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"Always think of what you have to do as easy and it will become so."
Anonymous.

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SUMMARY

THE PHYSICAL AND GAME SKILLS PROFILE OF THE SOUTH AFRICAN SCHOOLBOY RUGBY PLAYER

Keywords: Physical and game skills, elite rugby players, South African schoolboys.

Rugby union is a popular sport played in more than a 100 countries worldwide. In South Africa rugby is a major sport compared to other playing countries such as Australia, England, France, Ireland and Scotland where it is only third, fourth or fifth most popular sport (SARFU: 2003d:11) Rugby consists of various activities that require certain anthropometrical, physical and motor and rugby-specific components. These components are specific to the positional requirements in rugby (Craven, 1974; De Ridder, 1993; Noakes & Du Plessis, 1996; Malan & Hanekom, 2001; Van Gent, 2003). Du Randt and Headley (1993:112) stated that the process of talent identification in South Africa was uncontrolled and in the beginning phase. Since then scientific research on talent identification of youth rugby players in South Africa has been done by De Ridder (1993), Pienaar and Spamer (1995, 1998), Hare (1997) and Van Gent (2003) to name a few. Research has been done regarding positional requirements (Van Gent, 2003) in the adolescent rugby player. However, little is known about the elite schoolboy rugby player in South Africa and internationally.

In 1995, the National Sports Council of South Africa compiled a policy, highlighting the need and importance of a scientific identification and development programme of talented sportspeople (South Africa, 1996). Eight years after the national policy was compiled, the South African Rugby Football Union (SARFU) launched a major new player identification and development strategy (SARFU, 2003d:15). In 2003, SARFU identified the U/16 age group schoolboys as the first level of talent identification thus the focus should be on South African schools in particular, because this is the breeding ground for elite sportsmen and women. The U/16 and U/18 players are chosen to represent their provinces at a national rugby week. The U/16 and U/18 rugby

players chosen at the end of the national rugby week (Grant Khomo U/16 week and the U/18 Craven Week for High Schools) are named the Green Squad and consists of a 100 top players from both the U/16 and U/18 groups (SARFU, 2003b:2).

This study is the start of a new phase of research on the elite youth rugby player. The significance of this study is the compilation of a profile of the U/16 and U/18 elite rugby player, with reference to anthropometrical variables, physical and motor abilities and game-specific skills which will serve as a guide to the school and provincial coaches on team selection and individual training programmes. A further contribution is that this research will support SARFU in the process of identifying and developing youth rugby players. Furthermore, this study will also form part of an international research profile on talent identification of elite youth rugby players as well as the development in school sport.

The aim of this study was to compile a status profile of the U/16 and U/18 elite rugby player in South Africa with reference to anthropometrical variables, physical and motor abilities and game-specific skills as well as a status profile for different playing positions of the U/16 and U/18 elite rugby player in South Africa.

The literature review emphasises the value of sport education and physical education in schools as well as the growth and motor development of the adolescent. According to Dick (1992:125) the adolescent period is the best time for the athlete to develop physical and motor abilities. Physical and sport education in schools offers the adolescent the opportunity to develop certain skills be it physical, motor, emotional or mental skills. In South Africa many talented and less-talented adolescents have the opportunities to participate in sport due to player development programmes in various sports. Not only does physical and sport education aid to improve health-related and skill-related fitness but also aids in talent detection and talent identification programmes. It is also important to fully understand the adolescent's growth and motor development as these variables have an influence on sporting performance.

The literature review also discusses talent identification models that have evolved over the past decades as well as talent identification in youth sport and youth rugby development in South Africa. Salmela and Règnier (1983) stated that talent identification is a long process in which potential sportspeople are identified and developed in a specific kind of sport. Assessments of talent identification programmes should be done regularly to get the best value for a country's

sporting achievement as well as an individual's future sporting performance. This could help researchers to adapt regularly to the physical profile of youth rugby players and help to establish norms that can be used to identify and develop elite youth sportspeople.

The empirical study (chapter 4) explains the different measurements and tests that were done with the Green Squad players. The research group consisted of U/16 (n = 93) and U /18 (n = 97) elite South African schoolboy rugby players, also known as the Green Squad of SARFU. The players of the Green Squad represented all 14 provinces of South Africa. Each player was tested in August 2003 and February 2004 according to a rugby test protocol of SARFU. The test protocol consisted of anthropometrical variables; body height, body mass, body fat percentage, muscle percentage, skinfold thickness and somatotype. The game-specific skill components that were used included ground skills, kicking for distance, passing for distance, passing for accuracy 4 m and catching and throwing over the crossbar. Physical and motor components consisted of bench press, pull ups, push ups, speed over 10 m and 40 m, agility Illinois test and speed endurance.

Descriptive statistics ($\bar{x}$, standard deviation, minimum and maximum) were used as well as practical significant differences (d-values) (Cohen, 1988). The method of principal components analysis (PCA) and correlations was used to determine best player position of the Green Squad 2003/2004 season (Bartholomew et al. 2002). The SAS-computer programme package of the North-West University, Potchefstroom campus (SAS Institute Inc., 1999) was used for data analysis.

By means of the results that were obtained, it was indicated that as far as the anthropometrical variables among the U/16 Green Squad players were concerned differences were found between the Green Squad group and U/16 rugby players of other studies. The U/16 Green Squad players also reported practical significant differences with regard to anthropometrical components from 2003 to 2004. The results of the anthropometrical data of the U/18 Green Squad players compared favourably to literature. Although the U/18 Green Squad group improved from 2003 to 2004 in terms of anthropometrical components, low practical significance was recorded.

In terms of physical and motor, the U/16 Green Squad players presented more improvements from 2003 to 2004 than the U/18 Green Squad players that could be due to growth and training programmes that were followed. However, the U/18 Green Squad players presented a better performance than the U/18 players in literature that could also be due to conditioning and training

programmes that were followed. With regard to game skill components the U/16 and U/18 Green Squad rugby players possessed better game-specific skills in most tests than their counterparts in literature.

Differences between national and provincial youth rugby players were recorded with regard to anthropometrical, physical and motor and game-specific components, thus the importance of further studies on the elite schoolboy rugby players, are evident.

Practical significant differences were found between different playing positions in both age groups with reference to anthropometrical, physical and motor and game-specific components. It can be derived that differences do exist between playing positions with regard to anthropometrical, physical and motor and game-specific components and that it is necessary to include the components in a player position test battery.

To summarise, this study succeeded to compile a status profile of the elite youth rugby player with reference to physical and game-specific variables. This test battery can be used in positional talent identification and development models for elite schoolboy rugby players. School and provincial coaches can use this test battery as a guide on team selection and individual training programmes. It adds an enormous amount of knowledge on talent identification of youth elite rugby players.

OPSOMMING

'N FISIEKE EN SPELSPESIFIEKE PROFIEL VAN DIE ELITE SUID-AFRIKAANSE JEUG RUGBYSPELER.

