

# The pubertal gain in height is inversely related to body mass index (BMI) in childhood



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## Background/Objective

Weight in childhood may influence the pubertal timing and pattern of growth. The objective of our study was to investigate the impact of body mass index (BMI) in childhood on further growth, especially the specific pubertal pattern of growth.

## Conclusion

The higher BMI in childhood, the faster the pre pubertal growth, the earlier onset of puberty, the less pubertal gain. This was evident across the whole BMI-range, making weight status an important modifier of longitudinal growth.

## Results

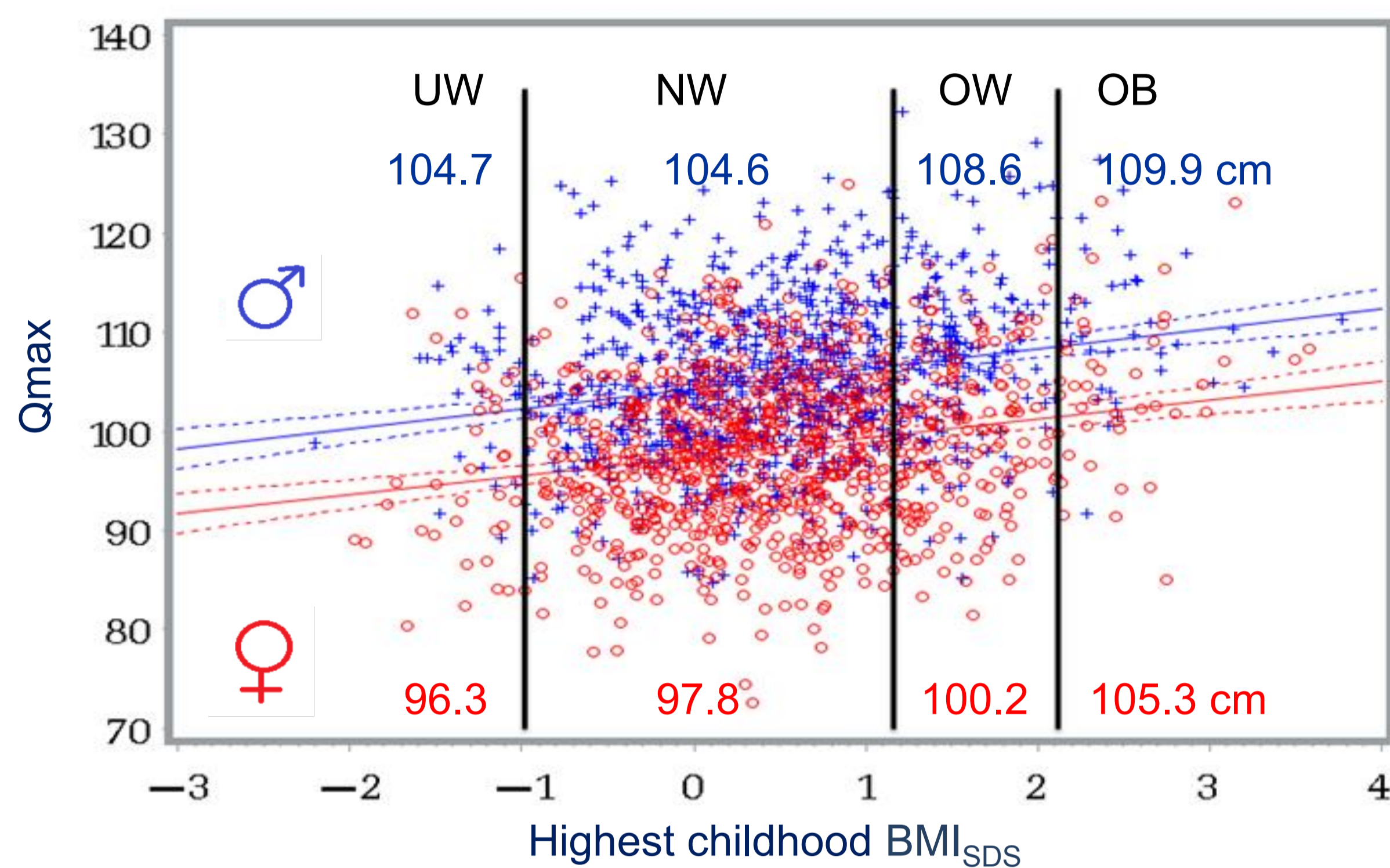


