CHAPTER 24

Working as a physiologist in professional soccer

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Discussion

Soccer is characterised by high-intensity efforts superimposed on a background of endurance running. Both the aerobic and anaerobic energy systems (around 90 and 10% respectively; (1) are taxed during match-play. Soccer also requires players to perform specific match actions such as jumping, kicking, tackling and changing direction quickly that require the rapid development of force. Performance in such activities is related to the strength of the muscles used to produce such movements. These general requirements of soccer are dependent to a large extent on the positional role of the player (2).

The participant in this case study was a male full-time youth trainee soccer player (age 17, height 1.82 m, body mass 78.4 kg) who played in midfield at a Nationwide League One football club. Midfield players typically cover the greatest distances during match-play (3) as a result of their role as a link between defence and attack. Increases in activity tend not to only reflect the greater distances completed at sub-maximal intensities (e.g. walking and jogging) (4) but may also reflect greater requirements for high speed running and sprinting (5). These specific positional requirements indicate that a high aerobic capacity as well as effective pathways for anaerobic energy provision is important for midfield players. Such fitness attributes will enable players to produce energy to develop and maintain a high-intensity of exercise for prolonged periods of time and to recover quickly after a bout of maximal exercise. The requirement to perform specific match actions will also necessitate an ability to generate force. The evaluation and development of a range of fitness parameters are therefore required to ensure that a midfield players' fitness matches the demands imposed on him during competition.

A needs analysis was completed using a two stage process. A performance profile, that included the key physiological requirements for the athlete's specific playing position, was presented to and completed by him in a private meeting. This process enabled me to obtain a personal perception of the clients perceived physiological strengths and weaknesses. This personal evaluation was followed by objective physiological tests. The use of physiological tests to provide an indication of their performance potential was preferred over the use of the individual's match performance. This was a direct consequence of the large variability observed in indicators of match performance (6). The inherent variability (which is a consequence of factors such as the specific tactical requirements of a given opposition, the score-line, the venue etc) of such data makes it unsuitable for the detection of the relatively small changes that may occur in physiological function as a consequence of the completion of a relatively short-term training programme. An emphasis on the interpretation of changes in the outcomes of carefully controlled physiological tests provides a more robust approach to detecting changes in performance status in interventions of this nature. Such data also allows the quantification of the individual's abilities in relation to group averages and other published data, as well as their own individual performance data, thereby enabling meaningful comparisons to be made with other individuals/populations.

The test battery comprised both laboratory tests and more soccer-specific field based evaluations. The assessments were chosen based on their relevance to the fitness characteristics under consideration, their ease of use, their sport specificity and their time efficiency. Laboratory tests were used to provide a more general physiological assessment of aerobic fitness with field tests providing information relating more to soccer-specific performance. All field tests were performed on an artificial indoor surface where environmental conditions could be continuously controlled. All tests employed had been previously assessed for reliability using the standard error of measurement (SEM) (7). The player was fully familiarised with all tests prior to the relevant assessments. The following assessments were included in the test battery partly as a consequence of the analysis of the individual needs analysis: Maximal Oxygen Consumption ($\dot{V}O_{2\ max}$); Yo-Yo Intermittent Recovery Test Level 2 (Yo-Yo IR2); Repeated Sprint Test (8).

The outcomes of the subjective aspect of the needs analysis suggested that the athlete's weaknesses were his "endurance" and his ability to "repeat high-intensity efforts". These views were supported by the objective data collected (see Figure 1). The player's $\dot{V}O_{2\,max}$ value was lower than both the group average for other players in the squad and the mean values observed for other similar soccer players. Data from the Yo-Yo IR2 also indicated that the client's performance did not match that of other age matched individuals. The data from the repeated sprint test illustrated that while one off sprint performance was similar to other players the ability to perform repeated high-intensity bouts of exercise was inferior to others. This information would suggest that a major focus of any intervention should clearly be on the development of the athlete's aerobic fitness. Development in these areas would lead to improvements in the general aerobic fitness of the player but also increase the individual's capacity to support and recover from repeated intense bouts of exercise. Such physiological changes may enable performance of higher numbers of repeated bouts of intense exercise to be performed in matches and subsequently improve match activities.

