Competition schedules in football often require teams to play matches with only a few days of recovery between them. When the time between matches is limited, players can experience transient fatigue, which can adversely affect on-field physical performance. Surprisingly however, the objective data available seem to indicate that elite adult football players are likely able to cope with the physical demands of consecutive games played within a few days (i.e. match running performance is generally maintained throughout the games). One of the reasons why elite adult football players appear to be resilient to match-play induced fatigue may be related to the fact that virtually every professional player is exposed to post-game recovery strategies.

Youth football tournaments typically require teams to play several games within few days (e.g. 4 games in 8 days, 6 games in 9 days). These competition formats are certainly more demanding than those encountered in professional football. However, the available information on how young, developing players, such as those training in elite academies, cope with such condensed competitive demands is scarce. Understanding the performance responses of this population to congested fixtures periods, as well as the actual need for post-game recovery interventions is important for the design of optimal training programmes and, in turn, to realise promising players’ full potential.

Young players, especially those before and during puberty, are known to either resist or delay fatigue better than adolescents and adults during repeated, high-intensity exercise bouts. This is of interest in football as these high-intensity activity patterns are an integral part of the physical demands of youth football match-play. Recovery from previous exercise is also enhanced in young children compared with their older counterparts (i.e. adolescents). For example, it has been reported that several physiological markers related with fitness and fatigue (i.e. exercise heart rate and post-exercise heart rate variability) remained unchanged during a congested competitive period in Under 15 highly-trained young soccer players. This suggests an enhanced ability to resist game-related fatigue in young soccer players.

To further improve the ability to tolerate or delay the onset of cumulative fatigue during periods of consecutive games, any additional recovery intervention that players receive during the post-match period could provide a performance benefit in the subsequent match. Several recovery strategies are commonly used in soccer
and include cryotherapy (e.g. cold water immersion, ice pack applications and cold showers), hydrotherapy (e.g. hot water baths, contrast therapy, spa treatment), massage, compression garments, and active recovery (e.g. low intensity running). In young football players specifically, cold water immersion alone or associated with active recovery have been shown to reduce perceptions of general fatigue and leg soreness after matches, but had no impact on physical test performance. However, the direct effect(s) of post-match recovery strategies on actual match running performance, which is likely to be the most important measure of all, have received little attention. Promising preliminary results have been observed and will be detailed here.

The aim of the present paper is therefore to review the available evidence on the value of post-match recovery interventions in young developing soccer players. To do so, the experience gained at Aspire Academy (Doha, Qatar) over the past 5 years will be presented. In particular, we will present data aimed at:

1. Examining whether non-mature (pre-peak height velocity) and mature (post-peak height velocity) developing soccer players have similar needs for post-match recovery strategies.
2. Examining the effects of selected recovery interventions following games on repeated match running performance. In particular:
   a. The effect of a combination of sauna, cold water immersion and jacuzzi (i.e. spa treatment) between two consecutive matches (within 48 hours) played against the same opponents, in comparison with a no-recovery modality.
   b. The effect of a combination of different recovery interventions (including cold water immersion, stretching, water-based, football-specific active recovery and individualised assisted stretching/massage) during congested fixtures (i.e. international tournaments and competition camps) in Under 17 players in relation to match outcomes.

EFFECT OF MATURATION ON REPEATED MATCH RUNNING PERFORMANCE

We first examined the effects of maturation on repeated match running performance during two consecutive matches against the same opponents, without any specific recovery intervention. To do so, we looked at the eventual changes in different running variables (collected with GPS) during two consecutive games played within 48 hours (Figure 1), in players classified as non-mature and mature. Maturation status was assessed from the estimated age at peak height velocity (PHV), and players were classified as pre- or post-PHV. We selected time-motion data only for players who met all of the following criteria:

1. played against the same opposition in two consecutive matches within 48 hours,
2. played in the same position in both matches and
3. played the entire match on both occasions.

This lead to 19 pairs of matches for 15 pre-PHV players, and 15 pairs of matches for 13
post-PHV players. Results are summarised in Figure 2 and show that:

- without specific post-match recovery interventions, post-PHV (i.e. mature) players appear to experience some signs of residual fatigue 48 hours post-match, as evidenced by a decrease in very-high intensity running and the number of repeated-sprint efforts.
- match running performance is likely improved in pre-PHV (i.e. non-mature) players during the following match, even without any post-match recovery intervention.

