COMPETITION ANALYSIS AT THE WORLD SWIMMING CHAMPIONSHIPS

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Biomechanical competition analysis is now a regular occurrence at major swimming championships. Prior to such analyses being conducted, the coach had only lap splits and finish times to objectively assess the competition performance of swimmers under his or her direction. Competition analysis provides the coach with comparative information concerning the performance of swimmers with respect to the start, free swimming, turns and the finish. Depending upon how well the information is presented, the coach can identify strengths and weaknesses of swimmers throughout the race. The Australian format for competition analysis is presented in the form of a spreadsheet. The competitive information about the various swimmers is provided in columns such that by working down the page and comparing the various swimmers' parameters, the coach can see why and where each swimmer was successful or unsuccessful. The Australian format presents the following parameters: the Start time (15m), and in free swimming for each half lap Stroke Length, Stroke Frequency, Swim Velocity and Efficiency Index, for each lap the Turn Time (2*7.5m) and at the completion of the race the Finish Time (5m). The parameters associated with free swimming and turns are also presented as an average for each competitor throughout his or her race.

During the 1994 World Swimming Championships conducted in Rome, a biomechanical competitive analysis was performed for all finalists in both the A and B Finals. The swimming performances which occurred there, theoretically represented the performances of the best 16 swimmers for each event in the world. In the statistical analyses of the performances within each event, the average parameters, in the case of free swimming and the turns, as well as the start and finish times were correlated with the criterion measure. The criterion measure was the resulting time (swimmer's finishing time) for the race. Where a significant relationship existed between one of the average variables and the criterion variable, the relationship between its components and the variable itself was further examined. For example the components of average swim velocity were the swim velocities for the various half laps of the race. Although a significant correlation does not infer a cause and effect relationship between the variable being examined and the criterion variable, a significant correlation does not exclude the possibility of cause and effect. Significant correlations are also helpful in focusing the attention of the coach on the importance of certain variables, particularly if the coach's swimmer has performed relatively worse than the other swimmers in the race for that variable.

The analysis revealed that for most events, the average velocity correlated most highly with result time and such correlations were of the magnitude of $r = 0.9$, $p = 0.0001$ with an $n = 16$. In many events the findings for the male event corresponded very highly with the female equivalent event. In the case of lOOm events, apart from average velocity, the next most significant variable was turn time ahead of start time. In the 100m Backstroke, turn time ($r = 0.88$) correlated more highly than average velocity ($r = 0.86$) and for lOOm Breaststroke, after average velocity ($r = 0.91$), start time ($r = 0.63$) correlated more highly than turn time ($r = 0.5$) with result time. This held true for both the male and female events. For the 200m events, in all strokes and for both genders, average velocity ($r = 0.95$) followed by average turn time ($r = 0.85$) followed by start time ($r = 0.65$) correlated most significantly with the result time. In both the 400m Individual Medley and Freestyle events for both genders, average velocity ($r = 0.96$) followed by average turn time ($r = 0.8$) correlated most highly with result time. On examining the relationship between the individual lap velocities withaverage velocity itself, for the males the earlier laps were more significant whereas with the females the later laps were more significant. In the 800m Freestyle for females average velocity ($r = 0.97$) was most significant. On examining the relationship between the components of individual lap velocities and average velocity itself for this event, the later laps were more significant than the earlier laps. In the 1500m freestyle for men, average velocity ($r =0.98$, $n = 8$, $p < 0.0001$) followed by start time ($r=0.75$, $p < 0.05$) followed by turn times ($r = 0.72$, $p < 0.05$) was the order in the relationship with result times.

In summary, average velocity followed by average turn time followed by start time were significantly related to the resulting time in most of the events examined. The significant relationship between average velocity ($r = 0.95$, $p < 0.0001$ for $n = 16$) and result time can be readily explained by simple physics but the correlation of average turn time ($r = 0.8$, $p < 0.001$ for $n = 16$) over all distances with result time is surprising. The fact that start time in the longer events ($r = 0.65$, $p < 0.01$, $n = 16$) correlates so highly with result time provides some indication that distance swimmers need to emphasise starting more in their training. Correlations in the order of ($r = 0.9$, $p < 0.0001$, for $n = 16$) were common for many variables with result time. In the lOOm breaststroke and lOOm backstroke as compared to the other lOOm events, there was a change in the order of significance for the variables average velocity, average turn time and start time when correlated with result time. An examination of the components of average velocity revealed there was a trend indicating that in the middle distance events the early laps were more significantly correlated with result time for the males whereas the later laps in the race were more significant for the females. There appeared to be no such trend when the various lap turn times were correlated with average turn time. The fact that stroke length, stroke frequency and the efficiency index rarely correlated highly with result time indicated the unique nature of these variables. Although, the relationship between these variables is of importance to the individual swimmer, this relationship is specific to the individual swimmer and there is not a function that can be generally applied to optimise these parameters over all swimmers.