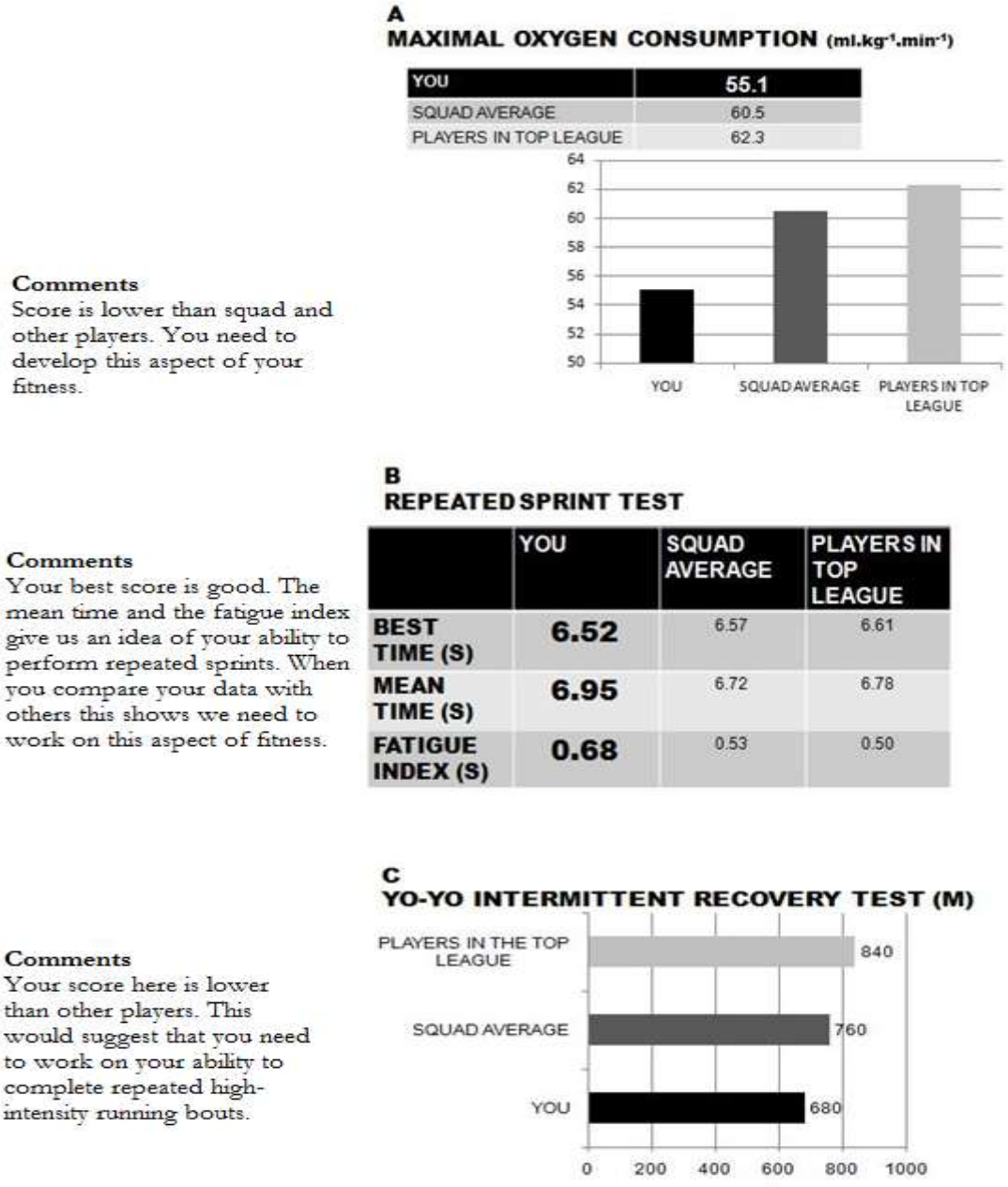

Figure 1: Results from the pre-test assessments for the individual player; (A) maximal oxygen consumption, (B) repeated sprint test, (C) YoYo IR2

The player followed an eight week training schedule. This training schedule was agreed with the individual's coach. The needs to continue the technical and tactical development of the player prevented him from been withdrawn from the squad to complete dedicated fitness work. The intervention was therefore designed around 3 supplementary training sessions. It is likely that such models of intervention are the most applicable to this specific sport as it is unlikely that alterations to the overall training programme completed by players are possible in the majority of clubs. The training intervention was predominantly aimed at improving the aerobic fitness of the player.

Training sessions were predominantly high-intensity in nature. This strategy was partly informed by the limited time that was available for additional training and the effectiveness of this type of training prescription for improving aerobic fitness (9) Short duration sprint based high-intensity training sessions were also included within the programme such short-term sprint interval training programmes have recently been shown to be a potent training stimulus for the aerobic energy system both generally (10) and in specific populations (11). The inclusion of this type of activity would also provide a specific anaerobic training stimulus for the client. This would be important as a basis for improvements in performance parameters that rely more on anaerobic energy provision such as discrete sprints or repeated high-intensity efforts over relatively short durations of time. Table 1 shows an example week from the training intervention

Table 1: Example week of supplementary training from the 8 week training programme