The result in post-PHV players supports previous findings in adult soccer players showing that a 48-hour recovery period is not always sufficient to restore all physical capacities back to baseline levels. These findings also confirmed the previous results of post-match fatigue-induced decrements in some physical performance characteristics in highly-trained young soccer players. While changes in tactics between the games could definitely also explain the observed change in running performance, games were played against the same opponents and players played in the same position. Present results suggest therefore that mature players are likely to benefit from post-match recovery strategies. It is, however, worth noting that changes in match running performance had high inter-individual variations, suggesting heterogeneous match-induced fatigue. Differences in player characteristics (e.g. physical capabilities, training background), as well as position-specific differences in match demands, could contribute to these individual responses.

The meaningful improvements in match running performance observed during the second match in the non-mature players (Figure 2) was unexpected. Physical performance is known to be dependent on the balance between physical capability and training and/or exercise-induced fatigue. Therefore, the increased physical capabilities noted in the second match could be related to faster post-exercise recovery abilities in pre-PHV athletes. This could be related to their lower muscle mass and force production ability that is accompanied by less homeostatic disturbance and less muscle damage. Alternatively, short-term improvements in physical performance (i.e. supercompensation) could be another explanation. Irrespective of the mechanisms involved, the present results show that pre-PHV players are unlikely to experience marked fatigue during two consecutive matches performed within 48 hours. Our findings indicate that the implementation of post-match recovery strategies may not be necessary in pre-PHV players. This study does not, however, allow detailed investigation of possible mechanisms that account for the changes in match running performance seen during the second match. For a better understanding of the possible mechanisms involved, readers are referred to reviews on the topic. The outcome of the first match, which could have affected player motivation, was not taken into account in the analyses and is therefore a potential limitation of this study.

**Figure 2:** A summary of the changes in match running performance between two consecutive matches (48 hours apart) without any recovery intervention, for non-mature (pre-PVH, 19 games collected in 15 players) and mature (post-PVH 15 games collected in 13 players) young players. Figure shows very-high-intensity running (>16.1 to 19 km/hour), number of sprints (>19.1 km/hour), peak match speed and the number of repeated-sprint sequences (minimum of two consecutive 1-second sprints within 60 seconds). PVH=peak height velocity. Adapted from Buchheit JSS 2010.

**Effect of maturation on repeated match running performance**

<table>
<thead>
<tr>
<th>Pre-peak height velocity players (&lt;14 yrs)</th>
<th>Post-peak height velocity players (&gt;15 yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Total distance</strong></td>
<td></td>
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<tr>
<td><strong>Very high intensity running</strong></td>
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<tr>
<td><strong># Sprints</strong></td>
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<tr>
<td><strong>Peak game speed</strong></td>
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<tr>
<td><strong># Repeated sprint sequences</strong></td>
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</table>

PVH=peak height velocity.

Recovery from previous exercise is enhanced in young children compared with their older counterparts (i.e. adolescents).
To summarise:

- Mature players are likely to show a decrease in high-intensity running performance between two consecutive games separated by 48 hours. They are therefore likely to benefit from post-match recovery strategies.
- Non-mature players are unlikely to show impairments in match running performance when games are repeated (they even show an improvement). The implementation of post-match recovery strategies players may not be necessary in pre-PHV players.

**EFFECT OF POST-GAME RECOVERY INTERVENTIONS ON REPEATED MATCH RUNNING PERFORMANCE IN MATURE PLAYERS**

*Spa treatment*

We first examined the effect of a spa treatment (Table 1, Figure 3) on repeated match running performance during two consecutive matches (48 hours apart) against the same opponents (Figure 1), in comparison with a no-specific recovery intervention scenario. To do so, we extracted 20 game files collected in 5 players who played both 2 games with and without the spa treatment in between (5×2 games interspersed with spa, 5×2 games without). We then compared the changes in performance in both conditions (i.e. with and without recovery) (Figure 4). Results showed that:

- The combination of sauna, cold water immersion and jacuzzi (i.e. a spa treatment) the day following a match is likely to reduce the deterioration of match running performance during the second game.

The present results obtained in Aspire players are in accordance with another study on the same population, where cold-water immersion alone was shown to improve perceptions of fatigue and recovery and enhanced the restoration of some match-related performance measures during a 4-day tournament. The inter-individual differences in the responses to the spa treatment in our study suggest nevertheless that not all players benefit from post-match recovery interventions to the same extent. As previously hypothesised, individual and/or positional differences in match-related fatigue could account for these observations. However, while the present investigation provides support for the use of post-match recovery strategies to promote restoration of physical capabilities, the precise physiological mechanisms by which match running performance (i.e. sprinting) was possibly improved after spa treatment remain unclear. For a better understanding of the possible mechanisms involved, readers are referred to reviews on the topic. Whether or not the beneficial effect of a spa treatment on match running performance influences match outcomes (i.e. winning or losing) is not straightforward because match running performance is only one of the several factors for success in soccer.

