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INDICES OF PHYSIQUE AND PERFORMANCE IN PREPUBERAL SWIMMERS

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A b s t r a c t. Two groups of prepuberal swimmers (10 boys and 17 girls) with a training history of 2.5 to 3 years were studied three times in three consecutive years from the age of 10 to 12. The purpose was to follow physical development and disclose the relations, if any, between performance and physique. To this end seven body dimensions and swimming scores at the second and third observations were recorded, Conrad's metric and plastic indices and correlation coefficients were calculated. Boys exceeded in some, girls in most dimensions the comparable non-athletic reference groups of earlier and recent origin. Swimming scores correlated only with hand circumference in the girls and with hand circumference, chest breadth, shoulder width, weight, height and plastic index in the boys. Though correlations of performance with physique became closer with age, also functional aspects have to be considered in explaining improvement in swimming.

Key words: Physique, performance, swimming performance, prepuberal swimmers, sex-dependent traits of physical development.

Introduction

In dealing with athletic youth swimming is an area of particular interest since competitive engagement and success in it too occur at a relatively young age. Our purpose in this work was to study male and female course of development in a group dedicated to this sport and the relationships that may exist between performance and body dimensions of young swimmers.

Material and Methods

The subjects were 10 boys and 17 girls having a training history of 2.5 to 3 years of swimming. This case number might appear very low, but it is not a negligible fraction of this age group of proficient swimmers in Hungary today. Their age ranged from 9.5 to 10.5 when observation began. All of them were observed three times with approximately yearly intervals in between. Observation ended in 1978 when the boys were 11.9 and the girls were 12.1 on the average.

In taking body dimensions IBP suggestions (Weiner and Lourie 1969) were observed. Of the data metric index as a form factor and plastic index as a robustness factor (Conrad 1963) were calculated. Performance scores relying on the scoring system of the Hungarian Swimming Federation were recorded at the second and third observations and were related to all observed parameters of physique.

Results and Discussion

All of our subjects lived in the capital, and also the two reference groups of non-athletic children were inhabitants of Budapest. EIBEN et al. (1971) carried out their measurements in 1968/69 while the data reported by the author mentioned second above (MÉSZÁROS and MOHÁCSI 1978) refer to more recent years. Except for body weight, reference data significantly differ from one another. The boy swimmers' weight did not differ from reference data (Fig. 1), and their stature differed only at the second and third observations from the report of EIBEN and collaborators. Their shoulder width only differed from earlier data. Transverse diameters and girths of the extremities tended to follow the slightly upward concave line of weight increase. Yearly increments were always significant on a 1% level except for the metric and inverse ponderal indices (Fig. 2), which showed a peak in body linearity at 11 years of age and

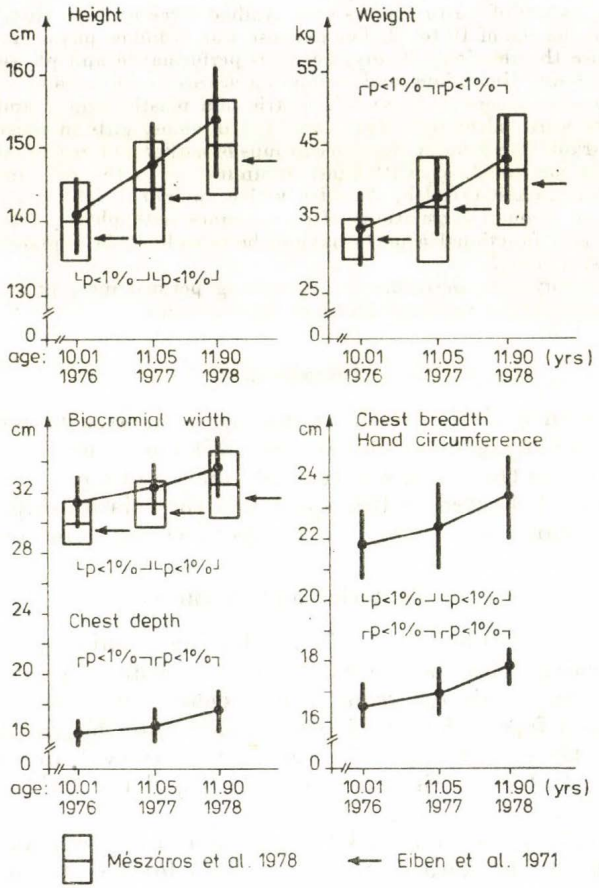

Fig. 1: Development of boy swimmers, 1 ($\bar{x} \pm$S.D.; N = 10). Horizontal axis is that of time and age. The arrows denote means of nonathletic reference material reported by EIBEN et al. (1971). The frames of means and S.D.'s refer to a similar material of MÉSZÁROS et al. (1978). Brackets indicate levels of significance of differences