Sleutelwoorde: Fisieke en spelspesifieke profiel, elite rugbyspeler, Suid-Afrikaanse jeug rugbyspeler.

Rugby is 'n gewilde sport en word in meer as 'n 100 lande wêreldwyd gespeel. In Suid-Afrika is rugby een van die mees gewilde sportsoorte vergeleke met lande soos Australië, Engeland, Frankryk, Ierland en Skotland waar dit slegs die derde, vierde of vyfde mees populêre sportsoort is (SARFU:2003d:11). Rugby bestaan uit verskeie aktiwiteite wat sekere antropometriese, fisieke, motoriese en rugby-spesifieke komponente vereis. Volgens Craven (1974), De Ridder (1993), Noakes en Du Plessis (1996), Malan en Hanekom (2001) en Van Gent (2003) is hierdie komponent-spesifieke komponente ten opsigte van die posisionele vereistes van rugby. Du Randt en Headley (1993:112) was van mening dat die talent identifiseringsproses in Suid-Afrika ongekontrolleerd en in die begin fase was. Sedertdien is wetenskaplike navorsing gedoen in talent identifisering van jeug rugbyspelers in Suid-Afrika deur De Ridder (1993), Pienaar en Spamer (1995,1998), Hare (1997) en Van Gent (2003). In 'n studie deur Van Gent is navorsing gedoen rakende posisionele vereistes van rugby vir die jeug rugbyspeler. Daar is egter min navorsing oor die elite jeug rugbyspeler in Suid-Afrika en internasionaal beskikbaar ten opsigte van posisionele vereistes van rugby.

Die Nasionale Sport Raad van Suid-Afrika het in 1995 'n beleid saamgestel waarin die belangrikheid van wetenskaplike talent identifiserings en ontwikkelingsprogram van talentvolle sportlui beklemtoon word (South Africa 1996). Die Suid-Afrikaanse Rugby Voetbal Unie (SARVU) het agt jaar daarna 'n nuwe talent identifisering en ontwikkelingsprogram geloots (SARVU, 2003d:15). SARVU het in 2003 spelers op o/16-jaar vlak geïdentifiseer as die eerste

vlak van talent identifisering, dus val die klem op Suid-Afrikaanse skole omdat dit die teelaarde is vir elite sportlui. Op skoolvlak word o/16 en o/18 rugbyspelers onderskeidelik gekies om hulle provinsies op nasionale vlak te verteenwoordig tydens die o/16 Grant Khomo week en o/18 Craven Week vir hoërskole. Na afloop van die nasionale rugbyweek word die Groen Squad saamgestel wat bestaan uit 100 spelers van elk van die o/16 en o/18 groepe (SARVU, 2003b:2).

Hierdie studie betree 'n nuwe fase, naamlik om navorsing te doen oor die elite jeug rugbyspeler. Die waarde van die studie het ten doel om 'n profiel saam te stel van die o/16 en o/18 elite jeug rugbyspeler ten opsigte van antropometriese, fisiek, motoriese en spel spesifieke vereistes. 'n Verdere bydrae is dat die navorsing van jeug rugbyspelers vir SARVU van hulp sal wees rakende die nuwe talent identifiserings strategie. Die navorsing studie sal ook deel vorm van 'n internasionale profiel van talentvolle spelers asook ontwikkeling in rugby op skoolvlak.

Die doel van die studie was om 'n profiel van die o/16 en o/18 elite jeug rugbyspeler in Suid-Afrika saam te stel ten opsigte van antropometriese, fisiek, motoriese en spel spesifieke vereistes. Die tweede doel van die studie was om 'n profiel saam te stel van die verskillende posisionele vereistes van die o/16 en o/18 elite jeug rugbyspeler in Suid-Afrika.

Die literatuurstudie beklemtoon die belangrikheid van sport- en liggaamlike opvoeding op skoolvlak asook die groei en motoriese ontwikkeling van die adolessent. Volgens Dick (1992:125) is die adolessensiefase die beste tydperk vir die ontwikkeling van fisiek-motoriese kenmerke. Op skool speel liggaamlike opvoeding en sport opvoeding 'n belangrike rol. Die skool skep die geleentheid vir die adolessent om tydens liggaams- en sportopvoeding sekere vaardigheid te ontwikkel naamlik fisieke, motoriese, emosionele en intellektuele vaardighede.

In Suid-Afrika bestaan verskeie ontwikkelingsprogramme in verskillende sportsoorte wat talentvolle en minder talentvolle adolessente die geleentheid gee om deel te neem aan sport. Liggaamsopvoeding en sportonderrig skep dus die platform vir bevordering van fiksheid, gesondheid en sekere vaardighede maar ook die geleentheid vir die ontwikkeling van talent identifiseringsprogramme. Die adolessent se groei en motoriese ontwikkeling speel 'n belangrike rol ten opsigte van die sportprestasie en is dus belangrik om die invloed van groei en motoriese ontwikkeling van die adolessent te verstaan.

In die literatuur word verwys na verskeie talent identifiseringsmodelle wat oor die laaste dekades ontwikkel het asook na talent identifisering in jeug sport. Salmela and Règnier (1983) meld dat talent identifisering 'n lang proses is waardeur potensiële sportlui geïdentifiseer word en in 'n spesifieke sportsoort opgelei word. Talent identifiseringsprogramme moet egter gereeld evalueer word sodat die beste voordeel vir 'n land se sporttoekoms asook 'n individu se sportprestasie behoue bly. Die evaluasie proses van talent identifiserings het ten doel om navorsers te help om gereeld aanpassings te maak ten opsigte van die profiel van elite jeug rugbyspelers. Sodoende word normskale vasgestel wat gebruik kan word in die proses van talent identifisering en ontwikkeling van elite jeug sportlui.

Die empiriese studie verklaar die verskillende toetse van die toetsbattery wat uitgevoer is. Die navorsingsgroep het betstaan uit o/16 (n = 93) en o/18 (n = 97) elite Suid-Afrikaanse jeug rugbyspelers ook bekend as die Groen Squad van SARVU. Die Groen Squad spelers is verteenwoordigend van al 14 die provinsies van Suid-Afrika. Elke speler was in Augustus 2003 en Februarie 2004 getoets volgens die SARVU toetsbattery.

Die SARVU toetsbattery het bestaan uit antropometriese komponente naamlik liggaamslengte, liggaamsmassa, vetpersentasie, spierpersentasie, velvoumates en somatotipes. Die spelspesifieke vaardighede was: grondvaardighede, aangee vir afstand, aangee vir akkuraatheid oor 4 m, skop vir afstand en gooi en vang oor dwarslat. Die onderskeie fisieke en motoriese vermoëns was: spoedtoets oor 10 m en 40 m, spoeduithouvermoë, dartellope vir ratsheid, opstote, optrekke en bankie opdrukke.

