

BODY SIZE, SOCIOECONOMIC STATUS, AND TRAINING
BACKGROUND OF A SELECT GROUP OF U16 SOUTH AFRICAN
RUGBY UNION PLAYERS (2010-2013): THE IMPACT ON NATIONAL
SELECTION

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SUPERVISOR:

PROF. M.I.LAMBERT, PHD

DIVISION OF EXERCISE SCIENCE AND SPORTS MEDICINE,
DEPARTMENT OF HUMAN BIOLOGY, FACULTY OF HEALTH
SCIENCES, UNIVERSITY OF CAPE TOWN

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Mr. Robin Arkell

B(Hons) Biokinetics

Certified Strength and Conditioning Specialist (NSCA)

Master of Philosophy in Biokinetics

Department of Human Biology

Faculty of Health Sciences

University of Cape Town

Correspondence

Robin Arkell

Department of Human Biology

Faculty of Health Sciences

University of Cape Town

3rd Floor Sports Science Institute of South Africa

Boundary Road

Newlands, 7700

Cape Town

South Africa

Email: arkell07@hotmail.com

DECLARATION

I, Robin Anthony Webster Arkell, hereby declare that the work on which this dissertation is based is my original work (except where acknowledgements indicate otherwise) and that neither the whole work nor any part of it has been, is being, or is to be submitted for another degree in this or any other university.

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Signed by candidate

(Signature)

15 DECEMBER 2015

(Date)

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LIST OF ABBREVIATIONS

AU – Arbitrary Units

BMI – Body Mass Index

ES – Effect Sizes

FNB – First National Bank

GPS – Global Positioning systems

HRmax – Heart Rate maximum

IRB – International Rugby Board

LTAD – Long Term Athlete Development

NP – National Party

N S – National Squad

Non N S – Non National Squad

NFL – National Football League

NSCA – National Strength and Conditioning Association

PHV – Peak Height Velocity

PWV – Peak Weight Velocity

RWC – Rugby World Cup

SARB – South African Rugby Board

SARFU – South African Rugby Football Union

SARU – South African Rugby Union

SD – Standard Deviation

SES – Socioeconomic Status

TMA – Time Motion Analysis

U13 – Under 13 years of age

U16 – Under 16 years of age

U18 – Under 18 years of age

USA – United States of America

ABSTRACT

Background

Rugby Union is an international sport characterized by bouts of short duration, high intensity exercise in which players frequently collide into one another while running at high speeds.

Players are commonly required to engage in phases of play involving contact such as tackling, rucking, mauling and scrumming. These phases of play require certain physical qualities, including strength, aerobic power, speed and explosive power. Perhaps, the growth and professionalization of the game has resulted in more emphasis being placed on the physical preparation of the players. Physical preparation of players not only happens at elite senior levels, but has also filtered down into the junior ranks, where it is common for school teams to be trained by professional strength and conditioning coaches. The rules of the game have changed, which have influenced the physical demands. For example, ball-in-play time has increased, players are covering more distance per game, making more tackles and engaging in more scrums. It is therefore important to identify the various physical characteristics that are required to be successful at a particular level of rugby union. The socioeconomic status and ethnicity of the player in association with the physical characteristics can determine the success of an adolescent rugby player.

Objective

To determine the association between body mass and stature (referred to as physical characteristics for this study), race, socioeconomic status, and weight training (referred to as non-physical characteristics for this study) on the chances of success among U16 provincial rugby union players. In particular, size, socioeconomic status and ethnicity of players in the

U16 national training squad were compared to players who represented their provinces but did not get selected for the national squad.

Methods

Data were collected for each player who attended the Coca Cola National Grant Khomo week from 2010 to 2013. Players participating in this tournament had already undergone a process of selection trials to be selected to represent their province at U16 level. The national squad players were chosen based on performances at the Coca Cola National Grant Khomo week. The characteristics of the players selected for the national squad vs. players who did not get selected for the squad from 2010 to 2013 were compared using an ANOVA and the magnitude of the differences were quantified using effects sizes.

Results

White players are heavier (ES = 0.59) and taller (ES = 0.82) than black players as well as heavier (ES = 0.87) and taller (ES = 0.82) than coloured players over the four-year period from 2010 to 2013. Players selected into the National squad were on average heavier (ES = 0.50) and taller (ES = 0.40) than those players not selected into the National squad. White players were the heaviest and tallest of the race groups selected into the National squad ($p < 0.00002$). Players with a high socioeconomic status were heavier (ES = 0.30), taller (ES = 0.40), and had more playing experience (ES = 0.30), than players from a low socioeconomic status background. Grouping according to socioeconomic status did not differentiate between race groups and selection for the national squad.

Conclusion

This study showed that the taller and heavier players were more likely to get selected for the national U16 squad. Since size was also associated with socioeconomic status, the players with a high socioeconomic status had an advantage over players with a low socioeconomic status. These findings have implications for transforming the game to ensure that the representative teams reflect the composition of the South African population.

CHAPTER 1:

1.1 Introduction and scope of thesis

The Coca Cola U18 Craven week tournament for rugby union started in 1964 with 15 teams competing in the tournament. The size of the tournament increased to 32 teams in 2000, and in 2001 the format changed and the number of teams competing was reduced to 20 teams¹. Since then the exposure for school rugby has increased. For example, tournaments and competitions such as the FNB Classic Clashes and various Easter festivals for school rugby have regular coverage on national television. The exposure of Varsity Cup rugby together with the success of players being selected from Varsity Cup into national teams has meant that players at school are becoming more competitive because the path into senior ranks starts at school^{2 3}. Also, the increasing pressure placed on international rugby players is filtering into the junior amateur ranks of schools sport. The general assumption is that the bigger, stronger and faster players at the senior level are the players who are the most successful. This has prompted young players, many as young as 13 years to engage in strength and conditioning programs to gain a competitive advantage. It may be argued that players who do not start training at this early age are going to be disadvantaged, particularly from a physical perspective. In the South African context, it is important that provisions for differences in socioeconomic status are made as this also impacts on growth and development. Players from a low socioeconomic environment are not afforded the same opportunities in education and sporting competition. These same players are also raised in an environment where habitual nutrition is not optimal. This affects their early development leading to differences in body mass, stature, inadequate sports coaching, competition and

facilities compared to children living in better conditions. It may also impact on maturation, which has significant effects on the development of an individual.

The Grant Khomo tournament for U16 rugby union players lasts one week and is held annually at different venues around South Africa. Each provincial union selects a representative team and the teams play each other in a tournament format. Therefore, the tournament showcases the best rugby talent in the country. It also provides an opportunity for talented players to be identified by U16 national selectors and selected into a group considered as youth elite level rugby players. The U16 tournament provides an opportunity to address questions related to size, socioeconomic status and weight training in terms of what requirements are needed for success at the youth level.

Youths participating at the U16 Grant Khomo tournament are at different stages of their maturation (pre – during – post puberty). The different stages of development can influence their physical development. For example, pre – pubertal youth are generally less well physically developed and lack size, strength and power compared to those who are post – pubertal. Post pubertal players at the U16 level are more likely to be classified as talented and therefore gain selection into national squads. This poses challenges for the development of the game in South Africa where players represent the full spectrum of socioeconomic statuses. If the development of players is not carefully controlled, players from a lower socioeconomic status are at risk of being disadvantaged and underrepresented in the representative teams. This leads to several questions that need to be answered for players to be offered equal opportunities for their development. For example, are late maturers disadvantaged because of their smaller stature and lower body mass compared to earlier developers? Are players from low socioeconomic groups also disadvantaged because they

are generally associated with late maturation? Is weight training associated with physical size and socioeconomic status? The questions about players participating at the U16 Grant Khomo tournament are presented below. These questions form the basis of this MPhil thesis.

1. Are there differences in body mass and stature in white, black and coloured U16 players and do changes from 2010 to 2013 occur at a similar rate?
2. Is there a difference in body mass and stature between national squad players and non – national squad players?
3. Did national squad players have more playing experience before selection compared to non – national squad players?
4. Does socioeconomic status have an effect on playing experience, body mass and stature?
5. Are there any differences in socioeconomic status between white, black and coloured players?
6. Did players selected into the national squad have a higher socioeconomic status compared to players not selected into the national squad?
7. What proportion of players, divided into their different race groups, have the same physical size of the players selected for the national squad?

This thesis is divided into three remaining sections. In the next section (Chapter 2), the research that is relevant to the questions outlined above is presented and discussed.

Chapter 3 is the experimental section of the thesis and answers the questions in an

evidence-based way. The final section (Chapter 4) reviews the findings and discusses them in the context of rugby development in South Africa.

CHAPTER 2:

Literature review

2.1 Introduction

Rugby Union (henceforth “rugby”) can be classified as a team sport with the players requiring a diverse range of physical attributes to tolerate a large amount of physical contact and numerous maximal sprints⁴. The demands of the game are characterized by intermittent bouts of short duration, high intensity exercise which includes sprinting, tackling, competing for the ball and player collisions. These bouts are interspersed with periods of lower intensity aerobic activity and rest⁵.

The team of 15 players is split into 8 forward players and 7 backline players. The key responsibility of the forwards is to gain possession of the ball. Forwards are generally taller and heavier than the backs⁶. Backs are generally faster and more agile than forwards, and are responsible for gaining field possession and scoring points^{7 8 9}. Player demands have increased, specifically since the start of professionalization in 1995. The modern day rugby player at the elite level is in general bigger, stronger and faster compared to the rugby player of 20 years ago. The change in physical characteristics of modern day players can be attributed to more refined training techniques¹⁰, advanced nutrition practices¹¹, and in some cases the use of ergogenic aids^{10 11 12}. A distinct change in body size has occurred among elite level adult rugby players, with the greatest change occurring in the last two decades¹⁰. Research on the change in body size of adolescent level rugby players over time is scarce. Anecdotally it appears as though the increased game demands and professionalism at the elite level has filtered down into the junior ranks. Players who are bigger, faster, and

stronger while being able to resist fatigue tend to have an advantage over smaller, less powerful and less fit players in the senior game⁹. While it is also important that the rugby player have a high skill level to cope with the demands of a specific position, it is becoming increasingly difficult to succeed at the highest level without adequately developed physical characteristics.

Identifying factors associated with success at the adolescent level can contribute to talent identification and development. Having a reference of characteristics (body mass and stature, socioeconomic status and race) associated with success in rugby is helpful in identifying and developing future talent. Adolescent rugby players are still maturing. Therefore, it is an opportune time for them to engage in properly structured supervised weight training¹³. The consequences of performing systematic resistance training are that the young player becomes bigger, stronger and fitter, as well as resistant to fatigue. Furthermore the potential benefits of engaging in resistance training include developing correct movement patterns as well as reducing the risk of injury¹³. Making use of the window of opportunity that exists during adolescence is therefore beneficial to the future success of the player.

One factor which contributes to early success and has the potential to interfere with the talent identification process is the stage of maturity¹⁴. Variation in size, function and skill associated with maturity status within the same age groups can be considerable. This favors early maturing individuals who are physically superior and more proficient in childhood and often outperform their less-mature peers of the same chronological age. Early maturers could possibly be at an advantage, physically, as they are believed to experience greater growth around Peak Height Velocity (PHV) compared to late maturers¹⁵. Fitness

characteristics such as speed, lower and upper body power developed with increasing maturity¹⁵. However, the dominance of the early maturer often decreases in later years when peers catch up with them¹⁴.

Factors such as socioeconomic status can influence the biological age and maturity of a player¹⁶. In particular, players from a low socioeconomic region can have delayed physical and technical development. This is relevant in South Africa, with its unique situation of having such a range of socioeconomic levels.

In summary, several issues have been raised with regards adolescent rugby players. The aim of this study is to determine whether players who are bigger (taller and heavier), participate in weight training, and have a higher socioeconomic background are more likely to be selected into the national U16 squad compared to their peers who are smaller, do not participate in weight training and have a lower socioeconomic status.

The background to these issues will be discussed in the literature review which follows.

2.2 Rugby

2.2.1 The history of the game: Rugby Football

The game was formed and popularized in the early 1800's in England, Warwickshire, in a town named Rugby. In its original form, players were not allowed to run with the ball, matches were played without limits to the number of players per side, and games were allowed to continue for a maximum of five days. However, in 1823 a local boy, William Webb Ellis and pupil of Rugby School House picked up the ball and ran with it during a game of football. His complete disregard for the rules of football was the catalyst for the game of Rugby football¹⁷. The game, in its various forms began to grow and spread across England, with the first set of formalised rules being compiled in 1845 by students from Rugby School House with the assistance of their school master¹⁷.

In 1871, the first union for the sport was formed. The Rugby Union was based in England and the first international match was played that same year between England and Scotland¹⁸. Other countries became interested in the game and formed their own unions; Scotland in 1873; Ireland in 1879 and Wales in 1880¹⁸. In 1882 the international championship was formed with the four home nations competing against each other in tournament style¹⁹. This has since expanded to include France and Italy and is now known as the Six Nations Championship. With the ever expanding popularity of the game, the need for an international governing body became apparent and the International Rugby Board was formed in 1886 by Ireland, Scotland and Wales¹⁸.

In 1889, the South African Rugby Football Board was formed to govern the unions already established in the Western Cape, Griqualand West, Gauteng and Natal²⁰. The first international played by a South African team was in 1891 against a touring British Isles team.

A great schism between amateur and professionalism in rugby football became apparent in 1895, when a split occurred. Unions in the North of England began paying their players for time lost from work due to rugby commitments. The Rugby Union disallowed such action. This resulted in players in the North and West of the country splitting from Rugby football forming rugby league²¹. Rugby football became known as rugby union. While rugby league fast became professional with no restrictions on player payments, rugby union remained an amateur sport until 1995.