Figure 1. Qmax (the "childhood component" of growth) related to the highest childhood BMI<sub>SDS</sub><sup>1</sup>. Vertical lines, shows the borders for underweight (UW), normal weight (NW), overweight (OW) and obesity (OB).

For girls; Qmax = 97.47 + 1.90 x BMI<sub>SDS</sub>, adjusted r<sup>2</sup> = 0.046.  
For boys; Qmax = 104.32 + 2.02 x BMI<sub>SDS</sub>, adjusted r<sup>2</sup> = 0.049.

	OWOB (N=187)	NWUW (N=742)	Difference Girls	OWOB (N=190)	NWUW (N=782)	Difference Boys
Birth weight (g)	3712	3491	221 p < 0.0001	3760	3638	122 p = 0.0029
Qmax (cm) childhood growth	101.15	97.77	3.38 p < 0.0001	108.81	104.57	4.24 p < 0.0001
AgeP <sub>05</sub> (years) onset of pubertal growth	9.54	9.83	-0.29 p = 0.0004	11.58	11.79	-0.21 p = 0.007
Pmax (cm) specific pubertal gain	11.16	13.42	-2.26 p < 0.0001	14.67	17.80	-3.13 p < 0.0001
Adult height (cm)	168.3	168.2	0.037 NS	181.9	181.6	0.29 NS

