Heights, Weights, and Skeletal Age of Jamaican Adolescents with Sickle Cell Anaemia

M. T. ASHCROFT, G. R. SERJEANT, and P. DESAI

From the MRC Epidemiology Unit and Department of Medicine, University of the West Indies, Kingston, Jamaica

Ashcroft, M. T., Serjeant, G. R., and Desai, P. (1972). *Archives of Disease in Childhood, 47*, 519. **Heights, weights, and skeletal age of Jamaican adolescents with sickle cell anaemia.** Weights, heights, and skeletal age, assessed from hand radiographs, were recorded in a cross-sectional study of 99 Jamaicans with sickle cell anaemia aged between 12 and 21 years. Compared with controls, weight and skeletal age were less at all ages. The data suggested that the average height of younger patients was less but that of older patients was at least as great as that of controls.

Little has been recorded about growth changes in sickle cell anaemia, particularly during adolescence, though the body habitus of a few patients has been briefly described by Winsor and Burch (1944, 1945), Sharpe and Vonder Heide (1944), Whitten (1961), and Jimenez et al. (1966). These studies suggested that adolescents with sickle cell anaemia were shorter than normal and it is therefore surprising that Serjeant et al. (1968) found that the mean stature of 60 Jamaican adults with sickle cell anaemia was as great as that of healthy Jamaicans, a finding that has been confirmed by Ashcroft and Serjeant (1972) in a further series of 121 adult patients.

A study of growth, including skeletal maturation of the hand, in children, adolescents, and young adults with sickle cell anaemia is in progress at University Hospital, Kingston, Jamaica. The results reported here are a cross-sectional analysis of data on heights, weights, and skeletal maturation.

**Material and Method**

Patients aged 12 years and over attended the sickle cell clinic. Some relatively asymptomatic cases have been found during family studies, and mild cases of the disease are therefore likely to be more common than in other series. Diagnosis was based on the presence of only haemoglobins S, F, and A₀ on starch gel electrophoresis. Patients with levels of Hb A₀ above 3·6% as measured by column chromatography by the method of Huisman and Dozy (1965), or with high levels compared with controls on starch gel electrophoresis, were excluded as possible cases of sickle β-thalassaemia.

When fetal Hb (Hb F) levels were higher than 15%, Bette-Kleihauer preparations were made in order to exclude cases of Hb S in association with hereditary persistence of fetal Hb.

All anthropometric measurements were made by one observer (M.T.A.). Subjects were weighed on a balance scale, wearing light clothing but with shoes removed. Stature was measured with a stadiometer, with the subject standing erect, heels together, and line of vision directed horizontally. Radiographs of the left hand and wrist were taken using nonscreen film; the tube was centred above the head of the third metacarpal at a distance of 76 cm. Radiographs of patients and controls were randomly mixed, and skeletal maturity was assessed by comparison with the standard atlas of Greulich and Pyle (1959). A single radiograph of the wrist and anthropometric measurements taken on one occasion during the period between July 1968 and December 1970 were used in the analysis. Radiographs and measurements of 43 boys and 56 girls between their 12th and 21st birthdays were analysed. Measurements of an additional 5 girls, who did not have wrist radiographs, were also included.

Pupils up to the age of 15 years attending a primary school in rural Jamaica acted as controls. Anthropometric measurements and hand radiographs had been taken in 1967 using the same techniques as in the present study and compared with those of British children by Marshall, Ashcroft, and Bryan (1970). For older controls, a secondary school in the same area was visited in 1970. Standards for height and weight of Jamaican schoolchildren up to the age of 15 and of adults, including subjects between 15 and 20 years, are available (Ashcroft and Lovell, 1966; Ashcroft et al., 1966). As shown in Fig. 1 and 2, mean heights and weights of controls were similar to those of these standards, except for males aged from 17 to 20 years who were...
heavier and slightly taller. The number of subjects and controls, all of whom were of predominantly African origin, is shown in the Table.

**Results**

In Fig. 1 and 2 weights and heights of patients were compared with the mean growth curves of Jamaican standards and of the controls used for comparison of skeletal development. Weights of all boys and of all except 8 girls were below the standard growth curves and in many patients were more than 2 SDs below the mean of the control group.

Differences in height were more complex than...
Heights, Weights, and Skeletal Age of Jamaican Adolescents with Sickle Cell Anaemia

TABLE

Skeletal Maturation of the Wrist in Patients with Sickle Cell Anaemia and in Controls

| Age (yr) | Males |  |  |  | Females |  |  |  |
|----------|-------|  |  |  |         |  |  |  |
|          | Total No. | No. with Maturity Complete | Total No. | No. with Maturity Complete | Total No. | No. with Maturity Complete | Total No. | No. with Maturity Complete |
| 12–15    | 19     | Nil             | 60         | Nil             | 22         | Nil             | 79         | 1             |
| 16–17    | 6      | Nil             | 15         | Nil             | 9          | 1               | 17         | 9             |
| 18–19    | 7      | Nil             | 7          | 2               | 8          | Nil             | 9          | 8             |
| 19–20    | 4      | Nil             | 4          | 3               | 6          | 3               | 6          | 6             |
| 21–22    | 6      | 2               | 2          | 2               | 5          | 5               | 6          | 6             |
| 23–25    | 6      | 3               | 11         | 9               | 4          | 4               | 6          | 6             |
|          | 9      | 9               | 11         | 9               |            |                 |            |               |

Those in weight. A trend in Fig. 2 suggests that younger patients were shorter but older patients were as tall as controls. The variation in height was, however, so large that firm conclusions cannot be drawn.