South African rugby went through a period of exile which coincided with the era of Apartheid. South Africa was banned by the International Rugby Board (IRB) from International competition in 1981 and expelled from competing until apartheid ended. The ban from international competition lasted until 1992 when apartheid ended and the non – racial South African Rugby Union (SARU) and the South African Rugby Board (SARB) merged to form the South African Rugby Football Union (SARFU)²⁰.

In 1995 the game of rugby union became professional when the IRB removed restrictions on payments to players and benefits to those connected to the game²². Since the start of the professional era, the game has experienced exponential global growth. The IRB, who in November 2014 changed their name to World Rugby, reports that there are currently over 3.5 million men, women and children playing rugby worldwide. There has also been an increase in the number of members in World rugby, expanding to 117 unions²³. The growth of rugby union is reflected through a continuous increase in not only television viewership but also

through stadium attendance numbers, and social media activity. RWC 2015 has been declared as the biggest and best tournament to date with the final being watched by an estimated record audience of 120 million²⁴.

2.2.2 Technical aspects of rugby union

Rugby is a contact sport played by two teams consisting of 15 players each and 7 substitutes. The objective is to score points by either placing the ball down in the opponents in-goal area by hand, thus scoring a try. Alternatively points may be scored by a player kicking the ball through the posts and over the bar following a penalty, a drop goal or a try²⁵. Figure 1 shows the team divided into its eight forward players (forwards) and seven backline players (backs). Forwards and backs each have different roles to perform in the team. Roles can differ within the forwards, as they are further split into front row, second row and loose forwards. The main responsibility of the forwards is to obtain and maintain possession of the ball through scrums, lineouts, rucks and mauls. The backs are divided into half backs, inside backs and outside backs. The main responsibility of the backs is to attack and be agile while running fast in an attempt to get the ball over the opposition's try line²⁶. At senior level the game is played for 80 minutes with two halves of 40 minutes each. After the first half the teams change the playing direction. At junior level in South Africa, the game is played over a 70 minute period, with two halves of 35 minutes each.

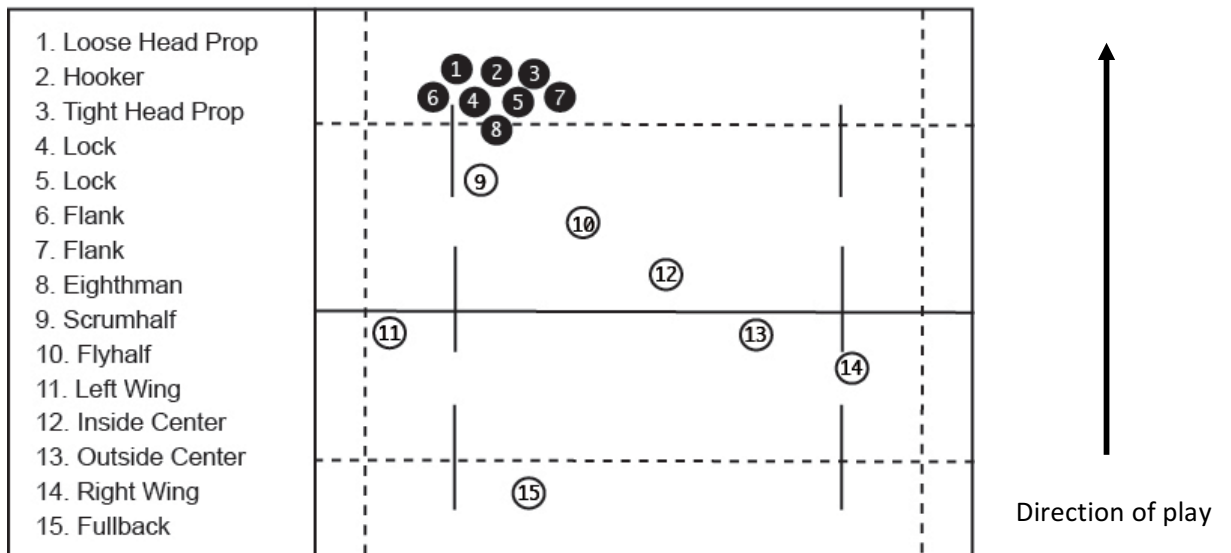


Figure 1. Rugby union playing positions as set up in a formation for a scrum. Positioning of the players might differ during open play as they react to the tactics and play of the opposing team. The solid circles represent the forwards and the open circles represent the backs.

2.3 Demands of rugby

Time Motion Analysis (TMA) studies have described the physical demand on players²⁷.

However, more recently Global Positioning Systems (GPS) technology has refined the measurement of the load during training and matches, improving the understanding of the specific physiological demands of the game^{7 28 29}. It is however, important to note that the specific sampling rate of the GPS unit will have an influence on the data presented. For example, a 5 Hertz unit has been shown to be less accurate than a 10 Hertz unit.

Improvements in GPS technology over the decades will also contribute to some between-unit error. It is therefore worthy to mention that these data should be interpreted with some caution.

Professionalization in rugby has provided opportunities for players to pursue careers as professional athletes. One of the most prominent changes to the sport as a result of the professionalization, has been the increased physicality with players becoming bigger, faster and stronger³⁰. Players have had to adapt to demands of increased physical and mental robustness as well as show the strength and speed expected of a full time athlete³¹. Rule changes since the onset of the professional era have also increased the demands of the game. One study showed that ball in play time had increased³², while a recent South African study showed that the total match time and total stoppage time in Currie Cup rugby increased significantly, while the total ball in play time decreased significantly³³. It did show that the game played in South Africa had developed a more continuous flow than in the past. Total time spent at rucks / mauls, scrums and lineouts had decreased while total tackling time had increased³³.

Limited research has been conducted on the physical demands of adolescent players in rugby union. An Australian study using TMA showed that young players (average age 16 years old) covered 4000m during the game, with no significant difference between forwards and backs²⁷. These players performed about 22 sprints with an average duration of 2 seconds²⁷. Venter, Opperman, & Opperman, (2011) conducted a study on U19 rugby players using GPS technology to assess movement demands and impacts. They showed that players covered on average 4470m per game, with 72% of the total time spent either standing or walking²⁸. This is in contrast to two different studies done on elite adult rugby. For example, Roberts et al (2008) showed that elite English rugby union forwards covered less distance (5581m) than the backs (6217m)³⁵. Lacombe et al (2014) studied French International rugby players and showed that forwards covered less total distance (7006 m), compared to back line players (7994m). This was considerably more distance than what was reported in elite English rugby union²⁹, in which front row forwards covered the least distance. In the same study, back row forwards and outside backs covered more than front row forwards but less than inside backs²⁹. Back row forwards had the highest number of impacts (defined as a collision between players, measured in G-force) in a game (683 impacts), while the inside backs experienced the highest number of severe impacts (> 10g) per game (13 severe impacts)²⁸.

These physiological demands differ slightly compared to a 2009 study by Cunniffe et al who also used GPS technology to study the physiological demands of a group of elite players competing at premiership level in England, Scotland, Ireland and Wales⁷. They showed that the mean and peak heart rates of the players were 172 and 200 bpm⁻¹ respectively, with

backs spending 42% of playing time at 80 – 90% HRmax whereas forwards spent 27% of playing time in these heart rate zones.

A study of elite English rugby union players showed that forwards spent more time in high intensity activity when compared to backs (12 % vs. 4 %). It is important to define high intensity in this instance as forwards spent more time in static exertions such as scrums, rucks, mauls and tackles whereas backs spent a greater percentage of time running above a certain velocity³⁵. Forwards performed about 89 bouts of static exertions with a mean duration of 5.2 seconds, whereas backs performed 24 static exertions in a game with a mean duration of 3.6 seconds per exertion³⁵. Interestingly, forwards spent 88 % in low intensity compared to backs who spent 96 % of the game in the low intensity zones³⁵. This illustrates the intermittent nature of rugby union match play, with short bursts of high intensity activity interspersed with long low intensity activity³⁵.

Speed and power over a short distance are important characteristics for any position in rugby union. Players generally accelerate for between 4 – 6 seconds at any given time and velocity, covering distances of between 30m – 60m⁷. Backs perform more sprints, have longer sprinting efforts, and have a higher total time spent sprinting than forwards^{35 36}. Back row forwards were involved in more acceleration efforts above $3\text{m}\cdot\text{s}^{-1}$ during a game compared to any other position group. Forwards were also more likely to sprint from a standing start (41%) with an average duration of 2.5 seconds (15m) per sprint³⁶. They were however, also more likely to show decreases in acceleration between first and second halves²⁹.

The 'impact load' referred to by Cunniffe et al, described thresholds of light impact to severe impact loads distinguished by varying degrees of G-forces⁷. For example;

- 5 - 6 G refers to light impact, hard acceleration, deceleration, and change of direction;
- 6 - 6.5 G refers to light to moderate impact in player collision and contact with the ground;
- 6.5 – 7 G refers to moderate to heavy impact and is described as a tackle;
- 7 – 8 G refers to heavy impact tackle;
- 8 – 10 G refers to very heavy impact such as a scrum engagement and tackle;
- 10 + G refers to severe impact, tackle and collision⁷.

According to these definitions, forwards experienced a greater number of impacts, 1274 per game, compared to 798 impacts experienced by the backs⁷. The differences in number of impacts between position groups can be attributed to the difference in measurement with six variables determining impact load. Forwards had greater impact load in each category ranging from light impact to severe impact, resulting in an overall greater body load per min (1426 vs. 376 AU)⁷. Forwards are involved in more collisions per game due to being involved primarily in scrumming, rucking and mauling, resulting in greater impact loads.

In summary, the demands of the game have been well studied and it can be concluded that the demands have increased following the professionalization of the game. The collisions between players, sometimes running at high speeds increases the physiological stress, and highlights the importance of the physical size in rugby. Although there are limited studies on younger players, it may be concluded that the demands on them are lower compared to adult players.

2.4 Factors associated with success in rugby

There are certain characteristics, physical (body mass and stature) and non – physical (socioeconomic status and race), that are associated with achieving success in rugby. For example, in senior World Cup competitions, teams who have had the tallest backs and the heaviest forwards, with the greatest collective team experience have achieved the best success in winning the competition³⁷. A study on *Factors associated with success in South African rugby union*, showed the Province in which the player was born and the school the player went to had a significant influence on the success of that player in rugby³⁸. Provincial rugby unions situated in the Western Cape (Western Province Rugby Football Union), Free State (Free State rugby union), Gauteng (The Golden Lions rugby union and The Blue Bulls rugby union) have produced the highest percentage of Springboks during a period between 2000 and 2010. These unions are amongst the most successful unions in South African rugby at both junior and senior levels, which may explain the high percentage of Springboks born in these regions. Some of the most prestigious rugby – playing schools (Grey College, Paul Roos and Afrikaans Boys High School) are situated in these provinces. These schools offer superior coaching expertise and opportunities from an early age which contributes to talent identification and development. These schools also have a well-developed rugby culture, regularly playing against each other, providing a high level of competition from early ages. Between 2000 and 2010, 29 % of the players who represented the Springboks were born in the Western Cape, while 15 % were born in the Free State and Gauteng provinces³⁸. In total, more than half of the Springboks during the defined period were born in three provinces with the remaining six provinces making up the balance.

The U18 Craven Week is a good tournament for identifying talented players in South Africa³⁸. It may however be too late for player development, making the U16 age group a crucial time for identification and development of young rugby talent with a long term vision of producing players for the national squad⁶. Rugby is a highly demanding physical, tactical and skill – based team sport. It is important that there is a strategy for talent identification and development, in conjunction with the adequate physical training resources. Included in this strategy should be an awareness that late maturers may drop out of rugby to participate in other sports which are less dependent on physical size characteristics⁶.

Differences in body size can be apparent as early as 6 or 7 years of age, increase with age, and are greatest during adolescence due to the individual differences in the timing and tempo of the adolescent growth spurt³⁹. It has also been shown that the maturity of adolescents may differ according to their ethnicity⁴⁰. Players from many different ethnic groups participate in rugby in South Africa, and the possibility exists that players from one group may mature earlier than players from another, affecting talent identification and development. There are also differences in the socioeconomic status of South African adolescents⁴¹. Therefore players from a specific ethnic group associated with a low socioeconomic status may be excluded due to differences in their maturation. This will be discussed in more detail under the heading ‘Socioeconomic status: the impact on physical development’ on page 49.

2.5 Size

Rugby is an example of a sport where physical size does matter. Players who are bigger, stronger and faster have an advantage over smaller, less powerful players⁴². The modernization of rugby, with its increased physicality, has meant that there is a tendency for

the most physically well-developed players to get selected over players who are not as developed⁴³. Therefore with the advent of professionalism in rugby and the natural evolution of the game, more emphasis is being placed on strength, speed and aerobic power in all players³¹. Studies on the evolution of the rugby player over a period of time have been conducted previously^{37 43 44 45 46}. Two distinct phases in the evolution of the rugby player have previously been reported, where the average physique steadily increased from 1905 – 1975, and then at a faster rate from 1975 – 1999¹⁰. It is important to note that the rate of change from 1975 – 1999 was almost 3 – 4 times greater than that between 1905 – 1975¹⁰. The period 1975 – 1999 included the introduction of the professional era. It has been shown that fitness and anthropometric profiles of elite players have steadily improved as a result of the increasing demands of the game⁴⁷. It is always pertinent to compare the evolution of the athlete to the secular changes in the normal population. Athletes who compete internationally generally display distinctive body size and shape compared with the normal population⁴⁵.

The phenomenon also occurs in other sports. For example, the body mass and stature of NFL players increased by 3.1kg/decade and 0.9cm/decade respectively between 1980 and 2011, with NFL players weighing 23.6 kg heavier than their normal population⁴⁵. Such dramatic increases in size have led to performance being impacted by morphology. This leads to standards and selective thresholds being targeted towards specific morphological characteristics⁴⁵.

