Prevalence of Brachymesophalangia V in Guatemalan Rural Children

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ABSTRACT

The overall prevalence of brachymesophalangia V (Bmf V) in the left hand-wrist X-rays of 1,206 rural Guatemalan children was 5.1%. No differences in prevalence were found between sexes or among ages from 0 to 7 years old. Children with Bmf V did not differ from children without this anomaly in regard to stature, weight, bone age or bone cortical thickness.

Brachymesophalangia is a bone condition characterized by a reduction in length and an increase in width of the affected phalanx. Brachymesophalangia V, hereafter referred to as Bmf V, is the presence of this anomaly in the middle phalanx of the fifth finger.

A genetic component in Bmf V is indicated by the 15-fold greater prevalence among patients with Down's Syndrome than among a normal control population (Garn et al., 1972a). Sixty-two percent of cases with Down's Syndrome have the anomaly (Hefke, 1940), while prevalence among population groups ranges from 1.3% to 5.0% (Garn et al., 1967). Further, Chinese and Negro children living under the same geographical circumstances show different prevalence rates (Hertzog, 1967). Finally, Sachs (1940) studied 32 members of a family, in five generations, who presented Bmf V. He found that the anomaly was equally transmitted by and to, males and females, concluding that this is a familial inherited trait. Garn et al. (1972b) suggested that Bmf V without cones is separately inherited without sex bias, while Bmf V with the cone-epiphysis of mid-5 and the cone-epiphysis of the

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mid-5 alone are both apparently inherited with a marked excess of females over males.

Snodgrasse et al. (1955), however, attributed bone anomalies to nutritional factors and, on the basis of an association of shortness of stature with "crooked fifth finger", Hewitt (1963) suggested that the middle fifth phalanx is commonly deformed because it is hyperresponsive to general growth factors. However, Pryde and Kitabatake (1959) found that *in utero* radiation from the atomic bomb had no effect on the incidence of this bone anomaly. Garn and co-workers (1967) found varying degrees of prevalence of Bmf V among populations of the same race but living in slightly different geographical areas. Such variations were possibly due to the presence of different environmental circumstances. Garn and co-workers (1972c) have shown further that Bmf V is associated with shorter metacarpal length and stature. They postulate that this reflects reduced nutrient needs among persons with Bmf V and thus, a selection advantage for Bmf V under conditions of suboptimal nutrition.

Thus, there is at present no consensus as to the relative contributions of nature and nurture in the development of Bmf V. The purpose of this paper is to report the prevalence of Bmf V in a group of children from the rural areas of Guatemala, where malnutrition is widespread. A second purpose is to relate the presence or absence of Bmf V with the somatic indices of malnutrition, namely, retardation of growth and of bone development.

Material and Methods

Bone age, as estimated by the Greulich and Pyle (1959) method, number of ossification centers, cortical thickness of the midpoint of the second proximal phalanx and the lengths of the middle fourth and fifth phalanges were measured in 1,206 X-rays of the hand and wrist of 593 boys and 613 girls aged 0 to 7 years, living in Guatemalan rural areas. The X-ray procedures were those recommended by Greulich and Pyle (1959). Cortical thickness and phalanx length were measured with a Helios caliper graduated to 0.05 mm.

Heights and weights were obtained in 40% of the children, whose X-rays represent an unbiased sample of all the X-rays taken (Blanco, 1971).

Bmf V was considered present when the ratio of phalanx length between medial phalanges V/IV was less than 0.5. This comparison

across phalanges is preferable to that of the lengths of the fifth phalanges, since the latter tend to a higher degree of correlation (Hewitt, 1963).

Results

We found 62 cases of Bmf V, that is, an overall percentage of 5.1%; 26 were boys (4.4%) and 36 were girls (5.9%). Table 1 shows the distribution of groups by age and sex. Neither the differences between sexes ($\chi^2_c = 1.082$, 1 d.f.; $P > .25$) nor among the age-groups ($\chi^2 = 4.715$, 6 d.f.; $P > .05$) are statistically significant. There is no increased prevalence of Bmf V with age.