## Results

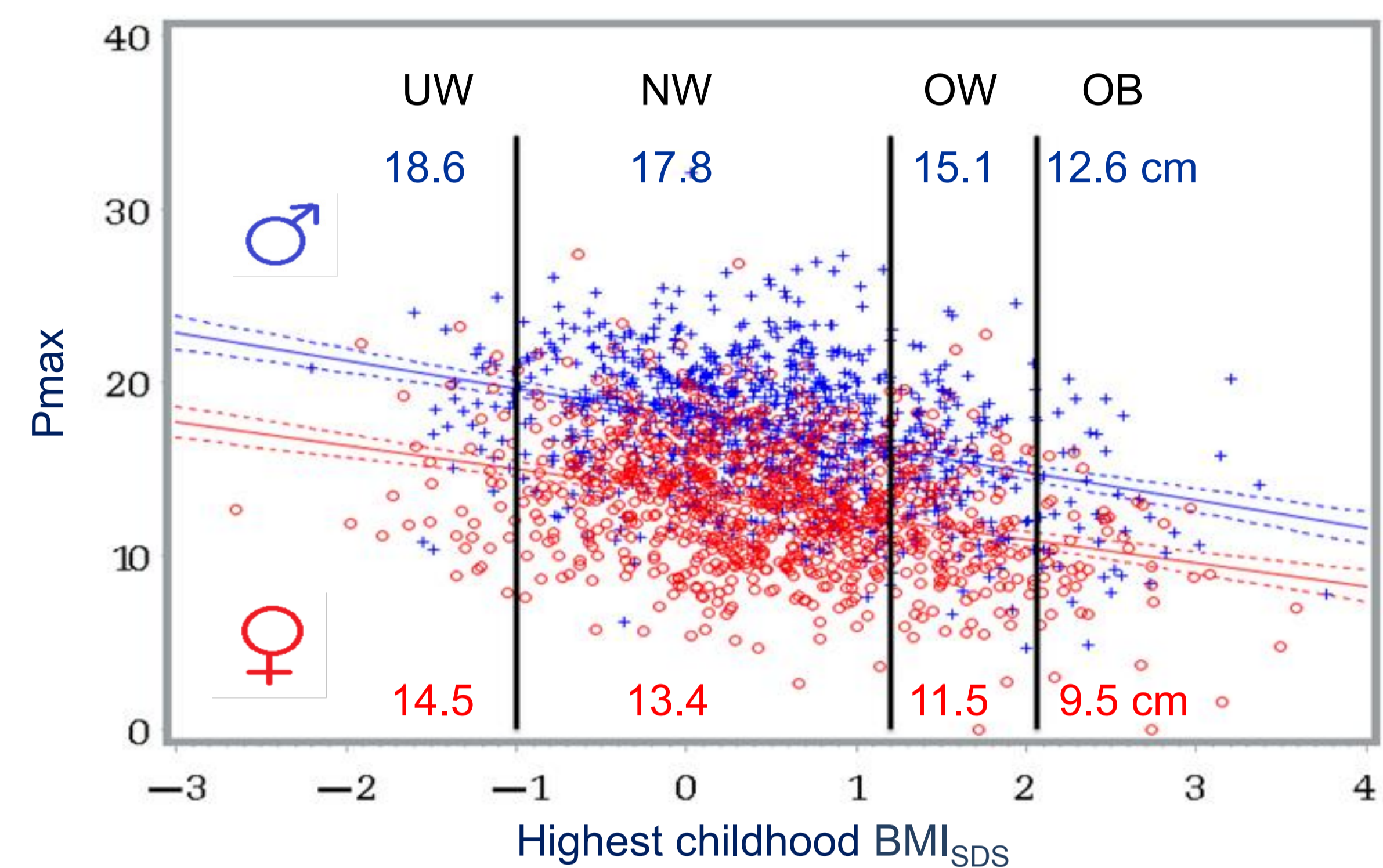


Figure 2. Pmax (the specific pubertal gain) related to the highest childhood BMI<sub>SDS</sub><sup>1</sup>. Across the whole BMI range a negative dose-response effect of childhood BMI on pubertal gain (Pmax) was found.

For girls; Pmax = 13.66 - 1.35 x BMI<sub>SDS</sub>, adjusted r<sup>2</sup> = 0.11. For boys; Pmax = 18.05 - 1.61 x BMI<sub>SDS</sub>, adjusted r<sup>2</sup> = 0.13.

OWOB children were heavier at birth, and they grew faster in height in the pre pubertal period compared to NWUW, as evidenced by an increased Q max.

OWOB children had earlier puberty, boys/girls, 91-117 days, reduced pubertal growth, boys/girls 3.13/2.26 cm less pubertal gain from the specific pubertal growth function (Pmax). The adult height was not related to BMI in childhood.

