The Science and Practice of Rugby Training

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Edited by

Michael Hamlin

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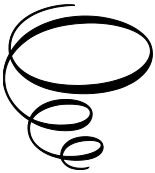

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Maria Choukri is a registered nutritionist with a background in psychology and biomedical sciences. Her main interests include nutrition and mental health, psychological factors in nutrition and lifestyle, health psychology, health behaviours, and dietary patterns and health. She teaches human nutrition at Ara Institute of Canterbury – Te Pūkenga.

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Richard Downey
Richard Downey grew up in York, UK and attended St. Peter's School, where he developed a strong passion for rugby union at an early age. Richards work is heavily influenced by this passion and hopes to provide readers with clear themes and concise points of view. After relocating to New Zealand and graduating with a Master of Sport Management with distinction in 2022 from Lincoln University, Richard now works as a management consultant in Wellington. Outside of work and study, Richard enjoys sports, quality time with friends and family, and experiencing new and different cultures.

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Hoani Smith is a PhD candidate at Lincoln University, Christchurch, New Zealand. Currently, Hoani's focus lies on research in sports science. His PhD work revolves around load management, aiming to optimise player's performance and reduce injuries. Hoani has been actively involved in strength and conditioning and management duties in both 15's and 7's rugby campaigns both nationally and internationally. He has also worked with the junior Maori All Blacks, nurturing young talent and helping them grow culturally and professionally. Over the past decade, Hoani has also been a strength and conditioning coach and manager for national and international 3x3 and 5x5 basketball teams in New Zealand.

Ashley Jones
Ashley Jones has worked in three professional sports across seven countries in a career that has lasted over 30 years. Specifically, Ashley has worked in rugby where he has worked with teams from club to international levels across the world, going to two Rugby World Cups with both a southern and northern hemisphere team. He is also in his 11th year as a columnist for elitefts.com (https://www.elitefts.com/author/ashley-jones/). Ashley was awarded a Registered Strength and Conditioning Coach Emeritus award in 2014 by National Strength and Conditioning Association (NSCA), and the Professional Coach of the Year in 2016 by the NSCA. He has held a Certified Strength and Conditioning Specialist (CSCS) certification continuously since 1988 and in 2023 and was awarded the Boyd Epley Lifetime Achievement award by the NSCA.

CHAPTER 1

INTRODUCTION

MICHAEL JOHN HAMLIN

Rugby union (herein referred to as rugby) is a game steeped in tradition and legend which is played by amateurs and professionals from as young as 3 or 4 years of age through to 90 years and over. Since its inception in 1823, the game has continually changed and developed, however, the introduction of professionalism into the sport in 1995 probably brought about the greatest changes in the game's history. Rugby players now had more time to spend on getting better at the game by improving their skill level in particular their playing techniques and fitness. Subsequently, the training of rugby players has followed the professionalisation of the game and become a specialised area of sport training.

Rugby players are unlike any other athletes, they must be aerobically conditioned to play the game for 80 minutes, but also require high levels of anaerobic fitness including strength, speed, explosive power, and the ability to complete work repeatedly with little rest. Players must be big enough to absorb the forces involved in the game such as tackling, scrummaging, and rucking, but also be agile enough to get to their feet quickly, evade opposition players and manoeuvre themselves to provide support for the ball-carrier.

Unlike many sports, rugby is played over a prolonged season which can stretch out to 10 months in some cases, which brings unique challenges to the strength and conditioning staff involved with rugby training. Rugby is also a collision sport and players are required to recover quickly in order to play again the following week. With collisions comes other problems that the strength and conditioning staff must deal with including muscle soreness, injury, and concussion.

In this book we uncover the science behind current training methods used by strength and conditioning staff for rugby players. We look at what the science and research say about the training techniques, but we also put this science knowledge into practice by illustrating practical ways to incorporate the training knowledge into players lives. The book incorporates over 25 years of research and coaching experience with young and developing high performance rugby players. This book will be an invaluable resource for junior and senior rugby coaches, strength and conditioning coaches, researchers involved in rugby and for students learning how to train team-sport players.