Basiese beskrywende statistiese ontledings ($\bar{x}$, standaard deviasie, minimum en maksimum waardes) asook praktiese betekenisvolle verskille (d-waardes) is met behulp van die SAS-rekenaarprogrampakket van die Noordwes Universtiteit, Potchefstroomkampus (SAS Institute Inc., 1999) gedoen. Die metode van hoofkomponent analise en korrelasies is gebruik om die beste speler posisie van die Groen Squad 2003/2004 seisoen te bepaal (Bartholomew et al. 2002).

Uit die resultate wat verkry is, is aangetoon dat daar verskille voorgekom het ten opsigte van antropometriese kenmerke tussen die Groen Squad o/16 spelers en o/16 rugbyspelers in ander studies. Die o/16 Groen Squad spelers het ook praktiese beduidende verskille met betrekking tot antropometriese komponente getoon van 2003 tot 2004. Die antropometriese data van die o/18 Groen Squad spelers het tiperende kenmerke getoon soos in die literatuur aangeteken.

Alhoewel die o/18 Groen Squad spelers 'n verbetering getoon het in sekere antropometriese kenmerke soos van 2003 tot 2004, het dit 'n lae praktiese betekenisvolle verskil getoon.

Die o/16 Groen Squad spelers het 'n groter verbetering getoon in fisieke en motoriese vermoëns van 2003 tot 2004 in vergelyking met die o/18 Groen Squad spelers. Dit kan te wyte wees aan die adolossente groeifase asook die oefenprogramme wat gevolg is. Die o/18 Groen Squad spelers het egter beter gevaar ten opsigte van fisieke en motoriese vermoëns as o/18 spelers in vorige navorsing. Die o/16 en o/18 Groen Squad spelers het beter spelspesifieke eienskappe getoon as hulle eweknieë in vorige navorsing.

Daar bestaan verskille tussen nasionale en provinsiale jeug rugbyspelers ten opsigte van antropometriese, fisieke, motoriese en spelspesifieke kenmerke, dus beklemtoon dit die belangrikheid van verdere navorsing oor die elite jeug rugbyspelers.

Praktiese betekenisvolle verskille ten opsigte van antropometriese, fisieke, motoriese en spelspesifieke kenmerke van verskillende spelposisies is gedokumenteer. Dit beklemtoon die belangrikheid van die komponente in 'n toetsbattery as deel van die samestelling van 'n speler posisie profiel.

Om saam te vat, hierdie studie was suksesvol in die samestelling van 'n profiel ten opsigte van die antropometriese, fisieke, motoriese en spelspesifieke vaardighede van die elite jeug rugbyspeler. Hierdie toetsbattery kan suksesvol geïmplementeer word in talent identifisering en ontwikkelingsprogramme vir die elite jeug rugbyspeler.

Skool en provinsiale afrigters kan die toetsbattery gebruik as 'n handleiding vir spankeuring asook individuele oefenprogramme. Hierdie studie lewer 'n besliste bydrae tot die talent identifiseringsproses van die elite jeug rugbyspeler.

INDEX

CHAPTER 1

CHAPTER 2

CHAPTER 3

CHAPTER 4

CHAPTER 5

CHAPTER 6

LIST OF TABLES

LIST OF DIAGRAMS

LIST OF FIGURES

CHAPTER 1

PROBLEM, AIM OF THE STUDY AND METHOD OF RESEARCH

CHAPTER 1

PROBLEM, AIM OF THE STUDY AND METHOD OF RESEARCH

1.1 INTRODUCTION

In South Africa rugby is a major sport compared to other playing countries such as Australia, England, France, Ireland and Scotland where it is only the third, fourth or fifth most popular sport (SARFU, 2003d:11). In South Africa the survival of this unique game, rugby, depends on continuing growth of the game at school level. This national sport must appeal to a majority of the people, be it players, spectators or supporters (SARFU, 2003d:15).

"For rugby to remain a national sport, the Springbok Rugby team must retain a good measure of world-class excellence, which is understood to mean a Springbok team that is rated top three in the world" (SARFU, 2003d:15).

One of the reasons for South Africa being toppled as the leader in world rugby is the neglect of one of the most important components of the present day rugby game, namely conditioning (Gilbert, 2004:21). According to Heyneke Meyer, former Springbok assistant coach, rugby is an aerobic sport, which makes specialised testing of fitness, stamina and strength of the players important. Meyer states that England is leading the trend in rugby with regard to conditioning. According to Meyer, 16 year-old youth rugby players in England are already engaged in a national conditioning or development programme (Gilbert, 2004:21).

In 1994, after the empowerment of the African National Congress (ANC), priority was given to sport development. A policy was compiled in 1995, highlighting the need and importance of a scientific identification and development programme of talented sportspeople (South Africa, 1996). According to News24.com, SARFU has identified the U/16 age group schoolboys as the first level of talent identification (SARFU, 2003b:1). With this new player identification and development strategy, the aim was to deliver the majority of Super 12 and Springbok players, and to carry SA rugby through to the 2011 World Cup. In South Africa, U/19 and U/21 year-old

players are representing the country internationally therefore it is important to identify talented rugby players at an early age. To achieve this, a junior and youth programme was implemented at school level. The programme includes game related core competencies such as talent identification of talented players at the earliest possible age, player conditioning, new schoolboy rugby tournaments, coaching and team selection (SARFU, 2003a:2).

According to Prof. Denver Hendricks, director-general of the national department of Sport and Recreation, emphasis has been placed on mass participation and support of talented athletes (Maarman, 2004:21). The current African National Congress (ANC) cabinet supports mass participation and want to introduce physical education as a compulsory subject in schools again. The physical education programme in South Africa will be based on the Cuban model for sport development (Coetzee, 2004:2).

Recently SARFU introduced a national U/16 rugby week, also known as the Grant Khomo Week, running simultaneously with the already existing U/18 rugby week, also known as the Craven Week for High Schools (SARFU, 2003b:1). The first level of identifying new players is the U/16 group. The next level is U/18, feeding into the U/19 national squad. The squad chosen at the end of the U/16 and U/18 national week is named the Green Squad. The Green Squad consists of a 100 top players from both the U/16 and U/18 group, and 50 players from the U/19 group (SARFU, 2003a:2).

According to SARFU, the provinces have the authority to manage and maintain the players of the Green Squad and their training programmes, as these players are in their provinces most of the time. The provinces have the authority to test and co-ordinate the players. The first tests were done in August 2003 and the next test session followed in February 2004. The results were sent to SARFU to be analysed and the training programmes were adjusted accordingly. The training programmes were then handed over to the provinces for implementation. Details and test results of these players are kept on a national database (Visagie, 2003:19). The North-West University has obtained the right to use the data gathered in this scientific programme on talent identification and development among young talented players.

Each year a new squad will be chosen at the end of the national U/16 and U/18 week, which allows for late developers to be included in the squad. A South African school and academy team consisting of 22 players each will be chosen from the U/18 squad for international games.

