The Metacarpal Index of Infants

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Some infants appear to have long fingers, and since arachnodactyly is a feature of Marfan's syndrome, it is important to know whether a baby's long fingers are outside the normal range.

In 1960, Sinclair, Kitchin, and Turner observed that arachnodactyly in Marfan's syndrome was related to the length and breadth of the metacarpal bones and showed that the metacarpal index was a useful criterion of arachnodactyly. The index is calculated by measuring the 2nd, 3rd, 4th, and 5th metacarpals. The sum of the lengths is divided by the sum of the breadths, as measured at the midpoint of each metacarpal. Sinclair's measurements were carried out mainly on adults, and it is not known if they are relevant to babies, or to children before the appearance of secondary ossification centres in the metacarpals.

The aim of this study was to obtain values for the metacarpal index of children aged 2 years and under, and to compare the normal values with the indices of some infants who were thought to have long or short fingers.

Material and Method

Dr. Alice Stewart kindly allowed us to use *x*-rays of the hands of normal children who had been observed in a longitudinal study of growth at Oxford (Acheson, Kemp, and Parfit, 1955). The *x*-rays of both hands of 25 girls and 25 boys had been taken at 6 months, 12 months, 18 months, and 24 months. The children had been examined and were known to be healthy.

The metacarpal index of each hand was measured in each child at all four ages by a method similar to that described by Sinclair *et al.* (1960). The mid-point of the metacarpal was identified by observation rather than by measurement; in practice this causes a difference of less than 0.5 mm. in the width recorded. The maximum length was measured, and in older infants the distal border of the epiphysal ossification centre was taken to be the end of the metacarpal. All measurements were recorded to the nearest 0.5 mm.

Results

Normal children. Table I shows the mean metacarpal index of the right and left hands of the

50 children at the ages of 6, 12, 18, and 24 months, as well as the standard deviation at each age. There is no significant difference between the right and left hands at any age.

Throughout the first two years girls have a greater index than boys, but the difference is small. A detailed comparison of the mean indices for each metacarpal of the 50 children at the age of 6 months showed that each metacarpal contributed to the higher mean metacarpal index observed in the girls, and their metacarpals were both longer and narrower than the boys.

There is a tendency for the index to increase with age; thus it is 0.17 more in boys and 0.24 more in girls at the age of 24 months than at 6 months.

Observer error was estimated by measuring the metacarpal index of the four sets of *x*-rays from each of 6 children at different occasions and secondly using different observers. No significant observer error was found ($p < 0.05$).

Abnormal children. Table II shows the metacarpal index of 7 children who were thought to have abnormally long fingers. For 3 of the children a diagnosis of Marfan's syndrome could be made confidently on the basis of family history, ocular, and other abnormalities. The index of each is 2 SD greater than the mean in the normal group. The other 4 children had long fingers and congenital heart disease, but a diagnosis of Marfan's syndrome could not be made; they are called

TABLE I
Metacarpal Index of 50 Normal Children During First 2 Years

Age (mth.)	Sex	Mean	SD
6	M	5.23	0.46
	F	5.60	0.37
12	M	5.30	0.41
	F	5.75	0.41
18	M	5.28	0.40
	F	5.82	0.45
24	M	5.40	0.43
	F	5.84	0.43

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TABLE II
Metacarpal Index of 7 Children with
Long Fingers

Diagnosis	Age (mth.)	Sex	Metacarpal Index	Normal Index $\pm$ SD
Marfan	24	F	7.4	5.84 $\pm$ 0.43
Marfan	12	F	8.4	5.75 $\pm$ 0.41
Marfan	6	M	7.0	5.23 $\pm$ 0.46
Arachnodactyly	12	F	8.6	5.75 $\pm$ 0.41
Arachnodactyly	6	F	7.5	5.60 $\pm$ 0.37
Arachnodactyly	6	M	6.1	5.23 $\pm$ 0.46
Arachnodactyly	6	F	7.2	5.60 $\pm$ 0.37

'arachnodactyly'. In 3 of these 4, the index is significantly greater than that of the normals.

In mongolism the fingers appear short, therefore we measured the metacarpal index in 43 mongol children aged less than 24 months. In mongols the index is very similar to the normal group.

Table III compares the findings in all the children. Since the metacarpal index varies with sex and age, the normal mean has been expressed as 100% and the other indices converted to a percentage of the mean (from Table I) so that they can be compared. Those children with 'Marfan's syndrome' and 'arachnodactyly' have significantly greater metacarpal indices.

TABLE III
Comparison of Metacarpal Indices of Normal and Abnormal Children

	No. of Children	Mean $\pm$ SD (% of Normal)	Significance of Difference from Normal Mean
Normal children	50	100 $\pm$ 13	
Marfan syndrome	3	136 $\pm$ 8	p < 0.003
'Arachnodactyly'	4	132 $\pm$ 12	p < 0.006
Mongolism	43	98 $\pm$ 10	p > 0.4

Discussion

The results show that the metacarpal index in normal young children steadily increases between the ages of 6 and 24 months. It must continue to increase, for Sinclair *et al.* (1960) found that 80% of adults had an index in the range 7.0-7.9. In the young children we studied, the slightly higher metacarpal index of girls might be accounted

for by their earlier skeletal maturation, but this factor cannot explain the finding in adults that the metacarpal index is higher for women than for men (Parish, 1966). Bonnard (1968) measured the metacarpal diameters of children up to the age of 11 years, and found them to be narrower in girls throughout childhood.

Though Sinclair showed a good correlation between long fingers and a high metacarpal index, it is less certain that short fingers are associated with a low metacarpal index. Therefore our finding of a normal metacarpal index in mongolism need not be at variance with the common observation that the fingers of mongol children are short.

The children with long fingers and congenital heart disease reported in Table II were included in order to illustrate the relevance and use of the normal values for the metacarpal index. Marfan's syndrome can be a difficult diagnosis in early life, and it is hoped that measuring the metacarpal index will contribute to a firmer diagnosis.

Summary

The metacarpal index of 50 children was measured at the ages of 6, 12, 18, and 24 months. The mean index and standard deviation at each age is presented. The index increases during the first 2 years and is higher in girls.

The figures for the metacarpal index can be used for the diagnosis of arachnodactyly and Marfan's syndrome.

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