Table 1

Distribution of Cases of Brachymesophalangia V in Guatemalan Rural Children by Age and Sex Groups

Age (months)	With Bmf V	Without Bmf V	Total
	BOYS		
0–11	4	86	90
12–23	2	80	82
24–35	1	70	71
36–47	5	97	102
48–59	4	81	85
60–71	6	70	76
72–83	4	83	87
Sub Totals	26	567	593
	GIRLS		
0–11	2	95	97
12–23	5	71	76
24–35	6	76	82
36–47	3	82	85
48–59	9	96	105
60–71	7	97	104
72–83	4	60	64
Sub Totals	36	577	613
Grand Total	62	1,144	1,206

The children are stunted in all the indices used to evaluate somatic growth and bone development, relative to well-nourished populations from which the standards are taken (Blanco, 1971). Children with Bmf V do not differ in weight (Fig. 1), height (Fig. 2), cortical thickness (Fig. 3), number of bone centers (Fig. 4) or bone age (Fig. 5), from those who do not present this anomaly.

Regarding the family distribution of this bone anomaly, Bmf V was found three times in two siblings and once in three siblings.

Discussion

The group of children under study had suffered from and were still affected by varying degrees of malnutrition, but there were no cases of mongolism or of severe mental retardation.

The difference in prevalence rates in Guatemala between this study and that of Garn, Feld and Israel (1967) may be due to differences in the definition of Bmf V. In this study population no distinction was made between cases of Bmf V alone and Bmf V with cone-epiphysis mid-5. No cases of cone-epiphysis mid-5 alone were included.

No evidence of sexual differences in Bmf V was detected in this population, nor is there sufficient evidence to indicate that Bmf V is a familial characteristic. If one includes or excludes the nine children who shared Bmf V with siblings, the incidence (P) of Bmf V in this population is 5.14% and 4.26%, respectively. The expected number of pairs of children drawn at random ($N = 1{,}206$) in which both have Bmf V is therefore 3.2 and 2.2 respectively ($N \cdot p^2$), as opposed to the 3 cases found. The expected number of triples drawn at random with Bmf V are 0.16 and 0.09 ($N \cdot p^3$) respectively, in contrast to the 1 case found. There is, therefore, no evidence in this sample for a family predisposition for Bmf V.

Neither is there any evidence suggestive of any association of Bmf V with malnutrition as indicated by a greater retardation in growth or bone development, than in children without Bmf V. However, these indices of growth are all strongly affected by post-natal nutrition in this study population, while the prevalence of Bmf V (Table 1) does not change with age. Thus, if nutrition is a factor, its influence must occur before birth. Only longitudinal nutritional data collected during pregnancy and birth compared to the appearance of Bmf V will answer that question.

