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# RELATIONSHIP BETWEEN INDICES OF SEXUAL MATURATION AND PHYSICAL PERFORMANCE

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Abstract: *Rural children (568 boys and 771 girls) aged between 9 and 14.5 years were studied. Maturation was assessed on the basis of breast development in the girls and genital development in the boys according to Tanner. The level of physical fitness was estimated by the motor tests of grip strength, standing long jump and 60 m running time. The children were subdivided into four groups by the stages of their secondary sex characteristics. The performance scores of the respective groups were compared by ANOVA followed by* F-*tests. Performance development was faster in the middle stages in the boys and unexpectedly in the early developmental stages in the girls. Linear correlation with age within the stage subgroups was found only for standing long jump in the boys. In almost every stage subgroup of the girls performance was related to age either linearly or by a second order function.*

Key words: *Secondary sex characteristics; Adolescence; Motor performance.*

## Introduction

This paper reports on the motor performance scores of children in the respective stages of sexual maturation. Our approach took account of both the stage of sexual development and chronological age.

The study compared the performance levels of the groups classified by the developmental stage of the breast in the girls and by that of the genitalia in the boys. We were naturally fully aware of the fact that the pubertal development and stages of these characteristics reflected dissimilar ages in the two genders.

## Material and Methods

The subjects were a rural and non-athletic subsample of the Jászság study. All of them had begun pubertal development. The calendar age of the girls ranged between 9.0 and 14.5, that of the boys between 10.5 and 14.5 years.

The developmental stages of the secondary sex characteristics were assessed as suggested by Tanner (1962). The subjects' distribution between the respective stages is shown in *Table 1.*

*Table 1.* **Distribution of the subjects by gender and stages of maturation**

| Stage of maturation | 2 | 3 | 4 | 5 |
|---|---|---|---|---|
| Boys (568) | 227 | 121 | 147 | 73 |
| Girls (771) | 161 | 196 | 246 | 168 |

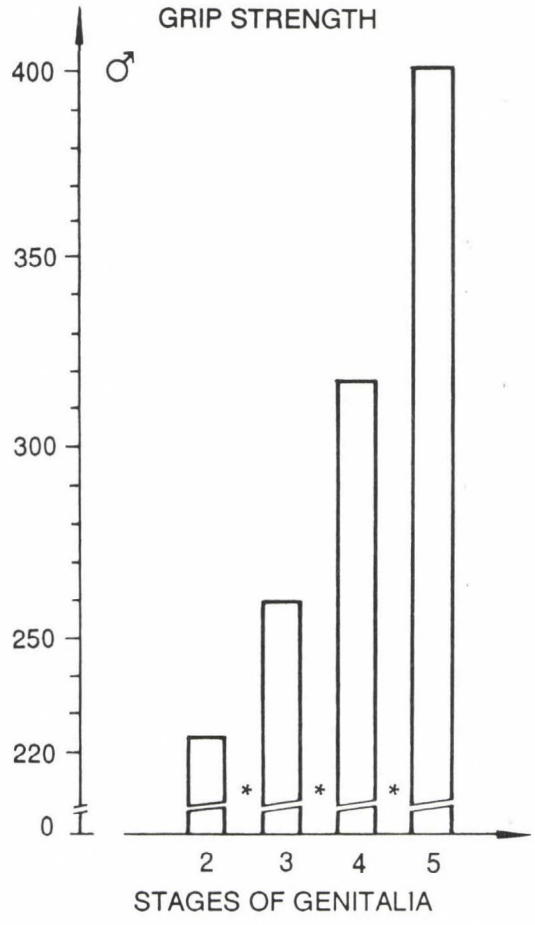


*Fig. 1:* Mean performance of the boys in grip strength in the respective stages of genital development denoted by numbers below the bars. Asterisks indicate intergroup differences significant at the 5% level