U/18 and U/19 players from this squad are also selected for the International Amateur Rugby Federation (FIRA) U/19 Junior World Championships (SARFU, 2003d:15).

1.2. PROBLEM STATEMENT

Talent identification is defined as "that process by which children are encouraged to participate in the sports at which they are most likely to succeed, based on results of testing selected parameters. These parameters are designed to predict performance capacity, taking into account the child's current level of fitness and maturity " (Peltola, 1992; Thomson & Beavis, 1985). The aim of talent identification and development programmes / systems in sport is to predict future sport achievements of athletes, based on their abilities (Singer *et al.* 1993). Headley (1992:93) recommends that a talent identification programme should be developed for the needs of each individual country. Du Randt and Headley (1993) state that in South Africa a serious effort must be made by means of research for different age groups to establish test batteries for all kinds of sport.

Bompa (1985) supports Thomson and Beavis (1985) in that tests administered have to be sport-specific. Nicholas (1997:376) stated that physical and motor abilities and anthropometrical variables have a significant implication in team selection. A study in 1994 by Pienaar and Spamer (1995, 1998) proved that rugby tests should include the following: physical and motor abilities, anthropometrical variables and game-specific skills. In a study by Hare (1997:99) on talent identification in 16 year-old rugby players, he noted that certain game skills namely passing abilities, catching abilities and kicking abilities; physical and motor abilities and anthropometric characteristics existed in the players. He compiled a test battery based on nine game skills, 13 physical and motor abilities, 22 anthropometric variables and seven psychological characteristics as talent prediction functions for 16 year-old rugby players. According to De Ridder (1993), Hare (1997), Nicholas (1997) and Pienaar and Spamer (1998), little research has been done on rugby specific characteristics in different age groups.

Since SARFU has identified the first level of new players as the U/16 group, the aim of this study is to compile a status profile of the U/16 and U/18 elite rugby players in South Africa, using physical and motor abilities, anthropometrical variables and game-specific skill components. At present, little is known about the elite schoolboy rugby player in South Africa and internationally.

To obtain the norm of the elite schoolboy rugby player, youth players must be tested and monitored to compile a profile of these players.

The results of these elite groups will also be compared to existing data available nationally and internationally. Further significance of this study is the compilation of a profile of the U/16 and U/18 elite player, which will serve as a guide to the school and provincial coaches on team selection and individual training programmes.

1.3 RESEARCH AIMS AND OBJECTIVES

From the previous discussion the following aims and objectives are derived.

1.3.1 The aim of this study is to compile a status profile of the U/16 and U/18 elite rugby player in South Africa with reference to:

1.3.1.1 Physical and motor components,

1.3.1.2 Anthropometrical variables,

1.3.1.3 Game-specific skill components.

1.3.2 Secondly, the physical and game skills profile for different playing positions of the U/16 and U/18 elite rugby player in South Africa will be compiled with reference to physical and motor, anthropometrical and game-specific skill components.

1.4 METHOD OF RESEARCH

Literature sources to be reviewed will include talent identification in youth sport, the role of sport education in school, test batteries used in talent identification and growth and development of the adolescent.

1.4.1 Review of literature

Databases to be used for the research of this study will include:

- PUBMED / MEDLINE
- FIMS newsletter and Sportsmed update

- Sport discuss
- SARFU publications
- South African newspapers
- Various journals
- Various books on relevant studies

1.4.2 Empirical Investigation

1.4.2.1 Experimental design

The test protocol as compiled by SARFU was used and this battery of tests was executed during August 2003 and February 2004. Qualified sport scientists received formal training in the specific test method that was used and in the recording thereof.

A first round of testing was done in August 2003 in allocated centres in each province and supervised by members of the Sport Science Institute of South Africa. The second testing session in February 2004 was done at the same centres and performed by regional assessors. All the tests were carried out on the same day and in the following order:

* Anthropometrics
* Physical and motor abilities
* Game-specific skill

These tests will be discussed in detail in chapter 4.

1.4.2.2 Population and sample

The research group consisted of U/16 (n = 93) and U/18 (n = 97) elite South African rugby players, also known as the Green Squad of SARFU. The Green Squad was chosen at the end of the U/16 (Grant Khomo) and U/18 (Craven Week for High Schools) rugby week. The Green Squad consisted of all population groups and had representation in all 14 provinces in South Africa.

1.4.2.3 Measuring instruments

1.4.2.3.1 ***Physical and motor tests:***

Speed 10m and 40m (Hazeldine & McNab, 1991)

Explosive leg power (Thomas & Nelson, 1985)

Agility Illinois- and T-test (AAHPER, 1966)

Speed endurance (Multistage shuttle run) (Lèger & Lambert, 1982)

Strength (1RM bench-press, pull-ups, push-ups) (Thomas & Nelson, 1985).

1.4.2.3.2 ***Rugby-specific skill tests:***

Ground skills ability (pick-up and place) (Australian Rugby Football Union, 1990)

Passing for accuracy over 4 m ability (Pienaar & Spamer, 1995)

Passing for distance ability (AAPHER, 1966)

Kicking ability (kicking for distance) (AAPHER, 1966)

Catching ability (catch and throw over the cross-bar) (AAHPER, 1966).

1.4.2.3.3 ***Anthropometry:***

The anthropometrical component will be done according to the Anthropometrics Standardisation Reference Manual (Ross & Marfell-Jones, 1991) and comprises of the following measurements:

1. Body Mass
2. Stature
3. Breadths (humerus, femur)
4. Girth measurement (flexed upper arm, calf, sub-gluteal, mid-thigh, knee, fore-arm)
5. Body fat percentage (sum of triceps, biceps, subscapular, supra iliac, calf, thigh and abdominal skinfolds)
6. Muscle mass
7. Somatotype

1.4.2.4 Statistical techniques

Statistical software was used for the data analysis. Descriptive statistics ($\bar{x}$, standard deviation, minimum and maximum) were used as well as practical significant differences (d-values) (Cohen, 1988). To comment on practical significance, the standardised difference between the means of two populations, i.e. the difference between two means divided by the highest standard deviation was used. The measure that was introduced is called the effect size. The effect size makes the difference independent of units and sample size and relates to the spread of the data (Steyn,

1999;2000). The SAS-computer-programme package of the North-West University, Potchefstroom Campus (SAS Institute Inc., 1999) was used.

1.4.2.5 Ethical aspects

All players completed an informed consent form, signed by the parent / guardian, since all players were under the age of 18.

1.5. CONTRIBUTION OF THE STUDY

The contribution of this study is to:

1. Assist the school and provincial coaches in identifying talented U/16 and U/18-year old schoolboy rugby players according to the profiles that will be compiled with the data of the study.

2. Support SARFU in the process of identifying and developing talented youth rugby players.

3. This study will also form part of an international research profile on talent identification and development in school sport.