**Other interventions**

During international tournaments and competition camps for Aspire players, post-game recovery strategies (Table 1, Figure 3 and 5) are generally implemented following each game. Match performance data from players who played at least all first halves during these periods of congested fixtures were analysed (Figure 6). These data show that:

- Players managed to maintain their high speed running activity during all games (i.e. there is no a decreasing trend over the games).

While a comparison with another type of aligned recovery and/or control condition...
is lacking, these results suggest that within these specific game settings, the recovery protocols used (Table 1) are likely efficient enough to allow players to perform (at least physically) adequately. Interestingly, there was no clear association between running performance and match outcomes. This confirms that match-to-match variations are likely related to team tactics, opposition and game outcomes, rather than physical capacity per se18,19.

To summarise:

- Mature players using the above-mentioned post-game recovery interventions are likely able to maintain their running performance during repeated games against high-level opponents. This supports the implementation of these recovery strategies.

CONCLUSIONS

- Only mature (post-PHV) players may experience match-induced fatigue within 48 hours, as evidenced by a
decreased match running performance during the following match. The implementation of post-match recovery strategies may only be necessary in mature players.

- In mature (post-PHV) players, a combination of sauna, cold water immersion and jacuzzi (i.e. spa treatment, Table 1) the day after a match is likely to limit the deterioration in match running performance (especially sprinting) in the following match, compared with a no specific recovery intervention scenario.

- During tournaments in mature (post-PHV) players, a combination of cold water immersion, stretching, water-based, football-specific active recovery, and individualised assisted stretching/massage (Table 1) may assist players in maintaining the required game running demands, however, this has no direct link with match outcomes.

- Assessment of player/position-related fatigue, as well as individual responses to recovery treatment as already partially implemented in Aspire, are likely required to optimise training and recovery sessions in developing soccer players.

Figure 5g-m: Hydro-work and post-match recovery protocol. 5k-m) Specific physiotherapy water treatment (with some players).

Figure 5n: Hydro-work and post-match recovery protocol. Mobility/flexibility/cardio activation: 30 to 40 minutes of football-tennis.
### Table 1

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Date of implementation</th>
<th>Contents</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2008-2012</td>
<td><strong>Shower</strong> 2-minute hot shower (temperature self-selected, 33 to 43°C) (Figure 3a)</td>
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<td><strong>Spa</strong> 3× the following spa sequence (highlighted)</td>
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<td><strong>Sauna</strong> (2 minutes, 85-90°C, seated position) (Figure 3b)</td>
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<td><strong>Jacuzzi/hydromassage</strong> (2 minutes, 36±1.5°C, seated position with water at the midsternal level) (Figure 3c)</td>
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<td><strong>Cold bath</strong> (2 minutes, 12±1°C, seated position with water at the iliac crest/umbilicus level) (Figure 3d)</td>
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<td></td>
<td><strong>Leg massage</strong> (2 minutes, between players) not consistently in the sequence (Figure 3d)</td>
</tr>
<tr>
<td>2</td>
<td>&gt;2012</td>
<td><strong>Shower</strong> 8 minute cold water immersion (10 to 16°C) (Figure 5a)</td>
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<tr>
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<td><strong>Spa</strong> Posterior muscular back chain stretching for all + individualised physio treatments (assisted stretching/massage) based on player’s profile and previous game load (Figure 5b-f)</td>
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<td><strong>Spa</strong> 15 minutes aerobic mobility work in water (Figure 5g-j)</td>
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<td></td>
<td></td>
<td><strong>Spa</strong> Specific physiotherapy water treatment (with some players) (Figure 5k-m)</td>
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<tr>
<td></td>
<td></td>
<td><strong>Spa</strong> 4 minute cold water immersion (10 to 16°C) (Figure 5a)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Spa</strong> Mobility/ flexibility/ cardio activation 30 to 40 minute football-tennis (Figure 5n)</td>
</tr>
</tbody>
</table>

**Table 1:** Post-game recovery protocols used in Aspire.

**Figure 6:** Average distance ran (with 90% confidence intervals) at high velocity throughout 5 (left panel) and 4 (right panel) consecutive games in players who played at least the full first half of all games. The left graph refers to the U17 AlKass tournament in Doha, Qatar (2013, with matches played against Liverpool, Esperance de Tunis, Boca Juniors, Aspire Africa and Liverpool, respectively). The lower graph refers to an Aspire (U17) competition camp in Italy (2010, with matches played against Lazio di Roma, Frosinone, To di Quinto and Perscara, respectively). Note that the confidence intervals always overlap the shaded area, which represents trivial differences in running distance (0.2 × between players SD). Match results are shown at the top of each graph.
References