Speed, strength, power and body composition have evolved rapidly, resulting in the game being played at an increased speed and with greater physicality⁴. For example, Lombard et al (2015) showed significant increases in muscular strength (40%), body mass (20%), muscular

endurance (50%) and improved sprint times among a group of South African national U20 rugby players between 1998 – 2010⁴⁸.

Since the start of the professional era (1995), significant changes in physicality and therefore body size have occurred. These changes could possibly be due to changes in the law of modern rugby, developments in match analysis, equipment technology, ergogenic aids and player training^{8 33}. The changes can also be ascribed to the principles of Darwin which refers to a situation where an object needs to conform to the situation or environment to survive. Rugby can be described as an example of Darwinian systems, in that certain selection pressures exist for physiques that match the demands of the game⁸.

2.5.1 Body mass and stature

Numerous studies have shown the importance of body mass and stature for success in rugby with bigger players having an advantage over their smaller opposition³⁷. This is well illustrated in a study by Sedeaud et al., (2012), which showed that at all Rugby World Cup competitions, the best teams had the tallest backs and heaviest forwards. Also over a 20 year period, from 1987 – 2007, forwards and backs have become heavier by 6.8 and 6.7 kg respectively and taller by 0.61 and 1.09 cm respectively³⁷. Research is now showing that certain physical characteristics and types of body composition are associated with specific playing positions⁴⁹. For example, among modern day elite Australian rugby union players, forwards were significantly taller, heavier and had a greater total fat mass and lean mass than backs, while backs had a higher percentage lean mass⁴⁹. Forwards also have greater girths, bone breadths and mesomorphy than backs. These characteristics can be advantageous as forwards are frequently exposed to tackling and collisions⁵⁰. It follows that players from populations with these specific characteristics are more suited to becoming

rugby players^{49 50}. For example, Polynesians are more likely to possess physical characteristics potentially beneficial to rugby performance, which may be position specific⁴⁹. Elite Polynesian rugby players have different distribution patterns of fat mass and lean mass compared to Caucasians, which may influence their suitability for particular positions⁴⁹. Polynesian forwards had a greater differential between lean mass and fat mass in the leg and periphery regions compared to Caucasian forwards. The differential exhibited among Polynesian forwards could provide an advantageous shift in power to mass ratio, and thus improve their ability to create greater force in explosive movements including tackles, mauls, scrums, rucks, hits and sprints⁴⁹.

It is well recognized that increases in anthropometric (increased sum of 4 skinfolds⁵¹) and physiological characteristics occur with increasing age^{15 51 52}. Age-related increases in anthropometric and physiological characteristics in adolescent rugby players are also well recognized where the adolescent team sport is characterized by disparities in physical size and maturation. In a comparison between U16 and U18 South African rugby players, U16 players were significantly lighter and shorter than the U18 players⁶. Position specific characteristics were evident, with locks being the tallest and the props being the heaviest, while scrumhalves were the lightest in both age groups⁶. Among a group of Australian adolescent rugby players, increasing age was related to faster and more powerful performances, as well as the players being taller, heavier, and having a greater BMI⁵². In the South African context, there are no differences in body composition between the two age groups, however positional differences did exist with props exhibiting a significantly higher body fat percentage compared to other positional groups⁶.

Findings have further demonstrated that height, body mass, countermovement jump height and peak power, sprint momentum, max velocity, acceleration, strength and isometric strength all improve with increasing age⁵¹. In a community based study of adolescent players between the ages of 12 and 15, the group of rugby players were consistently heavier than normative data for those specific age groups^{50 52}. However, physical size was not always predictive of superior performance and was not consistently linked to injury or player ethnicity. The greatest differences in physical size and performance among the group of adolescent players occurred in stature and body mass, however differences were influenced by playing position⁵². In this study, size and performance spectrums were created among the group of adolescents to show that only a small percentage of players were capable of being highly ranked for all the variables associated with performance. Only six percent of all players had the physical characteristics of being the heaviest, fastest, and most powerful, while only four percent of players displayed poor physical prowess and were in the lightest, slowest and least powerful tertiles⁵². It was therefore concluded that being larger is not the only factor to account for performance advantages among adolescent rugby players⁵².

It is known that being larger is not the determining factor for success in rugby, however a big strong, powerful, fast and skillful rugby player will have a significant advantage over the smaller, weaker, less powerful, slower and less skilled rugby player. Adolescents participating in supervised strength and conditioning programs can not only enhance the individual's physical capabilities but also ensure a reduced risk of injury. It is important that the youth athlete be considered as such and factors such as growth spurts, training age, and altered movement patterns are considered. This will be discussed in more detail in the next section.

2.6 Youth rugby

Players in the age range of 15 – 16 years old are, from an athletic perspective, at an opportune time for maximum development. Youth and adolescents, especially those involved in rugby, engage in specific strength and conditioning programs to prevent injury as well as enhance performance¹³.

When administering strength and conditioning programs with youth players, it is necessary to consider that adolescent players are experiencing the greatest change in peak height velocity (PHV) and peak weight velocity (PWV) as circulating androgen hormones are at their most active¹³. Changes in PHV and PWV reflect individual maturation rates, which allow children to be trained according to their biologic status as opposed to their chronologic age¹³. Changes in body dimensions which occur at puberty can impact on the adolescent's motor control patterns. Coaches should therefore be aware of the potential changes in motor coordination during this phase. For example, adolescents have to learn how to move with longer limbs. This period of adjustment is referred to as 'adolescent awkwardness'⁵³. The acquisition of new skills, as they progress through the various age groups, can therefore take longer than expected to grasp⁵³.

Youths, should not be treated as 'miniature adults' when prescribing strength and conditioning programs⁵³. It is therefore imperative that the content and delivery of youth strength and conditioning programs should be different to the programmes of mature adults¹³. Also, on field physical demands of adolescent rugby differ to adult and elite level rugby. This should be considered in the training of the different youth age groups^{7 27 28 29 35}.

2.7 Weight training in the youth

The primary emphasis of training for young team-sport players is on balanced physical development and building a foundation of athleticism⁵⁴. There is a plethora of literature supporting the need for a long term athlete development (LTAD) program^{53 55 56 57}. It is important to understand the meaning and difference between talent identification and talent development, two components crucial to the success of the LTAD program. This will be discussed in more detail under the heading 'Player talent identification and development' on page 43. The next section discusses the principles of the Long Term Athlete Development model and in particular how this may be applied to adolescent rugby players.

2.7.1 The Long Term Athlete Development (LTAD) model

The LTAD model comprises specific stages of athletic development. Each stage is planned according to the key phases of maturation; prepubertal, circa pubertal and postpubertal⁵³. The prepubertal phase is characterized by periods of peak brain maturation and maximum acceleration of the neuromuscular system. It is therefore advised that this phase of development is focused on learning the fundamentals (walking, running, jumping and catching) and learning to train⁵³. The circa pubertal phase coincides with the early stages of the training- to-train phase and is characterized by the natural development of the adolescents as they reach PHV. The post pubertal phase is synonymous with the latter period of the training- to-train stage and the early stages of the training-to-compete and the training-to-win stages⁵³. This phase is characterized by the player reaching PWV and increases in muscle mass as the player matures. Provided there is correct and consistent weightlifting technique, it is suggested that the player in this stage be introduced to greater external loads to further athletic development.

The LTAD model has been established to guide strength and conditioning coaches and clinicians in the development of safe and effective weightlifting programs for youth. The LTAD model importantly considers the maturational status of the child, offering a more strategic approach to athletic development. The LTAD model provides a systematic progression of the youth athlete through all the necessary stages of athletic development to ideally maximize athletic success at a later age⁵³.

2.8 LTAD and weight training

The inclusion of youth-based weightlifting programs have previously been questioned over concerns surrounding primarily the safety and well-being of the young athlete⁵⁸. However recent literature has suggested that injuries occurring as a direct result of generic resistance training and weightlifting programs among youths is relatively low⁵³. There is a comprehensive body of scientific evidence that supports regular participation in youth resistance training, reinforcing the positive health and fitness adaptations and enhancement of sports performance⁵⁸. The inclusion of resistance training into exercise programs have shown numerous performance improvements in muscular strength, power production, running velocity, change-of-direction speed and general motor performance, especially in youth⁵⁸. Benefits of exercise training programs inclusive of resistance training have also shown benefits relating to improved body composition, improved insulin sensitivity in overweight individuals, as well as enhancing skeletal health through improved bone mineral density, likely reducing the risk of sports related injuries in young athletes⁵⁸. An adequately designed strength and conditioning program in the presence of a suitably qualified trainer, means that resistance training in general is safe and effective for young athletes⁵³.

There has been concern about the potential damage to the epiphyseal growth plate in youths, claiming that weightlifting too early would stunt growth⁵⁹. However, more recently it has been shown that there is no evidence that weightlifting or resistance training in general is injurious to the epiphyses^{53 58 60}. It follows that there is no correlation with reductions in eventual height in young athletes who have a history of weight training from an early age⁵³. Also it has been shown that weight training is an osteogenic process which has long term consequences^{59 61}.

There are a number of recommendations proposed by the National Strength and Conditioning Association (NSCA) for youth resistance training which ensures that risk while training is minimized⁵⁶.

Strength and conditioning coaches should not focus on the supposed risks, but rather on the potential benefits of exposing a youth athlete to adequately designed weightlifting and resistance training programs⁵³. Concentrating on maximizing the window of opportunity that exists in the developmental stages of a youth athlete can far outweigh the potential risks of exposing such an athlete at a young age to weight training. In fact, the failure to use these “windows of opportunity” may result in the limitation of future athletic potential¹³. This was shown in Lloyd et al, (2013) where the implementation of multifaceted programmes including strength training in the younger age groups, prior to the onset of neuromuscular deficits and biomechanical alterations enhanced the risk of injury, movement mechanics and functional abilities⁵⁸.

Adaptations to the connective tissues and skeletal system that can be gained from weightlifting will better prepare the young athlete to tolerate the impact and ground reaction forces that they are likely to experience in a sporting environment⁵³.

2.9 Rugby in South Africa

Rugby is a popular sporting code within South Africa. The national team, Springboks, has achieved success ever since the first home game in 1891 against a touring British Isles team and has consistently been ranked within the top four teams in the world since the start of the professional era in 1995⁶² (2013). The reported male rugby playing population in South Africa is 633 229⁶³ (2015). The following age categories make up the total male rugby playing population; pre-teen males: 320 842; teen males: 199 213, and senior males: 113 174⁶³. Of interest is the systematic decrease in number of players as age increases, with only 18% of the total male rugby playing population being senior players⁶³. It has been shown previously that the majority of participants in sport never go on to reach the elite sporting level and therefore do not become professionals⁶⁴ (2010). The fact that since 1891, 852 rugby union players have represented South Africa at senior men's level, illustrates this point⁶².

In 2013, 441 male rugby players participated in the national U16 Coca Cola Grant Khomo Week; of this group only 45 were selected into an elite U16 player's squad for further development. This represents a 0.045 % of all the U16 players in the country. This is comparable to progression rates with increasing age in the National Football League (NFL) in the United States of America (USA). For example, youth age groups (6 – 17 years) have a playing participation population of 2 867 000, while there are only 1 643 football players who play in the senior NFL⁶⁴. Therefore, 0.09% of high school football players become professional football players, while only 2.0% of college football players make the transition from college football to professional NFL⁶⁴.

South Africa has 3.6 times more teen players compared to New Zealand and 7.4 times more compared to Australia⁶³. There are various age group tournaments in which these teen

rugby players are able to participate. The tournaments serve as South Africa's player talent and development pathways. The youth tournaments in South Africa will be discussed in more detail in the next section.

2.9.1 Youth tournaments

The South African Rugby Union (SARU) have annual age group tournaments at U13 (Craven week), U16 (Grant Khomo week) and U18 (Craven week and Academy week). Craven week (18 years old) is the premier age group competition in the country and show cases the best rugby players in the country and culminates in the selection of the South African schools team. These tournaments ensure that the best players in each age group are recognized and given the opportunity to compete against each other. It serves as a form of talent identification ultimately creating a pathway for the player from U13 level to senior provincial level. Research however, has shown that only a few U13 players who competed at the Craven week progress to become talented players at U16 and U18 level^{65 (2011)}. Specifically, 32% of U13 Craven week players were selected for their provincial U16 Grant Khomo team, while only 24% were selected for the U18 Craven week team⁶⁵.

As a means of player talent identification and development, the selection of players at U13 level may not be the best indicator of future success. Reasons for this are numerous and include differences in maturation between players and making selection criteria at U13 level different to selection criteria at U16 and U18 level. The physical demands of the game are also different through the age groups. Specific quota targets are also evident at U16 Grant Khomo week, U18 academy week as well as the U18 Craven week. At both Academy Week and Grant Khomo Week, provincial squads are selected with a ratio of a maximum 11 white players and a minimum of 11 players of colour (a term used in South Africa to describe

players who are not white)^{66 (2010)}. Provincial Craven week squads are selected based on being able to have a maximum of 13 white players and a minimum of 9 players of colour⁶⁶.

SARU have attempted to implement specific transformation programmes in an attempt to accelerate players of colour into high levels of performance. The Spoornet Rugby Excellence program was first designed and implemented in 1998. It was initiated to specifically accelerate the progress of black players. It targeted players of all ages with the aim of providing players with the necessary support to develop them into professional players, however it only lasted until 2002⁶⁷.

The Nike All Stars program was initiated in 1999 and was focused on identifying players between the ages of 12 and 15 years old. Players selected onto the Nike All Stars program attended regular training camps where they were exposed to the demands of a professional rugby player. The program failed in its objectives and subsequently replaced with a new program⁶⁷.

This led to the development of the Green squad and Elite squad projects, in 2003. Players were identified according to their rugby skills and grouped according to their age. There were five age groups; U16, U17, U18, U19 and U20, with each age group having 100 players. Players on the program were assessed on three occasions during the course of the year. This included physiological testing, nutritional advice, and skill assessments. Four years later (2007), SARU replaced the Green squad with the Elite squad project which had a more focused approach. Nutritional supplementation for players and testing equipment to measure physical characteristics was supplied to each union. The unions were also given funding to help support the project. The Elite squad project continued until 2010.

