# Module 4. The fatiguing effect of contact

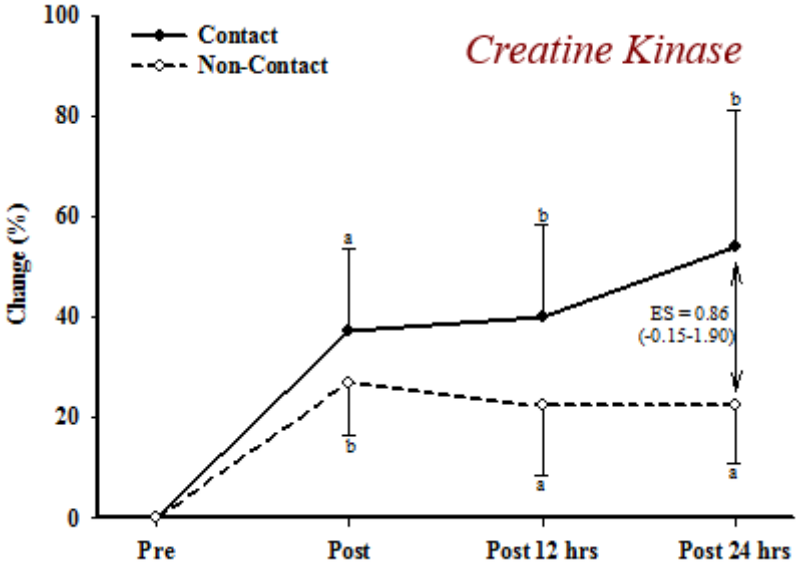
Not all sports rely solely on running to achieve the high-intensity demands. For example, water polo has grappling and wrestling that, along with swimming, passing and shooting contributes to the most demanding passages of play. In previous modules, it was also demonstrated that sports like rugby have very few repeated-sprint bouts, but the repeated high intensity effort bouts, that involve sprinting and collisions are much greater.

If practitioners just use repeated-sprinting to prepare these players for the repeated high intensity-effort bouts, it is highly likely that players will be underprepared for the most demanding passages of play. By introducing 'contact' into our training programs we may be providing game-specific conditioning programs, but if we do introduce contact components into our training, how does that impact on fatigue?

In a recent project we designed a protocol to determine the effect of collision activity on recovery, and whether it impacted players to a greater extent than just running-based activities. We developed a small-sided running-based game, that was played over two periods of eight minutes. This game was performed by group 1. A second group played the exact same game but every minute we blew a whistle, and the players had to find a partner, and wrestle for five seconds as hard as they could, and attempt to bring the opposing player to the ground. In this second game there was blunt force trauma, and eccentric exercise involved with the wrestling and grappling. At the end of the five seconds contact component, another whistle blew, and the game resumed. In this respect, we had a game that was predominantly *running-based* and a game that was predominantly *collision-based*. At the end of the week, the groups crossed over; the players who played the running-based game played the collision-based game, while the players who played the collision-based game played the running-based game.

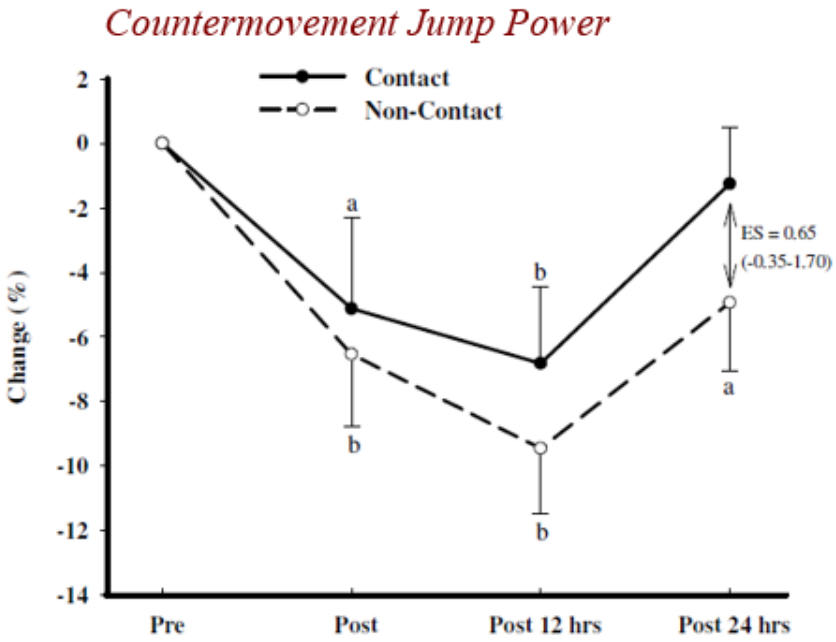
Prior to playing either game, and at the end of the games, we also measured some fatigue markers. We measured creatine kinase as an estimate of muscle damage. We used a lower-body countermovement jump to measure lower body neuromuscular function. In addition, we used an upper-body test, a plyometric push-up to measure upper-body neuromuscular function. We performed these tests pre-game, immediately post, and then for 12 and 24 hours post-game.

