treatment				
Boys	1427	5.897	0.143	.798
Girls	1602	5.461	0.141	.760
Total	3029	5.688	0.141	.768
Control				
Boys	1369	6.055	0.137	.745
Girls	1612	5.568	0.148	.755
Total	2981	5.802	0.143	.749

*The growth constants a and b are explained in the text. Least significant difference for sex comparisons (P – .05), approximately 0.009. Least significant difference (P .05) for village comparisons (pooled sexes), approximately 0.005.

heights and weights of the children at the end of the program could be made with heights and weights of school children observed in INCAP studies in the same village from 1953 to 1955.[12,13] The body size of the children participating in the present program will clearly be greater upon entering school at age 7 years than that of children in the previous decade. On the other hand, no such change was noted for the children in the treatment village where data on the growth of children go back to 1950.

It is also pertinent that differences in height among children of the three villages were not discernible at the start of the study; they developed only as the program proceeded. For weight, the picture is less clear, since the weight of children in the feeding village was slightly higher from the beginning than that of children in the other two villages.

A lesser morbidity and mortality have previously been reported[4-6] for the feeding village than for the treatment and control populations. From dietary records and consumption of the food supplement, we assumed a superior nutritional status of the children in this village. This is now supported by the multiple measurements of growth and development made in this study.

The question remaining is whether the growth and development of children in the treatment village give evidence of a beneficial effect from the improved environmental sanitation and medical services instituted there. The answer is clearly in the negative under the conditions existing during the study years. The reason has been discussed in earlier papers: namely, that the public health and medical measures taken in the treatment village did not decrease the burden of infection on preschool children during the period of the study. Instead, two prolonged epidemics of diarrheal disease actually gave increased risk in the treatment village compared with the other two villages. Since no decrease in morbidity from infectious disease and no dietary improvement occurred in the treatment village, improved growth during the program would not have been expected and was not observed.

Thus, the first hypothesis, that the nutrition program in the feeding village would improve nutritional status, was supported by moderately increased rates of gain in height, weight, bone age, skinfold thickness, and head circumference.

The second hypothesis, that introducing certain types of environmental sanitation, disease prevention, and medical care would reduce the frequency and severity of disease sufficiently to produce an improvement in the nutritional status of the children in the treatment village, even without specific nutritional measures, was not supported by the present findings. Epidemics of diarrheal disease are typical of Guatemalan villages, but with two epidemics in the treatment village and none in the control, the hypothesis did not receive a fair test. There is no way of determining whether or not the situation would have been worse without the treatment program.

For 182 children of the feeding village, 310 of the treatment village, and 324 of the control, growth and development during the first four months were similar to those of well-nourished reference children in Guatemala and the United States. By 6 months of age a decline was clearly evident, although to a lesser extent in the feeding village. In all three villages, nearly all children of the 1- to 4-year age group were below the tenth percentile for well-nourished children; but children in the feeding village had higher measurements for all parameters used.

The difference in rate of growth between the feeding village and the other two communities corresponded to a difference of approximately 3 cm in height and 1,000 gm in weight at age 5 years. Children of the treatment and control villages were about equal in growth development.

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RESEARCHERS

Persons who do research can be separated into three classes:

1. Those who develop new concepts—whose imaginative thinking conceives a new principle. These are the rare and precious scientists. Many of them are recognized and honored during their lifetime.

2. Those who develop new approaches to the study of someone else's idea. Obviously, these too are very valuable individuals. Additional benefits derive from their work when the techniques which they devise are applied to other problems, allowing new kinds of information to be obtained. Sometimes such information is the basis upon which a Class I scientist establishes a new principle. Class II is a larger group than Class I, and often more successful, because Class II scientists produce more data, also, their methods tend to be picked up and used by others—with proper identification.

3. Persons who apply someone else's methods to the study of someone else's ideas. These individuals, unfortunately, comprise the bulk of researchers. But they do contribute a great deal to the advancement of science. They provide those detailed data which are necessary to verify the new principle; they subject the new technique to varied conditions, determining the extent and nature of its limitations. The progress of science would be greatly slowed without this group. (However, we could well do without that individual who applies someone else's poor methods to someone else's poor ideas, under bad conditions.—Howard C. Hopps, MD, Chief, Division of Geographic Pathology, Armed Forces Institute of Pathology, Washington, DC.