It is clear that the SARU have attempted to introduce programmes to aid in the talent identification and development of players from around the country. However due to the complex nature of identifying talent and subsequently developing it, these programs have not always succeeded in achieving their goal of accelerating development of players to transform the game. It is therefore important that there is a deeper understanding of talent identification and development in the South African context to maximize the use of all the resources.

2.9.2 Player talent identification and development

The process of talent identification and development is a complex system of interacting variables between the individual and the environment⁶⁸. Individuals develop and mature at different rates and in response to different stimuli, resulting in a unique process of talent identification and development for each individual. The process of talent identification usually occurs during childhood and/or adolescence. Childhood is defined as the period from the age of six years through to the onset of adolescence or the period during which most bodily systems mature structurally and functionally⁶⁹.

Talent identification and talent development differ in definition, where the identification of talent can be described as the provision of the most appropriate environment in which to realize the talent that has been identified. The development of that talent is described as a complex interaction of various components which directly influence an individuals' opportunities and progression in sport⁷⁰. It is important to realize that talent development is not generic, but rather an individual process. Many individuals may reach the same end point in terms of performance, but their path to that end point does not have to be uniform. Ericsson's model of 10 000 hours of deliberate practice has received much attention and has

served as the principle model with regards to achieving elite performance⁷¹. Tucker and Collins propose that the achievement of elite performance is much more complex and is rather based on the interaction between genetic and training factors⁷². It is proposed that elite sporting performance occurs as a result of the exposure of an inherently talented individual to the appropriate combination of extrinsic factors⁷³.

2.10 Factors influencing talent identification and development

2.10.1 Genetics

Genetics, along with measures of physical characteristics such as stature, body mass and aerobic capacity have been used to identify talent, however, due to the multifaceted and complex nature of sport, the accuracy of these methods are questionable^{68 74}.

Genetics represents the complex makeup of human beings, and is virtually impossible to pinpoint the exact gene that is associated with various aspects of elite sporting performance.

It is in any case, highly unlikely that only one gene contributes to an individual's sporting performance⁷². A more probable explanation is that the individual's genetic makeup on factors such as sex, stature, aerobic capacity and skeletal muscle properties (all inherited traits associated with performance) plays a role in contributing to the sporting success of an individual^{72 75}.

2.10.2 Physical characteristics

Stature

Stature is an important characteristic for success in many types of sports (e.g. basketball, rugby union) and playing positions within certain sports^{75 76 77}. In rugby union, each playing position has different demands and players with certain physical characteristics are better suited to play in that position. For example, lock forwards need to be tall (greater than 1.95m at international level) while scrumhalves are usually shorter (1.79m at international level)⁷⁸. The relevance of stature in identifying talent is therefore sport specific and is affected by maturation as individuals grow at different rates.

Body mass

Body mass has been shown to be associated with success in rugby union at the elite level³⁷. Successful teams at world cup tournaments have typically been the heaviest among the forwards, and should therefore be an important consideration in talent identification and development. As body mass can affect physical characteristics such strength, power and speed, it is important that increases in body mass are due to lean muscle mass and not an increase in fat mass. Body mass as a means of talent identification has therefore been questioned, as it could potentially underpin characteristics such as strength, power and speed; characteristics inherent to success in many sport types. Without considering these characteristics could result in heavier individuals being favored for selection instead of lighter more skilful players⁷⁹.

2.11 Transformation in South Africa: What are the issues?

The National Party (NP), dominated by an Afrikaner minority, was the governing body of South Africa from 1948 to 1994. They passed legislation in 1948 enforcing a legislative system based on racial segregation in which the community was classified into four racial groups, namely white, coloured, native and Asian^{69 70}. This system became known as Apartheid. Apartheid was reinforced and further entrenched by the NP who at the time implemented various Acts resulting in the ruling white community having access to the best education, medical facilities, public areas, public services and sporting facilities. Conversely the non-white population groups that were subjected to the Apartheid system were negatively affected in all these aspects including sporting facilities and structure across all sporting codes⁸¹.

The Apartheid system allowed for white players to receive superior education, opportunities and sporting facilities compared to their black and coloured counterparts. This resulted in white players having improved opportunities for development and exposure to sport of a higher level and contributed to white dominance within South African sport, particularly rugby and cricket.

National protests against the Apartheid system of government began in South Africa in the 1950's. This influenced the international community resulting in international economic and sporting sanctions against South Africa. This led to South African teams being banned from international sporting competition⁸¹. The continued sanctions and unrest between South Africa and international countries eventually provided the impetus for the abolishment of the Apartheid system.

After the abolishment of Apartheid in June 1991, international sanctions of South African sport were removed. However, by then, after 43 years of discrimination against non-white players, the development of national sport had been severely affected. White players dominated most of the national representative teams for several years after the abolishment of Apartheid. Even now, 24 years later, national teams have remained overrepresented with white players.

The South African population has increased from 41.5 million people in 1995 to 54 million people in 2014^{82 83}. The black population has increased from 76.0% in 1995 to 80.2% in 2014, while the white population has decreased from 13.0% to 8.4% over the same time period. The coloured population also declined from 9.0% to 8.8% while the Indian/Asian population decreased from 3.0% to 2.5%^{82 83}. Despite the profile of the South African population being predominantly black, the majority of the sporting codes, except soccer have remained dominated by white players.

Transformation, in the South African context, is defined as an active process of eliminating discrimination as a result of unequal opportunity following Apartheid⁸⁴. In sport transformation is the process of making the representative teams in the country reflect the demographics of the population. Ideally this should occur by providing equal opportunities to all South Africans in education, coaching and access to facilities. There will be a point where an equal environment with equal opportunities has been established, and transformation processes will no longer be needed⁸⁴.

With all these changes taking place in the country, the sport of rugby has evolved. In 1992 the South African Rugby Football Union (SARFU), a body designed to govern all rugby in South Africa, irrespective of colour, was formed. Under this body the Springboks were readmitted into international rugby in 1992⁸⁵. In 2005, the SARFU changed its name to the South African

Rugby Union (SARU). Since readmission to international competition all players in South Africa have been eligible for national participation in all sporting codes. However, major national teams are still not reflective of the demographics of the country with an overrepresentation of white players.

Various programmes have been implemented across the different sporting codes to facilitate the development of non – white players.

However, despite the magnitude of these programmes the effect on transformation at the senior representative level was disappointing. A study, *'Playing time of senior rugby players across all levels of South African rugby, 2007 – 2012: implications for transformation'* examined whether transformation had been successful at all levels. This study analysed the playing time of all players. At Springbok level (2007 – 2012) the white players played more than expected based on the number of players whereas the black players played less than expected based on the number of players. During this period the total number of white players (n = 191) representing the Springboks increased from 76% to 79% while black players increased from 4% to 5% and coloured players decreased from 20% to 17%⁸⁶. Looking at the representation of each ethnic group based on number of players vs. playing time at Springbok level, white players were overrepresented 50% of the time, 0% of the time underrepresented and in 50% of the time equally represented. This is in comparison to black players at Springbok level, where 83% of the time they were underrepresented and 17% of the time equally represented. Coloured players were overrepresented 33% of the time, equally represented 33% of the time, and underrepresented 33% of the time⁸⁶. In summary, these data show that despite the efforts to develop and fast track non-white players, the game is still over- represented by white players at the highest senior level.

Although transformation processes are on-going, national teams in South Africa are still not reflective of the true demographics in the country. It was concluded that over the six-year period between 2007 and 2012, there were no clear changes in the proportion of white, black and coloured players at all levels of competition. It can therefore be said that the various programmes implemented by the SARU have not had the desired effect to transform the game⁸⁶.

While succeeding at the highest level in rugby requires integration of many factors, one possible explanation for underrepresentation among the non – white population is that a high proportion of non – white players have a lower socioeconomic status than white players. Children raised in a low socioeconomic environment will always have a competitive disadvantage due to differences in maturity and growth⁸⁷ as well as a lack of facilities and structured competition. In a sport where physical development is so important, a low socioeconomic status could have detrimental effects on growth and physical maturation with players not realising their true potential. Socioeconomic status and the impact on physical development will be discussed in more detail in the next section.

2.12 Socioeconomic status: the impact on physical development

Socioeconomic status refers to the relative position of an individual or family within a hierarchical social structure based on their access to, or control over wealth, prestige, and power. This is usually represented by parental educational levels, parental occupational prestige, and family wealth⁸⁸. In South Africa, the access to education, wealth, prestige and power was constructed on the basis of race through institutionalized inequality. People were restricted about where they could live, the type of education they could receive and the type of occupation they could engage in. Therefore in South Africa, socioeconomic status has

been distributed along racial lines⁸⁹. South Africa is an upper- middle income country scoring the lowest in a survey investigating the impact of socioeconomic status on reading performance, an aspect of educational achievement⁸⁹. A large gap exists in academic achievement between high and low socioeconomic status families. The educational system is usually inferior in the low socioeconomic regions, making it very difficult for children to overcome the disadvantage of social background. Therefore children from low socioeconomic status families are more likely to have a low socioeconomic status as adults. People from a higher socioeconomic status generally participate in more active sports. This coupled to access to facilities explains the potentially improved sport performances in people with a higher socioeconomic status⁹⁰. This is not only a South African phenomenon. For example, adolescents from low socioeconomic groups in Germany and America have a decreased sport performance compared to adolescents with a higher socioeconomic background. German adolescents from the lower socioeconomic strata are disadvantaged in their motor sport development compared to adolescents of middle and higher socioeconomic backgrounds⁹⁰. A study of American adolescents showed that girls with a lower socioeconomic status generally underperformed in sport performance. In contrast boys with a lower socioeconomic background were not necessarily affected in their motor sport performance but had significantly higher body composition characteristics compared to their peers from a higher socioeconomic background. Poor body composition characteristics, such as high body fat and low lean muscle mass could indirectly affect sport performance, through poorly developed strength and power levels, especially in contact sports such as rugby.

In the South African context, children from a lower socioeconomic environment are generally smaller and less powerful than children from a higher socioeconomic environment⁴². In South Africa the lower socioeconomic strata are primarily made up of black children, while the higher socioeconomic strata are primarily made up of white children⁹¹. White children were generally the tallest and heaviest while black children were generally the shortest and lightest when the groups were analyzed. The same study showed that white boys outperformed their black counterparts in numerous physical tests, including standing long jump, sit-up test, and cricket ball throw test⁹¹.

To address the disparity and promote the development of athletes at a young age, it is important that community clubs and schools have the necessary sporting facilities which include resources such as adequate coaching, competitive fixtures, and proper nutrition across all socioeconomic levels catering for young children.

2.13 Summary

The change in the nature and demands of the game, due largely to the onset of professionalism, has meant that rugby players are now full time athletes. This has resulted in a shift in the physical preparation of the players to meet the increasing demands of the modern game. Size in the modern game, characterized by collisions between players, is an important prerequisite for success. Players who possess superior physical qualities in combination with adequate skill triumph over the less physically prepared player with adequate skill.

Physical characteristics of players are also important at the adolescent level. Therefore, early maturers, who are likely to be heavier and taller than late maturers have a distinct advantage over later maturers.

It has become necessary for youths participating in collision based sports to prepare themselves for the demands of the sport by training with weights. Regular and safe practice resistance training improves muscular strength, power production, running velocity, change-of-direction speed and general motor performance, as well as a reduction in injury rate. Through the osteogenic process of weight training, adaptations are made to the connective tissue and the skeletal system, ensuring the athlete is adequately prepared to withstand the external forces during sport involvement.

In adolescent team sport, maturity related differences in physical characteristics impact the selection and non-selection of players. Early maturers are generally bigger than their peers of the same chronological age who are classified as late maturers in adolescence. A selection bias exists towards the early maturers as they are more physically developed and are seen as more talented than their late maturing peers. Coupled to the influence on size, socioeconomic status also affects key developmental tasks. A low socioeconomic status is often associated with late maturation. Also without adequate education, facilities, competition and nutrition, a player from a lower socioeconomic background is likely to be smaller with poorly developed fundamental skill and therefore negatively affected in competition against players living in a higher socioeconomic status. This is especially relevant in the South African context where the socioeconomic status of a family is segregated along racial lines. A failure to account for this in youth development programmes will impact on

players' development and decrease the chances of a player from a low socioeconomic group being selected for a representative team.

The next chapter is the experimentation section of this thesis, where data on adolescent player size, socioeconomic status, and training background will be presented and discussed.

There may be some overlap in chapters 2 and 3 but this is expected because chapter 3 is presented in the format of a manuscript. The answers arising from these data will be contextualized in chapter 4.

CHAPTER 3:

Body size, socioeconomic status, and training background of a select group of U16 South African rugby union players (2010-2013): the impact on national selection.

3.1 Introduction

The physical demands of rugby have increased following the introduction of professionalism into the sport in 1995. The body mass of the senior and junior players has increased^{7 10 44 48} in response to these increased demands. In particular the junior game has become more competitive. There are national youth tournaments catering for age groups as young as 13 years. Other age group tournaments include the national U16 Coca Cola Grant Khomo week, the U18 Academy week and the national U18 Craven week. In an attempt to accelerate the development of players from disadvantaged areas The SARU launched projects to target players from these areas. For example, projects include the Nike Allstars program (1999 – 2002) and the Spoornet Rugby Excellence program (1998 - 2002). These programs failed to achieve the necessary objectives and were replaced by the Green squads in 2003 and the Elite squads in 2007⁸⁶.