**Figure 1: Creatine kinase response to contact (collision-based) and non-contact (running-based) games**



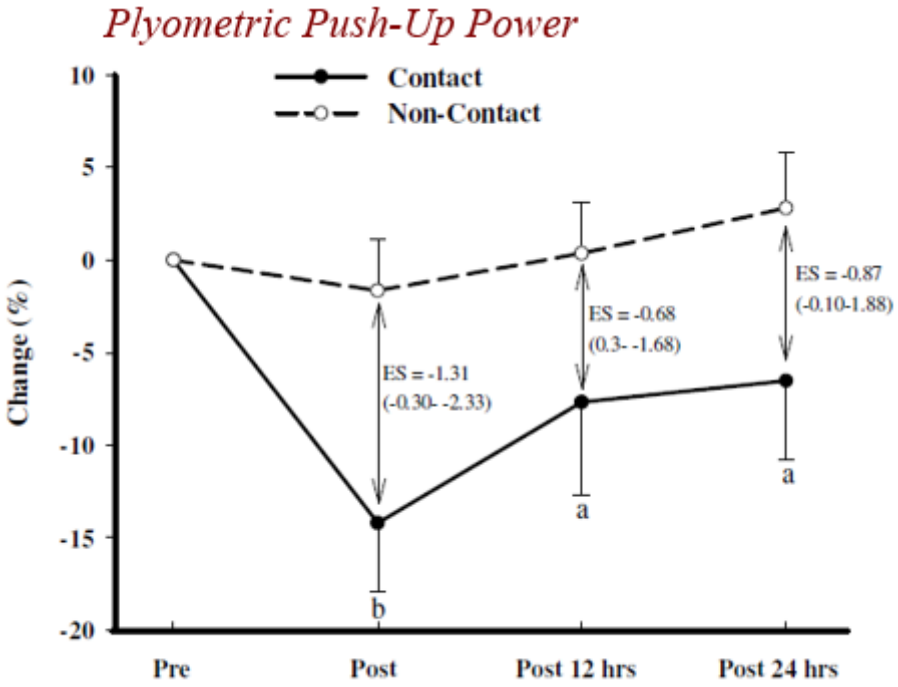

Source: Johnston, Gabbett, Jenkins, and Seibold, 2013, p. 537.

**Figure 2: Lower body fatiguing effect of contact (collision-based) and non-contact (running-based) games**




Source: Johnston, Gabbett, Jenkins, and Seibold, 2013, p. 538.

**Figure 3: Upper body fatiguing effect of contact (collision-based) and non-contact (running-based) games**




Source: Johnston, Gabbett, Jenkins, and Seibold, 2013, p. 538.

Creatine kinase (as an indirect measure of muscle damage), was much greater when the contact-based game was introduced. From a practical point of view, this finding indicates that the muscle damage (and therefore recovery needs) following collision-based sports will be much greater than during running-based sports.

Equally, this data can be used to inform recovery for specific positions. For example, in rugby league, the players who play in the middle of the field (i.e. the 'hit-up forwards') are involved in multiple collisions. However, the outside backs are involved in more high-speed running. This suggests that the players involved in more collisions will likely have greater muscle damage than the players that are mostly involved in running activities.

So, how does upper-body neuromuscular function and lower-body neuromuscular function recover during running-based and collision-based games.