## Material

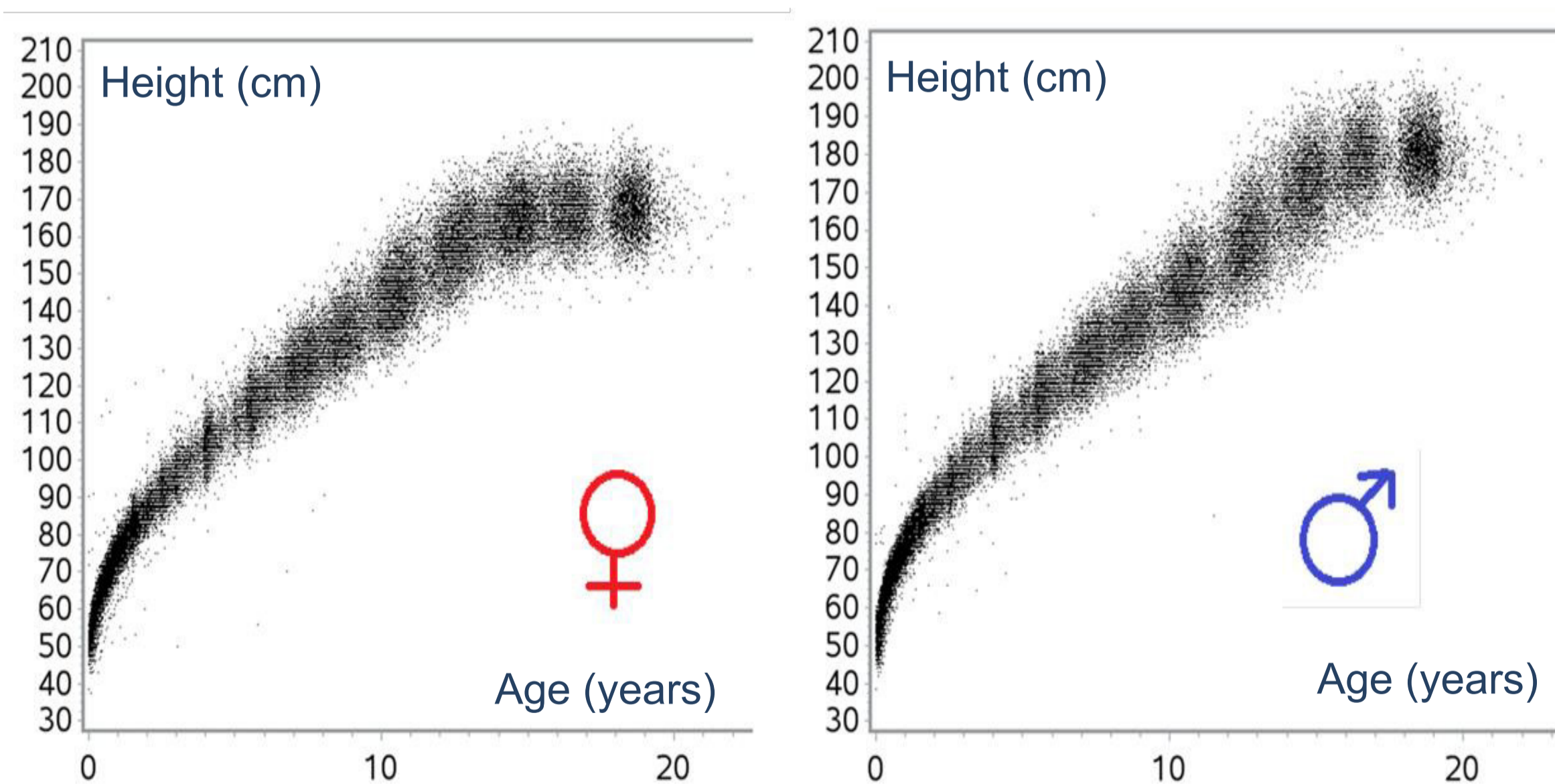


Figure 3. Individuals with complete longitudinal data in the longitudinally followed *GrowUpGothenburg1990* birth cohort (N=1,901), 45,349 measurements. Individual BMI<sub>SDS</sub> values, from 3.5-8 years of age were calculated for linear and subgroup analyses (normal/underweight –NWUW, overweight/obese –OWOB), based on the IOTF 2012 reference<sup>1</sup>.