The failure of the above mentioned programs to transform representative teams⁸⁶, has meant that the disparity in socioeconomic status among people in South Africa remains a barrier to having representative teams comprise of players reflecting the population demographics. Players with a low socioeconomic background are at a significant disadvantage. Without adequate education, facilities, competition and nutrition, a player from a lower socioeconomic background is likely to be smaller with poorly developed fundamental skills and therefore negatively affected in competition against players living in a

higher socioeconomic status. Of relevance to the South African context is the influence of a player's socioeconomic status on the biological age and maturity of the player¹⁶. In particular, players from a low socioeconomic region can have delayed physical and technical development. It is common to have players classified as early maturers and others as late maturers in the adolescent years⁹³. Early maturers are physically superior and often outperform their late maturing peers of the same chronological age.

Rugby is a contact sport with frequent collisions between players so it is clear that size is an important characteristic for success. With the modern day rugby player being bigger, stronger and faster in general to the rugby player of 20 years ago⁴⁸, it is important that the developing youth player be exposed to the necessary stimuli of proper coaching, strong competition, adequate facilities and good nutrition.

The benefits of engaging in a supervised resistance training program from an early age have been discussed in detail. Resistance training during adolescence is safe providing the sessions are properly supervised⁶¹. There is a general consensus that resistance training should be encouraged during adolescence to enhance physical development^{13 57 58 94}.

Although it is generally accepted that it is difficult to succeed at the highest level in youth rugby without adequately developed physical characteristics, the contribution of size and resistance training practices to success have not been quantified.

The aim of this study therefore is to determine the characteristics associated with the more successful players at an U16 level. Quantifying the physical and non-physical characteristics associated with success, will assist in the development of player talent.

3.2 Methods

3.2.1 Participants

Rugby players selected to represent their unions (Blue Bulls, Border, Eastern Province, Falcons, Free State, Griffons, Griquas, Kwa – Zulu Natal, Leopards, Limpopo Blue Bulls, Lions, Pumas and Western province) at the Coca Cola National Grant Khomo U16 week from 2010 to 2013 were recruited for this study (n = 1558). Assent was provided by the parents of the players, and the research was approved by the Faculty of Health Sciences Human Research and Ethics Committee of the University of Cape Town (HREC REF 585/2014).

3.2.2 Experimental design

This study was retrospective in nature and data obtained for each player was self-reported in questionnaires completed at each year's Coca Cola National Grant Khomo U16 week. The relevant data obtained from the questionnaires for this study included personal information, family and weight training. The data recorded for weight, height and date of birth were self-reported, and checked against the official tournament program.

3.2.3 Race

As part of the questionnaire, participants were required to self-report their racial group, with black, white, coloured and other as listed options. Race defined is the group a person belongs to as a result of a mix of physical features such as skin colour and hair texture, which reflect ancestry and geographical origins, as identified by others or, increasingly, as self-identified⁹⁵. Race differs to ethnicity, where ethnicity is defined as the social group a person belongs to, and either identifies with or is identified with by others, as a result of a mix of

cultural and other factors including language, diet, religion, ancestry, and physical features traditionally associated with race⁹⁵.

3.2.4 Socioeconomic status

The socioeconomic status of the player was determined in two ways; (a) the number of people per household and (b) the number of people per household room¹⁰⁷. The study used the ratio of the number of people per household as the main indicator for socioeconomic status in this group of U16 rugby players. The players were required to self-report the number of people living in their parents' house as well as the number of rooms in the house. The number of people per household was calculated as an average for each race group and reported¹⁰⁷. The number of people per household room was calculated by dividing the number of rooms by the number of people residing in the house.

3.2.5 Age started playing rugby

Players attending the tournament were required to self report the age in years at which they first started playing organized rugby, such as at school or at a club.

3.2.6 Weight training

Players attending the tournament were required to indicate whether they participated in weight training or not, by answering 'Yes' or 'No'.

3.2.7 National squad selection

Players were selected into the national squad by a panel of selectors based on the performance for their respective unions at the week-long U16 Grant Khomo week. A threshold for body mass and stature for selection into the national squad was calculated using the mean of the data between 2010 – 2013 \pm 1 SD.

3.2.8 Statistical analyses

Descriptive data were analyzed using the Statsoft, Inc. (2013) (STATISTICA data analysis software system, version 12. www.statsoft.com). The magnitude of the differences between main effects (whites vs. blacks vs. coloureds) versus (national squad vs. non – national squad) and years (2010 – 2013) were determined using a one way analysis of variance and a *Tukey post hoc test*. The magnitude of these differences were determined using effect sizes⁹⁶. In this analysis, an effect size of < 0.2 was regarded as ‘trivial’, 0.2 – 0.5 as ‘small’, > 0.5 – 0.8 as ‘moderate’ and > 0.8 as ‘large’⁹⁷.

3.3 Results

3.3.1 Body mass

Table 1 shows the body mass of all white, black and coloured players from 2010 to 2013.

There was a significant difference in body mass between the race groups and an increase

over time (2010 vs. 2013). There was a moderate difference between white and black

players (85.5 ± 12.0 vs. 78.0 ± 11.9 kg, ES = 0.59), a large difference between white and

coloured players (85.5 ± 12.0 vs. 74.4 ± 11.4 kg, ES = 0.87) and a small difference between

coloured and black players (74.4 ± 11.4 vs. 78.0 ± 11.9 kg, ES = 0.28). The specific

comparisons within the main effects (race and time) are shown beneath the table. There was

no significant interaction (race x time), suggesting the changes between races were similar

over time. The magnitude of the differences are represented as effect sizes in the legend

beneath Table 1 on page 70.

INSERT TABLE 1 HERE

Body mass: National squad versus Non – National squad

The body mass of the national squad and non – national squad players from 2010 – 2013 are shown in Table 2. The players are sub divided into white, black and coloured players with the overall effect size being moderate (86.4 ± 13.7 vs. 80.1 ± 12.4 kg, ES = 0.50). There was a significant difference between national squad and non – national squad players ($p < 0.000001$). The national squad players were consistently heavier than the players who did not get selected for the national squad. For example, in 2010 the national squad players were 8.0 % (ES = 0.53) heavier, in 2011 6.2 % (ES = 0.39) heavier, in 2012 5.4 % (ES = 0.35) heavier and in 2013 7.9 % (ES = 0.52) heavier.

INSERT TABLE 2 HERE

3.3.2 Stature

Table 3 shows the stature of all white, black and coloured players from 2010 to 2013. There was a significant difference in stature between the race groups. A large difference exists between both white and black players (181.9 ± 7.1 vs. 175.1 ± 8.4 cm, ES = 0.82), and white and coloured players (181.9 ± 7.1 vs. 175.1 ± 7.3 cm, ES = 0.82). Although the main effects of time was significant, a *Tukey post hoc* test did not have sufficient precision to detect the specific differences. There was a significant interaction between race x time. White and coloured players did not change over time, while a small magnitude of difference existed for black players between 2010 and 2011 (ES = 0.45). The magnitude of the differences are represented as effect sizes in the legend beneath the table.

INSERT TABLE 3 HERE

Stature: National squad versus Non – National squad

The stature of the national squad and non – national squad players from 2010 – 2013 are shown in Table 4. The players are sub divided into white, black and coloured players. When the data were grouped, the national squad players (181.3 ± 8.6 cm) were taller than the non - national squad players (178.0 ± 8.2 cm) ($p < 0.000003$) with an ES = 0.40. The specific comparisons between races are shown beneath the table. Between 2010 and 2013, there was an average difference of 1.2 % (ES = 0.24) (2010), 1.8 % (ES = 0.41) (2011), 2.1 % (ES = 0.45) (2012) and 2.3 % (ES = 0.53) (2013) between the national squad and non – national squad players.

INSERT TABLE 4 HERE

3.3.3 Playing experience

Age started playing rugby

Playing experience, expressed as the age at which the player started playing rugby is represented in Table 5 below and divided into national squad versus non – national squad and sub divided into race. There was no significant difference in the age the national squad started playing (7.6 ± 2.1 years) compared to the non – national squad players (8.1 ± 2.4 years). The effect size for this comparison was small ($ES = 0.21$). The white players started when they were significantly younger (6.8 ± 1.8 years) compared to the coloured players (8.4 ± 2.2 years) and black players (9.5 ± 2.4 years). The interaction (national squad x race x age started playing rugby) was not significant suggesting that playing experience and race did not have any influence on national squad selection between 2010 and 2013. All the details on the comparisons are shown beneath the table.

INSERT TABLE 5 HERE

3.3.4 Socioeconomic status

The effect on body mass, stature and playing experience.

Body mass, stature and playing experience, divided according to socioeconomic status (SES), is shown in Table 6. Players of high SES had fewer people per household room (0.7 ± 0.2 vs. 1.7 ± 0.8 people / room, ES = 1.9) compared to players of lower SES status. Players with a high SES were taller (178.9 ± 8.1 vs. 175.9 ± 8.3 cm, ES = 0.4), heavier (81.5 ± 12.7 vs. 77.7 ± 12.3 kg, ES = 0.3), and had a greater number of years playing experience (8.3 ± 2.4 vs. 7.5 ± 2.5 years, ES = 0.3) compared to players with a low SES.

INSERT TABLE 6 HERE

The number of people per household.

Socioeconomic status, expressed as the number of people per household, is shown below in Table 7 and divided into national squad and non – national squad and are subdivided into white, black and coloured players. There is a small significant difference ($p < 0.05$, $ES = 0.21$) between the national squad and non – national squad players. There were also significant differences between race groups with white players having the least number of people per home (4.1 ± 1.2 people) compared to black (4.5 ± 1.4 people) and coloured (4.3 ± 1.6 people) players. A *post hoc* analysis showed that the interaction (national squad x race x socioeconomic status) was not significant ($p < 0.83$).

INSERT TABLE 7 HERE

Are there differences between white, black and coloured players?

Table 8 shows the socioeconomic status of all players expressed as a ratio of people per number of household rooms. The representation of the data is similar to Table 7. The results of the comparisons are similar, except there is no difference between coloured and black players as there was in Table 7, and there was no difference between national squad vs. non – national squad players (as there was in Table 7). The details of the comparisons are shown beneath the table.

INSERT TABLE 8 HERE

3.3.5 Weight training

Participation

Table 9 represents weight training (Yes vs. No) of the players and sub divided into squad (N S vs. Non N S). One hundred and eighty players were selected into national squads from 2010 to 2013, and 77 % of those players have participated in weight training. Over the same time period, 1365 players attended the Coca Cola Grant Khomo U16 weeks but were not selected for the national squad. Of these players, 979 (72%) participated in weight training. The percentages (77 vs. 72 %; N S vs. Non – N S) were not significantly different.

INSERT TABLE 9 HERE

Body mass

Table 10 shows the body mass of all players from 2010 to 2013. After the group was subdivided into players who trained with weights (Yes) or did not (No), the group was also divided into players who were selected for the national squad and players who were not selected for the national squad. There was a significant difference in body mass between weight training (Yes vs. No) (82.3 ± 12.7 kg vs. 76.7 ± 11.9 kg, ES = 0.44) and between national squad and non – national squad (86.0 ± 13.6 vs. 80.1 ± 12.4 , ES = 0.5) ($p < 0.00001$). There was no significant interaction (weight training x national squad) ($p < 0.64$).

INSERT TABLE 10 HERE

Stature

Table 11 shows the stature of all players from 2010 to 2013 divided into national squad and non – national squad and whether or not they trained with weights (Yes vs. No). The players who trained with weights (179.0 ± 8.2 cm) were slightly taller than the players who did not train with weights (176.7 ± 11.9 cm) ($p < 0.02$; ES = 0.28). There was a significant difference in stature between national squad (181.4 ± 8.7 cm) and non – national squad (178.0 ± 8.1 cm) ($p < 0.00001$; ES = 0.41). A non - significant interaction (weight training x national squad) ($p = 0.82$) exists.

INSERT TABLE 11 HERE

3.3.6 Physical size requirements for national squad selection among a group of U16 rugby players

The distribution of body mass and stature of the white, black and coloured players are shown in Figure 2. The dashed line represents the mean body mass (86.4 kg) and stature (181.3 cm) respectively, of the players selected for the national squad. The dotted line represents the standard deviation for body mass (± 13.7 kg) and stature (± 8.6 cm). Assuming that players below the lower standard deviation (72.7 kg for body mass and 172.7 cm for stature), do not have the prerequisite physical dimensions for selection for the national squad, the number of players with the appropriate physical dimensions can be estimated. These estimates are shown in Table 12 (> 73.0 kg body mass) and Table 13 (> 173.0 cm stature).

INSERT FIGURE 2 HERE

Body mass

Table 12 shows the percentage of players who theoretically have a body mass to be considered for national squad selection. A greater percentage of white players (n = 627; 58 %) are 73 kg and heavier and are theoretically eligible for national squad selection based on body mass compared to black (n = 289; 27 %) and coloured (n = 172; 16 %) players.

INSERT TABLE 12 HERE

Stature

Table 13 shows the percentage of players who theoretically have the stature to be considered for national squad selection. A greater percentage of white players (n = 661; 60 %) are 173 cm and taller and are therefore theoretically eligible for national squad selection based on stature compared to black (n = 244; 22 %) and coloured (n = 199; 18 %) players.

INSERT TABLE 13 HERE

Table 1: Body mass (kg) of all players (n = 1528) who attended Grant Khomo week from 2010 to 2013. Data are divided by race and reported as mean ± SD.