CHAPTER 2

HISTORY OF RUGBY AND ITS ORIGINS IN NEW ZEALAND

GREG RYAN

Rugby union has a rich history that dates back over 200 years. It started off as a folk game between villages, with hundreds of players on each side and few if any rules. The contemporary game today by contrast is much more complicated and pitched between two fifteen-a-side teams that is heavily policed for rules. The origin of rugby does not rest with William Webb Ellis who never knew that he was supposed to have picked up the ball and run with it at Rugby School in 1823. That myth emerged only in the 1880s when the leaders of English rugby wanted to assert its elite and amateur origins against threats from both working-class influences and soccer (Williams 1989; Baker 1981).

Rather, a wide variety of handling and kicking 'folk football' games, often involving hundreds of players, and ranging for miles across the countryside, had been played for centuries in villages throughout Britain. These games were gradually 'tamed' from the eighteenth century onwards as a growing and increasingly urban population and changing work patterns created limits to where and when sport was played. Football also became prominent in the elite school system as an important element in the moral and physical training of the young men who would lead the new society and serve the expanding British Empire (Holt 1989).

For reasons that are not entirely clear, the game preferred at Rugby School that was in opposition to the kicking game, had a formal set of written 'laws' by 1845 and became the most popular of the handling and running games by the 1860s. Strong arguments, that were as much about older school rivalries as the best form of football, emerged between supporters of the two types of game. In late 1863 a series of meetings called to resolve the impasse resulted in the formation of the Football Association (soccer) and the

alienation of those who advocated a handling code. At issue were questions about the acceptable level of violence to be tolerated in football – and especially the question of 'hacking', or the deliberate kicking of an opponent's shins. Supporters of soccer felt that a less physically demanding, more open and exciting game with simpler rules was better suited to an increasingly civilised society. Supporters of the handling game emphasised its 'manly vigour' and tended to portray soccer as somewhat effeminate (Collins 2012).

In 1871 England's Rugby Football Union was formed to govern the handling game. It quickly abolished hacking, reduced teams from twenty to fifteen players and made various other law changes to bring structure to a game that had been dominated by long scrummages and mauls. The first international fixture, between England and Scotland, took place in Edinburgh in March 1871. Ireland entered the international field in 1875 and Wales in 1881. But even with this expansion, the rugby establishment remained amateur, elitist, and largely opposed to such 'popular' innovations as numbering jerseys, keeping records, arranging formal competitions with trophies and providing for spectators. Rugby was to be played only for the enjoyment of those involved. Therefore, the true 'gentleman amateur' saw no need to practise or to make any special effort to get fit to play the game (Williams 1989).

Rugby soon attracted interest beyond the elite, especially in the industrial north of England and Wales where working-class players pursued a more competitive approach to the game. As winning mattered to the pride of local communities, players were expected to be in peak condition to play, and it was increasingly common to surreptitiously compensate them to ensure that they could take time off work to prepare. But amateur opposition to payment or any form of compensation automatically excluded those who could not afford to take time off work for sport. It was commonly argued that if rugby was commercialised or players paid, the 'spirit' of the game would be threatened by those needing to win 'at all costs'. Eventually, when these tensions could not be resolved, various northern clubs broke away from rugby union in 1895 to form what later became rugby league as a mainly working-class game that allowed payment for play (Collins 2012).

From the 1850s settlers brought various football codes including rugby to New Zealand and other parts of the British Empire. Handling rather than kicking games became more popular in part because of the public-school origins of those who established the first clubs, but also because the

undeveloped state of grounds in the new colonies were more suited to running and handling than kicking. But even as the game expanded throughout New Zealand during the 1870s, there were still considerable variations in rules, team sizes, field sizes, scoring values and the length of the game (Swan 1948).

While New Zealand rugby has always presented itself as a game of the rural 'heartland' for people from all walks of life, the reality was that it struggled in rural areas with small populations and difficult transport and communication. The strongest growth has always been in the four main centres and in the elite secondary schools. Beginning with Canterbury and Wellington in 1879, Otago in 1881 and Auckland in 1883, provincial rugby unions were gradually established and a desire to standardise the laws and procedures of the game led to the founding of the New Zealand Rugby Football Union in 1892 (Ryan 2005).

As in the north of England, the fledgling New Zealand game soon diverged from its elite and amateur origins. With a small population, rugby did not have the numbers to remain elite and had to cast its net wider for players from different social backgrounds. While the population was not large enough to finance a professional game, by the late nineteenth century it was clear that New Zealand rugby, and especially through its emerging provincial rivalries, had a strongly competitive element and a commitment to developing 'scientific' innovations to create a more structured and attractive game for spectators. These included the 2-3-2 scrum with a wing-forward, and different alignments among the backs such as the five-eighths system. Whereas many British teams continued to use nine forwards until the early 1890s, and persisted with a 'first up, first down' approach to packing the scrum until 1905, eight forwards in specialist positions became the norm in New Zealand by the 1880s (Vincent 1997).

