

# Impact of puberty on final height in children and adolescents with congenital adrenal hyperplasia (CAH)

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on behalf of the German CAH registry

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## Introduction

An optimized replacement regimen with glucocorticoids and mineralocorticoids in subjects with congenital adrenal hyperplasia (CAH) aims at preventing life-threatening salt wasting and adrenal crises, virilization and pubertal precocity, and at enabling normal linear growth.

## Aim

We investigated puberty and its impact on final height in children and adolescents with CAH

## Patients and Methods

In a cohort of post-pubescent male (n=172) and female (n=284) adolescents with CAH, the following parameters, documented in the German CAH registry, were retrospectively analyzed:

- Age at pubertal onset (Tanner stage B2 / single testicular volumes  $\geq$  4 ml),
- final adult height and parental target height,
- the  $\Delta$  between height SDS of the subjects during ages 0-4, 5-8, 9-12, 13-16 and  $>16$  years and their corresponding target height SDS.

In addition, the relationship of age at pubertal onset and the  $\Delta$  between height SDS at pubertal onset and final height SDS were investigated.

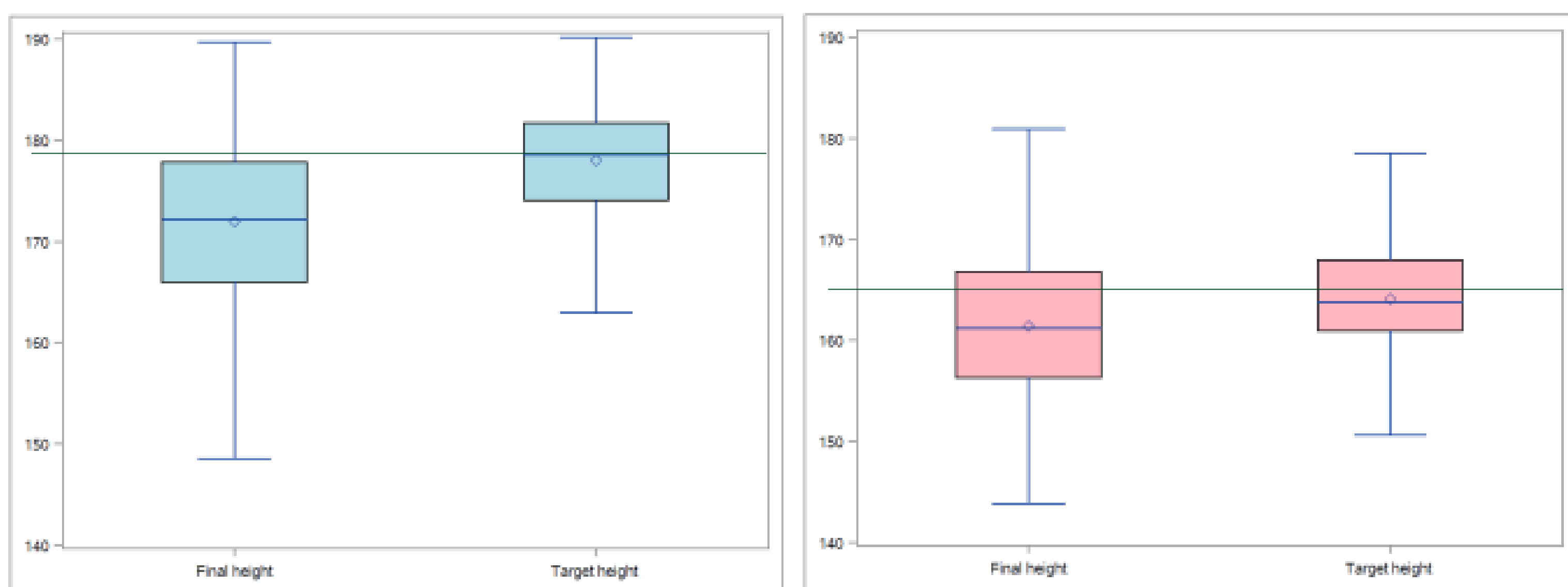
Puberty data were compared to published references from the Danish puberty study (1); height references were retrieved from the German KIGGS study 2003-2006 (2).

## Results

Median age at pubertal onset was 9.75 [Q1;Q3:8.43;10.74] years in CAH females (vs. 10.88 years in the reference population) (1), and 10.83 [8.69;12.99] years in CAH males (vs. 11.66 years).