Year	White	n	Black	n	Coloured	n	Total	n
2010	84.1 ± 11.6	178	75.3 ± 10.6	113	72.5 ± 11.0	74	79.0 ± 12.2	365
2011	86.2 ± 12.0	174	78.4 ± 11.8	110	73.3 ± 10.8	80	81.0 ± 12.8	364
2012	85.3 ± 12.1	197	79.6 ± 12.9	122	75.0 ± 11.0	101	81.1 ± 12.7	420
2013	86.5 ± 12.3	177	78.5 ± 11.8	120	76.3 ± 12.4	82	81.8 ± 12.9	379
Average	85.5 ± 12.0	726	78.0 ± 11.9	465	74.4 ± 11.4	337	80.8 ± 12.7	1528

Race groups

Effect Size

$F_{2, 1516} = 122.7$

$p < 0.00001$

White versus Black

$p = 0.00002$

0.59 (Moderate)

White versus Coloured

$p = 0.00002$

0.87 (Large)

Coloured versus Black

$p = 0.00007$

0.28 (Small)

Time period

$F_{3, 1516} = 4.6$

$p = 0.003$

2010 versus 2013

$p = 0.008$

0.22 (Small)

Table 2: Comparison of body mass (kg) over time (2010 – 2013) and between players of different races (n = 1530) selected into the national squad (N S) versus players not selected for the national squad (Non N S). Data are shown as mean ± SD.

Year	N S	n	Non – N S	n	% Change	Effect sizes
2010						
White	88.7 ± 13.7	24	83.4 ± 11.2	154	6.2	0.53 (Moderate)
Black	83.9 ± 8.9	9	74.6 ± 10.4	104	11.7	
Coloured	76.4 ± 15.5	10	71.9 ± 10.2	64	6.1	
Average	84.8 ± 13.9	43	78.3 ± 11.8	322	8.0	
2011						
White	90.3 ± 13.1	24	85.6 ± 11.7	150	5.3	0.39 (Small)
Black	85.1 ± 13.8	12	77.6 ± 11.3	98	9.2	
Coloured	75.4 ± 9.4	11	72.9 ± 11.0	69	3.8	
Average	85.4 ± 13.7	47	80.3 ± 12.6	317	6.2	
2012						
White	89.3 ± 12.6	26	84.7 ± 11.9	171	5.2	0.35 (Small)
Black	86.9 ± 16.4	9	79.0 ± 12.4	113	9.5	
Coloured	75.5 ± 12.5	13	74.9 ± 10.9	88	0.8	
Average	85.1 ± 14.3	48	80.6 ± 12.5	373	5.4	
2013						
White	91.8 ± 12.5	24	85.7 ± 12.1	153	6.9	0.52 (Moderate)
Black	85.8 ± 13.5	9	77.9 ± 11.5	111	9.7	
Coloured	80.9 ± 10.1	12	75.5 ± 12.6	70	6.9	
Average	87.7 ± 12.7	45	81.0 ± 12.8	335	7.9	
Average	86.4 ± 13.7	183	80.1 ± 12.4	1374	7.6	0.50 (Moderate)

Race groups

$F_{2, 1504} = 58.4$

White versus Black

White versus Coloured

Coloured versus Black

$p < 0.00001$

$p = 0.00002$

$p = 0.00002$

$p = 0.00006$

Squad (N S vs. Non N S)

$F_{1, 1504} = 30.5$

$p < 0.000001$

Table 3: Stature (cm) of all players (n = 1495) who attended Grant Khomo week from 2010 to 2013. Data are divided by race and reported as mean ± SD.

Year	White	n	Black	n	Coloured	n	Total	n
2010	182.0 ± 7.3	176	172.5 ± 9.4	101	174.0 ± 7.5	70	177.6 ± 9.1	347
2011	182.5 ± 6.9	174	176.2 ± 8.1	106	174.7 ± 6.8	79	178.9 ± 8.0	359
2012	181.4 ± 7.3	197	175.5 ± 7.8	120	175.6 ± 8.1	101	178.3 ± 8.1	419
2013	181.7 ± 7.0	176	175.9 ± 8.0	116	175.8 ± 6.5	77	178.6 ± 7.8	370
Total	181.9 ± 7.1	723	175.1 ± 8.4	443	175.1 ± 7.3	327	178.4 ± 8.3	1495

Race groups

Effect size

$F_{2, 1481} = 153.4$

$p < 0.00001$

White versus Black

$p = 0.00002$

0.82 (Large)

White versus Coloured

$p = 0.00002$

0.82 (Large)

Time period

$F_{3, 1481} = 3.6$

$p = 0.02$ (Non - significant)

Race x Time interaction

$F_{6, 1481} = 2.2$

$p < 0.038$

White players do not change over time

Coloured players do not change over time

Black players show significant change between 2010 and 2011 $p = 0.024$

0.45 (Small)

Table 4: Comparison of stature (cm) over time (2010 – 2013) and between players of different races (n = 1530) selected into the national squad (N S) versus players not selected for the national squad (Non N S). Data are shown as mean ± SD.

Year	N S	n	Non – N S	n	% Change	Effect sizes (N S versus Non – N S)
2010						
White	183.8 ± 9.2	24	181.7 ± 6.9	152	1.1	0.24 (Small)
Black	173.7 ± 8.0	9	172.4 ± 9.5	92	0.8	
Coloured	174.8 ± 6.6	10	173.9 ± 7.6	60	0.5	
Total	179.6 ± 9.5	43	177.4 ± 9.1	304	1.2	
2011						
White	183.6 ± 8.2	24	182.3 ± 6.7	150	0.7	0.41 (Small)
Black	181.3 ± 8.6	12	175.3 ± 7.8	94	3.4	
Coloured	177.9 ± 10.4	10	174.3 ± 6.1	69	2.0	
Total	181.8 ± 8.9	46	178.5 ± 7.8	313	1.8	
2012						
White	183.5 ± 7.9	26	181.0 ± 7.1	171	1.4	0.45 (Small)
Black	178.2 ± 9.2	9	175.3 ± 7.7	111	1.6	
Coloured	180.2 ± 8.8	13	175.0 ± 7.8	88	2.9	
Total	181.6 ± 8.5	48	177.9 ± 8.0	371	2.1	
2013						
White	184.7 ± 7.6	24	181.2 ± 6.8	152	1.9	0.53 (Moderate)
Black	179.0 ± 7.4	9	175.6 ± 8.0	107	1.9	
Coloured	179.2 ± 6.0	11	175.3 ± 6.4	66	2.2	
Total	182.2 ± 7.6	44	178.1 ± 7.7	326	2.3	
Total	181.3 ± 8.6	181	178.0 ± 8.2	1341	1.8	0.40 (Small)

Race groups

$F_{2, 1409} = 56.9$

White versus Black

White versus Coloured

$p < 0.00001$

$p = 0.00002$

$p = 0.00002$

Squad (N S vs. Non N S)

$F_{1, 1469} = 21.9$

$p < 0.000003$

Table 5: Age (years) at which players (n = 1547) started playing rugby. Data are described according to race group and also whether the players were in the national squad (N S) or not (Non – N S). Data are shown as mean ± SD and combined for 2010 - 2013.

Playing experience - age	N S	n	Non – N S	n	Total	n	Effect sizes (N S versus Non – N S)
Race							
White	6.8 ± 1.6	98	6.9 ± 1.8	627	6.8 ± 1.8	725	0.16 (Small)
Black	9.3 ± 2.1	39	9.6 ± 2.5	444	9.5 ± 2.4	483	0.13 (Small)
Coloured	8.0 ± 1.9	46	8.5 ± 2.3	293	8.4 ± 2.2	339	0.23 (Small)
Total	7.6 ± 2.1	183	8.1 ± 2.4	1364	8.0 ± 2.4	1547	0.21 (Small)

Race

$F_{2, 1541} = 82.5$

$p < 0.00001$

White versus Black

$p = 0.000022$

White versus Coloured

$p = 0.000022$

Coloured versus Black

$p = 0.000022$

Squad (N S vs. Non N S)

$F_{1, 1541} = 2.2$

$p < 0.14$

National squad x race x age started playing rugby

$F_{2, 1541} = 0.5$

$p < 0.61$

Table 6: High SES versus Low SES in comparison to stature (cm), body mass (kg) and playing experience of players. Data are shown according to mean \pm SD.

	Low SES	n	High SES	n	T score	P value	Effect size Low SES versus High SES
Stature	175.9 \pm 8.3	263	178.9 \pm 8.1	1201	5.6	0.0000001	0.40 (Small)
Body mass	77.7 \pm 12.3	278	81.5 \pm 12.7	1221	4.5	0.0000008	0.30 (Small)
SES ratio	1.7 \pm 0.8	289	0.7 \pm 0.2	1235	-39.2	0.0000001	1.9 (Large)
Years playing experience	7.5 \pm 2.5	284	8.3 \pm 2.4	1234	4.9	0.0000001	0.30 (Small)

Table 7: Number of people living in the home of the players' parents. Data are described according to race group and also whether the players ($n = 1547$) were in the national squad (N S) or not (Non N S). Data are shown as mean \pm SD.

Socioeconomic status - people	N S	n	Non – N S	n	Total	n	Effect sizes (N S versus Non – N S)
Race							
White	4.1 \pm 1.2	98	4.2 \pm 1.0	629	4.2 \pm 1.0	727	0.10 (Small)
Black	4.5 \pm 1.4	39	4.8 \pm 1.8	442	4.8 \pm 1.8	481	0.20 (Small)
Coloured	4.3 \pm 1.6	45	4.5 \pm 1.3	294	4.5 \pm 1.4	339	0.14 (Small)
Total	4.2 \pm 1.4	182	4.5 \pm 1.4	1365	4.4 \pm 1.4	1547	0.21 (Small)

Race

$F_{2, 1541} = 8.4$

$p < 0.00024$

White versus Black

$p = 0.00002$

White versus Coloured

$p = 0.0046$

Coloured versus Black

$p = 0.0012$

Squad (N S vs. Non N S)

$F_{1, 1541} = 4.0$

$P < 0.05$

National squad x race x socioeconomic interaction

$F_{2, 1541} = 0.2$

$p < 0.83$

Table 8: Socioeconomic status represented by the ratio of people per household room. Data are described according to race group and also whether the players (n = 1547) were in the national squad (N S) or not (Non - N S). Data are shown as mean ± SD.

Socioeconomic status - ratio	N S	n	Non - N S	n	Total	n	Effect sizes (N S versus Non - N S)
Race							
White	0.6 ± 0.2	98	0.7 ± 0.4	624	0.7 ± 0.4	722	0.25 (Small)
Black	0.9 ± 0.6	39	1.0 ± 0.7	434	1.0 ± 0.7	473	0.14 (Small)
Coloured	0.9 ± 0.4	45	0.9 ± 0.7	293	0.9 ± 0.7	338	0 (none)
Total	0.8 ± 0.6	182	0.9 ± 0.6	1351	0.8 ± 0.6	1533	0.3 (Small)

Race

$F_{2, 1527} = 20.8$

$p < 0.000001$

White versus Black

$p = 0.000022$

White versus Coloured

$p = 0.000022$

Squad (N S vs. Non - N S)

$F_{1, 1527} = 2.2$

$p < 0.14$ (Not significant)

National squad x race x socioeconomic status ratio

$F_{2, 1527} = 0.2$

$p < 0.85$

Table 9: Frequency table showing percentage of players (n = 1545) who attended Grant Khomo week from 2010 to 2013 who participated in weight training (Yes) versus no weight training (No) and who were selected into the national squad (N S) versus non-national squad (Non – N S).

Participation	N S	n	Non – N S	n	Total	n
Weight training						
Yes	77 %	139	72 %	979	72 %	1118
No	23 %	41	28 %	386	28 %	427
Total	100 %	180	100 %	1365	100 %	1545

Chi Squared = 2.41

p = 0.12 (Not significant)

Table 10: Body mass (kg) of players (n = 1519) who attended Grant Khomo week from 2010 to 2013 and divided into players selected into the national squad (N S) versus players not selected into the squad (Non – N S). Groups were subdivided into players who participated in weight training (Yes) versus players who did not participate in weight training (No). Data are shown as mean ± SD.

Body Mass	N S	n	Non – N S	n	Total	n	Effect sizes (N S versus Non – N S)
Weight training							
Yes	87.4 ± 13.4	139	81.6 ± 12.5	964	82.3 ± 12.7	1103	0.42 (Small)
No	81.0 ± 13.7	41	76.3 ± 11.6	375	76.7 ± 11.9	416	0.38 (Small)
Total	86.0 ± 13.6	180	80.1 ± 12.4	1339	80.8 ± 12.7	1519	0.5 (Moderate)
Effect size (Yes versus No)	0.47 (Moderate)		0.43 (Small)		0.44 (Small)		0.44 (Small)

Weight training

$F_{1, 1515} = 25.5$

$p < 0.000001$

Squad (N S vs. Non – N S)

$F_{1, 1515} = 20.6$

$p < 0.000001$

Weight training x national squad interaction

$p = 0.64$ (Not significant)

Table 11: Stature (cm) of players (n = 1486) who attended Grant Khomo week from 2010 to 2013 selected into the national squad (N S) versus non-national (Non – N S) squad. Groups were subdivided into players who participate in weight training (Yes) versus players who do not participate in weight training (No). Data are shown as mean ± SD.