Running-based games are associated with greater lower-body fatigue (as estimated from the countermovement jump) and less upper-body fatigue (as estimated from the plyometric push up). However, collision-based games that involve blunt force trauma, wrestling and grappling, are associated with a lot of upper-body fatigue and very little lower-body fatigue.

These findings have important implications for the way that we manage our players from those particular sports, and those particular positions that involve higher running or higher collision demands.

Let's consider the outside backs (e.g. wingers). These are the players who do a lot more high-speed running and are involved in fewer collisions during competition. These players will experience greater *lower-body fatigue* following the game. Because of this greater lower-body fatigue, it would not be sensible for their first training session following a match to involve high-speed running or heavy lower-body activity.

Typically, we would provide those players with an extra-day of lower-body recovery, with any weight training, involving upper-body activity.

Equally, let's consider the hit-up forwards that play in the middle of the field. This position is associated with a lot of collisions, wrestling and grappling but not particularly large amounts of high-speed running demands. When they return to training following a match, they will be experiencing a lot of *upper-body fatigue*. Therefore, we try to provide these players more upper-body recovery. Rather than making them perform upper-body training in the gym, we'll prescribe a lower-body session to those players.

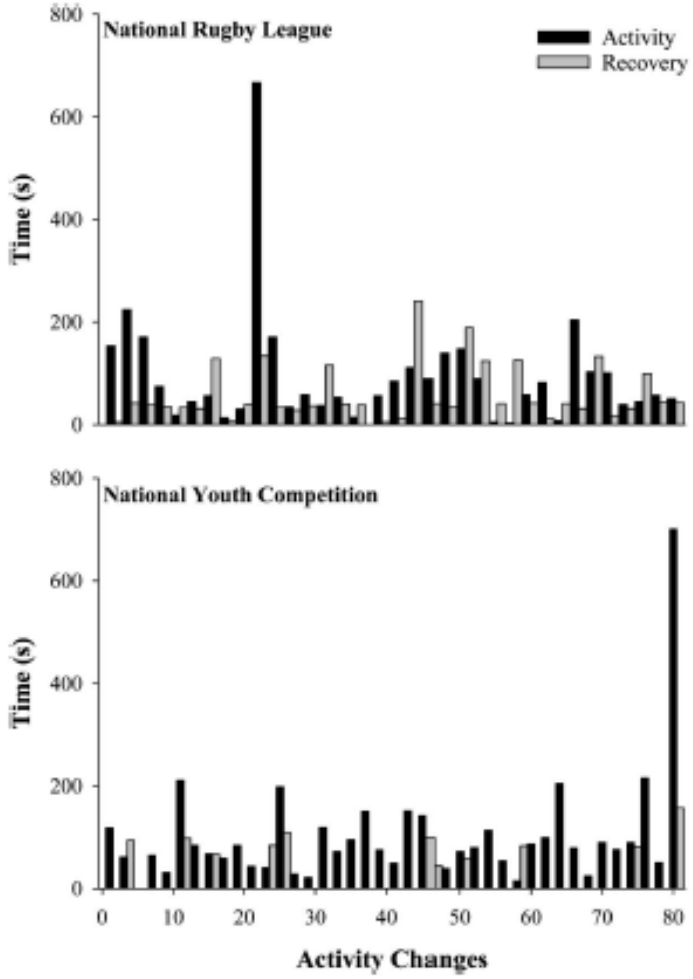
Measuring both upper-body and lower-body neuromuscular function allows practitioners to gain a greater appreciation of the fatiguing nature of collision sports. This in turn allows recovery protocols to be tailored to the specific needs of individual players.

**The "arm wrestle"**

The "arm wrestle" describes the moments when the game is in the balance. The moments when no team is giving an inch and the crowd is on the edge of their seat, because they know that the pressure is building. This is what we call the "arm wrestle". It is a really grueling aspect of the game.

The "arm wrestle" components of a game could come in the first minute or near the final minutes of play (Figure 1).