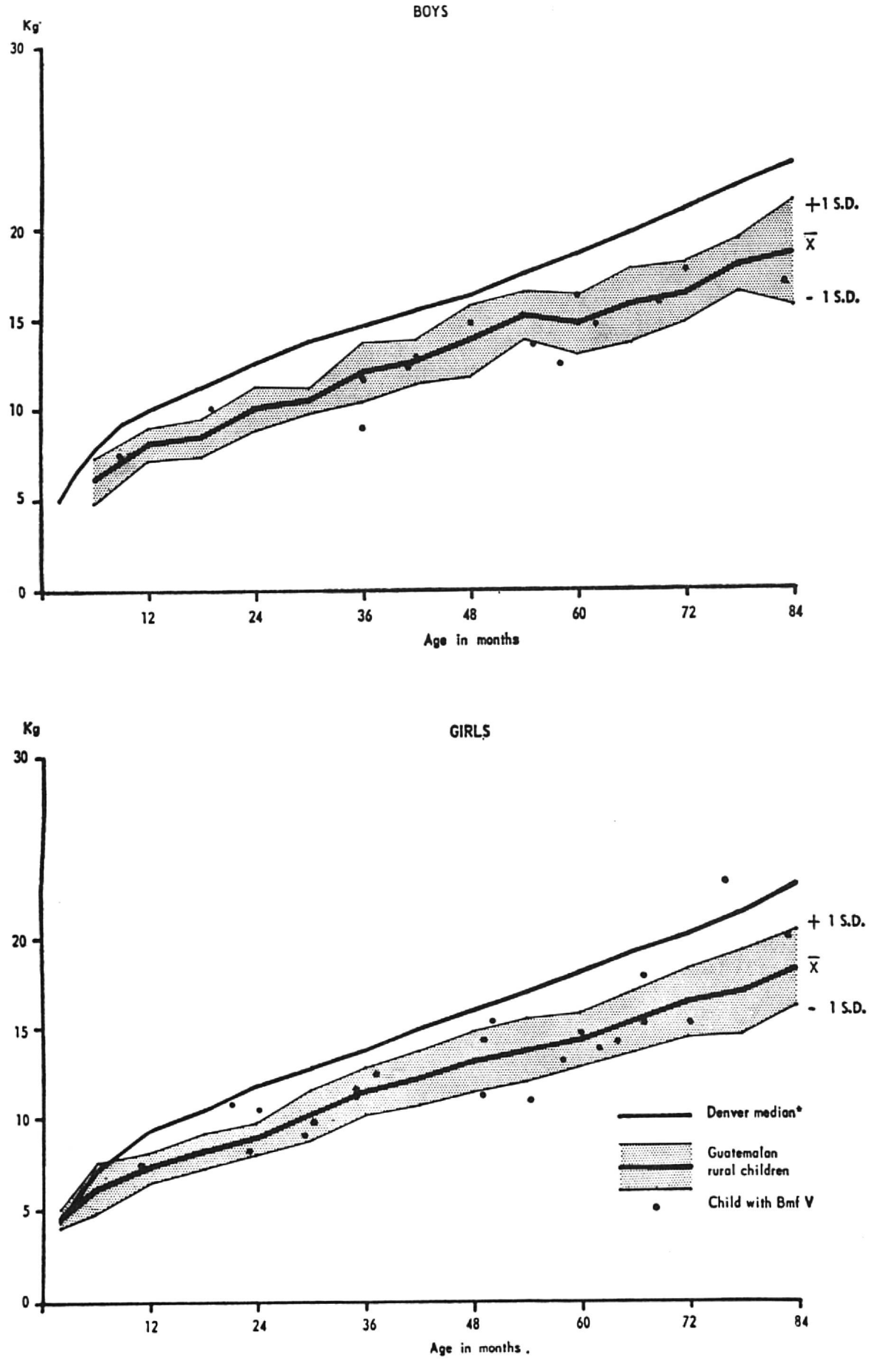

FIG. 1. Weight of children with brachymesophalangia V (Bmf V) compared with that of their playmates and of Denver children (McCammon, 1970).