Stature	N S	n	Non – N S	n	Total	n	Effect sizes (N S versus Non – N S)
Weight training							
Yes	181.8 ± 8.7	138	178.5 ± 8.0	948	179.0 ± 8.2	1086	0.37 (Small)
No	180.1 ± 8.4	40	176.6 ± 8.4	358	176.7 ± 11.9	398	0.44 (Small)
Total	181.4 ± 8.7	178	178.0 ± 8.1	1308	178.4 ± 8.3	1486	0.41 (Small)
Effect size (Yes versus No)	0.19 (Small)		0.23 (Small)		0.28 (Small)		0.23 (Small)

Weight training

$F_{1, 1480} = 5.4$

$p < 0.02$

Squad (N S vs. Non – N S)

$F_{1, 1480} = 19.1$

$p < 0.00001$

Weight training x national squad interaction

$p = 0.82$ (Not significant)

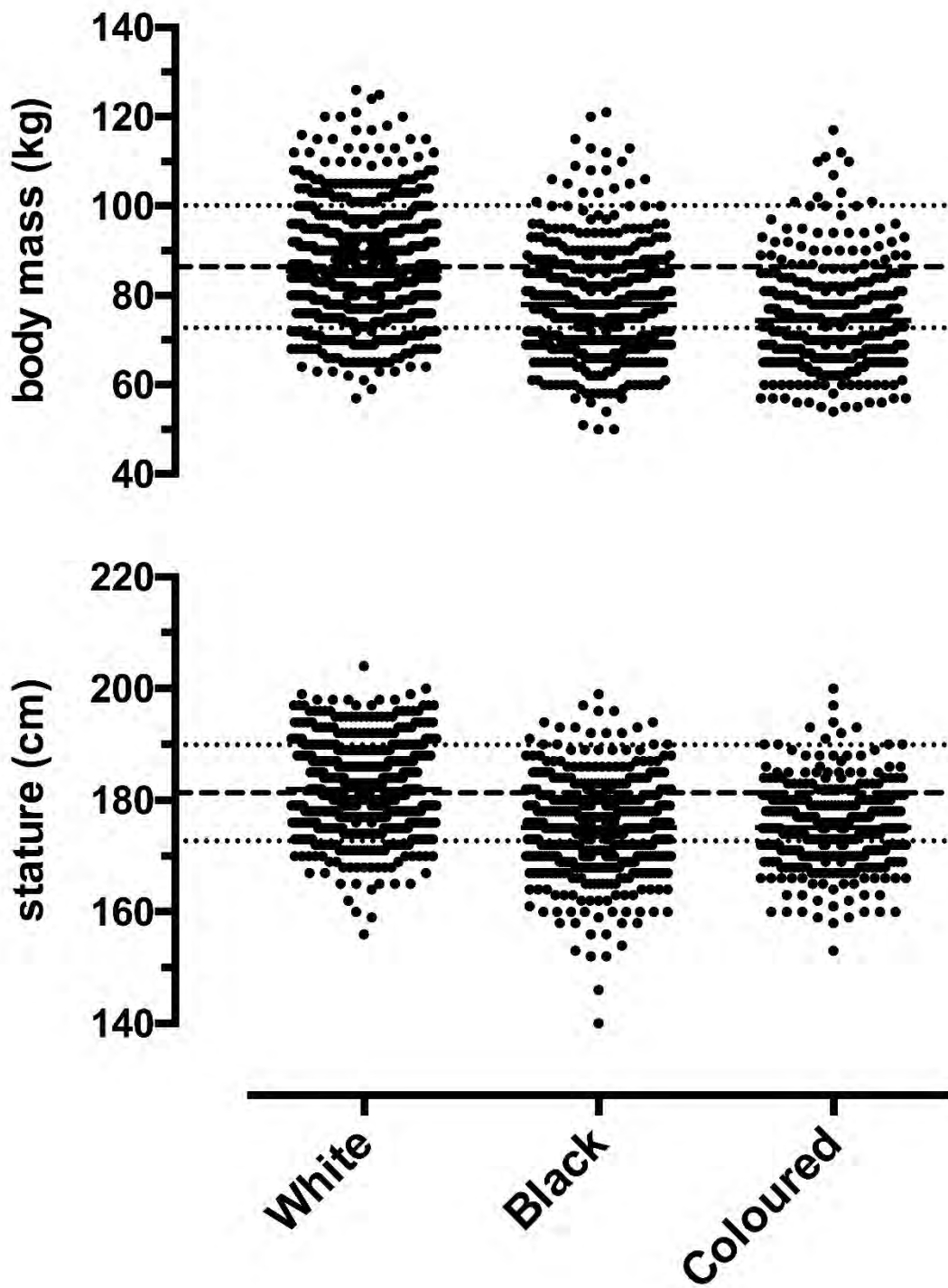


Figure 2: Body mass (kg) and stature (cm) of all players (n = 1547). The dashed line represents the mean of the players selected into the national squad and the dotted lines represent the standard deviation above and below the mean. Data are described according to different race groups with mean \pm SD.

Table 12: Body mass (kg) of players (1528) above and below 1 SD of mean. Data are shown according to different race groups with mean ± SD.

Body mass	White	%	Black	%	Coloured	%	Total
> mean - 1 SD (73.0 kg and above)	627	86	289	62	172	51	1088
< mean - 1 SD (72.0 kg and below)	99	14	176	38	165	49	440
Total	726	100	465	100	337	100	1528

White (627 / 1088) = 58 %

Black (289 / 1088) = 27 %

Coloured (172 / 1088) = 16 %

Table 13: Stature (cm) of players (1442) above and below 1 SD of mean. Data are shown according to different race groups with mean ± SD.

Stature	White	%	Black	%	Coloured	%	Total
> mean - 1 SD (173.0 and above)	661	91	244	6	199	61	1104
< mean - 1 SD (172.0 and below)	62	9	148	38	128	39	338
Total	723	100	392	100	327	100	1442

White (661 / 1104) = 60 %

Black (244 / 1104) = 22 %

Coloured (199 / 1104) = 18 %

3.4 Discussion

The current study is concerned with determining the association between body mass and stature, race, socioeconomic status, and weight training on the chances of success among U16 provincial rugby union players. Particular interest is given to size, socioeconomic status and ethnicity of players in the U16 national training squad and compared to players who represented their provinces but did not get selected for the national squad.

One hundred and eighty-three players have represented South Africa at the national U16 training camp between 2010 and 2013. Body mass and stature with socioeconomic status showed to have the greatest influence on selection or non selection into the national squad. Weight training participation did not show a significant difference between the national squad and the non-national squad.

These findings will be discussed in more detail under the sub headings which have originated from the questions of this study.

3.4.1 Physical characteristics: differences between race and changes over time

Previous studies have shown the importance of body mass and stature for success in rugby, with numerous research papers showing the evolution of the player over a period of time, where the players are getting heavier and in some cases taller^{37 43 44 45 46}. Bigger players generally have an advantage over their smaller opposition³⁷. This finding was also evident in this group of U16 rugby players, where there was a significant difference in body mass and stature between the race groups. This could have a significant impact on transformation in the sport in South Africa where white players were bigger than the other race groups and

more likely to be advantaged in selection over the smaller players from the other race groups.

The trend of players getting heavier also applies to this group with the players from 2013 being 2.8 % heavier than the players from 2010. This pattern seems to be common in other sports. For example, the body mass of American College Football players increased by 16 % from 1942 to 2011⁹⁸.

Black and coloured children in South Africa, as a result of low socioeconomic status, are more likely to be stunted in growth than white children, who in most cases live in more affluent areas⁹⁹. It has been shown that height is an indicator of health status and living standards, reflecting cumulative exposure to low nutrition and infections⁹⁹. White players were heavier and taller than both black and coloured players for an elite group of U16 rugby players. A similar trend was evident in a study on white and black children in the 1980's. Body mass and stature in white children (male and female) increased more rapidly while also having significantly greater body mass and stature at 18 years of age than black children¹⁰⁰. The difference in body mass and stature between the three race groups in the current study did have an impact on performance and ultimately selection into a team. In the younger age groups, there is a greater differential in size between players and until size is not an issue, the bigger players (in this study – white players) will always be advantaged and have a better chance of getting selected than the smaller players. This can have a negative impact on transformation. White players were the heaviest and tallest of the three race groups, while coloured players were the lightest and shortest, and were below the mean for all race groups and time periods. The potential to influence an increase in height is minimal compared to body mass, which can be affected by nutrition, ergogenic aids and resistance training. Stature is less controllable and is reliant on the osteogenic process of bone

formation⁵³. Bone stimulation and formation can however be affected by adequate and progressive weight training load.

Elite athletes in the majority of sports have superior physical qualities compared to the general population⁴⁵. The National Football League (NFL) is an example of elite athletes who have superior distinctive body size and shape compared with the general population. For example, NFL players weigh, on average 23.6 kg more than the general population⁴⁵. In Australian rugby, Polynesians have been identified as having superior physical attributes to other race groups, making them potentially more suited to playing and succeeding in rugby⁴⁹. Even within rugby union, players with certain physical characteristics are predisposed to certain playing positions⁴⁹. South African U16 rugby players selected into the national squad (elite players) were 7.6% heavier than the players who did not get selected into the national squad while national squad players were marginally (1.8 %) taller than non – national squad players. Among a group of French and Qatari soccer players, those selected for national squads were taller, heavier, faster and fitter than their non – selected peers¹⁰¹. Similarly it is now known that the fastest runners and swimmers are not only continuously becoming faster, but are at the same time becoming heavier, taller and more slender¹⁰². It is therefore a trend seen in not only rugby but in many sporting codes that the most successful athletes are those with more well developed physical characteristics of body mass and stature.

Until the differences in size are accounted for, and to a large extent negated completely, the bigger players (predominantly white players) will always have an advantage over the smaller players (black and coloured players) who have been disadvantaged and in most cases raised in a low socioeconomic environment. Transformation is therefore compromised at the youth

level of rugby in South Africa. It follows that transformation at the senior level will also be compromised until the differences at the junior level are negated.

3.4.2 National squad versus Non – national squad

One hundred and eighty three players have represented South Africa at the national U16 training camp between 2010 and 2013. 98 (54 %) have been white players, 39 (21%) black players and 46 (25%) coloured players. Players selected for the U16 national squad were on average 7.6 % heavier and 1.8 % taller than the players who did not get selected for the national squad. Selection into the national squad represents the first exposure of a professional environment for the players, where they are treated in a similar way to the senior national squad. The level of professionalism, on and off the field, is highlighted demanding increased levels of physicality during play as well as enhanced mental capabilities to cope with the added pressures of the modern game. Players are required to become bigger, faster and stronger from an earlier age, and therefore due to this increased physical confrontation, only the most powerful players are selected⁴³. Krause et al (2015) identified in a group of community based Australian adolescent rugby players that the rugby playing group were consistently heavier than normative data for body mass. While we only had data for body mass and stature as an indication of a players physical characteristics, Krause et al (2015) showed that physical size, which included the players strength, power and speed abilities was not always predictive of superior performance as positional demands dictate specific physical requirements⁵².

Rugby can therefore be considered an example of a Darwinian system, where selection pressures exist for specific physiques that match the demands of the game. White players had a greater chance of getting selected into the national squad based on physical

characteristics. A total of 1 088 players across the period of investigation were deemed to have a significantly higher chance of getting selected for the national squad based on their body mass (> 73.0 kg) while 1 104 players were eligible based on their stature (> 173.0 cm). The majority (86 and 91 %) of these players were white players. While more variables (size and performance) were considered in the Australian community study⁵², only size was measured among the adolescent group of South African players affecting the percentages of players considered to be eligible for respective selection. In an environment where both size and performance related variables are taken into context, only a small percentage of a population have the necessary physical requirements to succeed.

Playing experience of rugby players participating at the Rugby World Cup have shown to be an important contributor to success³⁷. Teams with the highest collective playing experience have generally performed the best. The number of years playing was assessed among the U16 group of rugby players to determine whether a greater number of years' experience meant higher success (national squad selection). National squad players had been playing for a longer period (8.6 ± 2.9 years) compared to non – national squad players (8.1 ± 2.5 years). Although this was significantly different, it is hardly practically significant as 6 months more of rugby is unlikely to have an influential effect on selection into teams.

3.4.3 Effect of weight training

Strength and conditioning has become an important aspect of preparation for the rugby player at all levels. One of the primary aims of implementing a properly designed strength and conditioning program is to reduce the likelihood of injury⁵⁸. The implementation of an effectively designed weight training program will help develop strength, aerobic power, speed and explosive power¹⁰³; qualities imperative for the successful rugby player⁵⁸. The

data from this study of U16 South African rugby players, showed that 72% of the total study population participated in weight training. Surprisingly no significant difference in participation levels between national squad selection and non – national squad players existed despite a 5.9 kg difference in body mass between the two groups.

Another important consideration with youth and adolescent athletes is the concept of a late developer. It is recognized that the more mature players at age group level, whether chronologically, biologically or a combination of both are at a performance advantage compared to those less mature players¹⁰⁴. Typically these players are physically less developed during the adolescent years, reaching full development in late adolescence and early adulthood¹⁴. It might be necessary to include a skill assessment into testing batteries, as often late maturers will lack the physical size but display the necessary skill required⁴².

When including a soccer specific coordination test among Belgium adolescent soccer players, there was no distinguishable difference between the more mature players and the later maturing players¹⁰⁵. It could therefore be beneficial to include maturity independent performance tests during talent identification and selection processes in rugby to identify those who have the necessary skill but possibly lack the physical size.

3.4.4 Socioeconomic status

In the South African context, socioeconomic status is an important consideration in explaining maturation and understanding differences in certain physical characteristics. In this select group of U16 rugby players, white players generally had a higher socioeconomic status compared to black players and coloured players. It follows that the white players were heavier and taller compared to black players and coloured players who generally had lower socioeconomic backgrounds because children from a lower socioeconomic background are

generally smaller and less powerful than their peers from a higher socioeconomic background^{42,90}. Players with low socioeconomic backgrounds are not exposed to environments that stimulate physical development to the same extent as players from high socioeconomic areas. They lack access to proper nutrition, education, adequate coaching resources and gym equipment, and therefore will not develop at the same rate as someone who does have access to these factors. This compares to another study in South Africa, where white children outperformed their black counterparts in numerous physical tests⁹¹. Once socioeconomic status was controlled for, the differences between race groups disappeared. A study of German schoolchildren, showed that children with a lower socioeconomic background were disadvantaged in their motor development compared to children of higher socioeconomic status⁹⁰. The study also showed that girls and boys were affected differently. For girls, a lower socioeconomic status represents a significant predictor for low sport motor performance, whereas for boys, socioeconomic status mainly affects their body composition and not their sport motor performance directly⁹⁰. However, when applying this situation to the current study, we know that body composition is an important factor in sport performance, especially in a contact sport like rugby.