Male patient's median final height was 7 cm below their median target height (172 [166;178] vs. 179 [174;182] cm) and female's median final height 3 cm below it (161 [156;167] vs. 164 [161;168] cm) (Fig. 1).

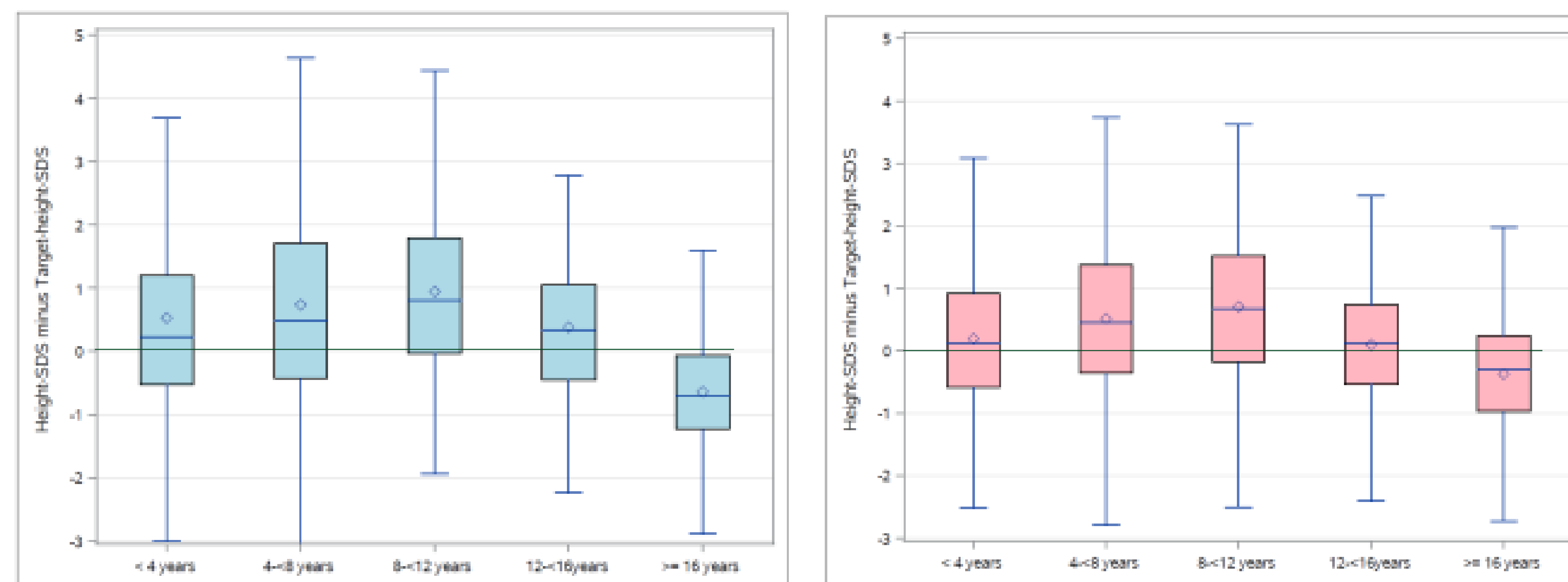
Median final height of healthy German boys/girls (KIGGS reference population) was 179.0 /165.8 cm, respectively (2).



**Fig. 1**  
Box plots with median/ upper and lower quartile of final height and parental target height in boys and girls with CAH.  
The bars indicate median final height achieved in healthy German boys/girls.

## Results

While median height-SDS *before* pubertal onset in both genders was *above* median target height SDS, it continuously dropped *during* puberty on a value *below* it (Fig.2).