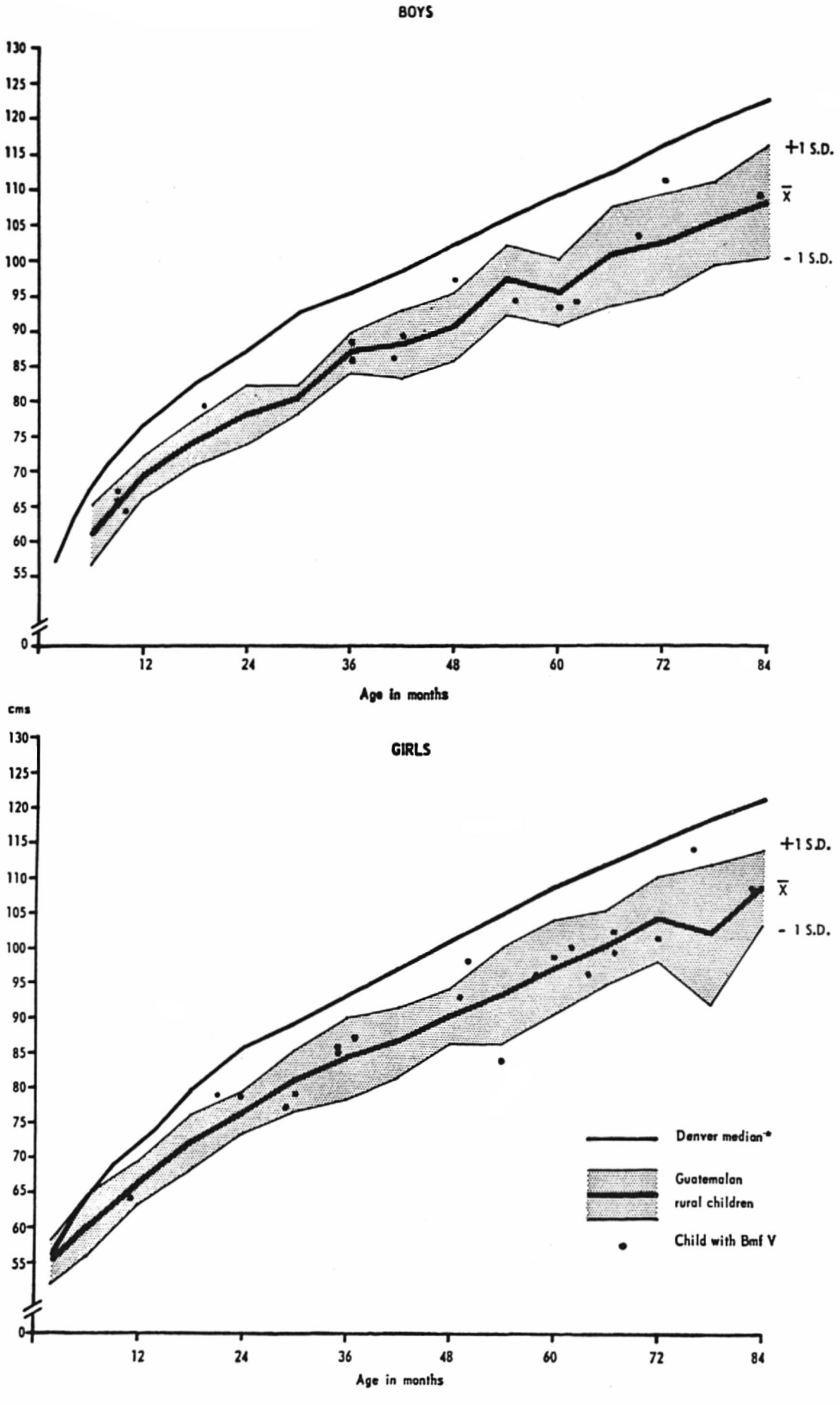

FIG. 2. Height of children with brachymesophalangia V (Bmf V) compared with that of their playmates and of Denver children (McCammon, 1970).

