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Prenatal Progesterone and Educational Attainments*

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Summary. Children whose mothers received prenatal progesterone have been shown to be advanced in development at one year and to have greater academic achievement at 9–10 years. This study compares the educational attainments at 17–20 years of 34 progesterone children with 37 normal and 12 toxaemic controls. More progesterone children continued schooling after 16 years compared with controls; a higher proportion left school with 'O' level and 'A' level passes, the average number of passes per child was greater at both levels and more obtained a university place. The best academic results were in those whose mothers had received over 5 grams of prenatal progesterone, and for whom administration commenced before the sixteenth week and treatment lasted longer than eight weeks.

Introduction

A survey of 633 pregnant women attending University College Hospital revealed that 25 per cent of those with toxaemic symptoms (headaches, depression, tiredness, nausea and fainting) between the 16th and 28th week later developed pre-eclamptic toxaemia, compared with only 10 per cent of women who had none of these symptoms during the same period (Dalton, 1960). Controlled trials have shown that the incidence of toxaemia among women with toxaemic symptoms can be reduced to 3 per cent if they are treated with progesterone injections (Dalton, 1962) or progesterone suppositories (Dalton, 1976). Toxaemia in the mother is associated with diminished intelligence in the child of that pregnancy (Baker and Edwards, 1967); but among children whose mothers received prophylactic progesterone there has been noted an advanced development at 1 year and enhanced educational attainment at 9–10 years (Dalton, 1968). Children suffering from congenital adrenogenital syndrome (hyperadrenocortical hermaphroditism) are exposed to an excess of endogenous progesterone in prenatal life; they too have been found to have high IQ (Ehrhardt and Money, 1967).

This paper reports the educational attainments in 1975 of 34 children whose mothers received progesterone during pregnancy ('progesterone children') compared with matched controls.

Method

All the children in this study were born between January 1955 and May 1958, either at the City of London Maternity Hospital or in the author's general practice. The children who are classified as progesterone children are those whose mothers received a minimum of 500 mg progesterone by intramuscular injection for the relief of toxaemic symptoms.

Each progesterone child was matched to the next born child in the hospital labour ward or the general practice register whose mother had a normal pregnancy (normal controls) or whose mother's pregnancy was complicated by toxaemia (toxaemic controls). Four mothers were included in both the hospital and the general practice series and were each matched with a control from each register. There were two pairs of twins among the progesterone children but none among the controls.

Questionnaires were sent to 65 progesterone children, 71 normal controls and 25 toxaemic controls—161 in all; and 83 completed question-

* The C.O. Hawthorne BMA Prize Essay, 1976.

naires (52 per cent) were received, 34 from progesterone children, 37 from normal and 12 from toxaemic controls. On an even distribution with 52 per cent response one would have expected replies from 33·5 progesterone, 36·6 normal and 12·9 toxaemic controls; this suggests that there was no bias as between the groups in respect of completing questionnaires. The poor response would appear to be due to the many removals which occur in an interval of 18 years.

All mothers were white Europeans, and none of the children were adopted. No parents were university graduates or had received professional training at the time of the child's birth; they belong to social classes III to V. One progesterone and two normal control girls were now married. One set of twin progesterone boys completed the questionnaires.

Results

The age at which the children left school showed that 29 per cent progesterone children, 37 per cent normal controls and 58 per cent toxaemic controls left at 16 years; whereas 59 per cent of progesterone children, 46 per cent of normal controls and 33 per cent of toxaemic controls stayed on to 18 years (Table I). No 'O' level passes were obtained by 15 per cent progesterone children, 24 per cent normal controls and 42 per cent toxaemic controls.