In Fig. 3 and 4 bone age, as estimated by the Greulich and Pyle atlas, is compared with the expected value when bone age is, by definition, the same as chronological age, and with mean values of the bone age of controls. Bone ages of patients were considerably less than expected values and than those of controls at all ages under study, and many were more than 2 SDs younger than the mean of the control group.

By the atlas method skeletal maturation is complete at 19 years in males and at 17 in females so that calculation of mean bone age has little meaning if maturation has been completed in some subjects in the age group under study. In these circumstances, the proportion of subjects whose skeletal maturation has been completed is a better index than mean bone age (Table). Patients attending the clinic up to the age of 25 years have also been included because skeletal development was not
Always completed by 20 years. The number of male controls for skeletal development was few, but maturation was complete in 5 of the 6 subjects aged 19 and 20 years. In contrast, maturation was incomplete in the one patient aged 19, and in many of those from 20 to 22 years. In most female controls maturation was complete by 17 years but was incomplete in all 8 patients aged 18 and in 3 of the 6 patients aged 19. After the 20th birthday, maturation was complete in female patients except 2 aged 21 and 2 aged 25, all of whom had incomplete fusion of the distal epiphysis of the radius. It is possible that fusion may never occur in these older patients.

Weights and heights of patients at their estimated bone ages were compared to mean weight and height curves of controls calculated for bone age. Fig. 5 shows that the weight for bone age of male patients was almost always below the mean of controls and several were more than 2 SDs below the mean. Weight for bone age of female patients was also, on average, less than that of controls but not as much so as that of males. Fig. 6 shows that height for bone age of patients was not less than that of controls and, though there were wide variations, it appears that older patients tended to be taller than controls of the same bone age. As an index of physique, weight divided by height was calculated. Fig. 7 shows that this index in patients was in most cases less than that of the mean.
for the controls, indicating that leanness is a characteristic of sickle cell anaemia, even after allowance has been made for delay in skeletal maturation.

Discussion

The subjects used as controls came mainly from peasant families with low incomes living in a rural area, and may on average have represented a slightly lower socioeconomic group than that of the patients, some of whom came from middle-class homes in the city of Kingston. Differences in measurements and skeletal maturation might have been greater had it been possible to match for socioeconomic conditions accurately. The Hb status of the controls was not determined, but the presence of any subject with homozygous SS disease would be improbable. Some controls may have been heterozygous, AS, but no significant differences in height and weight were found between AA and AS adults living side by side in a rural community (Ashcroft, Miall, and Milner, 1969). The number of controls, especially those aged 18 years and older, was less than desirable owing to the difficulty of arranging for suitable subjects to have radiography of the wrists, but the general direction of the differences between patients and controls was consistent.

The study was cross-sectional and a single measurement of each patient was considered so it cannot be assumed that the younger children would necessarily attain the physique of the older children, though we have no reasons to suppose that there was any difference in their selection which might lead to a different pattern of growth.

The results show that patients weighed less and had a retarded bone age compared with controls. The results suggest that height in the early teens was less but by the late teens was as great as that of controls. However individual heights varied greatly. The heights of females, for example, at ages between 18 and 20 years, ranged from 146·0 to 178·1 cm. More detailed investigations of factors which might have led to these differences in height might be worth while.

The weights, and weights divided by heights, of patients were on average substantially less than those of controls of the same true age or of the same bone age. In our experience, a subject with SS Hb is rarely other than thin. When a reasonably well-covered patient with a positive sickle test is referred to the clinic, the Hb genotype is almost invariably found to be AS, SC, or S-thal. A low amount of subcutaneous fat, and possibly of muscle tissue, appears to be a characteristic feature of sickle cell anaemia.

As children with sickle cell anaemia have been found to be smaller than normal in other studies (Sharpe and Vonder Heide, 1944; Whitten, 1961), and as the average height of a series of Jamaican
adult patients was as great as that of controls (Ashcroft and Serjeant, 1972), it seems probable that in sickle cell anaemia the increase of stature during adolescence is, on average, greater than normal—a feature that may be associated with delay in skeletal maturation. Longitudinal studies now in progress will reveal with greater accuracy the growth patterns of sickle cell anaemia.

REFERENCES
Winsor, T., and Burch, G. E. (1945). Habitus of patients with active sickle cell anaemia of long duration. Archives of Internal Medicine, 78, 47.

Correspondence to Dr. M. T. Ashcroft, M.R.C. Epidemiology Unit (Jamaica), University of the West Indies, Mona, Kingston 7, Jamaica W.I.
Heights, Weights, and Skeletal Age of Jamaican Adolescents with Sickle Cell Anaemia

M. T. Ashcroft, G. R. Serjeant and P. Desai

Arch Dis Child 1972 47: 519-524
doi: 10.1136/adc.47.254.519

Updated information and services can be found at:
http://adc.bmj.com/content/47/254/519

These include:

Email alerting service
Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

Notes

To request permissions go to:
http://group.bmj.com/group/rights-licensing/permissions

To order reprints go to:
http://journals.bmj.com/cgi/reprintform

To subscribe to BMJ go to:
http://group.bmj.com/subscribe/