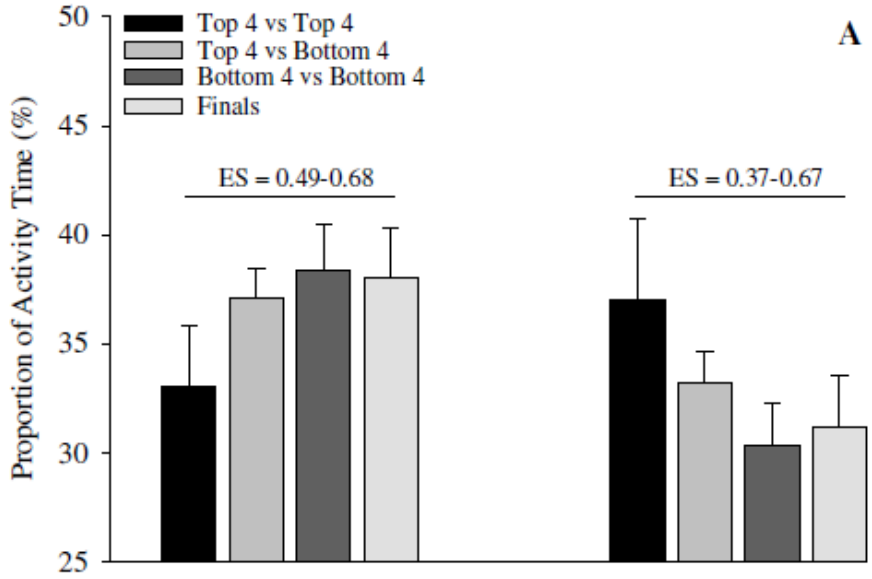
**Figure 1. Longest individual activity cycle for National Rugby League and National Youth Competition matches**




Source: Gabbett 2012 p. 1519.

If we compare across a number of different sports, like football and the rugby codes, we see that the ball tends to be in play longer in higher quality games, when the better teams are playing. There are fewer stoppages during the game, fewer errors, and the ball tends to be in play longer in those high-intensity Top-level games (Figure 2).

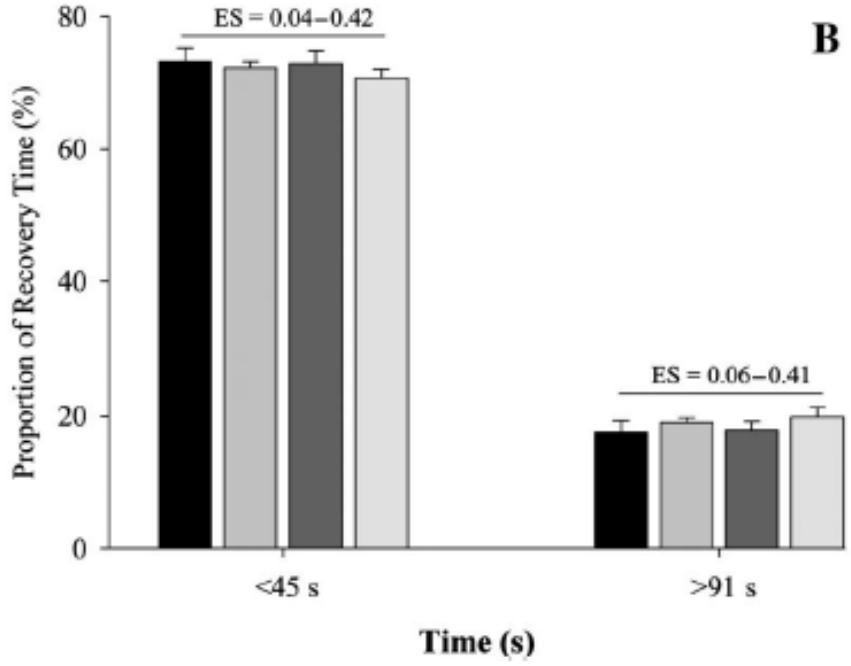
**Figure 2: Influence of ladder position on ball-in-play demands (A)**




Source: Gabbett 2013 p. 1625.

It is important to note that stoppage periods do not increase when ball-in-play times increase (figure 3). The implication is that the activity: rest ratio is higher when the ball is in play longer.

**Figure 3: Influence of ladder position on ball-in-play demands B**




Source: Gabbett 2013 p. 1625.

These results have important implications: winning teams are prepared to get in the "arm wrestle", whereas the losing teams tend to opt out of the "arm wrestle" component because it gets too difficult. They are physically unprepared or mentally unwilling to get into the "arm wrestle".