The success of New Zealand methods was revealed when the 1905 All Blacks toured Britain, France and North America winning all but one of their games while scoring 976 points and conceding only 59. Thereafter, as such successes created pressure on teams to repeat them and rugby became an important component of New Zealand's sense of national identity and its place in the world, the earlier open style of play became increasingly cautious as winning well became less important than not losing. Even at club level, forward play dominated, and adventurous backs were the exception to the rule during much of the twentieth century. This uncompromising attitude did not always sit well with the traditional

'guardians' of the game in the northern hemisphere. It was inevitable that the very committed New Zealand game became one of the leaders in the push to modernise rugby through such things as the World Cup from 1987 and the eventual acceptance of open professionalism in 1995 – exactly a century after rugby league had broken away. By this point, and mindful of the need for rugby to be an attractive commercial spectacle, New Zealand had returned to a more expansive style of play (Ryan 2008).

Fig 2-1. The All Blacks playing Midland Counties at Watford Road, Leicester on 28 October 1905. Image from the New Zealand Rugby Museum, Palmerston North.

Since the 1970s rugby has reflected dramatic changes within New Zealand society more generally. Māori and especially Pasifika players have come to dominate due to both their own skill and dedication as well as the tendency of more affluent Pākehā to pursue a wider range of sport and leisure alternatives beyond rugby. The women's game, once regarded as dangerous and degrading to the players and a threat to the traditional masculine values of rugby, is also now accepted as a key component of the game (Ryan and Watson 2018). These developments confirm that the long history of rugby is one of constant innovation and adaptation. Not only has the game of rugby itself developed and changed over time, the development of the physical attributes and training techniques of the players has also changed

dramatically, particularly since full professionalism was introduced in 1995. Playing rugby is now a full-time career for many and with the increased pressure to perform, players need to be committed to serious training to reach the physical attributes required of the modern player.

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CHAPTER 3

SIZE AND STRENGTH OF RUGBY PLAYERS

RICHARD DOWNEY
AND MICHAEL JOHN HAMLIN

Following the success of the World Cup held in South Africa in 1995 and subsequently the International Rugby Board's decision to develop rugby union into a professional sport, a number of changes have occurred in professional teams including the desire to have taller and heavier players for a competitive advantage and to ensure their longevity in the game. Size and strength have been identified as important characteristics for rugby players, which contribute to winning games, and have been used to discriminate between levels of competition (Lombard 2015; Argus, Gill, and Keogh 2012).

After the move to professionalism, there have been significant advancements in all aspects of rugby. Firstly, various rule changes have facilitated the current situation of the game that has an emphasis on fast, dynamic, and physical matches. Due to these rule changes, rugby has become more physical through an increased number of collisions (Lombard 2015; Van Rooyen 2008). The most notable changes in game demands are the increased number of passes, tackles, rucks, duration of ball-in-play and decreased number of lineouts, mauls, kicks, and playing time per player (Quarrie and Hopkins 2007; Tucker et al. 2021), indicating a faster game, with the ball in play for a greater length of time.

The professionalism of rugby has seen advancements in recruitment and selection, with academies being more aware of appropriate pathways and development programs to help bridge the gap between junior and senior elite rugby. An increase in awareness for the need to develop high-performance training models for elite development has seen advancements in training methods, specifically, position-specific programming (Appleby, Newton, and Cormie 2012; Deutsch, Kearney, and Rehrer 2007; Nicholas

1997). Additionally, the economic impact of professionalism is significant with salaries averaging NZ$90,000 for top-level players, with the highest-paid reaching up to NZ$1.4million, creating a viable career option for many players.

The average height of today's population has increased by as much as 5% compared to people living 100 years ago (Knight 2014). Similarly, the average size of rugby players has also steadily increased from 1905 to 1999, however, the rate of change from 1975-1999 has been three or four times greater than that of the previous 70 years (Lombard 2015; Olds 2001). Increased professionalism has elicited rapid changes in fitness profiles of rugby players, with the modern game placing significant demand on all energy systems, regardless of playing position (Duetsch 2007). At the elite level, athletes are heaviest, strongest, and fastest (Brazier et al. 2020) but at the amateur level changes in size and shape have not altered as markedly (D. Smart, Hopkins, and Gill 2013).