CHAPTER 2

LITERATURE REVIEW

THE ADOLESCENT IN SPORT

2.1 INTRODUCTION

2.2 PHYSICAL EDUCATION

2.3 SPORT EDUCATION

2.4 ADOLESCENT GROWTH AND MOTOR DEVELOPMENT

2.4.1 Growth

2.4.2 Maturation

2.4.3. Motor development

CHAPTER 2

LITERATURE REVIEW

THE ADOLESCENT IN SPORT

2.1. INTRODUCTION

The aim of this chapter is firstly to discuss relevant literature concerning the role of sport education and physical education in the adolescent phase. Secondly, as part of physical development, literature research on growth, maturation and motor development of the adolescent will be reported.

2.2 PHYSICAL EDUCATION

Physical and sport education is interrelated, but differ in some aspects. The meaning of sport has evolved over time, but the three elements that highlight the meaning of sport are: play, physical education /exercise and competition (Zakrajsek, 1991:10).

Physical education is defined as follows: "Physical education is planned, sequential instruction that promotes lifelong physical activity. It develops basic movement skill and physical fitness as well as enhances mental and social abilities" (Anon., 2002). The definition of physical education as described by the Australian Capital Territory Health & Physical Education Curriculum Framework (1994), is as follows: "it is the area of learning in which students develop skills, knowledge and attitudes to enable the pursuit of an active, healthy lifestyle, contributing to the individual's emotional, mental, physical and social well-being " (Australian Capital Territory Government, 1994)

According to Coetzee (1978), a physical education programme exposes the broader population of school-aged children to a wide range of movement, activities and sport as well as enhancing physical well- being. Physical education equips the child with the ability to participate in sport or physical activities or to participate in recreational activities. Physical education does not train the

child to become a sport hero but guides the child towards active participation in a wide variety of leisure time and fitness activities within the community during school years and into adulthood.

In the United States of America, the National Association for Sport and Physical Education (NASPE), believes that quality physical education programmes are important in the role that they play in improving a child's mental alertness, academic performance and enthusiasm for learning, thus providing learning experiences needed for the development of children. The NASPE President, Carl Gabbard, states that: "Children who are physically fit do better in school" (Gabbard, 2000). Another reason for physical education as a subject at school is that not all children have opportunities to participate in sports, dance, gymnastics and recreational activities sponsored by the community. Physical education thus has an important role as school subject in providing all children opportunities to participate in and learn about regular physical activity (Ratliffe & Ratliffe, 1994:8).

According to the NASPE, the physical-educated child has the following characteristics:

- the child is physically fit,
- the child has learned skills necessary to perform various physical activities,
- the child understands the benefits of participation in physical activities, which are good health, wellness, developing motor skills, learning rules and strategies of certain physical activities, enjoyment and expressing oneself and communicating,
- the child respects and values the lifelong benefit of physical activities (Young, 1997).

Young (1997) states that physical education existed in schools in the United States of America (USA) since 1850. In general, physical education consisted of gymnastics, recreation, dance and K-programmes (NASPE, 1995). The approach since then has changed from physical training to performance-related fitness and development of competitive sports-skills. World-wide concern exists though, because of the declining levels of participation in physical activities and sport amongst adolescents. One of the reasons given for the declining participation is that children spend more time watching television and playing video games thus they are far too sedentary (Associated Press Wire Service, 2000).

On the World Wide Web, in Physical Education in the News, (Sept.2000), various quotes from magazines voice the concerns on the decreasing physical education requirements in public schools across the USA. The former president of the USA, President Clinton, instructed the

secretaries of Education and Health & Human Services to renew physical education in schools as well as after-school programmes (Clinton, 2000).

In South Africa particularly, physical education plays a vital role. Large rural populations exist in South Africa. For the child to learn various skills and fitness by means of Physical education, is only possible in schools where children and adolescents spend most of their time. Sadly the current trend in South Africa is the phasing out of physical education, even though policy states that it is a compulsory subject (Khumalo, 1999:63). Physical education will be officially phased out in terms of Curriculum 2005 but will be replaced by Life Orientation Learning Area. In reality though, members of Parliament of the African National Congress (ANC) want physical education to become a school subject again in South African schools. They consider the abolishment of this school subject as a mistake (Coetzee, 2004).

Components of physical education are physical fitness, the learning and development of motor skills, development of cognitive concepts about motor skills and fitness, improvements of social skills and development of strategies for using their leisure time (AAHPERD, 1995). A brief discussion on physical fitness follows:

- ***Physical fitness***

"Physical fitness describes the capacity of the body to function effectively during work, play and emergencies" (Ratliffe & Ratliffe, 1994:20). Physical fitness normally promotes good health and optimal physical development. Components of physical fitness are health-related and skill-related (Ratliffe & Ratliffe, 1994:4). Important health benefits include:

- Cardiovascular efficiency
- Lowering blood pressure
- Strengthening muscles and bones
- Providing more energy for daily activities
- Helping to maintain a normal body weight
- Increasing efficiency in work and play
- Reducing stress and tension
- Combating boredom (Ratliffe & Ratliffe, 1994:21)

Prior to World Wars I and II, emphasis in America and the European countries was on training youths to become fit and getting into shape by doing fitness activities. Little importance was placed on the educational aspects of physical fitness (Ratliffe & Ratliffe, 1994). The benefits of educating the young at school in exercise and healthy habits will aid in the reduction of illness and diseases and improve fitness. Extending fitness and health activities beyond childhood can ensure the future well-being of children through to adulthood as well as that of society (Ratliffe & Ratliffe, 1994:8). This opinion is echoed by Roy (1971:22), "The graduate should therefore leave school with a sound knowledge in the maintenance of health and physical fitness in adulthood".

Encouragement, guidance and teaching by the teacher and parents to exercise are essential. This requires a special personal interest by the teacher in both the child and fitness concept (Roy, 1971:173-174). However in South Africa this is difficult to achieve because Physical education is not a subject in school anymore.

The adolescent has the opportunity to increase health-related fitness and improve skill-related fitness through physical education and sport education. Health-related fitness focuses on cardio-respiratory efficiency, muscular strength, flexibility and body composition. These components increase good health and prevent diseases and problems arising due to inactivity. Skill-related components consist of abilities needed to perform movements in dance, sports and gymnastics (Ratliffe & Ratliffe, 1994:4).

According to Dick (1992:125), the adolescent period is the best time for the athlete to develop physical and motor abilities. This supports the opinion of Roy (1971:173) in which he states that "Physical activity is a growth stimulus." Not only skills and health fitness but also mental and emotional factors are interdependently involved in physical fitness. Confidence and personal physical fitness are interrelated. Thus physical fitness is a condition of total well-being involving mental, physical and emotional factors (Roy, 1971:173). According to Roy (1971:176), physical educators are discovering that as a child's personal fitness and physical ability improves so does academic learning potential. Without doubt, physical education forms a vital part of the total educational achievement of the child. From the previous discussion it is evident that a child's participation in a physical education programme is important from a health, mental, emotional and skills point of view.