The "arm wrestle" component of team sports have been described in many ways, including "match activity/inactivity cycles" and "ball-in-play". Ball-in-play can be studied in any team sport competition, including elite football (e.g. the English Premier League) and basketball (e.g. the National Basketball Association). Let's use the National Rugby League competition as an example. Across an 80-minute game of professional rugby league, the ball is in play for 55 minutes (on average); 25 minutes is ball-out-of-play. Of those 55 minutes, in any single ball-in-play period, the average is only 82 seconds. This means that the ball is in play for an average of 82 seconds before it goes out of play and then comes into play again.

Now let's look "inside" that data! The longest average period across any game is ~6 minutes. This is quite a long time for the ball to be in play. Teams will be required to perform multiple tackles and collisions, and the ball goes back and forth; it is the "arm wrestle" portion of the game.

**Table 1: Mean, minimum, and maximum ball-in-play and recovery periods for different type of matches**

| | Top 4 vs. Top 4 | Top 4 vs. Bottom 4 | Bottom 4 vs. Bottom 4 | Finals |
|---|---|---|---|---|
| Ball-in-play, s | | | | |
| Average | 88.8 ± 6.1 | 83.8 ± 2.2 | 81.9 ± 4.1 | 82.7 ± 3.6 |
| Minimum | 6.4 ± 1.1 | 4.6 ± 0.7 | 8.4 ± 1.1 | 5.6 ± 0.9 |
| Maximum | 327.7 ± 22.2 | 336.2 ± 16.4 | 332.4 ± 25.1 | 324.3 ± 16.9 |
| 0–15 (%) | 6.9 ± 1.1 | 8.6 ± 0.7 | 7.5 ± 1.1 | 8.2 ± 1.0 |
| 16–45 (%) | 26.1 ± 2.4 | 28.6 ± 1.5 | 31.0 ± 1.5 | 29.8 ± 2.0 |
| 46–90 (%) | 30.0 ± 1.8 | 30.1 ± 1.2 | 31.3 ± 1.9 | 30.8 ± 2.0 |
| 91–300 (%) | 34.7 ± 3.3 | 30.7 ± 1.3 | 28.1 ± 1.9 | 28.9 ± 2.1 |
| ≥301 (%) | 2.3 ± 0.9 | 2.0 ± 0.4 | 2.2 ± 0.3 | 2.3 ± 0.5 |
| Recovery, s | | | | |
| Average | 47.4 ± 2.0 | 48.4 ± 1.0 | 46.8 ± 1.7 | 50.2 ± 1.5 |
| Minimum | 0.3 ± 0.3 | 1.1 ± 0.4 | 1.6 ± 0.6 | 0.3 ± 1.0 |
| Maximum | 173.5 ± 15.7 | 183.1 ± 1.8 | 178.3 ± 15.9 | 186.5 ± 9.9 |
| 0–15 (%) | 16.1 ± 2.3 | 18.1 ± 0.9 | 19.0 ± 1.4 | 16.0 ± 1.1 |
| 16–45 (%) | 57.1 ± 2.8 | 54.3 ± 1.1 | 54.0 ± 1.6 | 54.8 ± 1.7 |
| 46–90 (%) | 9.2 ± 1.0 | 8.8 ± 0.8 | 9.3 ± 1.1 | 9.4 ± 1.2 |
| 91–300 (%) | 17.6 ± 1.7 | 18.6 ± 0.8 | 17.7 ± 1.3 | 19.9 ± 1.4 |
| ≥301 (%) | | 0.4 ± 0.1 | 0.2 ± 0.1 | |

*Data are means ± *SE*.

Source: Source: Gabbett 2013 p. 1624.

Over the past 15 years of National Rugby League data, the longest ball-in-play period that I've uncovered is ~11 minutes. This means that we have some important data:

- 82 seconds is the average ball-in-play period (i.e. activity cycle) across any game;
- 6 minutes is the *average longest* ball-in-play period (i.e. activity cycle) across any game; and
- 11 minutes is ***longest*** ball-in-play period (i.e. activity cycle) across any game (i.e. the "worst case scenario").

If we tell a player: "I need you to get in the arm wrestle, and to stay focused on the contest for 11 minutes, maintaining the same intensity in every collision, every high-speed run, and every repeated-effort", probably the answer will be: "I don't know if I can do that!" When we communicate the duration of the "arm wrestle" in this way, the "finish line" is too far away in that kind of scenario.