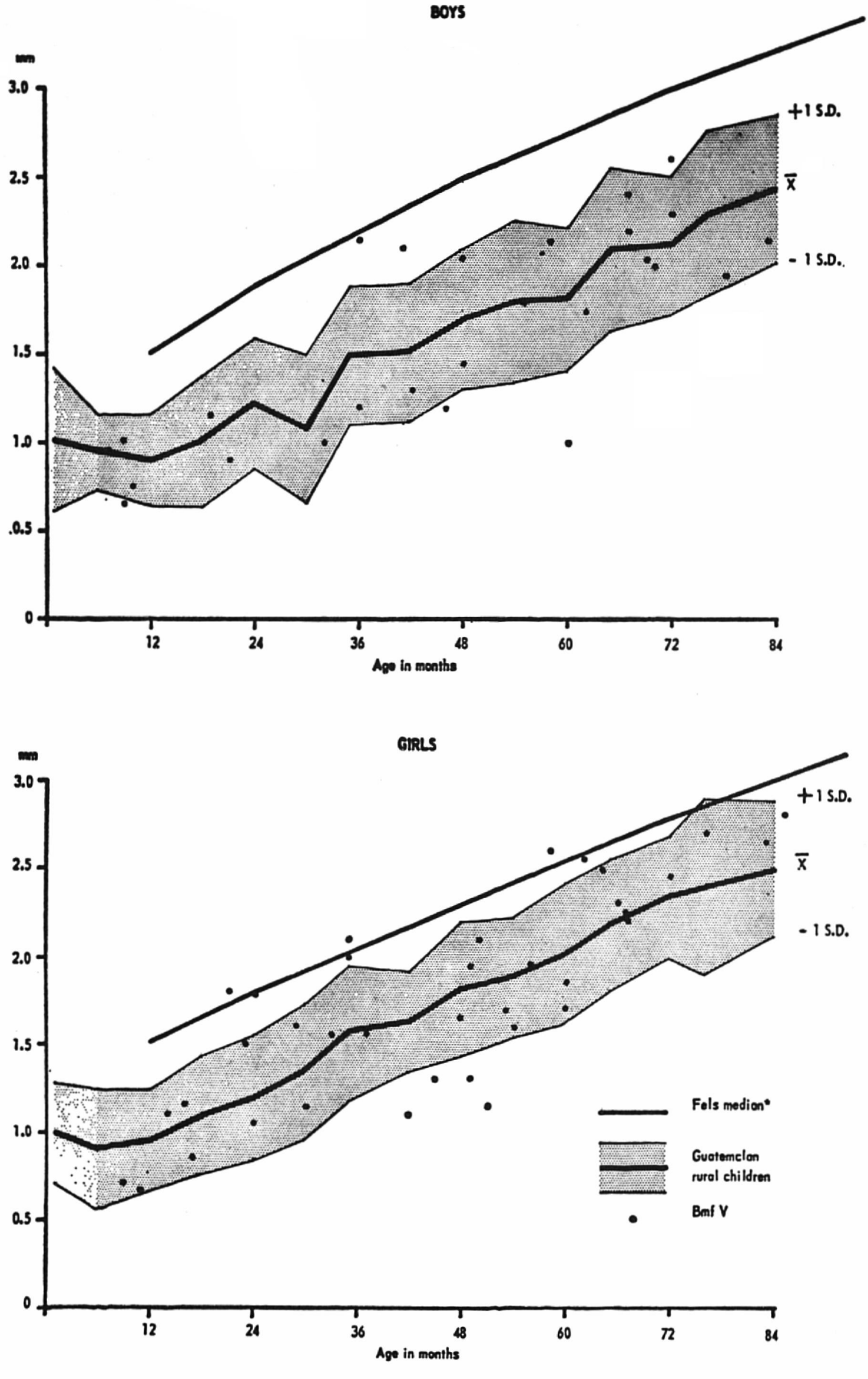

FIG. 3. Cortical thickness of children with brachymesophalangia V (Bmf V) compared with that of their playmates and of the Fels Institute study in Ohio (Garn et al. 1963).

