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Height of diabetic children at onset of symptoms

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Drayer, N. M. (1974). *Archives of Disease in Childhood*, **49**, 616. **Height of diabetic children at onset of symptoms.** At the onset of classical symptoms of diabetes mellitus, the height of the boys (expressed as SD score) was greater than the height of the girls. Also, diabetic boys were significantly taller than healthy (control) boys, but diabetic girls were not significantly taller than control girls. There was no significant difference in the midparental height, or in the age of the parents of the diabetic boys and girls.

When plotting the growth of diabetic children, it appeared that there was a difference in height of these children at the onset of symptoms compared with healthy controls, and that there was also a sex difference. The diabetic boys appeared to be relatively taller than the diabetic girls. An assessment of the initial height, as well as of the parental height and age, was therefore made.

Methods

The heights recorded for 62 diabetic children at the onset of the classical symptoms of diabetes, such as thirst and polyuria, were used. The diabetic children studied were living in the three northern provinces of the Netherlands. They were under the private care of two paediatricians, or were attending the diabetic clinic at the Academic Hospital. With the exception of 2 boys and 1 girl born in 1954 and 1957, the diabetic children were born after 1958.

In 1970 the heights and age of 639 boys and 322 girls, aged 4 to 14 years, attending school in Groningen, were recorded for matched controls. A matched control child was a child who most closely corresponded in age to the diabetic child's age.

The mean heights and SD of Dutch children, obtained from a national survey conducted in 1965 (van Wieringen, 1971), were used to calculate the SD score (Tanner *et al.*, 1971) for both the diabetic children and their matched controls. The SD score of the height measurement is the height minus the mean height divided by the SD of the height at the relevant age. Height measurements were made by the method of Tanner, Whitehouse, and Takaishi (1966) for the matched control children aged 6 to 14 years. For the other children a modification was used in which firm traction upwards was not applied under the mastoid processes.

The results are given as mean $\pm$ SD. Statistical significance was assessed by the 't' test (two-sided).

Results

The initial heights of 31 boys and 31 girls with diabetes mellitus and the heights of their matched controls were plotted on the Dutch growth charts (van Wieringen, 1971) and are shown in Fig. 1 and 2. Table I shows the mean and SD of the heights and ages of the diabetic and matched control children for

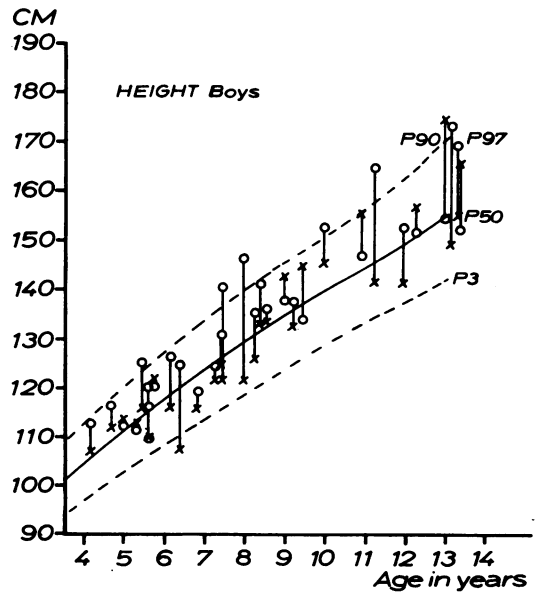

FIG. 1.—*Height of boys. Diabetes mellitus* O, *matched control* x.

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TABLE I

Height and age of diabetic children at the onset of symptoms and of matched controls

No.	Age group (yr)	Child	Height		Significance of difference in height compared with Dutch children (P)	Age (yr) (mean ± SD)
			cm (mean ± SD)	SD score (mean ± SD)		
Boys						
31	4–14	Diabetic	134·9 ± 17·5	0·79 ± 1·13	<0·001	8·31 ± 2·87
		Matched control	130·2 ± 18·7	−0·08 ± 1·13	NS	8·31 ± 2·86
20	4–9	Diabetic	125·0 ± 11·0	0·84 ± 1·11	0·001–0·01	6·51 ± 1·42
		Matched control	118·7 ± 9·6	−0·35 ± 0·98	NS	6·51 ± 1·42
11	9–14	Diabetic	152·9 ± 12·0	0·70 ± 1·22	NS	11·60 ± 1·56
		Matched control	150·9 ± 11·9	0·42 ± 1·26	NS	11·60 ± 1·57
Girls						
31	4–14	Diabetic	136·6 ± 17·2	0·11 ± 0·95	NS	9·40 ± 2·80
		Matched control	138·9 ± 16·5	0·47 ± 0·95	0·01–0·02	9·39 ± 2·80
12	4–9	Diabetic	118·6 ± 10·3	0·09 ± 1·23	NS	6·21 ± 1·27
		Matched control	121·6 ± 9·2	0·72 ± 0·95	0·02–0·05	6·20 ± 1·28
19	9–14	Diabetic	148·0 ± 8·6	0·12 ± 0·77	NS	11·42 ± 0·99
		Matched control	149·9 ± 8·7	0·31 ± 0·95	NS	11·41 ± 0·98

NS, not significant.

