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Letter to editor

Time motion analysis of Supercross BMX Racing

Dear Editor-in-Chief

The sport of bicycle motocross (BMX) was introduced as an Olympic sport in 2008. Until then, the sport was relatively unknown to the general public and has therefore been subjected to very little scientific research. The race is a one-lap event that commences when a mechanical gate falls, releasing the (maximum of) eight riders onto a course consisting of a start hill, jumps and banked turns. In this configuration, the Olympic caliber racers are able to reach peak power and cadence within 6.0 meters and 1.6 seconds (Herman et al., 2009). Due to the varied nature of the sport, there are multiple factors contributing to the success of a rider. The ability to get a good start, get to the first corner first and to successfully negotiate the obstacles on the course are all influences on the outcome (Zabala, et al., 2009).

A review of the literature reveals that there seems to be a great deal of information on the basic physical dimensions of a Supercross track (Campillo et al., 2007; Hodgkins et al., 2001; Slyter et al., 2001; Zabala et al., 2009). However, to the knowledge of these authors the temporal as well as the movement characteristics of how riders navigate the Supercross BMX track is unknown. Having such information would seem fundamental in the physiological and physical preparation of BMX athletes. Given the paucity of evidence in this area the purpose of the current study was to gather objective information regarding the sport of Supercross BMX by means of a time motion analysis (TMA). As the predominant and advantageous movement patterns become clear and the specific time breakdown of skill utilization is identified, the focus of conditioning and the direction for further research will become evident.

Union Cycliste Internationale (UCI) categorised Elite riders (n = 26) were the subjects of the TMA which occurred during the 2010 BMX World Championships in Pietermaritzburg, South Africa. The riders negotiated the course solo at a maximum pace and this provided data specific to the TT component of BMX racing where the riders were ranked according to course navigation in the shortest elapsed time. Video footage was captured at 25Hz and analysed using Quicktime™ (Apple Inc, California, USA) and VideoMotion© (Objectus Technology, Pennsylvania, USA) software. The movement patterns and time spent pedaling, jumping and "pumping" were determined for each run.

The specific values for each of the variables of interest for males and females can be observed in Figure 1. The Elite Men riders averaged 39.67 ± 0.81s and 30.45 ± 3.20 pedal strokes to complete the Supercross track at the 2010 World Championships. They spent 11.83 ± 1.11s, 9.64 ± 1.79s and 17.05 ± 1.51s pedaling, jumping and "pumping" respectively.

The Elite Women riders competed on a modified track where their 2nd and 3rd straightaways were different from that used for the men, thus allowing them ~3 more total pedal strokes than the men. Due to this, it would be inappropriate to try to make any comparison of men to women beyond the 1st straight. The Elite Women took 40.95 ± 0.91s to complete a track, utilising 33.65 ± 5.06 pedal strokes and spent 14.40 ± 2.17s, 6.28 ± 1.41s and 17.80 ± 1.83s pedaling, jumping and "coasting/pumping" respectively.

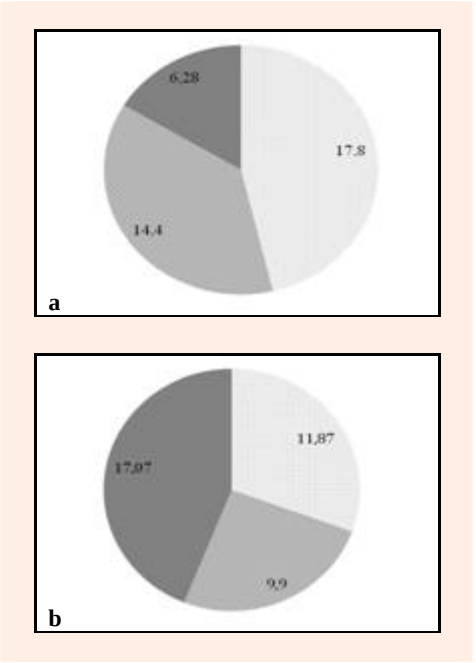

Figure 1. Total time (s) time spent for females (a) and males (b) pedaling (light grey), pumping (dark) and jumping (dark grey).

The dominant movement patterns were exhibited during the pedal stroke and when overcoming obstacles. Pedaling involves primarily flexion and extension of the hip and knee. When jumping or pumping, very little movement in the lower body was noted while the arms in relation to the torso appeared to be the prime movers in these portions of the track. The movement pattern observed was that of the arms' horizontal abduction and adduction to the torso.

It must be noted that the data was derived from the TT, where the rider is alone and is able to choose how to best navigate the course. In the context of a race, he or she will have to contend with a maximum of seven other riders and the corresponding riding behaviour will most certainly have to adapt accordingly. Furthermore, this data is indicative of the patterns on one specific track. Nonetheless the following observations of time spent pedaling, pumping and jumping were noted. Women spent 38%, 16% and 46% of their time pedaling, jumping and pumping respectively while the men spent 31%, 25%

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and 44% respectively. Because the men and women ride a different track after the first corner, this skewed the statistics. Figure 2 shows the differences in riding behaviour between men and women when riding the identical track.

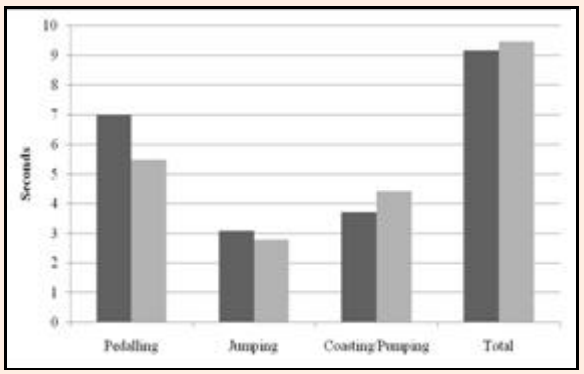

Figure 2. Time (s) time spent for males (dark) and females (grey) on 1st straightaway.

Given the duration of the race and the efforts it encompasses, BMX may be classified as a strength and power sport. Considering the dominant movement patterns, selection and inclusion of specific exercises such as the squat, deadlift and bench press is indicated. The loading parameters of these exercises should reflect the specific needs of the sport.

The results of the information collected establishes that many of the established testing protocols for cyclists, such as the 30 or 60 second Wingate test is largely irrelevant for BMX given that an entire BMX race lasts only slightly longer than 30 seconds and of that time, only 30-40% is devoted to pedaling.

The measurement of power output has been instrumental in changing the way that competitive cyclists train for their events (Allen, 2010). Ironically, in the cycling discipline that may be closest to a pure strength and power sport, the research on power output of the athlete is virtually non-existent.

Future research is needed to understand the relationship between power production and technique. With more comprehensive power recording coupled with acceleration and video data, a more thorough understanding of BMX will develop. From this, appropriate and specific testing, strength and conditioning as well as technique coaching can develop.

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