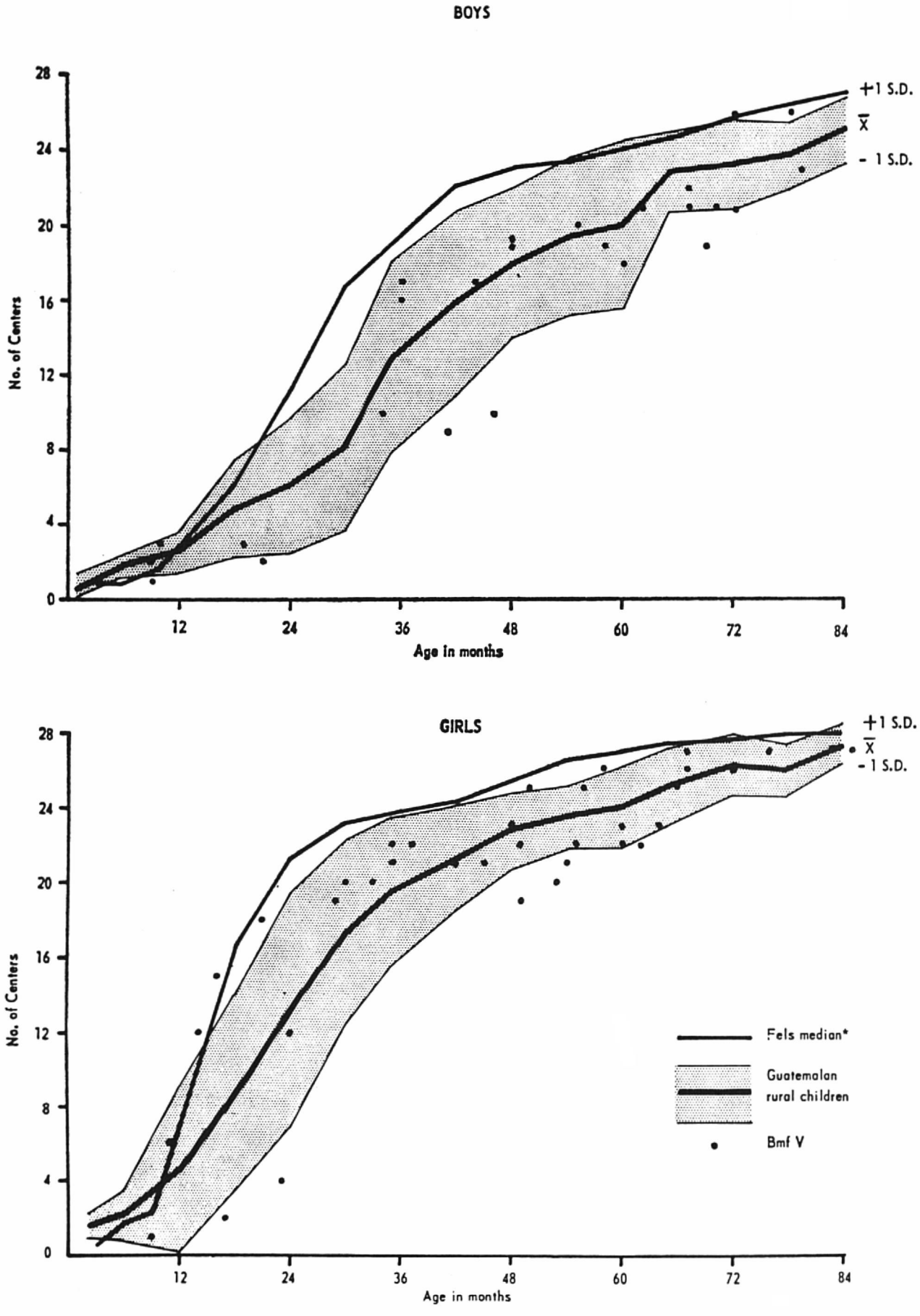

FIG. 4. Number of ossification centers of children with brachymesophalangia V (Bmf V) compared with that of their playmates and of the Fels Institute study in Ohio (Garn et al. 1963).

