ANTHROPOMETRY AND FITNESS TESTING AS PREDICTORS OF PERFORMANCE IN TWO ELITE CANOEISTS

Thomas W. Pelham & Laurence E. Holt
Dalhousie University, Halifax, Nova Scotia, CANADA

INTRODUCTION

During a 500 meter or 1000 meter single-man Canadian canoe (C-1) race, the international canoeist will propel the craft at an average velocity of 4.17 meters per second through generating quick and powerful muscular contractions at rates of 60 or more strokes per minute (Pelham et al., 1992). Biomechanically, the C-1 stroke is a complex action involving many muscles, joints, and body segments in generating an effective stroke. All of the muscular effort involved in the sport of canoeing ultimately is applied through the paddle against water resistance in order to accelerate the boat (Pelham & Holt, 1995). It is obvious that in such events the objective of the athlete should be to generate, at a sustainable level, a power output that, properly applied, will enable the canoeist to perform at his best. Loss of power output due to localized muscular fatigue should be avoided, particularly if the specific muscles fatigued are modest in their contribution to propulsion. It is preferable that the major portion of the work be done with larger, more centralized musculature.

Previous attempts to describe and interpret the Canadian single canoe (C-1) stroke have been based upon subjective judgement (Granek 1969) and limited on-water kinematic analysis (Plagenhoef 1979). The relationship between the anatomical features and physiological systems of the participant responsible for force production and its application (resulting boat dynamics) has been neglected. Indeed, within elite canoeing, there appears to be considerable variation in anthropometric characteristics and efficiency of energy systems among athletes. Understanding these relationships is essential if technique corrections, off-water and on-water training, and testing protocols are to be effective.

With this in mind, the purpose of this study was to measure and discuss the anthropometric and fitness profiles of the two elite canoeists discussed in the previous paper.

METHODOLOGY

Subjects were two males, both experienced international competitors and members of the Canadian canoe team; both left sided paddlers. An anthropometric and fitness profile of the S's is presented in Table 1. Before any testing or measuring, both were informed of the nature of the study and verbally consented to participate.

RESULTS

In the previous article it was evident that sport-specific testing indicated superiority of performance for subject 1 (S1). However, in table 1, a battery of anthropometric and general fitness tests currently used by the Canadian Canoeing and Kayak Team Program show superiority for subject (S2). S2 was larger (BMI, 25.9 versus 20.9; WHR, 0.87 versus 0.81) with less fat (% BODY FAT 5.5 versus 8.2), as well as superior in two of the three general muscular power tests. In addition, S2 was superior in other measures of strength and power not presented in this paper.

Table 1: Anthropometric and fitness characteristics of subjects.

CHARACTERISTIC	S1	S2
AGE	20	20
HEIGHT (cm)	179.9	180.1
WEIGHT (kg)	75.3	79.2
BMI	20.9	25.9
WAIST (cm)	78.4	83.7
HIP (cm)	97.0	96.0
WHR	0.81	0.87
% BODY FAT	8.2	5.5
POWER TESTS		
2 minute 32.5 kg bench pull maximum number of reps	95.0	116.0
2 minute 30.0 kg bench press maximum number of reps	96.0	134.0
2 minute chin ups maximum number of reps	68.0	53.0
300 METER SWIM (SECONDS)	234.0	312.0

DISCUSSION

Although, S2 is a well-endowed and well-conditioned canoeist, his higher level of strength, power and physiological conditioning cannot compensate for a less effective method of propelling the craft. S1 is a more efficient paddler than S2. Proper technique is more important than an intense and general conditioning program. Mechanically, considering the importance of the applied force in canoeing

performance, the preceding findings have strong implications for technique interventions for S2, a situation presently being corrected by both athlete and coach.

The differences may be related to history of development and training methods. As an age group competitor, the program for S2 consisted of strength training and C-15 racing with little attention placed on the skill development necessary for the C-1 craft. In addition, emphasis was placed on winning local age-group competitions. Whereas, the developmental program for S1 involved general aerobic activity enriched during the competitive season with a concentrated aerobic/skill development program specifically for the C-1 craft. S2 was instructed and trained to perform well on general fitness tests. The long-term development of S1 was directed towards on-water performance.

Entering the senior levels, S2 continued to focus on hypertrophy development during training, S1 refined his technique. Chronic hypertrophy resulting from strength training will reduce the muscle's respiratory capacity. Increasing the size of the muscle fiber without changing the metabolic capacity of the muscle to utilize oxygen will result in a reduction in the mitochondria per muscle fiber area, as well as, reducing the oxidative activity of such enzymes as; succinate dehydrogenase (Pelham et al., 1992). Oxidative metabolism is the dominant energy source during racing. The limiting factor in performance in canoeing is fatigue, either local muscular or systemic. The main objective of traditional resistance training for canoeists has been strength and hypertrophy gains to the trunk and shoulder girdle with little emphasis on hip and leg musculature (Pelham et al., 1992; Pelham & Holt, 1995). Pure strength training seems to be counterproductive, and often times injury producing.

The current method of evaluation used by the Canadian Canoeing and Kayak Team Program reinforces the notions that hypertrophy training is an important factor in elite canoeing performance. However, if the results of this study hold to be true for other paddlers, the current test battery should be changed to a more sport specific test battery.

Implications

The results of this study suggest that the current method of non-specific testing used by the Canadian Canoeing and Kayak Team Program should be re-evaluated. Training and testing should be sport-specific. The program's philosophy should include the notions of long-term development with an emphasis placed on skill and central oxidative adaptations. Testing should be sport-specific, preferably on-water, and if not, on an excellent simulator.

REFERENCES

Granek, F. (1969). Paddling Kayaks and Canoes. National Paddling Committee, Kenilworth, NJ.

Pelham, T.W., Burke, D.G. & Holt, L.E. (1992). The flatwater canoe stroke. National Strength and Conditioning Association Journal 14(1): 6-8, 86-90.

Pelham, T.W. & Holt, L.E. (1995). Testing for aerobic power in paddlers using sport-specific simulators.
9(1): 52-54.

Plagenhoef, S. (1979). Biomechanical analysis of Olympic flatwater kayaking and canoeing. Research Quarterly 50(3):443-459.