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Application of the Copenhagen Soccer Test in high-level women players – locomotor activities, physiological response and sprint performance

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ABSTRACT

We evaluated the physiological response, sprint performance and technical ability in various phases of the Copenhagen Soccer Test for Women (CSTw) and investigated whether the locomotor activities of the CSTw were comparable to competitive match-play (CM). Physiological measurements and physical/technical assessments were performed during CSTw for eleven Norwegian high-level women soccer players. The activity pattern during CSTw and CM was monitored using the ZXY tracking system. No differences were observed between CSTw and CM with regards to total distance covered (10093 ± 94 and 9674 ± 191 m), high intensity running (1278 ± 67 and 1193 ± 115 m) or sprinting (422 ± 55 and 372 ± 46 m) ($p > .05$). During CSTw, average HR was 85 ± 2%HRmax with 35 ± 2% playing time >90%HRmax. Blood lactate increased ($p < .05$) from 1.4 ± 0.3 mM at rest to an average of 4.7 ± 0.5 mM during CSTw, with no changes during the test. Blood glucose was 5.4 ± 0.3 mM at rest and remained unaltered during CSTw. Sprint performance (2 × 20 m) decreased ($p < .05$) by 3% during CSTw (8.19 ± 0.06–8.47 ± 0.10 s). In conclusion, the locomotor activities during CSTw were comparable to that of high-level competitive

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match-play. The physiological demands of the CSTw were high, with no changes in heart rate, blood lactate or technical performance during the test, but a lowered sprint performance towards the end of the test.

1. Introduction

Activity patterns in elite male soccer matches have been investigated comprehensively for many years (Bangsbo, 1994; Bangsbo, Norregaard, & Thorso, 1991; Drust, Reilly, & Cable, 2000; Mohr, Krustrup, & Bangsbo, 2003), and within recent years research has also examined female players (Andersson, Randers, Heiner-Moller, Krustrup, & Mohr, 2010; Gabbett & Mulvey, 2008; Krustrup, Mohr, Ellingsgaard, & Bangsbo, 2005; Krustrup, Zebis, Jensen, & Mohr, 2010; Mohr, Krustrup, Andersson, Kirkendal, & Bangsbo, 2008). It has been observed that the heart rate response to elite female soccer matches is similar to male elite matches, with average cardiovascular loading around 85% of individual maximal heart rate (HRmax) and with more than 25% of the total time in the aerobic high intensity zone, above 90% of HRmax (Andersson, Ekblom, & Krustrup, 2008; Bangsbo, Mohr, & Krustrup, 2006; Krustrup et al., 2005). Likewise, total distance covered in elite female matches of around 10 km is comparable to elite male match-play, whereas the amount of high intensity running, sprinting and the blood lactate values are observed to be lower in female than in male matches (Ekblom, 1986; Krustrup, Mohr, Steensberg, et al., 2006; Krustrup et al., 2005, 2010; Mohr & Krustrup, 2013; Mohr et al., 2003, 2010). Interestingly, when using both equal cut-off limits and cut-off limits relative to maximal sprinting speed less distance is covered at high-intensity running and sprinting in female matches (Dwyer & Gabbett, 2012; Krustrup, Bendiksen, & Bangsbo, 2013; Krustrup et al., 2005; Mohr et al., 2003, 2008; Mujika, Santisteban, Impellizzeri, & Castagna, 2009). Another interesting finding is that the amount of high-intensity running and sprinting increases with the level of elite participation for both female and male players (Ingebrigtsen et al., 2012; Mohr et al., 2003, 2008) and that the amount of high-speed running and sprinting decreases after intense exercise periods during matches and towards the end of competitive and friendly soccer matches in both male and female elite players (Andersson et al., 2008; Bradley et al., 2009; Krustrup et al., 2005, 2006; Mohr et al., 2003, 2008, 2010).

In order to better understand the underlying factors responsible for fatigue in competitive football match play, muscle and blood metabolites, electrolytes, body temperatures and muscle damage markers can be assessed. Due to the inherent difficulties in obtaining such measurements relatively few studies have determined the muscle and blood metabolites in various phases of soccer matches or during soccer-specific exercise (Bendiksen et al., 2012; Greig, McNaughton, & Lovell, 2006; Krustrup et al., 2006, 2011; Mohr & Krustrup, 2013; Mohr, Krustrup, Nybo, Nielsen, & Bangsbo, 2004; Mohr et al., 2010; Nybo et al., 2010; Rostgaard, Iaia, Simonsen, & Bangsbo, 2008; Thorlund, Aagaard, & Madsen, 2009). As exercise intensity changes dramatically throughout soccer matches (Mohr & Krustrup, 2013; Mohr et al., 2003, 2004, 2010), this has an impact on the physiological response during different match periods. Investigating this is difficult, since the physiological response is highly dependent on the activity pattern, and exercise intensity immediately prior to the sampling (Krustrup et al., 2006). The activity pattern, including high intensity running and sprinting, has also been observed to vary from match to match in elite soccer (Andersson et al., 2010; Gregson, Drust, Atkinson, & Salvo, 2010; Krustrup et al., 2010; Mohr et al., 2003). Sampling during a soccer simulation that allows for continuous measurements may be a useful tool to obtain reproducible measurements under standardized conditions as have been previously described for elite male soccer players (Bangsbo & Lindquist, 1992; Bendiksen et al., 2012; Gunnarsson et al., 2013; Rostgaard et al., 2008). Soccer simulations have been done on treadmills, but the nature of treadmill testing prevents the inclusion of soccer specific movements and activity changes (Drust et al., 2000; Stuart, Hopkins, Cook, & Cairns, 2005) and to our knowledge, the physiological response has not previously been investigated in soccer specific simulations for high-level female players.

The Copenhagen Soccer Test (CST) was recently developed in order to mimic match play conditions, to induce similar physiological responses to elite male competitive matches, and to allow for blood