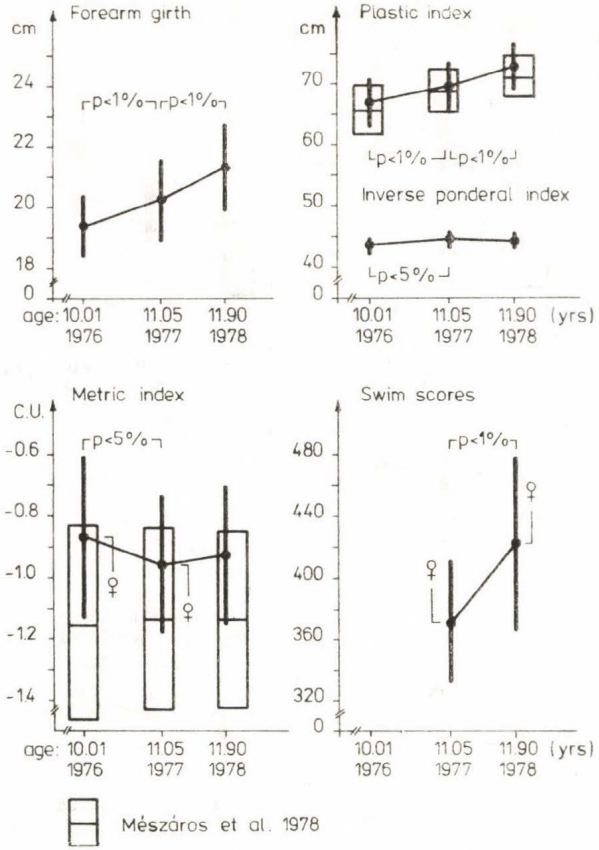

Fig. 2:. Development of boy swimmers, 2 ($\bar{x} \pm$S.D.; N = 10). Arrows pointing to the female sex symbol refer to significant differences from the girl swimmers. Other symbols and notation agree with that in Fig. 1. C.U.: CONRAD units of the leptomorphy-pyknomorphy scale. A more linear body build is denoted by more negative values in the metric index and by larger numbers in the inverse ponderal index

a slow decrease in it later. Though swim scores improved considerably, the boys' performance was much inferior to that of girls.

The pattern of growth in the girls was slightly different (Figs 3 and 4). All comparable dimensions were greater than the reference data. While their stature ran along an upward, slightly convex line, weight increase had an opposite curvature. Neither of these trends was followed, however, by the other dimensions most of which had an almost straight course with significant yearly increments. Since the girls' performance was markedly better, it is interesting to note that none of the body dimensions differed between the two sexes and the girls had a significantly more leptomorphic build. On the other hand, while peak body linearity in the boys was reached by a relatively steep change, the girls showed — after a plateau between 10 and 11 — a turn toward roundness between 11 and 12 years of age. This and the upward con-