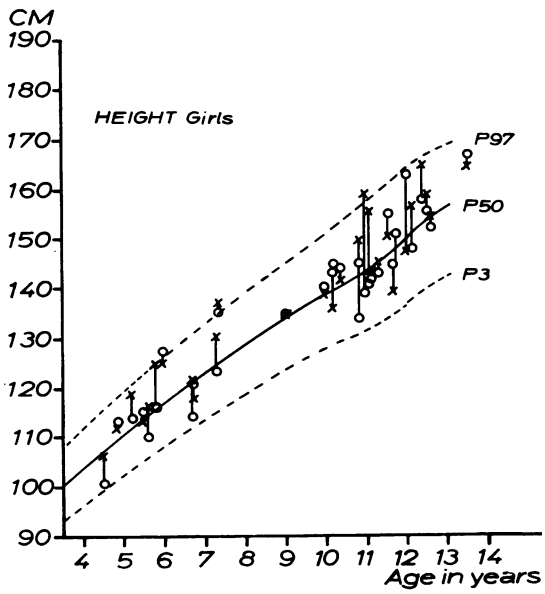

FIG. 2.—*Height of girls. Diabetes mellitus* O, *matched control x.*

the age group 4 to 14 years. The heights are expressed in cm as well as in SD scores. The greatest difference in age between a diabetic child and his matched control was 0·071 years.

The diabetic boys were significantly ($P < 0·001$) taller than the Dutch children, but the diabetic girls were not. Subdividing the age group of 4 to 14 years into two groups, 4 to 9 years and 9 to 14 years, showed that the diabetic boys aged 4 to 9 were taller ($P < 0·01$), but that the diabetic boys aged 9 to 14 were not significantly taller ($0·5 < P < 0·1$) than the Dutch children.

Of the matched control children the boys did not differ significantly in height from the national survey boys, but the girls did. They were taller in the age group 4 to 14 years ($P < 0·02$) and in the subgroup aged 4 to 9 years ($P < 0·05$).

Compared to the matched controls, the diabetic boys aged 4 to 14 years were taller ($P < 0·01$) (Table II). The boys in the subgroup of 4 to 9 years were also taller. The diabetic girls were not significantly different in height from the matched controls; however, the diabetic girls in the subgroup 4 to 9 years were shorter ($P < 0·05$). The diabetic boys were significantly taller than the diabetic girls, but the difference in height for both subgroups 4 to 9 years and 9 to 14 years was not significant (Table III).

There was no significant difference in the mid-parental heights, or in the mean ages of the fathers or of the mothers of the diabetic boys and girls, as shown in Table IV. There was no striking difference in the birth order of the diabetic boys and girls, as shown in Table V.

Discussion

The difficulty in obtaining a good control series has been raised previously by other authors (Leupold, 1960; Craig, 1970). The influence of secular changes in the heights should be minimal, as nearly all diabetic children were born after 1958 and the controls were measured in 1965 (national survey controls) or in 1970 (matched controls).

The diabetic children lived in the three northern

TABLE II

Difference in height between diabetic children at the onset of symptoms and matched controls

No.	Age groups (yr)	Difference in height			
		cm (mean ± SD)	P	SD score (mean ± SD)	P
Boys					
31	4–14	+4·7±10·7	0·02–0·05	+0·87±1·69	0·001–0·01
20	4–9	+6·3± 7·4	0·001–0·01	+1·19±1·35	0·001–0·01
11	9–14	+2·0±15·0	NS	+0·28±2·12	NS
Girls					
31	4–14	−2·3± 7·6	NS	−0·36±1·16	NS
12	4–9	−3·0± 4·5	0·02–0·05	−0·63±0·94	0·02–0·05
19	9–14	−1·9± 9·1	NS	−0·19±1·28	NS

TABLE III

Difference in height between diabetic boys and girls at the onset of symptoms

Boys (no.)	Girls (no.)	Age group (yr)	Difference in height	
			SD score (mean)	P
31	31	4–14	+0·68	0·01–0·02
20	12	4–9	+0·75	NS
11	19	9–14	+0·58	NS

TABLE IV

Mean age of parents and midparental height of diabetic children

No.	Age (yr)		Midparental height (cm)	
	Fathers (mean ± SD)	Mothers (mean ± SD)	No.	(mean ± SD)
Boys				
20	33·97±4·95	30·33±4·72	20	172·3±4·6
Girls				
20	32·54±5·53	29·41±5·18	18	170·4±5·8

TABLE V

Birth order of diabetic boys and girls

Birth order	1st	2nd	3rd	4th+
27 boys	8	6	4	9
22 girls	7	10	2	3

provinces of the Netherlands. The mean height of children from two of these provinces is known. For the age groups 4 to 9 years and 9 to 14 years, mean height of boys was 0·9 cm and 1·6 cm, respectively, and of girls 0·8 cm and 1·4 cm, respectively—taller than the Dutch children from the national survey (van Wieringen, 1971). Since children from the third province are reputedly smaller than the average Dutch children and their mean heights are unknown, it was decided to use height data from the national survey and not the data from the two provinces.

