and perhaps underreported terminal event. The importance of subclinical colonisation of the lower respiratory tract needs to be studied.

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1 Pifer LL, Hughes WT, Stagno S, Woods D. *Pneumocystis carinii* infection: evidence for high prevalence in normal and immunosuppressed children. *Pediatrics* 1978;61:35-41.

- 2 Leigh TR, Wakefield AE, Peters SE, Hopkin JM, Jacoub MH, Cattell WR, *et al.* The detection of subclinical *Pneumocystis carinii* infection using the polymerase chain reaction in asymptomatic renal and heart/lung recipients receiving no *Pneumocystis carinii* prophylaxis. *Thorax* 1991;46:743.
- 3 Peters SE, Wakefield AE, Sinclair K, Millard PR, Hopkin JM. A search for *Pneumocystis carinii* in post mortem lungs by DNA amplification. *J Pathol* 1992;166:195-8.
- 4 Lipschik GY, Gill VJ, Lundgren JD, Andrawis VA, Nelson NA, Neilson JO, *et al.* Improved diagnosis of *Pneumocystis carinii* infection by polymerase chain reaction on induced sputum and blood. *Lancet* 1992;340:203-6.

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Predicting the adult height of short children

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Some recent studies have suggested that treatment with growth hormones can stimulate growth in very short children who do not have growth hormone insufficiency,¹ but others suggest that growth hormone treatment may modulate normal puberty and shorten the pubertal growth spurt.² It is not known whether growth hormone treatment in children with short stature will make them taller than if they had not been treated. Most of the ongoing research uses changes in standard deviation scores of height before and after treatment as the measure of effect.³ Evidence supporting the common assumption that children who are short before puberty will also be short in adulthood is lacking. The present study therefore sought to describe the adult height of subjects who were short in childhood.

Methods and results

The data represent a subset of 93 800 Danish conscripts born 1930-1956 who attended the schools in the central municipalities of Copenhagen.⁴

Height (without shoes) was measured in all subjects except for those who were unquestionably unfit for service and did not appear before the board.⁴ Short stature was, by itself, not an acceptable reason for exemption from examination. In a random sample of 529 conscripts exempted, one was a dwarf owing to chondrodystrophia. One per cent of the total

population was randomly selected for the study. This sample comprised 938 draftees, of whom 912 had had their height measured. The median age at this examination was 19 (range 18-27) years.

In all schools of the central municipalities of Copenhagen, annual systematic health examinations, including measurements of height, were carried out. Every year at ages 7 through 13, about 80 000 of the 93 800 subjects had been examined.

Height was measured to the nearest centimetre and given as integers. Boys with heights below the height closest to the third centile are denoted boys with short stature.

Mean height of boys aged 7 increased from 124 (SD 6) cm to 176 (SD 7) cm in adulthood. For each age from 7-13 years the eventual adult height of boys with short stature ($n=18-26$) was 1.68-1.91 SD below the mean, and 30-43% of these boys remained below the third centile in adulthood. None of the boys with short stature had adult heights above average, and 90% had adult heights of more than 1.0 SD below the mean.

The figure shows the cumulative distribution of adult height for boys with short stature at 7 and 13 years, together with adult height in the total sample.

Comment

Data on childhood and adult heights were collected over a period of 26 years, during which the height of Danish men increased appreciably. This secular trend affected all height classes equally.⁵ As we compared heights of the same individuals as boys and adults, this trend will not affect predictions of adult shortness from childhood shortness. All men may not have achieved final height when measured at the draft board. In 313 subjects measured 4-34 years later height increased 0.5 (1.4) cm; height of subjects who were short in childhood increased 1.1 (1.4) cm.

The finding that short boys will, if untreated, remain short through adulthood, is important for evaluation of treatment with growth hormone in short children without growth hormone deficiency. The data may serve as references for final height in healthy boys small for age.

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- 1 Wit JM, Rietveld DHF, Drop SLS, Oostdijk W, Gons M, Otten BJ, *et al.* A controlled trial of methionyl growth hormone therapy in prepubertal children with short stature, subnormal growth rate and normal growth hormone response to secretagogues. *Acta Paediatr Scand* 1989;78:426-35.
- 2 Stanhope R, Albanese A, Hindmarsh P, Brook CGD. The effects of growth hormone therapy on spontaneous sexual development. *Horm Res* 1992;38 (suppl):9-13.
- 3 Lesage C, Walker J, Landier F, Chatelain P, Chaussain JL, Bouganères PF. Near normalization of adolescent height with growth hormone therapy in very short children without growth hormone deficiency. *J Pediatr* 1991;119: 29-34.
- 4 Sørensen TIA, Sonne-Holm S. Risk in childhood of development of severe adult obesity: retrospective, population-based case-cohort study. *Am J Epidemiol* 1988;127:104-13.
- 5 Christensen U, Sonne-Holm S, Sørensen TIA. Constant median body mass index of Danish young men, 1943-1977. *Hum Biol* 1981;53:403-10.

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Cumulative distribution curves of adult height in boys who had short stature (<3rd centile) as children and for all adults in sample