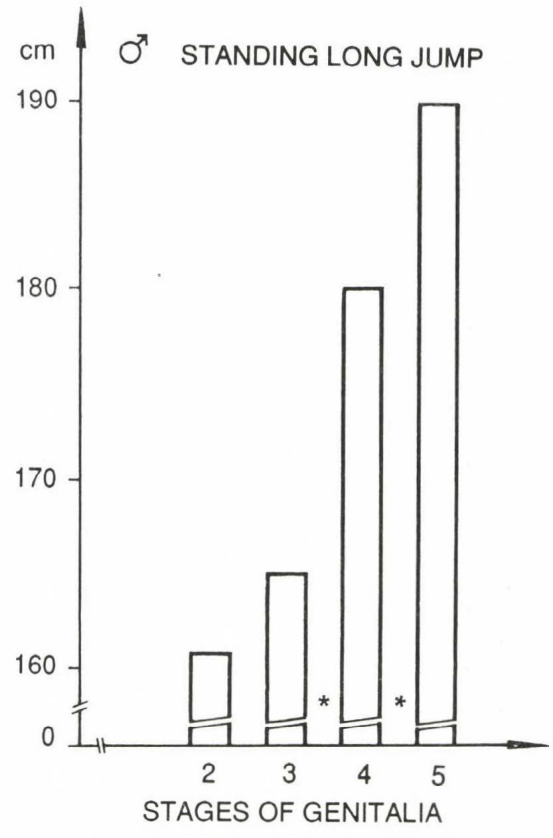


*Fig. 2:* Mean performance of the boys in standing long jump in the respective stages of genital development. Symbols as in Fig. 1.

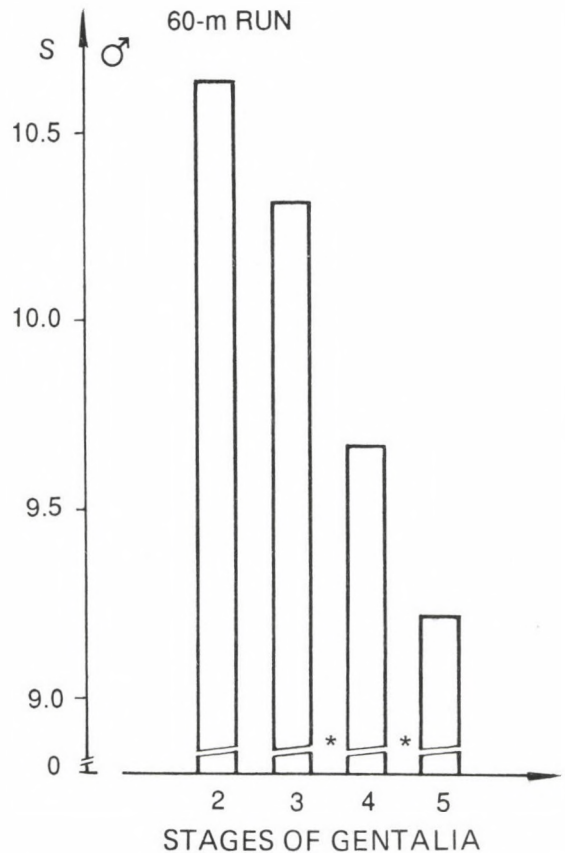


*Fig. 3:* Mean performance of the boys in 60-m run in the respective stages of genital development. Symbols as in Fig. 1.