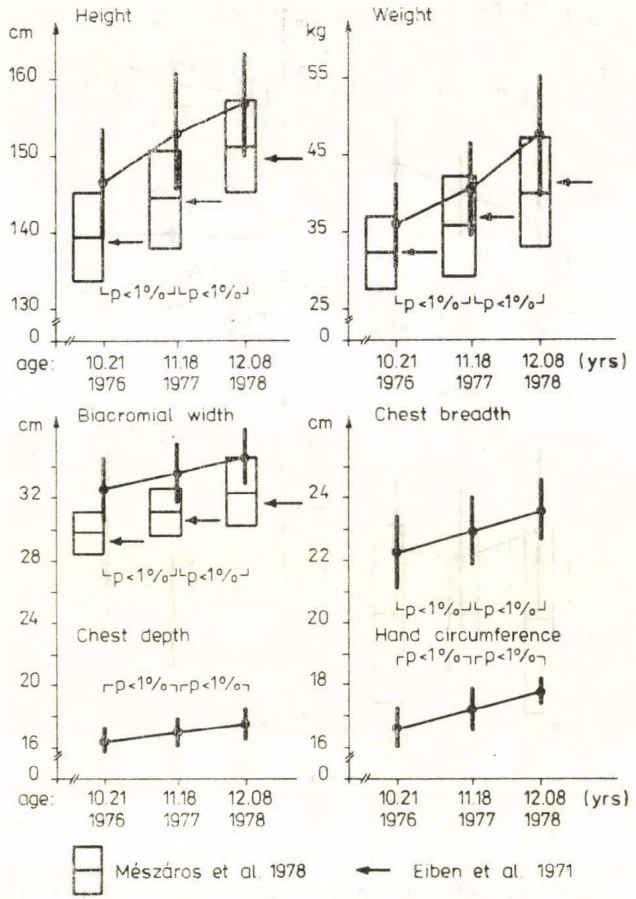

Fig. 3: Development of girl swimmers, 1 ($\bar{x} \pm$S.D.; N = 17). Symbols, notation and abbreviations conform to those in Fig. 1

vexity of the stature line seem to forecast the earlier termination of female development.

There are some signs — at least in the stature of young adults — that the secular trend of increasing height is now levelling off in Hungary, too. This may be of course a transitory phase as well, because in the younger age-groups differences from the 1968 reference data are still present, as shown for some dimensions. In regard of athletic groups one should consider selection effects, too, because structural advantage is believed to associate with better performance.

The relationship of body parameters to swimming performance (Figs 5 and 6) became closer with age, though some in the boys and most in the girls failed to reach the level of significance even later. Beyond the marked and striking difference in the number of dimensions significantly related to swim scores it was more surprising that the girls showing a superior performance had

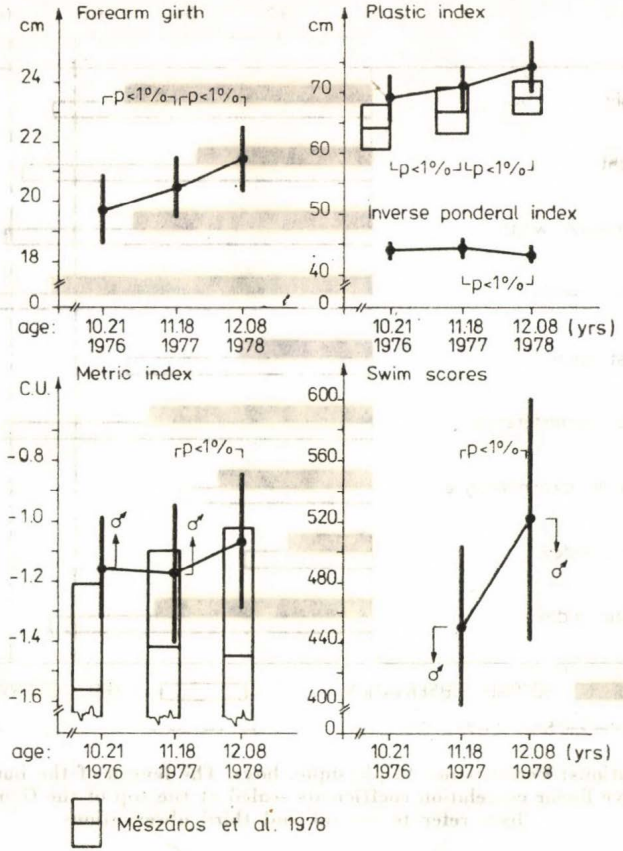

Fig. 4: Development of girls swimmers, 2 ($\bar{x} \pm$S.D.; N = 17). Symbols, notation and abbreviations conform to those in Fig. 2. Arrows pointing to the male sex symbol refer to significant differences from boy swimmers

only two significant coefficients altogether and their high plastic index of robustness was not among these. Another unexpected result was that chronological age was significantly related to performance whereas its coefficient was negligible in the boys. Chest breadth and shoulder widths, the best and second best predictors of performance in the boys, were also unrelated to the girls' scores.

We can offer only a tentative explanation for these unexpected results. In view of the taller than reference stature of these girls, they might have been accelerated as well. This assumption, however, is apparently invalidated by the correlation of chronological age, which would be decreased rather than increased by earlier maturation. Thus their tall stature may be a selection effect rather. In addition, this period of life is usually one of conspicuous gain in strength, speed and coordination in athletic girls. These faculties are likely, then, to influence performance to the same, if not greater extent, as the underlying biomechanical structure, though the importance of the latter cannot be neglected either.

