

# Identifying Critical Periods for Maintaining Weight Loss in Obese Children

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THE AUTHORS HAVE NOTHING TO DISCLOSE

**Background** – Studies in adults have shown physiological protection of a “set-point” for weight, explaining why obese adults who diet eventually regain weight.

**Aim** - We hypothesised that set-points for weight, and their physiological defence, are flexible in childhood but become fixed at around the time of puberty. We aimed to show that obese young children who had lost weight had less “reflex” changes in satiety hormone profiles that would drive weight regain compared with obese adolescents who had lost weight.

**Methods** – Prospective Cohort Study

21 obese pre-pubertal children (age 3-7 years; 11 male) and 20 obese adolescents (age 14-18 years; 10 male). Obesity defined as BMI >2.4 SDS (UK 1990 Growth Reference). Subjects recruited as either “reducers” (relative/absolute weight loss of ≥10% in the preceding 9-15 months) or “maintainers” (controls). Measures: Resting Energy Expenditure (REE), bioelectrical impedance, fasting and post-prandial (every 30 minutes for 3 hours) satiety hormone profiles, including acylated Ghrelin, Gastric Inhibitory Peptide (GIP), Amylin, Pancreatic Polypeptide (PP), Glucagon-Like Peptide-1 (GLP-1) and total Peptide YY (PYY).

## Results

### Patient characteristics

The patient characteristics in the 9-15 months prior to and at the time of the satiety hormone profiles are shown in table 1.

**Table 1** – Characteristics of the patients at Baseline and at the time of their satiety profile (plus-minus values are means ± SD).

Baseline (Values taken 9-15 months before satiety hormone profile)	Characteristic	Pre-Pubertal Reducer (N = 11)	Pre-Pubertal Maintainer (N = 10)	Post-Pubertal Reducer (N = 10)	Post-Pubertal Maintainer (N = 10)
		Age (yr)	5.3 ± 1.6	7.1 ± 0.7	15.1 ± 1.6
Weight (Kg)	45.1 ± 10.5	45.7 ± 6.1	103.3 ± 25.4	111.3 ± 24.7	
BMI	29.8 ± 4.6	26.3 ± 4.1	37.6 ± 6.4	38.2 ± 6.5	
BMI SDS	4.9 ± 1.1	3.4 ± 0.8	3.4 ± 0.5	3.4 ± 0.5	
Time Interval (mths)	12.7 ± 2	11.1 ± 2.7	11.8 ± 3.2	11.5 ± 2.7	
Male Sex (%)	9 (82)	2 (20)	6 (60)	4 (40)	
Satiety Hormone Profile	Age (yr)	6.3 ± 1.6	8 ± 0.6	16.1 ± 1.6	15.6 ± 0.8
Weight (Kg)	48.3 ± 13.3	52.7 ± 6.1	99.8 ± 19.5	119.2 ± 25.2	
BMI	28.4 ± 5.3	27.9 ± 4.6	35.5 ± 5.3	40.6 ± 6.6	
BMI SDS	4.2 ± 1.3	3.3 ± 0.8	3.1 ± 0.5	3.6 ± 0.5	
Fat (%)	38.5 ± 8	40.5 ± 8.9	42.2 ± 9.7	47.8 ± 6.4	
REE (Kcal/day)	1197.3 ± 247.4	1246.8 ± 160.2	1852 ± 279.1	2104 ± 393.2	
Oxygen Production - VO2 (ml/day)	181.3 ± 35.8	185.5 ± 36.5	266.9 ± 40.3	319.2 ± 76.4	

### Satiety Hormone Profile

Post-pubertal adolescents had 31% lower Ghrelin concentrations (4%-51%, p = 0.03) and 50% higher Amylin concentrations than pre-pubertal children (18%-91%, p=0.001).

When all the reducers (pre- and post-pubertal) were compared to all the maintainers, the reducer group was slower to reach their maximum GIP peak concentration compared to the maintainer group (p=0.05).

The association between Ghrelin, Amylin and GIP concentration and weight change was similar for both pre- and post-pubertal children (p=0.79, p=0.39 and p=0.79 respectively). No associations were found for Peptide YY, PP and active GLP-1.