## Methods

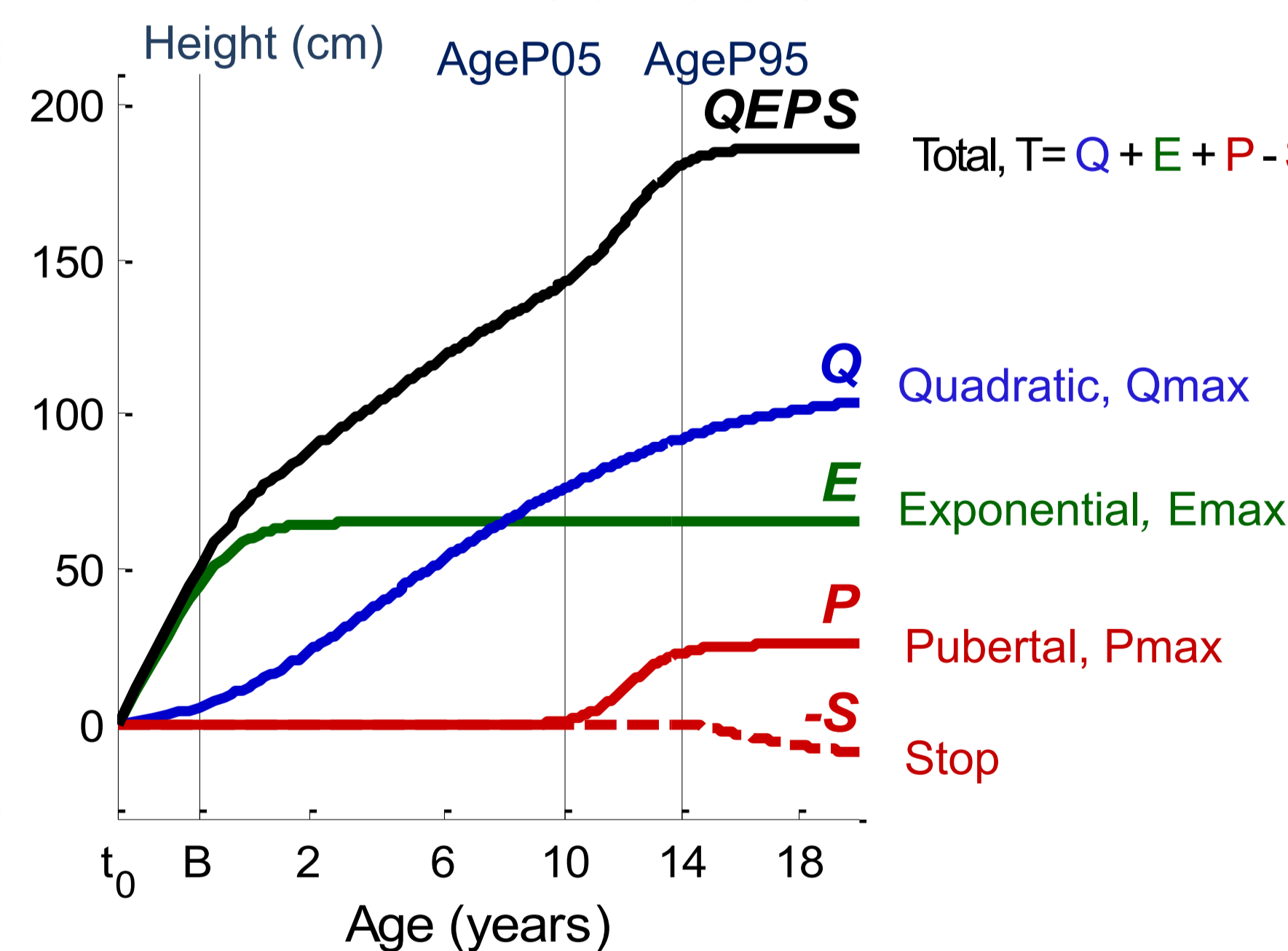


Figure 4. The QEPS growth model<sup>2</sup> (describing total height as a combination of four mathematical functions; Quadratic Q, Exponential E, Pubertal P and Stop S). T<sub>0</sub>=about 6 weeks after conception, B=birth.