In this respect, I try to break down the game into small moments. The game is made up of a series of little "moments", and essentially, what we are trying to do is just win each of those moments. Each of these little battles are part of a larger battle that occurs across an 80 or 90-minute game. We want our players to win a little battle so that they can gain ascendency in the bigger battle.

In rugby league (and union), the end of a ball-in-play period typically indicates an error. Thus, one of the teams gets a "reward" for the effort of staying in the "arm wrestle". The ultimate reward is a try or a goal is scored. The team works so hard that they "break" the opposition, defences begin to loosen up and points a scored. I try to encourage my players to look for those little battles that occur in competition because the little battles help them to win the bigger battle. Look to engage in those tasks, the grueling aspect of the "arm wrestle" because *something good* can happen at the end of it.

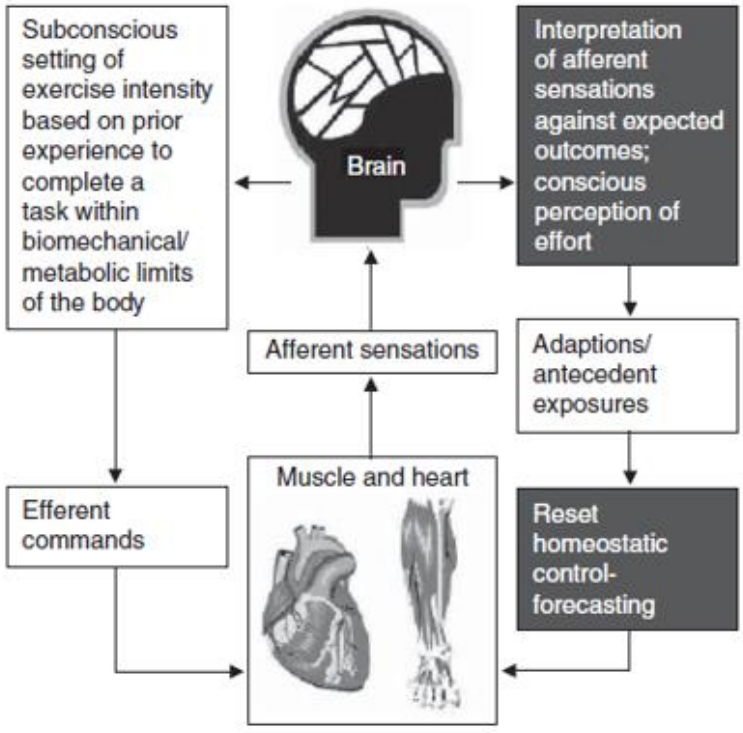
One final point on the "arm wrestle". Whether we are training for an 82 second ball-in-play period, 6 minutes or 11 minutes, we want to prepare our players for whatever the game demands. Whether it's a 6 or an 11 minute ball-in-play period, we want our players to be prepared for it. That is the kind of mindset that we want to develop in our players. We want to develop the physical attributes that allow players to compete in the grueling components of the game, and also the mental resilience that provides them the "will" to stay in the "arm wrestle".

The ability to embrace those physically grueling aspects of play don't happen by accident. Athletes need to work hard at it, and they need to be exposed to physically hard training in order to cope with those demands, and thrive in those "moments".

Every time we train physically we train the brain. Every time we expose our players to training, we are not just training them to look good in the mirror! We are training the brain to go to places where it hasn't been before. So when players need to go to that moment in a game, they've experienced it before. It becomes a memory: "*I've been here before. I know exactly what this feels like. I don't die when I go to these moments. I can attack it and I can come out winning this moment.*"

It sounds like a coaching cliché that physical training creates mental toughness. However, there is scientific evidence to suggest that the brain *regulates* exercise intensity, rather than the exercising muscles *limiting* exercise performance. Tim Noakes and his colleagues (2005) suggest that "exposing the brain to hard physical work on a regular basis improves the body's ability to cope with fatigue. If athletes have not been exposed to hard physical work on a regular basis, then the brain instructs the body to stop exercise earlier to prevent exhaustion." In other words, hard physical training can create mentally resilient players.