3.4.5 Player profile: youth national squad selection

In attempting to create a player profile of the physical characteristics best suited for selection among a group of U16 rugby players in South Africa, we showed that a player's socioeconomic status was an important factor to consider. Players with a higher socioeconomic status were taller, heavier and had a greater number of years playing experience. These characteristics are likely to provide an advantage compared to a smaller player with less playing experience. This tendency is likely to persist, as the players seem to

be getting bigger based on the comparison between 2010 and 2013. In addition over the same period, the players selected into the national squad had more experience than those players not selected. While this study is essentially concerned with the elite players in the U16 age group, it is important to note that differences in socioeconomic status, playing experience and size become even more pronounced in the lower levels of participation.

3.5 Conclusion

In conclusion, the findings of this study show that it is important to quantify physical (body size) and non – physical characteristics in determining factors for success among a group of elite U16 rugby players. Knowledge of the specific characteristics associated with achieving success at the youth level can assist in the development of player talent. The socioeconomic status of the player is a significant contributor to succeeding at the youth level. It should therefore be the focus of the government as well as SARU to implement structures across all socioeconomic levels to ensure that the disparity between socioeconomic groups is levelled, affording an equal opportunity to all race groups. Until all inequality is negated, an overrepresentation of players from the more affluent areas will always dominate representative teams.

CHAPTER 4:

4.1 Practical applications and recommendations

Rugby is classified as a contact sport with the game consisting of repeated bouts of short duration, high intensity exercise. There are numerous collisions between players running at high speeds. It is well documented that successful players have specific physical qualities, including strength, aerobic power, speed and explosive power. The contribution of these factors to performance varies depending on the playing position. It is also important, as shown in this study, that the non-physical characteristics such as a player's socioeconomic status is also quantified when developing the youth level rugby player.

The SARU have attempted to implement programmes to accelerate the development of players of colour at all levels of South African rugby. The focus has traditionally been on youth players from disadvantaged areas with a low socioeconomic status. Despite no previous studies on the efficacy of these projects, it remains difficult to determine the success of the previously mentioned programmes implemented by the SARU due to the lack of a clear measurable definition for transformation⁸⁶. Although there is no consistently successful talent identification and development pathway in South African rugby, the current study has provided a reference for physical (body mass and stature) and non – physical (socioeconomic status and race) characteristics which contribute to success at a youth level.

This study has contributed to a greater understanding of the attributes of an elite youth level rugby player in South Africa by providing answers to the following questions;

1. Are there differences in body mass and stature in white, black and coloured U16 players and do changes from 2010 to 2013 occur at a similar rate among these groups?

The study showed there was a significant difference in body mass and stature between the race groups. White players were taller and heavier than both black and coloured players in this population of adolescent rugby players. Body mass increased by 2.8 % in all groups (2010 vs. 2013). Stature did not change over the four years of the study.

2. Is there a significant difference in body mass and stature between national squad players and non – national squad players?

Players selected into the U16 national squad were on average heavier (7.6 %) and taller (1.8 %) compared to the players who did not get selected for the national squad. The majority of players selected into the national squad were white players with the majority of all players across the race groups being above 73 kg and 173 cm.

3. Did national squad players have more playing experience before selection compared to non – national squad players?

National squad players had been playing for a significantly longer period (8.6 years) compared to non – national squad players (8.1 years). The national squad players started playing rugby when they were 7.6 years old compared to non – national squad players who started playing when they were 8.1 years old. White players started significantly earlier (6.8 years old) than black and coloured players, who started at the age of 9.3 years and 8.0 years respectively.

4. Does socioeconomic status have an effect on playing experience, body mass and stature?

Players from a higher socioeconomic background were heavier (4.8 %) and taller (1.7 %) as well as had more years of playing experience compared to players from a lower socioeconomic background.

Commensurate with their environment, players from a lower socioeconomic group would have had limited access to adequate coaching resources and equipment, and their habitual nutrition would have been at a lower level compared to players from more affluent areas. These factors would have impacted on their playing experience and body size.

5. Were there any significant differences in socioeconomic status between white, black and coloured players?

In this study socioeconomic status was determined by the number of people per household room. According to this definition there were an average of 4.1 people per household for white players, compared to 4.5 and 4.3 people per household for black players and coloured players respectively. Therefore, it may be concluded that in general white rugby players were from a higher socioeconomic background compared to black players and coloured players.

6. Did players selected into the national squad have a higher socioeconomic status compared to players not selected into the national squad?

Generally, players selected into the national squad were from higher socioeconomic backgrounds compared to players who were not selected into the squad. (4.2 vs. 4.5 people per household; national squad vs. non national squad).

7. What proportion of players, divided into their different race groups, have the same physical size of the players selected for the national squad?

Of the one hundred and eighty-three players to be selected for the national squad from 2010 to 2013, the majority (54 %) were white players, while 25 % of the players selected were coloured and 21 % were black players. We assumed that to be selected for the national squad the body mass and stature would have to be within the mean and 1 standard deviation of the group. According to this assumption, 58 % of white players (n= 627) were considered to be heavy enough for the national squad compared to 27 % of the black players (n = 289) and 16 % of the coloured players (n = 172). With regards stature 60 % of total white players (n = 661) were considered to be tall enough compared to 22 % of the black players (n = 244) and 18 % of the coloured players (n = 199). Based on these values, it is clear that the pool of players eligible for selection (based on size) is biased towards the white players.

4.2 Limitations

Limitations to the current study include the self reporting of data for body mass and stature as well as data for socioeconomic status, race and weight training. Data for body mass and stature was cross checked between two sources (official tournament programme and player profiles on sarugby.net), while data for socioeconomic status, race and weight training were obtained via questionnaires. It is therefore necessary to interpret some of the data with slight caution. A further limitation was the reporting of the player's race. Players had to indicate on the original questionnaire whether they were classified as white, black, coloured or 'other'.

4.3 Summary and conclusion

Certain physical (body mass and stature) and non – physical characteristics (socioeconomic status and race) for success in youth rugby have been reported. It has previously been shown that the transfer of junior talent between age ranks is poor with only 24 % of the players chosen at U13 level making it to the U18 Craven week level⁶⁵, while an impressive percentage of players progress from U18 craven week to senior international level, where 68 % of Springboks playing between 1988 and 2008 represented an U18 Craven week team³⁸.

The sport is dominated by players who are physically superior, meaning that in the adolescent age group a large proportion of late maturers are not selected and therefore dropping out of the sport completely. The data also show that the lack of transformation of teams at the senior levels have their origins in the junior teams. The pool of black and coloured players with the appropriate size characteristics needs to be increased. The idea of streamlining players into certain positions could be beneficial and helpful in progressing players who lack weight and height. These players could therefore be streamlined into positions more reliant on speed and agility, such as the outside back positions. Until this occurs there will be a bias towards selecting the bigger white players.

At present there are not many testing protocols that consider the skill factors that are a prerequisite for rugby. It is therefore recommended that future talent identification and development projects include a skills testing component into the testing protocol. There is a precedent for this in Australian Rules Football¹⁰⁶. This will help to identify talented rugby players at a young age who lack the physical characteristics but are allowed time to mature and become a successful rugby player in their later adolescent years. This will benefit South African rugby in that the pool of players will be increased.

In conclusion, rugby is a sport where physical characteristics can determine success, the co-operation between schools, clubs, universities and provincial unions are instrumental in the development of the high performance athlete. The programmes implemented by the SARU to accelerate transformation need to be coordinated with the Department of Sport, Department of Education and Department of Health to ensure that facilities and coaching resources are available to all players. Until the disparities arising from differences in socioeconomic status are negated from an early age, there will also be a bias to select players from a higher socioeconomic status.

The data reported in this study are representative of elite adolescent rugby players in South Africa. These data can be used to provide a standard size for comparisons of future changes in body mass and stature, as well as a source of comparison documenting the impact of socioeconomic status on development and selection opportunities in adolescent players. Additionally, coaches and players could reference these values in setting goals for body mass and stature. Finally, the study can be used to provide a context of how the body size of the adolescent player has progressed to match the increased demands of the game.

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Appendix

Under Aged Player Consent Form

No Player may participate in the SARU Youth Week Tournaments if the Under Aged Player Consent Form and Medical Information Form are not completed and signed by the Player and his Parent/Legal Guardian and submitted to the Team Manager.

I, THE UNDERSIGNED:

_____ (Player's name)

_____ (Player's signature)

Duly assisted by my parent/legal guardian (delete what is not applicable):

_____ (Parent/Legal Guardian's name)

_____ (Parent/Legal Guardian's signature);

INTRODUCTION

I acknowledge that my attendance at and participation as a Team Member of my Provincial Union in the SARU Youth Week Tournament will result in certain benefits for me, including the opportunity to attend the Tournament and to participate in this prestigious event.

1. GENERAL ACCEPTANCE AND AGREEMENT

- 1.1 I accept the invitation to take part in the Tournament in accordance with this Agreement, a copy of which has been provided to the Provincial Union for which I shall be playing and which I have had an opportunity to read, and have read and understood and agree to abide by the terms thereof;

1.2 I agree to observe and abide by in every respect the provisions of the SARU Constitution and Regulations Relating to the Game, these Terms of Participation and any rule, direction or decision of the Tournament Director, SARU, the Disciplinary Committee or of any officer or body appointed or established by SARU pursuant to the Disciplinary Procedures and with the Anti-Doping Programme set out in this Agreement, save where the contrary is expressly stated, any such rules, directions or decisions shall be binding on me and I acknowledge that I shall not have the power to revoke or alter any such decisions;

2. ANTI-DOPING

2.1 I consent and agree to comply with and be bound by all of the provisions of the SARU and IRB Anti-Doping Regulations;

2.2 I acknowledge and agree that the SAIDS has jurisdiction to impose sanctions as provided for in the SARU and IRB Anti-Doping Regulations;

2.3 I agree that if I am on any specific medication which is on the WADA prohibited list, I shall submit a Therapeutic Use Exemption form from SAIDS and will make sure that all the relevant medical documentation (copies will be accepted) relating thereto will be available which will allow me to use the medication;

2.4 I agree that my personal anti-doping data relating to the Doping Control process (including test distribution planning, sample collection and handling, laboratory analysis, result management, hearings and appeals) can be processed (for example transmitted, disclosed, used and stored) by SAIDS.

2.5 I hereby give permission to be tested by the representatives of SAIDS.

3. ANTI-CORRUPTION AND BETTING

I consent and agree to comply with and be bound by all of the provisions of the IRB Anti-Corruption and Betting Regulations (IRB Regulation 6) as in force from time to time (www.irbintegrity.com).

4. DISCIPLINARY MEASURES

I consent and agree to comply with and be bound by IRB Regulation 17 (IRB website), SARU Illegal and Foul Play and Misconduct Regulations for Youth Weeks (**Schedule IV**) and the SARU Disciplinary and Judicial Matters Regulations (SA Rugby website).

Should I be suspended by the Disciplinary Committee from playing for whatever reason, the suspension shall be effective for the determined period during or after the Tournament.

5. EVENT ACTIVATION

I agree to fully participate and co-operate in all the Events as requested by my Team Manager and as directed by SARU.

6. PLAYER ATTRIBUTES

I agree and consent hereby to grant a perpetual license to SARU to utilise my player Attributes (as defined in the Main Agreement) in accordance with Clause 9.2 of this Agreement.

7. MEDICAL CLEARANCE

I am mentally, dentally and physically fit to attend and to participate in the Tournament.

8. MEDICAL AND INJURY DATA FOR RESEARCH

I hereby give consent that my medical and injury information can be used by SARU and their nominated research partners for research purposes.

- By signing this document the player and their parents and/or legal guardian where applicable provides informed consent to access all relevant information and agree to release all injury or illness data obtained during the tournament to SARU, which may or may not be used for research purposes
 - All analysed, researched or published information, will remain anonymous, and will be treated and handled with the utmost confidentiality

9. MEDICAL CONSENT

- 9.1 I hereby give the Team Manager permission to give consent to medical investigations management procedures that may be required to treat injury which I might sustain during the Tournament, and to complete and sign all documents required in this regard. The parent or legal guardian is responsible for all costs pertaining to these medical procedures.
- 9.2 If injured, I realise that I will be stabilised and assessed at the match venue to the best of the abilities of the contracted Medical Staff at no cost to me, my parent(s)/legal guardian(s) and/or the Provincial Union that I represent.
- 9.3 If additional referral or specialist medical intervention is required, based on judgement by the contracted Medical Staff, the costs of ambulance transportation, admission to hospital, and the additional assessment or intervention costs, will be for the account of myself or my parent(s)/legal guardian.
- 9.4 After hour medical services are for my account or that of my parent(s)/legal guardian(s).
- 9.5 Players with medical aid, who require hospitalisation, will be transported and admitted to the nearest and most appropriate private medical facility or hospital. Any costs over and above those covered by my medical aid, or my parent(s)/legal guardian's medical aid, are for my account or that of my parent(s)/legal guardian(s).

- 9.6 If I or my parent(s)/legal guardian don't have medical aid, I am aware that I will be transported and admitted to the nearest and most appropriate government or private medical facility or hospital, depending on their individual preference and circumstance.
- 9.7 I confirm that should I get injured, all costs incurred, are for my account or that of my parent(s)/legal guardian(s).
- 9.8 I undertake to provide the team manager with all the relevant information and documentation regarding to my medical aid status and any specific medical history.

MEDICAL INFORMATION FORM

<u>Player Details</u>	
First Name:	Surname:
Date Of Birth:	Age:
ID Number:	
School/Club:	Position:
Union:	
<u>Contact Details of Parent and/or legal Guardian</u>	
Home:	Work:
Fax:	Cell:
Email:	
<u>Next of kin</u>	
First Name:	Surname:
Relationship:	
Contact details: Home:	Work/Cell:
<u>Medical Aid Details</u>	
Medical Aid:	Number:
Main Member:	

This form needs to be signed and submitted to my Team Manager who will submit same to the nominated member of the LOC.

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