### Reported Satiety

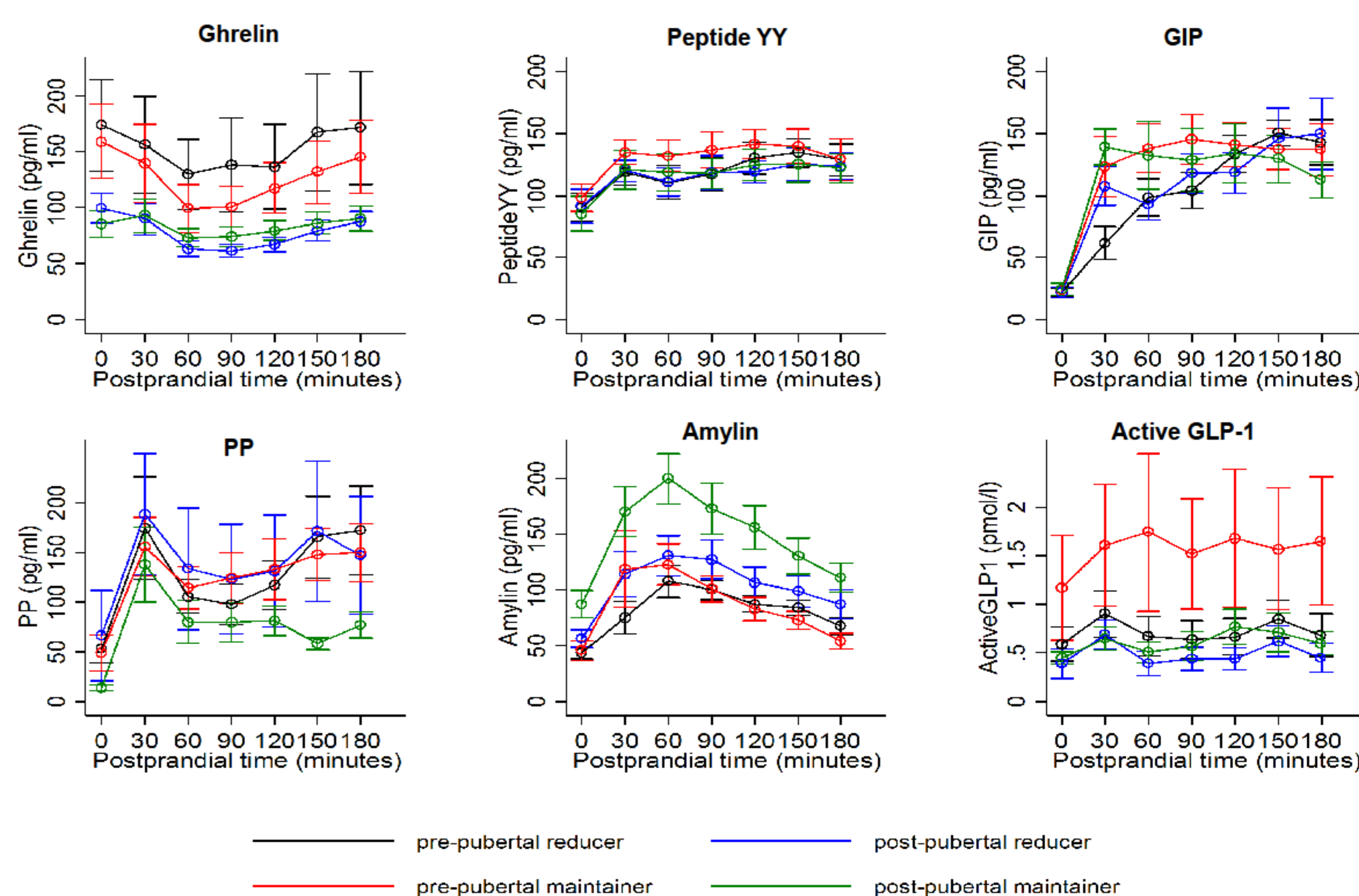
Post-pubertal adolescents who lost weight reported less hunger (p<0.001) and higher satiety (p=0.03) than pre-pubertal children (Figure 2).

