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Stability of elite freestyle performance from childhood to adulthood

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Abstract

Stability of athletic performance is important for practitioners and coaches, since it allows the selection of appropriate training methods and prediction of ages for best results. We performed a longitudinal study of 1694 season-best performances of 242 elite-standard swimmers throughout their careers, from 12 to 18 years of age. Mean stability (descriptive statistics and one-way repeated-measures ANOVA, followed by a Bonferroni *post-hoc* test) and normative stability (Cohen's kappa tracking index and the Pearson correlation coefficient) were determined for seven consecutive seasons. Performance improvements in all events were observed (14.36–18.97%). Bonferroni *post-hoc* tests verified changes in almost all events assessed. Cohen's kappa demonstrated low stability (0.17–0.27) in relative performance. Pearson correlations only became high from 15 to 16 years in the 50-m and 100-m events, and from 16 to 17 years in the 200-m, 400-m, and 1500-m events. Our results show that: (a) swimmers should display a substantial improvement (14–19%) to become elite standard as adults, such as at 18 years; (b) 16 is the age at which the ability to predict adult performance increases markedly.

Keywords: *Longitudinal assessment, elite swimmers, stability, prediction*

Introduction

Stability of athletic performance helps researchers to predict the future success of talented young athletes and coaches to select appropriate training methods. Longitudinal studies are required to do this. In swimming science, few such studies exist but those that have been conducted have: (1) related models of training demand with performance enhancement (Hooper, Mackinnon, & Ginn, 1998; Mujika et al., 1995; Mujika, Padilla, & Pyne, 2002; Termin & Pendergast, 2000; Trinity, Pahnke, Sterkel, & Coyle, 2008); (2) analysed performance variability between competitions, during or between seasons (Costa et al., 2010a, 2010b; Hopkins, Pike, & Nottle, 2010; Issurin, Kaufman, Lustig, & Tenenbaum, 2008; Pyne, Trewin, & Hopkins, 2004; Stewart & Hopkins, 2000); and (3) related performance progression with ranking (Sokolovas, 2006; Trewin, Hopkins, & Pyne, 2004).

It has been suggested that performance assessments based on longitudinal designs are informative, since they allow (Costa et al., 2010b): (1) estimation of the progression and variability of performance during and between seasons; (2) identification of ages at which predictions of swimmers' performance improve; and (3) determination of the probability of swimmers reaching finals or winning medals in important competitions. For example, training intensity has been shown to be the key factor in elite swimmers' performance enhancement from season to season (Mujika et al., 1995; Termin & Pendergast, 2000; Trinity et al., 2008). Improvements of approximately 1% in a competition and within the year were necessary to stay in contention for a medal at the Sydney 2000 Olympic Games (Pyne et al., 2004). The third season of the 2004–2008 Olympic cycle was shown to be the time when performance stability increased strongly for Olympic Games performance (Costa et al., 2010b). However, factors that affect adults are different from those that affect children and can vary during swimmers' careers. For instance, aerobic capacity, maximal-intensity exercise, and skill acquisition are influenced by growth

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