	Session 1	**Session 2**	**Session 3**
Session type	Soccer-specific interval session	Repeated sprint session	Soccer-specific interval session
Exercise prescription	5 x 4 min intervals at 95% max.heart rate	3 x 8 x 40 m sprints	2 x 10 x 1 min interval sessions at 95% max.heart rate
Recovery prescription	3 min at approximately 50% max.heart rate	20s between sprints, 4 min between sets	1 min recovery between each effort, 5 min between sets at approximately 50% max.heart rate

All of the training sessions were delivered using interval-training techniques. This provides a better representation of the intermittent activity pattern associated with soccer. The specificity of the training stimulus was further improved by using soccer-specific movement patterns during training as opposed to more conventional distance running techniques (i.e. track work or road running). All training sessions were carried out on a soccer field using relevant pitch markings to guide distances and to help guide the soccer-specific movement activity utilised. All recovery periods were active as this again replicates the activity profile that is observed in games. The client wore a HR monitor when possible during training sessions. He was also familiarised with Borg's RPE scale in order to rate the overall intensity of the session. This served to ensure that the correct intensity of exercise was achieved during the physical conditioning sessions.

Within two weeks of the completion of the intervention the pre-programme test battery was repeated (see Table 2). Improvements in the client's general aerobic fitness were observed following the intervention indicating that the players' general aerobic fitness was now in line with other players in his peer group and with the values observed for other midfield players. The total distance covered on the Yo-Yo IR2 was increased by around 180 m and relevant indices of the repeated sprint test (mean time, fatigue time) were also improved. This suggests that the player has improved both his ability to generate energy through the aerobic and anaerobic energy systems and/or improved the ability to recover from intense efforts. Such improvements may facilitate the completion of additional high-intensity running within games and hence improve the overall match performance of the player in question.

Table 2: Percentage change in performance test results for the individual player following the intervention

Performance Marker	**% change from pre-test**
Maximal Oxygen Consumption	9.8
YoYo IR2	26
Repeated Sprint test	
Best time	0.1
Mean time	3.6
Fatigue index	14.7

The successful attainment of the primary objectives of the support programme would seem to indicate that the case study represents a successful intervention though it is difficult to know if these discrete improvements will impact actual match performance. Some relevant considerations for similar future interventions may include (a) the inclusion of more dedicated anaerobic training sessions to facilitate greater improvements in anaerobic energy requirements, (b) potential changes in the sport-specific field based assessment protocols (i.e. the inclusion of specific discrete sprint tests at the expense of the repeated sprint protocol) and the way important parameters are calculated (e.g. the fatigue index), (c) an attempt to evaluate the impact of the training programme in a more soccer-specific performance context (that is not limited by the problems associated with using match-play activity profiles).

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The case study has raised some important aspects related to being a successful Sports Scientist working in an applied setting. Communication between the sports scientist, player and coaching staff being one of the most important.

The abundance of technology tracking player's exertion during match play means we are gaining a much clearer picture of what is required from each position on the pitch. This increases the validity of the initial needs analysis in terms of demands on the player, and therefore helps inform the subsequent test design and intervention strategy.

The initial private meeting with the player to discuss their perceptions of their physiological abilities can be a time consuming process with a large squad and sometimes neglected by many, who move straight to

the physiological battery of validated tests. However, this can be an invaluable opportunity to meet with the player, without the perceptions of their coaches or peers and have open discourse of issues/weaknesses they face. It also provides the opportunity to build your own relationship with a player (who up to this point may have only seen you at limited points of the season and their experiences are one of pain infliction and pocking and prodding!)

The next important line of communication is then with the coaching staff/management. Particularly important during high stress periods of the season where technical/tactical development takes priority (as well of course as the all-important 3 points). Drust puts forth a strong argument on how the improvement in repeated sprint ability will translate to match activities. This is a key point; the discussion with the coaching staff needs to make clear links between the additional workload and how it will benefit the player/team in terms that easily understood. This may not allow "dedicated fitness work" as indicated, but it will help development a relationship of trust with the coaching staff that the additional work is worthwhile and therefore more likely not to have its dedicated time in the training day "given away" to other aspects of the player's development.

Again, the time constraint the player has to perform any additional intervention helps to inform the sports scientist of the intervention that will provide maximum return (high intensity interval work is specific to nature of the sport, time efficient and easily quantified in terms of load on the player). As with a lot of team sports the idea of "additional" fitness work can be seen by many players as a punishment. It is important for not only adherence to the task, but also the moral of the player that this is not the case and the soccer specific movement patterns adopted in the case study, hopefully help keep the players interest and distract from the intensity of the session. As well, of course, a fitting into the initial needs analysis of the player's position and training goals.

A very relevant consideration raised in the case study is that of an attempt to evaluate the impact of a training intervention in a soccer-specific performance context. The idea would help add further weight to the importance of such interventions in the eyes of coaching and management staff who have a large say in time allocation available to the Sports Scientist.