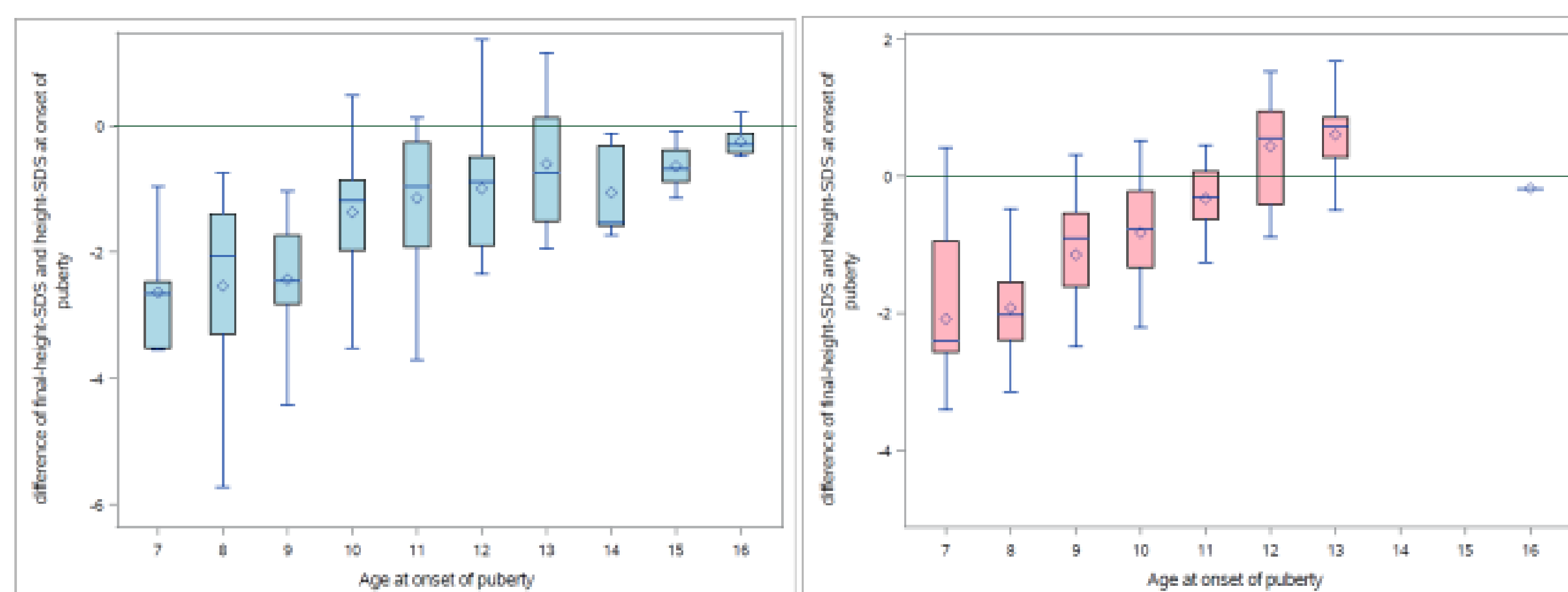


**Fig. 2**  
Box plots with median/ upper and lower quartile of the difference between height SDS at different ages in the course of childhood and adolescence and genetic target height SDS in boys and girls with CAH.

Pubertal height SDS-loss was highest in subjects with *precocious* pubertal onset: 2.5 [1.4;3.3] SDS in boys with pubertal onset  $\leq$  9 years and 2.1 [1.5;2.5] SDS in girls with onset  $\leq$  8 years.

Boys with *normal* pubertal onset (at ages 10-13) experienced a height SDS-loss of 1.0 [0.3;1.8]; girls with *normal* pubertal onset (at ages 9-12) lost 0.7 [0.1;1.2] height SDS during puberty.

In boys with *late* puberty (at ages  $\geq$  14), height SDS-loss was 0.4 [0.2;0.9] during puberty. By contrast, girls with *late* pubertal onset (at ages  $\geq$ 12) experienced a pubertal height SDS-gain of 0.5 [-0.2;0.9] (Fig. 3).



**Fig. 3**  
Box plots with median/ upper and lower quartile, illustrating the relationship between age at onset of puberty and the difference of achieved final height SDS and the height SDS at pubertal onset.

## Conclusions

Current treatment of CAH is more effective in delaying pubertal precocity in CAH boys than in girls. Height-SDS loss occurs in both girls and boys during puberty; this loss is inversely correlated to age at pubertal onset. Adult height within mid-parental expectations is reached more often in CAH females than in males.

## References

- (1) Sørensen K et al. Recent changes in pubertal timing in healthy Danish boys: associations with BMI. 2010; 95:263-70.
- (2) Rosario AS et al. German height references for children aged 0 to under 18 years compared to WHO and CDC growth charts. Ann Hum Biol. 2011; 38:121-30.