**Figure 4: Relationship between the teleoanticipatory governor centre in the brain and perceived exertion during exercise**



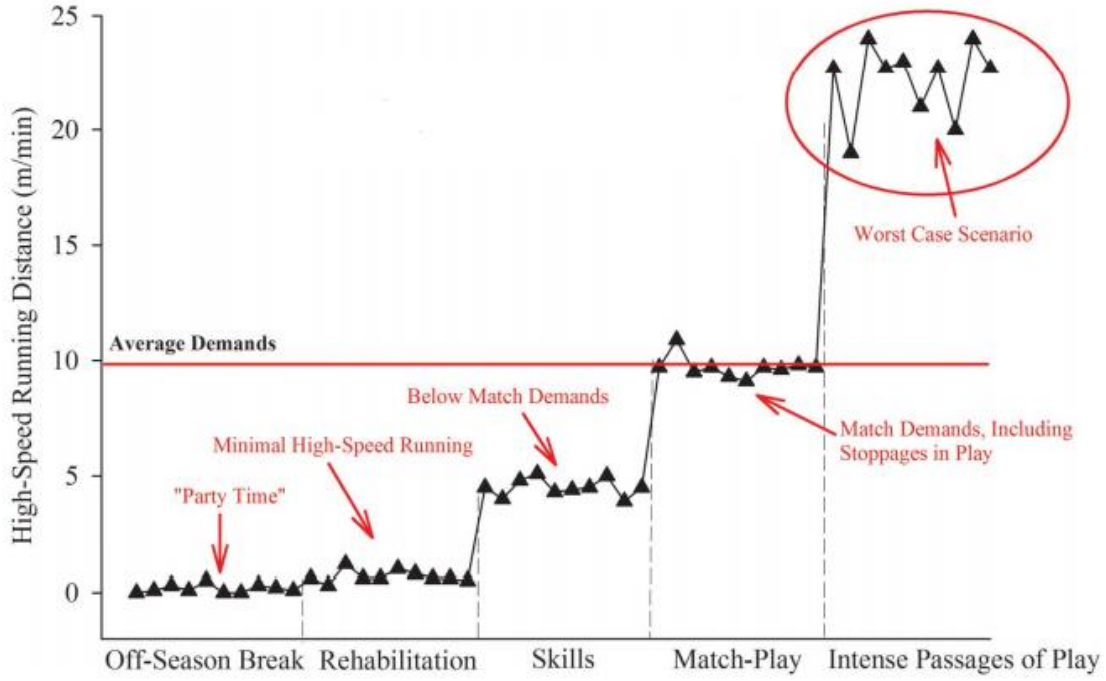

Source: Edwards and Noakes 2009 p. 8.

However, this type of mental resilience (or toughness) doesn't come after one training session! It comes from training consistency. Athletes can't even start to think about winning competitions on a regular basis, until they first learn to win sessions on a regular basis.

**The more often we expose our players to moments (in training) where they can either give in to themselves or they can dig in, and find something they did not realize they had; the more often we can help them win that moment. The more likely it is that it will become a memory, and the more likely it is that when they are exposed to those situations in competition that they are going to win that moment as well.**

The final point I would like to highlight in this section is about the most demanding passages of play. We have described these passages of play in many ways, including peak 5 minute periods, long passages of ball-in-play, and repeated-sprint and repeated high-intensity effort demands. The "worst case scenario" is a common phrase that has been used to describe these most demanding passages of play. However, perhaps we should change the way we look at these passages of play (Figure 5).

**Figure 5: High-speed running demands of different training and match play activities for an elite rugby league player**




Source: adapted from Gabbett, Kennelly, Sheehan, Richard Hawkins, Milsom, King, Whiteley, Ekstrand, (2016), p. 1018.

Based on the number of positive outcomes that occur after these most demanding passages of play, perhaps they should be described as an "opportunity"; an opportunity to win a small battle within the larger battle of the game. The more often we can win those little battles, the greater the chance that something good will happen at the end of that intense period of play.

To summarize this course, we've discussed the physical demands of competition; it is impossible to prepare players for the specific demands of competition unless those specific demands are known.

We've discussed the importance of "looking inside" data, and the importance of understanding the most demanding passages of play for your sport. Exposing players to these most demanding passages of play will likely help them during those high-intensity moments in the game. Finally, if athletes are trained for the average demands, it is highly likely that they will be underprepared for the most demanding passages of play.

## References

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