Anthropometric and physical characteristics are contributing factors to success. The importance of these qualities for match performance has been highlighted repeatedly in the literature (Brazier et al. 2020; Darrall-Jones 2015; Knight 2014), with the highest performing teams at Rugby World Cups being those with taller and heavier players (Knight 2014; Sedeaud et al. 2012). In this chapter, we wanted to review the existing literature and explore how these characteristics have changed since 1995 (the start of professionalism in rugby). To do this, we reviewed all the available research detailing changes in the height, body mass or strength of elite/professional senior rugby union players globally since 1995. Our results found in the Figures below indicate that elite professional rugby players have become taller, heavier, quicker, and stronger which are all physical characteristics that contribute to success.

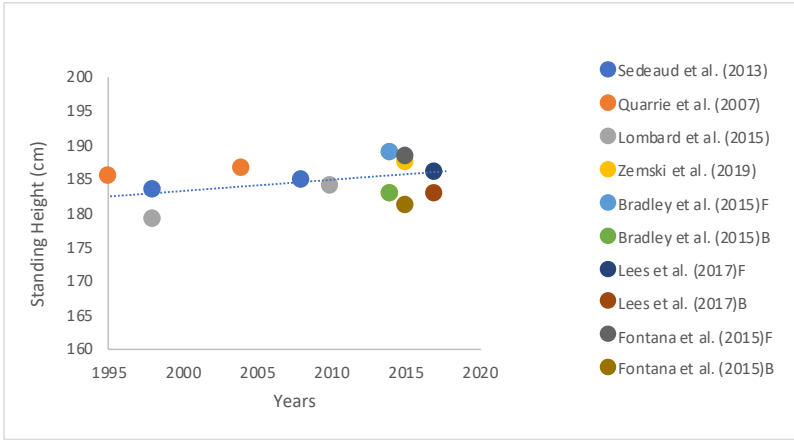

Fig. 3-1. Standing Height change (cm) of male professional rugby union players 1995 onwards. F = forwards; B = backs.

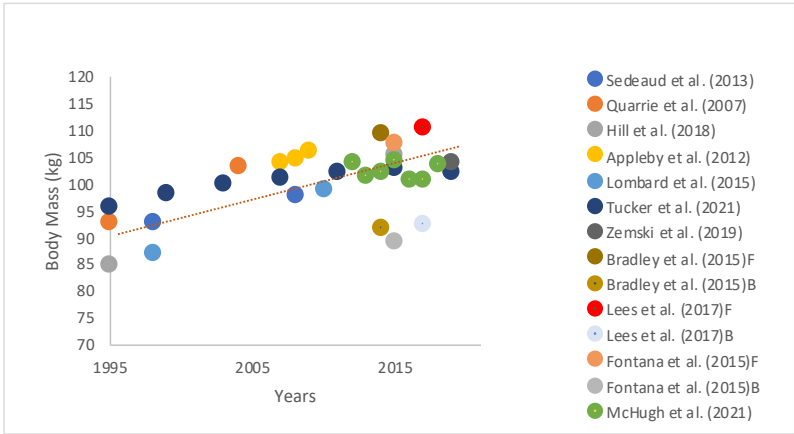

Fig. 3-2 Body Mass change (kg) of male professional rugby union players 1995 onwards.

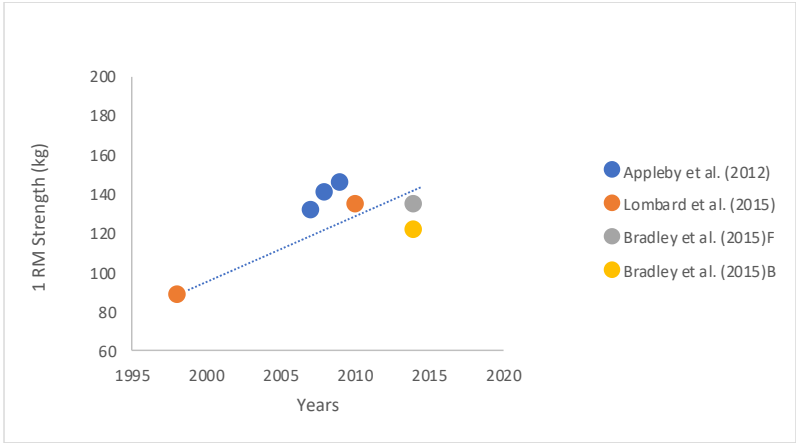

Fig. 3-3. Strength measured by a 1RM bench press in male professional rugby union players 1995 onwards.