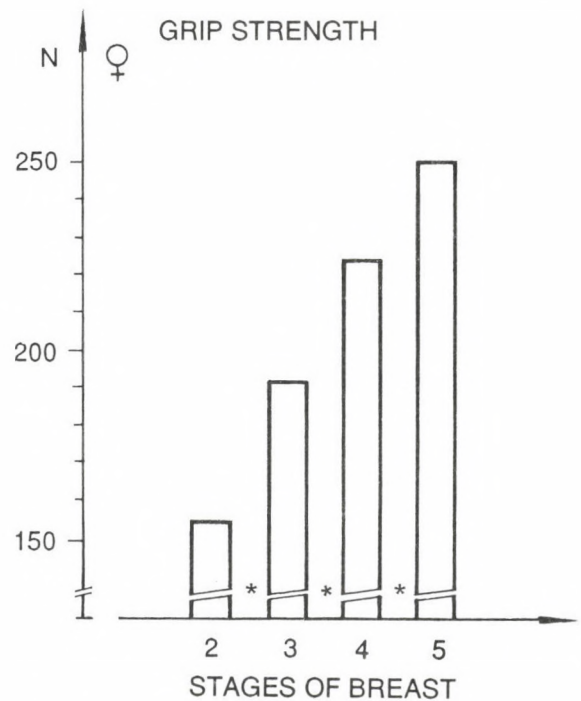


*Fig. 4:* Mean performance of the girls in grip strength in the respective stages of breast development. Symbols as in Fig. 1.

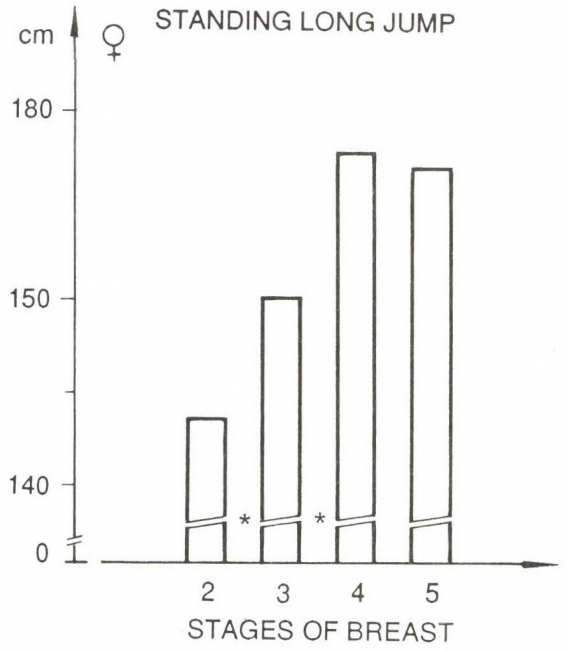


*Fig. 5:* Mean performance of the girls in standing long jump in the respective stages of breast development. Symbols as in Fig. 1.

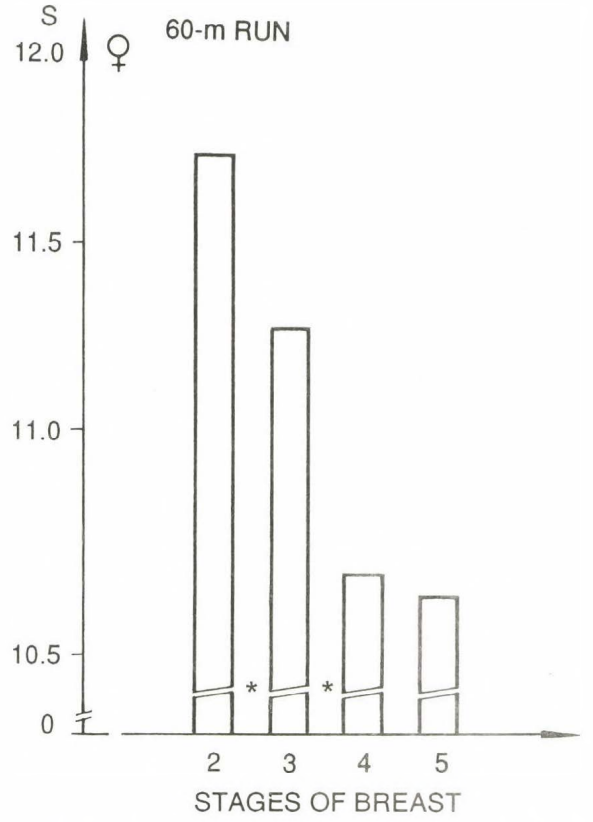


*Fig. 6:* Mean performance of the girls in 60-m run in the respective stages of breast development. Symbols as in Fig. 1.