## Methods

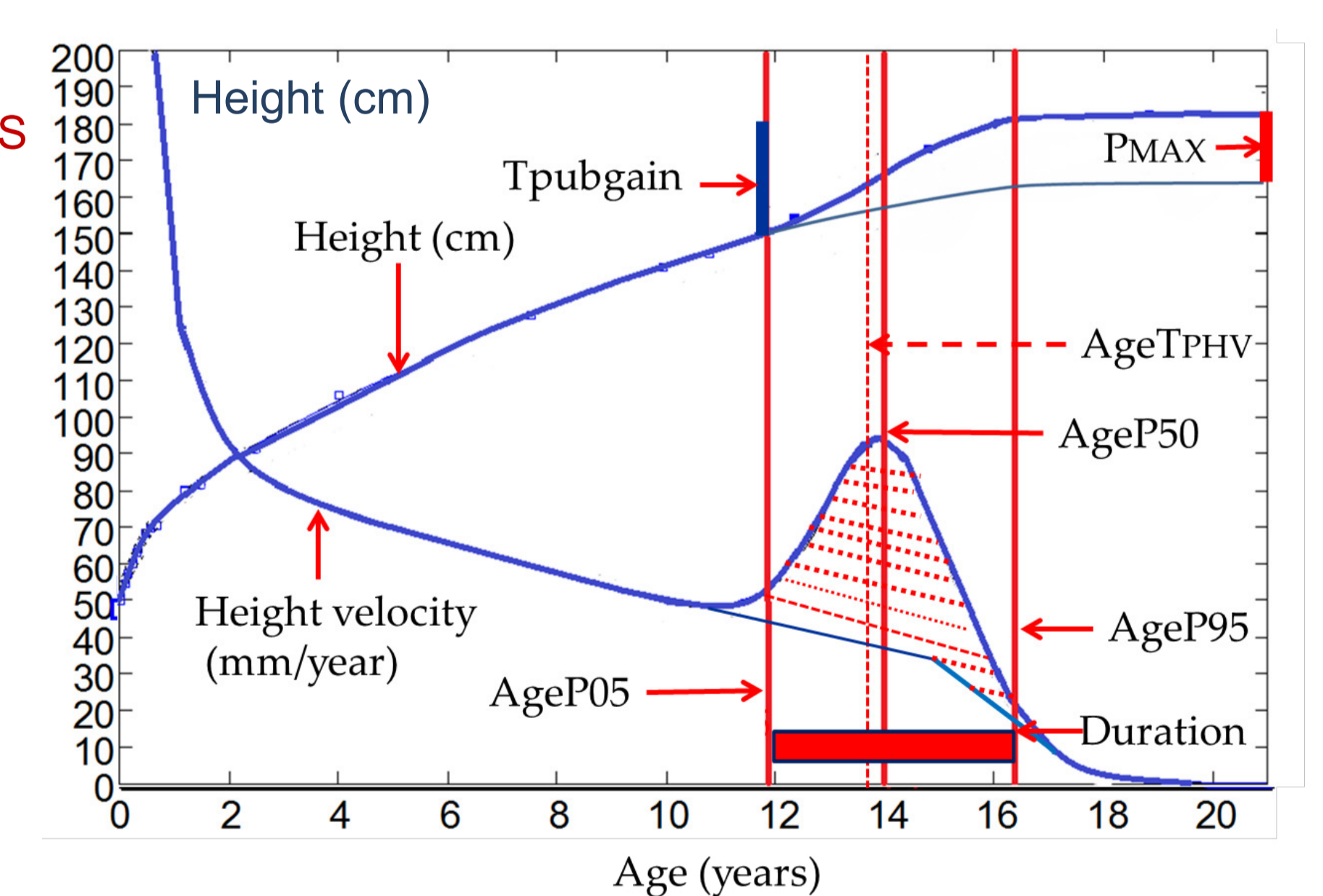


Figure 5. Height and height velocity graph of a boy by the QEPS-growth model, with pubertal growth estimates.

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## References:

1. Cole TJ, Lobstein T. Pediatric obesity. 2012;7(4):284-94
2. Nierop et al. Horm Res Pediatr. 2013;80(suppl1):152-153