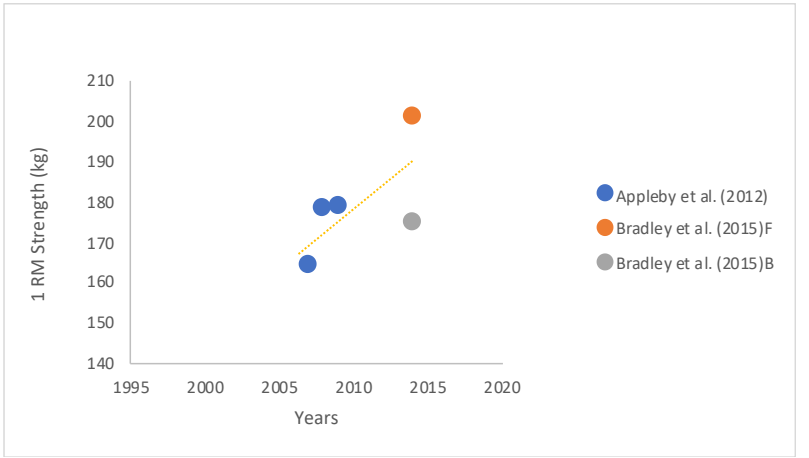

Fig. 3-4. Strength measured by a 1RM squat in male professional rugby union players 1995 onwards.

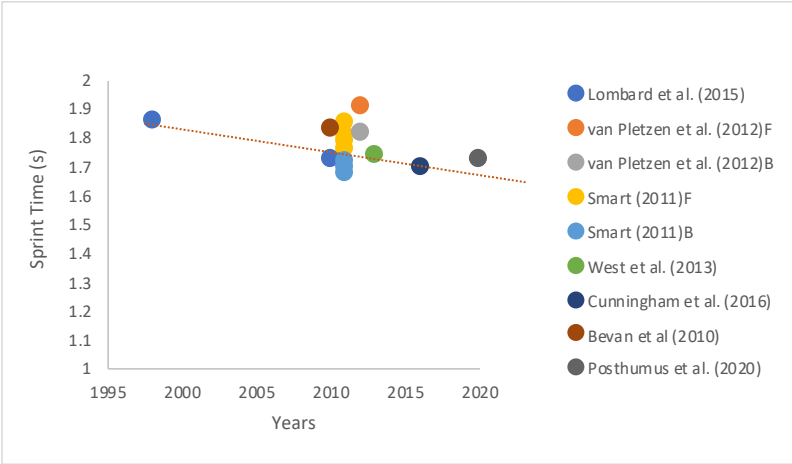

Fig. 3-5. 10-m Sprint time in male professional rugby union players 1995 onwards. F = forwards; B = backs.

Data in figures from the following references (Sedeaud et al. 2013; Quarrie and Hopkins 2007; Lombard 2015; Zemski et al. 2019; Bradley et al. 2015; Lees et al. 2017; Fontana et al. 2015; Hill et al. 2018; Appleby, Newton, and Cormie 2012; Tucker et al. 2021; McHugh et al. 2021; van Pletzen and Venter 2012; D.J. Smart 2011; West et al. 2013; Cunningham et al. 2016; Bevan et al. 2010; Posthumus et al. 2020).

Several factors may have impacted these changes and facilitated the current situation of taller, heavier, and stronger players.

a. Law Changes: Historically, substitutions were only permitted as a result of player injury, whereas currently, a maximum of eight substitutes can be made throughout an 80-minute game, allowing for powerful 'impact players' to be brought on towards the end of a game, taking advantage of fatigued opposition. Previously at a scrum, the ball was fed between both teams down an imaginary line, with both hookers being required to contest for the ball with their legs. It was rare for a scrum to be won against the head, however, teams now push against each other to contest for the ball and to overpower the opposing team. Similarly, in support of an increase in height and size of forwards, forwards can now be supported when jumping at a lineout by their teammates lifting them, where previously they had to outjump their opposition, un-aided. The above

changes not only highlight the benefit of taller, heavier, and stronger players, but also their necessity in gaining a competitive advantage.