Performance was studied in grip strength, standing long jump and 60 m run. After adjusting the handle bars to palm size, grip strength was measured by an electronic dynamometer. The readings were converted to newtons. Standing long jump was measured indoors, along a gymnastic mat, in centimetres. Running times for the 60 m run were measured to the nearest tenth of a second as usual in athletics.

The respective stage subgroups were compared by ANOVA; between-group differences were tested at the 5% level of random error. Multiple comparisons were tested by Scheffé's formula at the 10% level. Regression analysis of trends was used both along the respective stages and along the calendar age groups within the stages.

## Results

The first point studied was how performance scores differed between the stages of pubertal development.

*In the boys*, all stage means for *grip strength* differed significantly (*Fig. 1*). There was no significant difference between stages 2 and 3 for the *standing long jump* (*Fig. 2*), and the *60-m run* (*Fig. 3*),but stages 4 and 5 differed significantly from each other and stage 3 in both.

*In the girls, grip strength* differed significantly between each stage again (*Fig. 4*). Significant differences for the *standing long jump* (*Fig. 5*) and *60 m run* (*Fig. 6*) were only found between the early stages. Performance did not improve or even deteriorated in the later stages.

The trend lines of the mean performance scores were not linear along the stages, excepting the boys' 60 m run, but all the non-linear regressions were significant.

The second point under study was if children of the same biological developmental stage but of different calendar age differed in their physical performance.

*Table 2* summarizes the results of fitting regression lines to the calendar age group means within each stage of sexual development.

*Table 2.* **Significant linear (1) and second-order (2) relationships between calendar age and motor performance within the respective stages of maturation (0 = not significant)**

| Stage of maturation | Boys | | | | Girls | | | |
|---|---|---|---|---|---|---|---|---|
| | 2 | 3 | 4 | 5 | 2 | 3 | 4 | 5 |
| Grip strength | 0 | 0 | 0 | 0 | 1 | 2 | 1 | 0 |
| Standing long jump | 0 | 1 | 1 | 0 | 2 | 1 | 1 | 0 |
| 60 m run | 0 | 0 | 0 | 0 | 0 | 1 | 2 | 2 |

*In the boys*, only linear relationships were observed and even these were restricted to the standing long jump means.

*In the girls*, nearly an equal number of linear and second-order trends was found and only three analyses gave a not-significant verdict.

## Discussion

The study has evidenced that pubertal changes in physical performance differed for the boys and girls when the subjects were classified by the stages of secondary sex characteristic development. Until now such differences have only been shown for calendar or morphological age in Hungary (Mészáros et al. 1986) and for calendar, skeletal and menarcheal maturity age (reviewed by Malina 1975), but very few studies are available for secondary sex characteristics (Stoev and Rachev 1977). Based on the fact that motor performance in childhood is known to depend markedly on biological age (Szabó and Mészáros 1980, Simons et al. 1978), our working hypothesis was that motor performance would differ across the stages of maturation, but not for children within the same stage, i.e. in the same biological age group.

Strength development in the boys and girls has been reported by Jones (1949), Malina (1975) and Parker et al. (1990) to be very similar in prepuberty but to differ essentially in late adolescence. Jones attributed it to the differential action of sex hormones.

Our data have shown that performance improvement was more marked in the later stages of maturation in the boys, corroborating Bastos and Hegg's report (1986), but in the earlier ones in the girls for which observation we have not found comparable results. Testosterone level in the boys is known to rise steeply from on the 3rd stage and has a direct influence on muscle development. Such effects are absent in the girls (Winter 1978). Thus, some of these change patterns may be attributed to testosterone effects.

In this study motor performance within the respective stages of the boys varied independently of age. Similar observations were reported for boys by Stoev and Rachev (1977). They did not offer any explanation for the phenomenon. Contrary to our expectations, the girls showed various types of age-dependent performance change. The background mechanism for this is not fully clear for us. It may be related to the cross-sectional nature of the study, but one has to reckon with gender-linked dependence on body size as well (Bailey et al. 1978). It is noted, however, that secondary sex characteristics almost reached full development in our girls whereas in the boys this process was yet far from completion. Further research has to take this aspect into account as well.

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