Author: Mukherjee, Swarup
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Institute: Thesis (Ph.D.) National Institute of Education, Nanyang Technological University
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Supervisor: Chia, Michael
SUMMARY

The performance capabilities and fitness characteristics of soccer players change through the playing season. There is a dearth of studies monitoring youth professional soccer players throughout the soccer season. The overall activity pattern in soccer is of an intermittent high-intensity type and the capability to perform repeated high-intensity running is one of the discriminatory performance quality among soccer players at different standards of the game. Repeated high-intensity running derives energy from all three energy systems in different proportions depending upon the fitness level of the players and the physiological demands of the game in terms of duration, intensity and frequency of the high-intensity running efforts required during the game. Therefore, performance tests in soccer must involve surrogate measurements of all the three energy systems.

The primary objective of the present study was to examine the indicators of repeated high-intensity running capability through the complete soccer season in youth professional soccer players. The participants (n = 20; mean ± SD age, 17.5 ± 0.3 years; stature, 1.73 ± 0.04 m; body mass, 67.2 ± 7.5 kg) represented the Singapore National youth (under-18) soccer team and also participated in a local professional soccer league. Following the results on reliability and the suitability of the test protocols and the measurements in the pilot data, the participants completed three laboratory tests and two field tests of both aerobic and anaerobic measurements on three occasions (pre-season, early in-season and end mid-season) minimum 8 weeks apart during a nine-month period of the soccer season. The laboratory tests included estimation of peak VO$_2$, test of intermittent high-intensity running capability on the motorised treadmill and a repeated
sprint ability (RSA) test (6 × 6 s with 24 s recovery) on the non-motorised treadmill. The field tests included the test of intermittent high-intensity running capability (YoYo Intermittent Recovery Test Level 2) and a RSA test (8 × 20 m with 15 s active recovery). In addition, the present study also determined the percentage body fat (% BF) and lean body mass (LBM) using dual-energy X-ray absorptiometry (DXA), urinary total antioxidant capacity (uTAC, early morning sample, 72 hours post-match) and the match play work-intensity using heart-rate (HR) monitoring.

Results of phase-wise analysis of the measures showed a significant correlation between the performance in the laboratory and field test of intermittent high-intensity running with the amount of high-intensity exercise performed during match play (r = 0.55-0.82; p < 0.05). However, a non-significant negative correlation was observed between performance in the laboratory and field tests of RSA with the high-intensity exercise during match play (r= –0.11 to –0.43; p > 0.05). Results showed a non-significant correlation between peak VO$_2$ and the measures of intermittent high-intensity running (r=0.16-0.55, p > 0.05) and also between peak VO$_2$ and RSA performance (r= –0.07-0.26, p > 0.05). A significant correlation was detected between peak VO$_2$ and average work-intensity during match play (r=0.51-0.70, p < 0.05), but results showed a non-significant correlation between peak VO$_2$ and high-intensity exercise performed during match play (r=0.16-0.58, p > 0.05). Results also showed a significant negative correlation between % BF and performance in the laboratory and field tests of intermittent high-intensity running (r= –0.45 to – 0.77, p < 0.05), performance in the field test of RSA (r=0.53-0.64, p < 0.05) and with high-intensity work performed during match play.
play (r= – 0.66 to – 0.57, p < 0.05). uTAC as a global measure of antioxidant capacity was not correlated with any of the performance measures (r= – 0.01 to 0.44, p > 0.05).

Results of the longitudinal analysis showed a significant change (p < 0.05; * significant change from previous phase) in performance in the laboratory-based test of intermittent high-intensity running capability (distance covered, mean; 2799, 3084*, 3038 m), laboratory-based RSA test (average mean power, mean; 629, 649, 691* W), YoYo IRT L2 (distance covered, mean; 818, 950*, 1032 m) and in the field-based RSA test (total time, mean; 24.4, 23.9*, 24.3 s) through different phases of measurement during the soccer season. A non-significant change (p > 0.05) was detected in peak VO$_2$ through the season (mean; 54.9, 53, 53.2 ml·kg$^{-1}$·min$^{-1}$). A non-significant change was also observed in the average work-intensity (% of maximal HR; 87.7, 90.1, 90 %) while results showed a significant change in the high-intensity work performed (% of total playing time; 57.5, 69.5*, 58* %) during match play. Results also showed a significant change (p < 0.05) in % BF (13.2, 11.2*, 12.4* %), % LBM (82.5, 84.5*, 83.3*) and uTAC (3.1, 2.7*, 3.0 mmol·L$^{-1}$) through the season.

Results showed that repeated high-intensity running capability changes during the playing season in youth professional soccer players and this change was also reflected in the high-intensity work performed during match play. The results also showed that the indicators examined were sensitive to the change in this capability. Results of the study strongly supported the significance of low adiposity in performance of repeated high-intensity running. Based on the results, factors in addition to peak VO$_2$ like the muscle buffer capacity seemed to be important for repeated high-intensity running capability in youth professional soccer players. However, the results strongly supported the
importance of a high aerobic capacity to maintain an overall high-work intensity during match play. Results indicated that uTAC might be a generic response to soccer training and performance.

In conclusion, the measures of intermittent high-intensity running might be the appropriate indicators for assessing the repeated high-intensity running capability in youth professional soccer players especially with respect to evaluating the match-related fitness in terms of high-intensity work performed during the soccer games. Motion characteristic analysis studies might be necessary to evaluate the extent to which performance in the RSA tests is reflected during match play. Further, the results strongly suggested that it might be of consequence to include fitness training even during the in-season and that monitoring of the training intensity would be important to achieve the desired training gains and performance outcomes.