In conclusion, physical education at school level aids in developing a physically educated adolescent. The physically educated adolescent has learned motor skills, is physically fit, values the importance of good health, enjoyment and mental fitness derived from regular physical activities. The physically educated adolescent is equipped with health, mental and emotional well-being; all of which are carried through to adulthood.

2.3 SPORT EDUCATION

"Sport education aims to help students become competent, literate and enthusiastic sportspersons" (Siedentop, 2002:410). To be competent, children need to know the game. Literacy in sport means to understand and value the sport, engage in good sport practices and disregard bad sport practices. Enthusiastic players behave in such a way as to promote sport cultures. "Sport education has been defined as a process through which sport cultures might grow and prosper as humanising influences in the lives of nations and their citizens" (Siedentop, 2002:410).

This definition forms the basis of Siedentop's Sport Education model (SE) and curriculum that he developed in 1994. The SE model is an education model at school level. Sport education at school level is the platform that the teacher uses to achieve a balance between general health, emotional involvement and sport participation. Sport education in school involves all students equally; therefore each student has the opportunity to be a role player. They all get the same opportunity to participate. Their performances all contribute to team success. Different activities of the role players included in the sessions are score keeping, coaching, refereeing, team management, team training and other such roles (Siedentop, 2002:410).

New Zealand has successfully implemented Siedentop's Sport Education model in 214 secondary schools (Siedentop, 2002:414). The latest successful implementation of the sport education model is in the United Kingdom, where a sixteen-week study was conveyed (MacPhail *et al.* 2004:106). Physical education and sport education are interrelated (MacPhail *et al.*2004:106). Findings conclude that team sport is an opportunity derived from the child's physical education experience. Other findings from their study conclude that being part of a team is an extension of their sport education experience.

Van Deventer (1998:89) states that physical education or sport education programmes were non-existent in South Africa. Adolescents are spending more leisure-time being sedentary (e.g. watching television) than time in physical activity. According to research by Nel on 42,477 South African children they spend an average of 27 hours per week watching television. This passiveness results in poor physical and motor development (Malan, 2004:13) the lack of physical and sport education programmes and the tendency towards low levels of physical activity will threaten the adolescent's well-being. Tinning and Fitzclarence (1992) and Taggart and Sharp, (1997), state in their reviews that physical education as a cultural practice is out of touch with youth today. In a study by Alexander *et al.* (1995), they reported that sport education in the physical education programme (SEPEP) is a sport education curriculum adopted in Western Australia that is a different way of teaching physical education, bringing genuine skill, knowledge and social development within reach of all levels of participants. This model is a student-centred learning model.

Sport is played for fun but also allows the individual to improve skills and creates a platform for competitiveness. Currently there are many opportunities to practice some form of sport. Various leisure time and non-competitive activities include fishing, hiking, canoeing and dancing. These activities are also beneficial for children (Gallahue & Ozmun, 1995:391). The progression of individual play through group games and then participation in organised sport, assist the coach in developing the child's ability to express him/herself (Dick, 1992:159). Teams, coaches, umpires, rules, special skills, special equipment and competition are aspects that are part of organised sport (Davis, 1992:107).

According to Dick (1992:133), various factors affect, or could be affected by the adolescent's involvement in sport. Factors include success in work or study, opinions of peers, emotional involvement and general health, to name a few. The teacher or coach needs to balance these factors in order to meet the individual's needs within the total environment. Adolescents learn to participate at competitive, non-competitive and social levels.

Sport education involves adolescents in sport participation. Findings of the study by MacPhail *et al.* (2004), correlate with earlier studies by Siedentop (1994), stating that belonging to a team, gaining identity within the team and developing social skills are all experiences derived from sport education and participation MacPhail *et al.* (2004:106). Participation in sport happens at different levels. Sport is practised on an individual level, community level and national level.

The individual has the opportunity to develop physically and personally, to strive and to achieve excellence. Social interaction, intercultural relationships and community building are the benefits of sport participation on community level. National unity and pride are feelings developed by participation at national level (Dyck, 2000:140).

To be part of a team, you need to participate. Sport participation is done for various reasons, all giving meaning to the participant. The most important reason for participation during adolescence is to be part of a team and to represent the school. Excitement, the winning element, aggression allowed in sport participation, control, responsibility, independence, achievement, confidence and making new friends are the other important reasons (Putter, 2001:29). This statement is supported by the findings in a study by MacPhail *et al.* (2004:106) conducted in the United Kingdom by using Siedentop's Sport Education model. Apart from the physical benefits of sport participation, a few lessons in life can be derived from it too. Achieving success, self-discipline and patience are virtues that are important to the human being (Putter, 2001:15).

In summary, physical and sport education in schools offers the adolescent the opportunity to develop certain skills, be it motor, emotional or mental skills. It is of importance that, the adolescent is educated by, a teacher or coach at school level in such a way that there is an improvement in movement control, emotional control and learning enjoyment so that meaningful learning experiences are constructed for human excellence. In South Africa, many talented and less-talented adolescents have the opportunity to participate in sport due to player development programmes in various sports. Physical and sport education remain important in South Africa, not only to improve health-related fitness and skills-related fitness, but also to aid in talent detection and talent identification programmes. Thus it is important that physical education should remain a compulsory subject at school.

The rest of the chapter is dedicated to the effect of growth, maturation and development of the adolescent to illustrate how these changes influence rugby-specific physical and motor characteristics.

2.4 ADOLESCENT GROWTH AND MOTOR DEVELOPMENT

It is important to fully understand the adolescent's growth and motor development, as these variables have an influence on rugby performance. The following discussion will describe the changes that adolescents experience with regard to growth, maturation and motor development, and how these changes influence rugby-specific physical and motor characteristics.

Adolescence is derived from the Latin verb "adolescere", meaning "to grow up" or "to grow to adulthood" (Gouws *et al.* 2000:2). This stage lies between childhood and adulthood and ends when young people reach self-sufficient adulthood as defined by society. Different definitions of adolescence exist, but authors Boshoff (1976), Dasberg (1981), Mwamwenda (1995) and Sorenson (1962), agree that it is a transition period between childhood and adulthood.

According to Gouws *et al.* (2000:2), it is difficult to link a specific chronological age to the end of the adolescent phase due to the vast cultural differences. In some African countries, traditional lifestyles require adolescents to partake in certain initiation procedures to gain recognition as an adult. In some Western countries, adulthood is reached when the adolescent becomes financially independent. The end of adolescence in South Africa is reached when the adolescent is able to vote at the age of 18 years.

Mwamwenda (1995:63) defines adolescent years as those between 12 and 21 years of age. Boshoff (1976:19), Cole and Hall (1970:3) and Thornburg (1975:2) subdivide adolescent years into early adolescence: 12 to 15 years, middle adolescence: 15 to 18 years and late adolescence: 18 to 22 years. The beginning of adolescence is puberty.

