RELATIONSHIP BETWEEN TECHNICAL PARAMETERS AND PERFORMANCE IN FRONT CRAWL SWIMMING IN CHILDREN

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INTRODUCTION
Performance in adults swimmers was linked to morphological characteristics (Chatard et al., 1987) and technical abilities (Zamparo et al. 1996) determined by kinematic measures (Schleihauf et al., 1986). The underwater observation of swimmers showed that the sinusoidal trajectories for each spatial plane of the hand was very important in the swimmer’s propulsion. Deschodt et al. (1994) proved that kinematic parameters such as the forward, depth and backward movements of the hand during the aquatic stroke of swimming accounted for the swimmer’s velocity. In regard to these previous results, the aim of this study was to analyse the relationships between performance and kinematic parameters in young swimmers.

METHODS
Seventeen swimmers (12.3 yrs ±0.46; 1.57 m ±7.05; 47.36 kg ±6.8) volunteered to take part in the study. Subjects carried out a 400m in front crawl swimming at maximal velocity to determine maximal aerobic velocity (V400) (Costill et al., 1985). During the 400m, two digital cameras were used to film the underwater movements. Right hip joint and fingertip were digitalised. The fingertip entry was taken as spatial and temporal reference (0, 0, 0, 0). The length (SL), the duration (SD), the velocity (SV) of the whole stroke were studied as different points of the fingertip trajectory: the maximal coordinates in the forward direction (F), in the External direction (E), the Internal one (I) and the maximal depth (D). For the lengths, the points were noted Fm, Dm, Em, Im and for the durations, the points were noted Fs, Ds, Es, Is. Mean, standard deviation were calculated and a principal component analysis (PCA) was used to analyse the relationships between the studied parameters.

RESULTS AND DISCUSSION
The mean time for the V400 was 1.16 m.s\textsuperscript{-1} (±0.11). The mean values of SL, SD and SV were respectively 1.95 (± 0.34) m.stroke\textsuperscript{-1}, 0.55 (± 0.08) stroke.s\textsuperscript{-1} and to 1.08 (± 0.1) m.s\textsuperscript{-1}. For adult swimmers at sub-maximal velocities (1.26 m.s\textsuperscript{-1}), Keskinen and Komi (1988) obtained similar SD (0.52 strokes\textsuperscript{-1}) and higher SL (2.38 m.stroke\textsuperscript{-1}). These differences could be explained by lower force production for children (Vrijens, 1978). The lower SL observed for young swimmers could be also linked to slower neuromuscular characteristics (Belanger et al., 1983). The averages of spatial and temporal coordinates of each significant point of the trajectory of the fingertip were shown in Figure 1.

Even spatial parameters were not correlated to the height of the swimmers, children presented great differences with adults swimmers (Deschodt, 1994). The forward hand displacement was longer for the children compared to adults for a shorter duration. Children reached more quickly an equivalent maximal depth. On the transversal axis, they presented opposite results to adults swimmers with greater external outswEEP and shorter insweep movement. Children decreased all the phases that need forces due to their poorer strength.

On PCA the first factor (axis1) was mainly defined by Em located on the left side of the axis. This variable was negatively correlated to the group of variables located on the right of the axis (SD, Fs, Ds, Es, Fm, SL and V400). The 2\textsuperscript{nd} factor (axis2) was defined by SV (Fig.2).
Fig.2: Variables representation with V400 (maximal performance on a 400-meter), SL (Stroke Length), SD (Stroke Duration), SV (Stroke Velocity), the length and duration of the maximal point were respectively noted Fm and Fs (Forward direction), Dm and Ds (Depth direction), Em and Es (External direction), Im and Is (Internal direction).

The performance on a 400m test was correlated to temporal parameters (SD, Fs, Ds and Es (r=0.893, P<0.001 ; r=0.632, P<0.01; r=0.632, P<0.01 and r=0.586, P<0.05). These relationship hasn’t been found in any other study as well as for SD (Craig and Pendergast, 1979) as for parameters of hand trajectory (Deschodt et al., 1994). V400 was also correlated with SL and Fm (r=0.787; P<0.001 and r=0.593; P<0.05). The relationship between V400 and SL was in line with previous studies (Craig and Pendergast, 1979) when previous study proved that Fm was a weighty factor to the inter-individual differences of maximal velocities among international swimmers (Deschodt et al., 1994).

SUMMARY
This study of high-level young swimmers indicated that the variations of performance on a 400-meter could be explained by kinematic factors such as the time parameters (SD, Fs, Ds, Bs, Es) and spatial parameters (SL, Fm and Bm). Many authors proved that performance could be linked to other factors such as underwater torque (Zamparo et al., 1996) and muscular parameters. It is therefore necessary to carry out other tests in order to determine the precise influence of these factors on the young swimmer’s performance.

BIBLIOGRAPHY