b. Game demands: Currently the ball is in play up to 50% longer than previously recorded, which in turn has resulted in a 400% increase in the number of rucks, as well as 100% more passes in a game. Players are therefore covering more distance, in particular forwards, who also spend greater time in high-intensity exercise (Darrall-Jones 2015). An increase in the number of rucks and tackles requires a greater level of power in contact, as well as a greater mass through the increased momentum generated; the ball in play for longer also requires a greater level of speed and fitness from players (Quarrie and Hopkins 2007).
c. Player selection: Rugby now attracts athletes who are naturally bigger and more powerful (Pook 2012). Talent identification aims to predict future achievements based on present abilities and potential, with most of the game-specific skills, anthropometric measurements, and physical attributes changing during the development years, placing increased pressure on the selection of larger players, often on those who are in an older age band due to their advanced physical characteristics compared with their younger peers (Dimundo et al. 2021). A rugby player's career is limited in years due to the physical impacts on the body and injury, therefore necessitating early identification of potential talent. Scouts, therefore, favour taller players when looking at an equal skill-set amongst younger players, with academies being more aware of appropriate pathways and development programmes to help prepare young players for the demands of senior elite rugby (Sedeaud et al. 2013; Dimundo et al. 2021).
d. Strength and conditioning: The transition into the professional era has increased the level of scientific research and awareness of strength and conditioning training and nutrition, in response to the physiological demands of the game. This has led to an increase in mass, strength, power, and speed of professional rugby players, with teams using their programming to try to gain competitive advantage. As the demands of the game differ between forwards and backs, strength and conditioning training must now be aimed at helping players become stronger and bigger, as well as being able to resist fatigue (Lombard 2015), whilst being position-specific. Forwards are required to be heavier, taller, and stronger, whilst backs need to be able to sprint more, highlighting a need for individualised training programmes and fitness attainment targets.

e. Injury: Studies have shown, that with the increased physicality of games, comes an increased number of injuries (Tucker et al. 2021). Injury is shown to be related to a player's body size, specifically in the tackle area due to the impact force, with lighter and taller players experiencing a higher risk of concussion (Fuller et al. 2013; Chéradame et al. 2021). It is also reported that those who accumulate more playing time have a lower risk of concussion (Chéradame et al. 2021) so conditioning a player to contact situations can be a solution. It is evident, therefore, that whilst increases in mass are an injury risk, they are also a mitigating factor in protecting against high-impact collisions.

In summary, anthropometric, and physical characteristics have increased and may still be increasing; however, it is difficult to see what size and strength look like for male professional rugby players in 10-20 years' time. Logically, these characteristics should reach a plateau and other factors become contributors of success, perhaps because of additional law changes in the future that encourage a need for endurance, agility, speed, or injury resistance.

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CHAPTER 4

ON-FIELD TRAINING

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Theory of Training

An athlete's performance is the result of accumulated training and subsequent recovery sessions. Training is designed to overload the body, mainly through the cardiovascular and muscular system, which then stresses the body. Monitoring an athlete's stress response to an individual training session is important for checking how an athlete is adapting. But an athlete's stress response to training can be due to more than just the training programme itself. There are various factors that can influence an athlete's stress response to training, including personality, genetics, training history, sleep quality and sleep duration, academic pressure, family pressures, and more (Mellalieu, Neil, Hanton, & Fletcher, 2009). To understand the theory of training, it is paramount to understand the concept of stress.

Stress represents a deviation from a homeostatic norm (or your normal steady state) and is influenced by the relationship between the player and their environment where there is a perception (which may be true or not) of stress exceeding the players resources and thereby affecting their well-being. Stress can affect more than just sports performance, it also effects social, physiological, and psychological health. Unresolved stressors have been directly linked to adverse health outcomes such as coronary heart disease, gastrointestinal distress, and cancer, all of which have a negative impact on human survival, and ultimately a decline in life expectancy (Vitetta, Anton, Cortizo, & Sali, 2005).