Puberty refers to a point of physical maturation when sexual reproduction becomes possible (Cobb, 2000:81). According to Davis (1992:55-58) and Mwamwenda (1996:63-75), adolescence has different development stages: physical, social, emotional and intellectual. Malina and Bouchard (1991a:3), however, classify the stages as growth, maturation and development. Gouws *et al.* (2000:4-5) divide adolescent development into physical, cognitive, social, emotional and religious development. According to Gallahue and Ozmun (1995:103), the growth and motor development of the adolescent are characterised by a number of physical, biological and emotional events.

From these classifications it is clear that adolescent development has a physical, emotional, moral and cognitive component. Most authors agree that the chronological age of adolescence is between 12 and 21 years of age. The research group in this study is in middle adolescence, meaning 15 to 18 years old.

For the purpose of this study, the classification of Malina and Bouchard (1991a:3), namely growth, maturation and development, are used in this chapter.

2.4.1. GROWTH

Child growth from birth to adolescence is characterised by physical growth. Growth means a "quantitative increase in size throughout the life cycle brought about by interaction among the requirements of the task, the biology of the individual and the conditions of the environment" (Gallahue & Ozmun, 1995:3). Parameters of growth that are used are weight and length or height (Househam, 1991:18). According to Househam (1991:18-25) weight is most often used to monitor growth and development. Malina and Bouchard (1991a) stated that growth refers to measurable changes in size, physique and body composition. Therefore, growth means physical changes that can be measured. Various authors have the same opinion on adolescent growth. Researchers like Gouws and Kruger (1994:3) and Louw (1994:401) describes the changes during adolescence as physiological changes, referring to growth, the primary sexual characteristics (ability to reproduce) and secondary sexual characteristics (facial hair and breasts) and sexual changes referring to sexual maturity.

Growth in adolescence is that stage when body length and body mass increase, but body length precedes body mass (Hare, 1999:3). A rapid increase in body length (skeletal growth) and body mass during adolescence is called the growth spurt (Gouws *et al.*2000:13). The peak velocity of growth in height in males is reached by the age of 13 and the mature adult height is reached at about the age of 18 (Gallahue & Ozmun, 1995:368-369). According to Gouws *et al.* (2000:13), the growth spurt in males starts between ages nine and a half and 14; and males reach their mature length at 21 years.

Changes in growth follow a predictable pattern that occurs during infancy, childhood, puberty and adolescence. When the child's skeleton hardens and muscles develop during infancy, there is a rapid gain in height and weight. The growth in height, weight and body structures continue during early childhood. During puberty, the growth hormone is responsible for the beginning of

the growth spurt. The growth spurt continues through adolescence, marked by rapid growth of muscles and organs. The male adolescent becomes taller and heavier, thus strength and power improve (Davis, 1992:40-55).

During the early part of the adolescent spurt, the lower extremities illustrate a rapid growth. Growth in trunk length continues after growth in leg length has ceased. The growth spurt is characterised by accelerated growth of hands and feet, followed by calves and forearms and the hips and chest, with lastly, the shoulders. The female adolescent growth pattern is characterised by broad hips and an increase in body fat. Because the leg growth spurt ceases before the trunk growth spurt, the adolescent's sitting height contributes towards gain in stature (Malina & Bouchard, 1991e:259-260).

The muscle growth spurt occurs about three months after the increase in height, whereas weight peak velocity is at about six months after peak height velocity (Harrison *et al.* 1990:362). The typical body shape of the male adolescent comprises of broadening shoulders and enlarging muscle groups, especially thighs, calves and upper arms. The muscle enlargement leads to an increase in body strength (PPASA, 1998:13) and an increase in body weight (Southmayd & Hoffman, 1981:426). The percentage of body fat remains stable during this time. Growth of internal organs, especially the heart and lungs, increases the functional capacity of the adolescent (Gallahue & Ozmun, 1995:376). The physiological and anatomical changes, namely growth in stature, muscle enlargement and increase in size of internal organs during adolescence, results in an increase of athletic ability in boys (Harrison *et al.* 1990:367).

In each individual the onset of adolescence is easily recognised due to physical and physiological changes (Gouws *et al,* 2000:2). During adolescence, weight gain, due to increase in stature, muscle enlargement and growth of internal organs, is also influenced by diet, exercise, general lifestyle factors and hereditary factors (Gallahue & Ozmun, 1995:376). Hereditary factors set the limit of growth. The adolescent's growth potential or genotype will determine the body's skeletal and sexual maturation. Height, trunk, arm and leg length are all controlled by genetic factors (Gallahue & Ozmun, 1995:368).

Incorrect diet and nutrition, however, have harmful effects on growth from childhood to adolescence (Gallahue & Ozmun, 1995:215-216). According to Gouws *et al.* (2000:30), illness, decreased work capacity and lack of cognitive development result from nutritional deficiencies.

During mid-adolescence (15 – 18 years), nutrition is of utmost importance. A study (Rao *et al.* 1998:127) confirmed that under-nutrition in rural adolescent Indian children caused lower sitting heights and leg lengths, thus affecting components of linear growth. In a study by Olmedilla and Granado (2000:S11), it was stated that during the growth spurt, when skeletal growth takes place, 45% of the total adult mass is formed. Nutrition and specifically micronutrients are important to ascertain a satisfactory state of growth and to be a healthy person.

Malnutrition is one of the key factors in reduction of height. An important indicator of acute malnutrition in adolescents is the weight to height ratio. Calcium remains an essential nutrient related to growth. During adolescence 60 % of adult bone calcium is accumulated (O'Dea, 2003:4). Not only malnutrition but also improper exercises could significantly change growth endplates of long bones, thus affecting adolescent growth and height (Gallahue & Ozmun, 1995:304).

During adolescent growth, skeletal growth, muscle enlargement and the growth of internal organs cause an increase in weight. The growth stage has a significant influence on sporting performance. Functional capacity and strength improve and stature increases. These characteristics influence the adolescent player's ability in a competitive sport such as rugby. According to Nicholas (1997:383), rugby players have unique anthropometric characteristics such as body size and composition. Nicholas (1997:389) emphasises the importance of body composition of the rugby players because of the requirements of their positional responsibilities. These characteristics depend largely on positional role and playing standard. Growth determines anthropometric characteristics. Anthropometric characteristics refer to weight, height and body composition, hence the relevance of the literature review on growth.

In this study the elite U/16 and U/18 schoolboy rugby player's anthropometric characteristics referring to weight, height and body composition will be compared.