In addition, another control group was obtained by measuring schoolchildren in a town situated in one of the two provinces where the children's mean heights are known. From this group a child was paired with a diabetic child purely on the basis of corresponding age. No account was taken of other factors, such as the social background.

It is difficult to interpret the finding that the matched control girls, and not the boys, were significantly taller than the national survey children. In view of this finding one can understand that at the onset of symptoms the diabetic girls, who were not different in height from the national survey children, were smaller in the age group 4 to 9 years ($P < 0·05$) than the local matched controls.

It can be concluded that diabetic boys at the onset of symptoms are taller than the national survey children as well as taller than the local matched controls. Knowing the wide range at which puberty begins, it is not surprising that a comparison of two transverse studies fails to show a significant difference in height for the small subgroup of 11 boys aged 9 to 14 years, compared with both control groups.

The published reports summarized in Table VI give conflicting reports on the initial height of diabetic children. As a group, the diabetic children's height can be taller or smaller than the control group, or be of the same height.

No study yet mentions a sex difference, though Pond (1971) noticed that both diabetic boys and girls tended to be taller than controls, and that the tendency is more marked in girls ($P < 0·001$) than in boys ($P < 0·05$). In this study, by using SD scores, diabetic boys were found to be significantly taller

TABLE VI

Height of diabetic children at the onset of symptoms, compared to the height of nondiabetic children

Location of the diabetic clinic	Investigator	Author of the relevant control studies	No. of diabetic children studied	Compared to the controls, the diabetic children are
U.S.A.				
Boston	Spencer (1928)	Bowditch	45	Taller*
,,	White (1959)	Baldwin	810	Taller
Iowa City	Boyd and Nelson (1928)	Baldwin	20	'Slightly overheight'*
,,	Jackson and Kelly (1946)	Jackson	86	Shorter
,,	Beal (1948)	Stuart and Meredith	92	Same height
New York City	Ladd (1926)	Stratz	34	Taller*
,,	Fischer, Mackler, and Marks (1942)	Burgess	44	Taller
Pittsburgh	Danowski (1957)	Maresh	244	Same height or shorter
U.K.				
Birmingham	Jivani and Rayner (1973)	Tanner	104	Same height
Glasgow	Craig (1970)	Tanner†	80	Taller
London	Pond (1970)	Tanner	101	Taller
Switzerland				
Zurich	Leupold (1960)	Heimendinger	163	Same height
,,	Bihrer (1970)	Heimendinger	76	Same height
Sweden				
Falun	Hamne (1962)	Broman	155	Boys shorter; girls same height or shorter
Stockholm	Sterky (1967)	(Matched control)	150	'Boys slight increase in height'
Germany				
Greifswald	Katsch (1950); Lübken (1951)	Kornfeld	31	Taller*
The Netherlands				
Groningen	Present study	Van Wieringen (matched controls)	62	Boys taller; girls same height Boys taller; girls same height

*Diabetic boys and girls not analysed separately. †Adapted for Glasgow.

than diabetic girls. A sex difference was not found for the subgroups 4–9 years and 9–14 years, but a sex difference could conceivably have been shown to occur if both subgroups had been larger. No difference in midparental height, parental age, or in birth order was found between boys or girls.

The suggestion could be made that the diabetic condition favours the expression of the genes causing tallness, and this expression could be sex limited. It could also be that the metabolic and/or anatomic abnormalities inherent in juvenile diabetes mellitus cause either an imbalance in the neuroendocrine regulation of growth or a disturbance in the tissues responsible for growth, and in this way increase the growth in height in boys, but not in girls.

Tanner *et al.* (1959) suggested thyroid hormone as the only possible hormone that might be implicated in the mechanism, whereby the normal male maintains his relative growth retardation throughout the growing period. However, no indication of any sex difference in thyroid function in normal boys and girls could be found. Hypoglycaemia stimulates growth hormone release (Roth *et al.*, 1963) and hypoglycaemic episodes are known to occur before the classical symptoms of diabetes mellitus, such as thirst and polyuria, appear (Allen, 1953). However, no difference in the occurrence of these hypoglycaemic episodes between boys and girls has been reported to the author's knowledge. Also, no sex difference has been reported in skeletal maturation in diabetic children (White, 1959).

The mechanism(s) causing the sex difference in the initial height in our diabetic children remains obscure.

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