On the other hand 62 per cent of the progesterone children obtained 5 or more 'O'

TABLE I

Educational attainments of progesterone and control children

	Progesterone	Normal control	Toxaemic control	χ^2 on 2 df*	Probability less than
No. of children	34	37	12		
Age of leaving school					
16 years	10 (29%)	14 (37%)	7 (58%)		
17 years	4 (12%)	6 (16%)	1 (8%)	ns	ns
18 years	20 (59%)	17 (46%)	4 (33%)		
'O' levels per child					
None	5 (15%)	9 (24%)	5 (42%)		
1–4	8 (23%)	11 (30%)	4 (33%)	ns	ns
5 or more	21 (62%)	17 (46%)	3 (25%)		
Total 'O' levels	196	201	43	8·18	0·02
'O's per child	5·7	5·4	3·6		
Total 'O' levels in					
Sciences	84 (43%)	76 (38%)	12 (28%)	ns	ns
Arts	112 (57%)	125 (62%)	31 (72%)		
'A' levels					
Total 'A' levels	44	34	6	6·1	0·05
'A's per child	1·3	0·9	0·5		
'A' grade 'A' level ..	11	6	0	5·15	ns
'A' grade per child ..	0·32	0·16	0		
Total 'A' levels in					
Sciences	30 (68%)	14 (41%)	4	5·95	ns
Arts	14 (32%)	20 (59%)	2		
No. of children entering University	11	2	1	9·23	0·02

* Two-tailed test.

level passes, compared with 46 per cent normal and 25 per cent toxaemic controls.

Of the 440 'O' level passes obtained by the 83 children, there was a significant difference ($P < 0.02$) among the groups; thus the average number of passes per progesterone child was 5·7, with 5·4 passes per normal control and 3·6 per toxaemic control. 'A' level passes showed a significant difference ($P < 0.05$), with an average of 1·3 passes per progesterone child. The top grade 'A' was obtained in 'A' level by 11 progesterone children (32 per cent) and 6 normal (16 per cent), but by no toxaemic controls.

It was noted that in 'A' level passes, the science subjects accounted for 68 per cent of passes by the progesterone children compared with 41 per cent among normal controls.

Eleven of the 34 progesterone children obtained a university place compared with 2 normal controls and 1 toxaemic control, that is 32 per cent of progesterone children compared with 6 per cent among all the control children ($P < 0.02$). The corresponding figures for 18-year-olds entering English universities in 1974 were 6·3 per cent for the Inner London Educational Authority (HMSO, 1975), and 6 per cent for the London Borough of Haringey in which most of the children lived.

In the previous study of progesterone children at 9–10 years, the enhanced attainment was noted to be related to both the dose administered and the time of administration (Dalton, 1968). In this series (Table II) it was found that for children whose mother's therapy was started before the 16th week of pregnancy the average number of 'O' level passes was 7·5 compared with 4·9 for those whose mothers received late therapy ($P < 0.01$). When the duration of treatment exceeded 8 weeks (long duration) the average number of passes at 'O' level was 6·8, compared with 4·8 where treatment had been for a shorter duration ($P < 0.02$). If the total dose exceeded 5 grams of progesterone the

TABLE II

Effect of timing, duration and dosage of progesterone therapy on educational attainments

	Number of children	Total passes	Pass per child	χ^2 on 1 df*	Probability less than
'O' levels					
Early therapy	11	83	7·5	9·29	0·01
Late therapy	23	112	4·9		
Long duration	16	109	6·8	6·12	0·02
Short duration	18	86	4·8		
High dosage	13	83	6·4	ns	ns
Low dosage	21	112	5·0		
Optimal therapy	7	54	7·7	6·02	0·02
Sub-optimal therapy	27	141	5·2		
'A' levels					
Early therapy	11	19	1·7	ns	ns
Late therapy	23	25	0·9		
Long duration	16	24	1·5	ns	ns
Short duration	18	20	1·1		
High dosage	13	18	1·4	ns	ns
Low dosage	21	26	1·2		
Optimal therapy	7	15	2·1	4·9	0·05
Sub-optimal therapy	27	29	1·1		

* Two-tailed test.

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