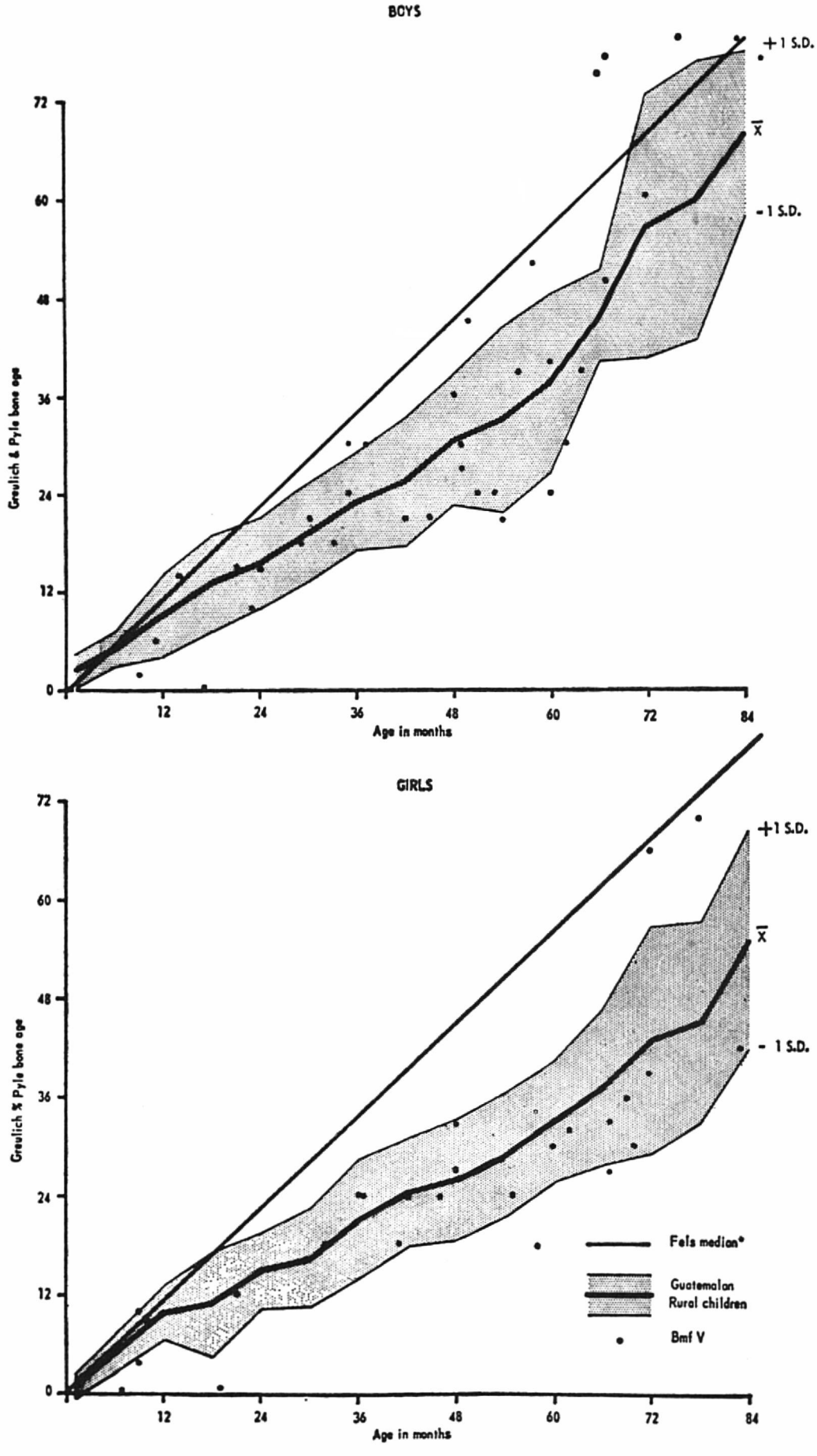

FIG. 5. Bone age of children with brachymesophalangia V (Bmf V) compared with that of their playmates and of the Greulich and Pyle (1959) standards.

These findings are at variance with those reported from the U.S.A. (Garn et al. 1972c) in that Bmf V is not found to be associated with short stature in the Guatemalan children. The population of those with Bmf V who were taller than the population from whom they were drawn, was 61% in Guatemala and 22% in the U.S.A. (Garn et al., 1972c). The difference between these two proportions is statistically significant ($p < 0.01$).

If children with Bmf have less growth potential than those lacking Bmf V as suggested by the U.S.A. data, then the fact that there is no difference between the growth of malnourished Guatemalan children with or without Bmf would indicate that the limiting factor on growth is nutrition. Further, this would also suggest that under the inadequate nutritional conditions of these Guatemalan children, potential growth has no effect on growth whatsoever.

Acknowledgements

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