Stress can help an individual achieve goals and stimulate positive productivity if short-lived, but unresolved chronic stress can become crippling to human

well-being, leading to physical and psychological illness. Hans Selye in the 1970's showed that the adrenal cortex which produces the hormones for the fight or flight response (adrenaline and noradrenaline) responds with increased secretion upon exposure to stressors, emphasising the biological underpinning of stress. Later in his career, Selye (1973) distinguished the difference between eustress and distress, with eustress being caused by positive experiences such as falling in love, and distress being caused by negative experiences such as grief (Selye, 1973).

Athletes commonly encounter stressors because of their high level of involvement in sport for extended periods of time. These stressors include injury or illness, performance failures (see Chapter 8), coach demands and expectations, as well as competing whilst injured, watching other competition, large crowds, and weather conditions (Mellalieu et al., 2009). Training is a common requirement associated with exercise prescription and aims to provide the body with adequate physical stressors to generate adaptive changes, resulting in improved performance. This can be seen as an acute challenge to the body that is intended to optimize chronic improvements in physiological capabilities (P. Bishop, Jones, & Woods, 2008). In professional sport, training is seen to be an important requirement for athletes because it ensures adequate physical development (Gabbett, Whyte, Hartwig, Wescombe, & Naughton, 2014).

Rugby union is a contact team sport which is characterized by periods of high-intensity exercise interspersed with periods of low-intensity activity. Typically, rugby union athletes require high aerobic fitness to be able to complete up to 80 minutes of match play and have adequate recovery between high-intensity bouts during the match, but also high levels of anaerobic fitness. Depending on the playing position, but in general, rugby union players require high levels of muscular strength and endurance, muscular power, acceleration and speed, agility, flexibility, and mobility.

Warm Up

It is normally recommended that training or exercise sessions be preceded by a period of warm-up and followed by some form of cool-down. A great variety of warm-up routines have been suggested over the years, with recent research concluding that warm-ups completed well, generally have a beneficial effect on subsequent match performance (D. Bishop, 2003a; McGowan, Pyne, Thompson, & Rattray, 2015). Traditionally, a warm-up was considered important as it increased several physiological systems in

readiness for physical work, however more recently the psychological aspects along with neuromuscular activation is also thought to be significant. In a recent review on the subject, the authors concluded that relatively short warm-ups (e.g., 5 minutes jogging followed by 7 minutes of dynamic exercise) improved sprint, jump and agility performance (Silva, Neiva, Marques, Izquierdo, & Marinho, 2018). The same review also suggested that small-sided games were an effective warm-up strategy. Overall, warm-up strategies worked if the warm-ups were interspersed with 2-10 minutes of passive (no exercise) rest and if the start of the match was within 15 minutes of the end of the warm-up.

In practice, warm-ups used in team sports such as rugby consist of general low-intensity aerobic exercise, followed by dynamic stretches, neuromuscular primers, injury resistance exercises and sports-specific skill exercises. But many traditional warm-ups are quite long in duration (well over 20 minutes) and may even cause a decrease in performance rather than improving the athlete's performance. For example, several studies have reported that a traditional long warm-up decreased performance compared to shorter warm-ups involving a 12-minute small-sided game or 8 minutes of back squats (Sue, Adams, & DeBeliso, 2016; Zois, Bishop, & Aughey, 2015; Zois, Bishop, Ball, & Aughey, 2011). Therefore, having shorter warm-ups seems beneficial and incorporating skill coaches in warm-up routines increases number of touches (of the ball or of the particular skill) for players and time on task that keeps players more engaged in the process.

Having a decision-making component in the warm-up is also popular as it primes the player for decisions that will have to be made on the field. Ultimately, the warm-up is time-dependent and varies on the coach's timeframe. Because of the importance placed on warm-ups by coaches, trainers, and players, several warm-up programs have been developed recently. Most follow the 'RAMP' (Raise, Activate and Mobilize, Potentiation) method introduced by Jeffreys (2007) (see Table 4-1) (Jeffreys, 2006). In rugby, the popular 'RugbySmart' program that was introduced by New Zealand Rugby in 2001, and now requires all coaches to complete yearly, has a section on warm-up activities for players prior to matches and practices. Similarly, the Federation International Football Association (FIFA) have developed an injury prevention program that involves warm-up exercises (running, plyometric, balance, cardiovascular and neuromuscular activities) called FIFA 11+ aimed at safe warm-ups for football players (Soligard et al., 2009). World Rugby have also released the 'ACTIVATE' program that is a warm-up program aimed at injury prevention. In our