

## Adrenocorticotrophic hormone (ACTH) responsiveness to standardized exercise as a marker of neuroendocrine maturation during puberty?

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**Summary** – A cross-sectional study of 56 children undergoing a 15 min submaximal exercise-test shows that ACTH increases during exercise only in postpubertal children.

**exercise / ACTH / puberty.**

**Résumé** – La réponse d'ACTH à un exercice standardisé est-elle un marqueur de la maturation neuroendocrinienne ? Une étude portant sur 56 enfants effectuant un test d'effort submaximal standardisé de 15 minutes suggère que la réponse sécrétoire d'ACTH à l'exercice ne devienne significative qu'après le déclenchement de la puberté.

**exercice / ACTH / puberté**

An increase in plasma ACTH concentrations in animals [2] as well as human adults [3] during exercise has been reported by several authors with a great variability in results, depending on exercise intensity or duration. Very little data, however, are available relating to this hormonal response in puberty-aged children. As puberty supposedly induces some changes in physiological adaptation to exercise, the aim of this study was to investigate potential differences in pituitary response to exercise between prepubertal and postpubertal children by comparing plasma levels of ACTH in children both at rest and during a submaximal workload, and searching for a fitness correlation.

### MATERIAL AND METHODS

#### Subjects

Fifty-six healthy children participated in the study. They were

divided into two groups according to their pubertal maturation stage in the Tanner classification [4]. Demographic characteristics are shown in table I. Children were examined in our department for idiopathic growth retardation, and endocrine or metabolic disorders were ruled-out for these subjects. They all played sports at school but were not involved in any particular training. None were receiving medication at the time of the study.

**Table I.** Characteristics of prepubertal and postpubertal children.

| Characteristics                    | Prepubertal<br>children (n = 30) | Postpubertal<br>children (n = 26) |
|------------------------------------|----------------------------------|-----------------------------------|
| Sex ratio                          | 20 boys, 10 girls                | 17 boys, 9 girls                  |
| Age (yr)                           | 11.6 ± 0.3                       | 14 ± 0.4                          |
| Height (cm)                        | 134 ± 2                          | 144 ± 1.4                         |
| Weight (kg)                        | 29.6 ± 1.2                       | 37 ± 1.3                          |
| Height standard<br>deviation score | -1.9 ± 0.1                       | -2 ± 0.2                          |
| W <sub>170</sub> (W/kg)            | 1.92 ± 0.11                      | 1.82 ± 0.15                       |

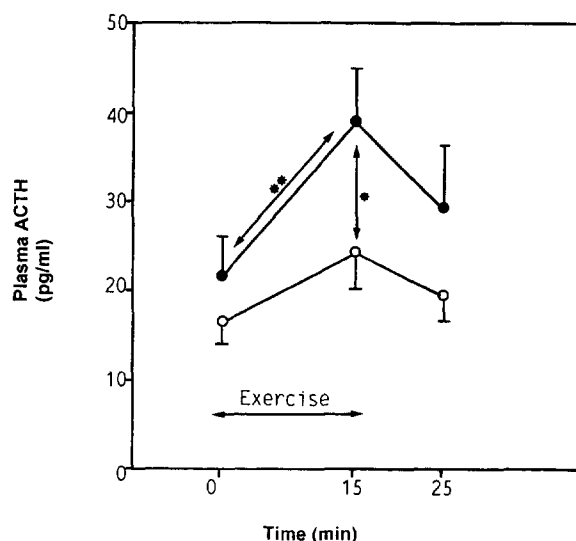


Fig 1. Exercise-induced ACTH secretion ( $m \pm SEM$ ) in prepubertal (O) and postpubertal children (●). \* $P < 0.04$ ; \*\* $P < 0.005$ .

### Exercise test

An exercise test was performed on a cycle ergometer with an incremental submaximal workload being used for increasing heart rate up to 90% of the theoretical maximal value, which was maintained for 5 minutes. Exercise intensity was therefore proportional to the working capacity of each subject. Total duration of the exercise test was 15 minutes, with subjects remaining supine 30 minutes before and 20 minutes after exercise.

The fitness index  $W_{170}$  was measured during the test.

A venous catheter was set in the cubital fossa at the start of the 30 minutes pre-exercise rest period. Blood samples were drawn before exercise (t0), just before exercise end (t15) and after 10 minutes of rest (t25). Samples were collected in tubes containing EDTA (50  $\mu$ L) and aprotinin (100  $\mu$ L).

After centrifugation (15 minutes, 3,000 rpm, + 4 °C), plasma samples were stored at - 20 °C until assayed.

### Laboratory methods

Plasma ACTH assay was carried out using a kit purchased from Cis Bio International, Gif-sur-Yvette, France. ELSA-ACTH is a solid phase two-site immunoradiometric assay using monoclonal antibodies recognizing the N terminal part for the solid phase and the C terminal part for the tracer. ACTH molecules are sandwiched between the solid phase and the tracer. After a washing step, the bound radioactivity is proportional to the concentration of ACTH in the samples.

### Statistical analysis

Values are given as mean  $\pm$  SEM. Statistical comparisons were performed using the Wilcoxon test and the Mann-Whitney U-test. The Spearman test was used for correlations.

Statistical significance was set at  $P < 0.05$ .

## RESULTS AND DISCUSSION

Results are shown in figure 1. Exercise-induced ACTH secretion was significant only in postpubertal children ( $P < 0.005$ ), with post-exercise plasma ACTH levels being higher in the postpubertal group at t15 ( $P < 0.04$ ).

We investigated whether post-exercise ACTH rise (difference t15/t0) was correlated to the fitness index  $W_{170}$ , and such a correlation was found in postpubertal children (Spearman:  $r = 0.44$ ,  $P < 0.05$ ).

The particularity of these subjects was their small stature, but it did not exceed more than - 2.5 of height standard deviations. Furthermore, all children were in a good health without any notable medical history. Growth retardations were not found to be due to endocrine abnormalities. Since blood sampling from healthy children cannot be performed for obvious ethical reasons, we believe that the children involved in this study can be considered as normal short children, and that the current results can be extended to other children.

Our findings show that ACTH response to exercise becomes significant and correlated to fitness only after onset of puberty. Bouix et al [1] did not support this concept in a similar study, and this controversy may be attributed to a small number of subjects (23 children), which may have induced a type-two error.

## CONCLUSION

Results presented above are consistent with the hypothesis of a marked modification of corticotropic response to exercise throughout the puberty maturation process.

## REFERENCES

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