### Resting Energy Expenditure (REE)

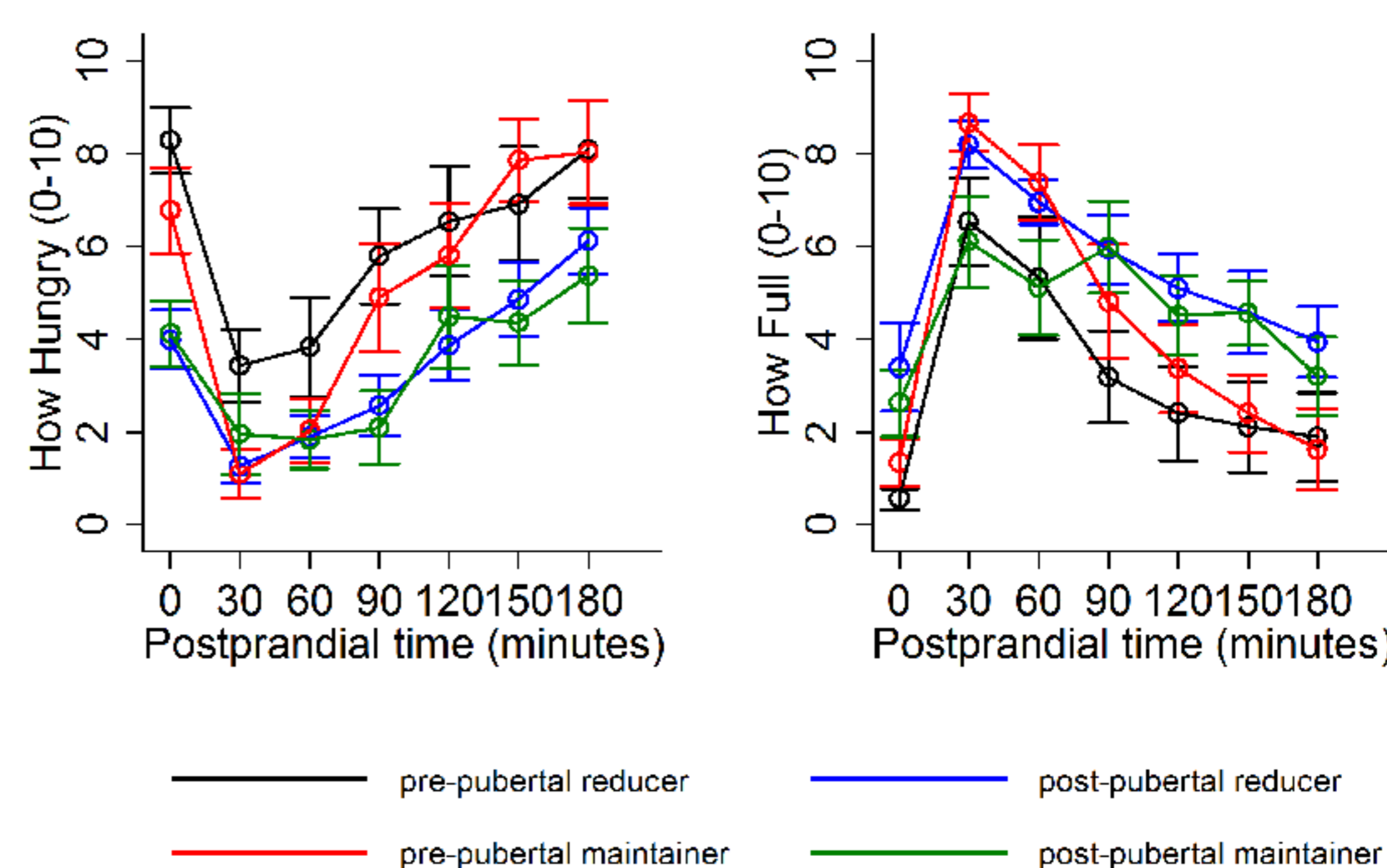
REE in pre-pubertal weight reducers and maintainers was similar (50kcal lower, -143 to 242, p=0.6), but post-pubertal reducers had 250kcal lower REE compared to post-pubertal maintainers (-68 to 572, p=0.1).

**Figure 1**

Post-prandial response trajectories for active Ghrelin, Peptide YY, GIP, PP, total Amylin, and active GLP-1, comparing pre-pubertal reducers and maintainers and post-pubertal reducers and maintainers over 3 hours post meal



**Figure 2** – Ratings of appetite using validated visual analogue scales at baseline and over 3 hours post meal comparing pre-pubertal reducers and maintainers and post-pubertal reducers and maintainers



**Discussion** – Satiety hormone profiles were similar between pre- and post-pubertal subjects, and appeared to contrast with previously published adult data, where weight reduction leads to sustained increases in Ghrelin and reductions in the other hormones. Subjective sensations of appetite were unaffected by weight loss. Study limitations included the absence of an adult group for comparison, and lower power to detect significant interactions between satiety hormones and weight change, although acceptable power was achieved for the main comparisons. In conclusion, these findings indicate that the physiological mechanisms which act to protect against weight change may develop later than in the adolescent years.

## References

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