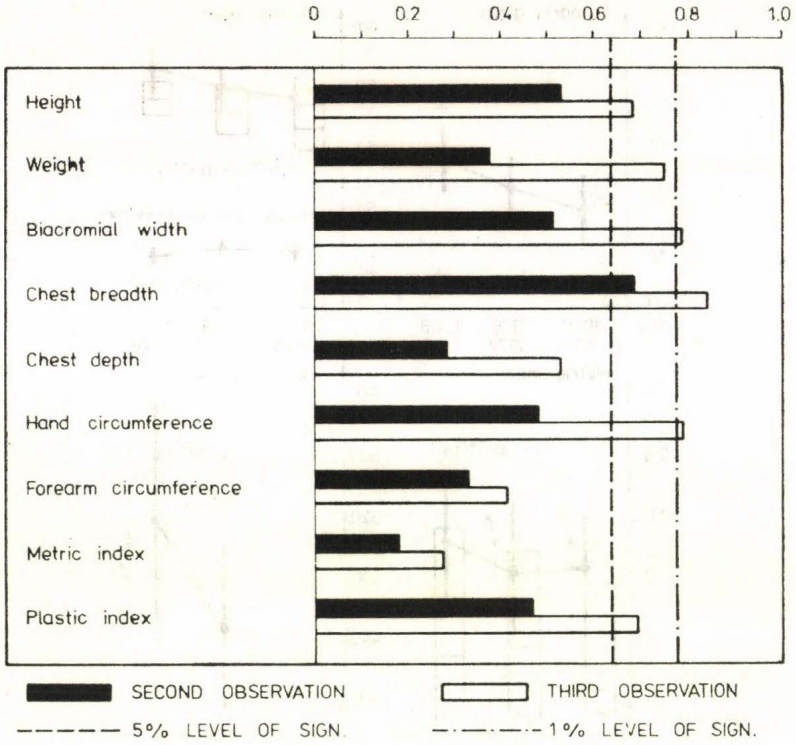

Fig. 5: **Correlations: Performance to physique, boys. The length of the bars is proportionate to the respective linear correlation coefficients scaled at the top of the figure. Bold and open bars refer to second and third observations**

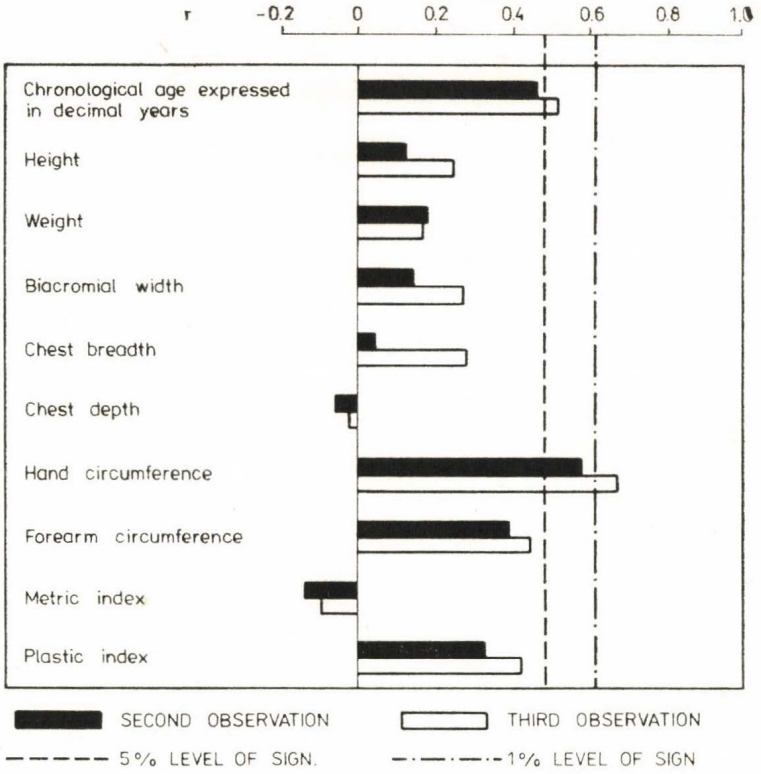

Fig. 6: **Correlations: Performance to physique, girls. Notation conforms to that in Fig. 5**

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