2.4.2 MATURATION

Maturation is a "process, which enables individuals to ascertain higher levels of function" (Gallahue & Ozmun, 1995:16). Krogman (1980) defines maturation as a "time component that marks the rate of progress towards the developed state ..... Maturation is a process, maturity is a goal." Malina (1997) views the process of biological maturation in three ways, namely skeletally, sexually and somatically. Maturation of the skeleton, somatic maturation and

sexual maturation are measurements of maturation widely used in growth studies. A brief discussion on maturation now follows referring to skeletal, somatic and sexual maturation.

- ***Skeletal maturation***

Biological age or maturity status in all children can be determined by skeletal maturation. Skeletal maturation is a process where, prenatally, cartilage develops into a skeleton of bone. This process can be determined from beginning to end, the end being early childhood (Malina & Bouchard, 1991c:232). Radiography is used to measure the degree of development of the skeleton (Harrison *et al.* 1990:370). However, this proves to be an expensive method.

- ***Somatic maturation***

Body measurements are indicators of somatic maturity, and stature is by far the most popularly used measurement to determine somatic maturity (Malina & Bouchard, 1991c:232). Maturation plays an important role in development. Changes that are influenced through maturation are motor skills, stature, body proportion and physiological changes during puberty (Louw *et al.* 1985:8). During the growth spurt of early adolescence, when height and weight increase, some children experience clumsiness. The result is diminished motor and physical skills, which will influence the athlete's performance in sport activities (Gouws *et al.* 2000:13 & 16). Maturity assessments are valuable aids used to match athletes for contact sports. Training programmes can be adjusted according to growth periods and to counter any possible injuries (Gallahue & Ozmun, 1995:384).

In this study the anthropometric characteristics as a measurement of somatic maturation of the U/16 and U/18 South African schoolboy rugby player are compared. The physical and motor skills that have an influence on the athlete's performance are also compared to different age groups and playing positions in rugby.

- ***Sexual maturation***

During puberty, which is the beginning of adolescence, the secretion of growth and sex hormones takes place (Gouws, *et al.* 2000:11). Primary sexual characteristics, such as the development of the reproductive system, is followed by the development of secondary sex characteristics like breast development and menarche in girls, penis lengthening in boys, and pubic hair growth in both sexes (Gouws, *et al.* 2000:14). The size of the heart and lungs increases during this period. Testosterone, the male sex hormone, is responsible for an increase in red blood cells in boys. An

increase in red blood cells is one of the factors accountable for superior athletic ability in adolescent boys (Craig, 1992:391).

The development of secondary sexual characteristics has a marked sequence starting at around 12 years in males and ends at the age of 15 years with the start of middle adolescence. As the testes grow, the skin of the scrotum darkens, followed by the lengthening of the penis. Pubic hair, body hair and facial hair growth begins in conjunction with the development of underarm and sweat glands.

The first ejaculation, the sudden discharge or ejection of semen, is a most important event of puberty and happens at ages 13 to 14 years, as well as the deepening of the voice at ages 14 to 15 years (Gouws *et al.*2000:15). The appearance of secondary sexual characteristics indicates the progress towards sexual maturity (Gallahue & Ozmun, 1995:383).

Physical changes and sexual maturation go hand in hand with psychological changes (Bukatko & Daehler, 1995:192). Mwamwenda (1996:68) correlates with Bukatko and Daehler that the rapid physical changes during adolescence have psychological implications. Emotional difficulties experienced by the adolescent are largely due to the adjustment towards the rapid physical changes. Adolescents become very aware of the bodily changes. This leads to increased levels of self-consciousness. The development of secondary sexual characteristics heightens their interest in the opposite sex, but at the same time, conflicts arise towards the establishment of heterosexual relationships. The need to belong to a particular peer group increases. Adolescents want to become independent and the selection of a career and lifestyle is important (PPASA, 1998:31).

Self-esteem and sexual behaviour are important in relation to physical changes. Acceptance of bodily image, positive attitude, peer group relations and relations with persons outside the group can influence the adolescent's self-concept positively or negatively (Mwamwenda, 1996:73). During this stage of adolescence, the support of parents as well as teachers is important in helping the adolescent go through this transition. Information relating to the changes they undergo and understanding the adolescent and sensitivity towards them, help to create a positive self-esteem (Mwamwenda, 1996:80). Preissers (2000:5) reinforces Mwanwenda's statement of support and reassurance to adolescents in search of their identity.

In a competition situation such as rugby, the importance of acceptance by a peer group offers the adolescent the opportunity to compete with members of the same age group in the same team. This is important preparation for adulthood and gaining a place in society (Gouws *et al.* 2000:77).

- ***Early and late maturers***

Each adolescent develops at his/her own rate. Some adolescents enter and complete puberty before others begin experiencing physical changes (Preissers, 2000:2). Early maturers tend to be taller and stronger and therefore better athletes. Their peers treat them with special respect. The perception of being taller and stronger sometimes earns them leadership roles and greater responsibility (Mwamwenda, 1996:70). Early maturers have an easier time in adolescence; they seem to have more confidence, pride and a strong ego compared to late maturers who seem irresponsible, childish and seeking attention (Rappoport, 1972:281). Early maturers often display a skilled athletic ability, earning them popularity in schools (Gouws *et al.* 2000:19). Thus, early maturation amongst boys holds more advantages than disadvantages.

In contrast, late maturers have more disadvantages. They often struggle with heterosexual relationships, they often feel inadequate as a result of the lack of physical strength and sexual maturity and they tend to be less popular at school (Gouws *et al.* 2000:19). According to Saldi (2001:21), the main advantage of late maturers is that the boy adapts to changes in his body easier because of the lengthened pubertal period.

Growth and maturation are important factors in the development of the adolescent. In rugby, advance maturity status such as large body size and muscle mass are assets (Malina & Bouchard, 1991d:445-446). Stature and strength directly influence achievement in sport. Adolescents with an underdeveloped physique have little interest in sport, thus leading to a decline in achievement in rugby (Hare, 1997:13). Mwamwenda (1995:70) is of the opinion that early and late maturation amongst adolescents differs from one culture to another. This is a factor to take into account as the elite schoolboy research group in this study consists of boys from different cultures.

To conclude, in review of the literature resources, growth and maturation are important factors during adolescence leading to adulthood. Increases in body height, body mass and maturation during the growth spurt of the adolescent affect certain motor skills and physical abilities, which have an effect on sporting performance. To meet the demands of the physical game like rugby, the player should match a certain physical and motor characteristic profile. The absence of certain

rugby-specific characteristics could lead to loss of interest and diminishing sporting excellence. The U/16 and U/18 elite schoolboy groups from this study are experiencing these changes. The study aims to compile a profile of anthropometric characteristics, physical skills and motor skills in the adolescent growth spurt period.

2.4.3. MOTOR DEVELOPMENT

During childhood, motor development can be described as the appearance of new skills and the refinement of existing motor functions to achieve specific levels of movement. A newborn's simple, unorganised movements become organised, complex motor skills through the motor development process (Haywood, 1986:73). According to Malina and Bouchard (1995:5), motor development and the accompanying refinement of skill is a major developmental task of childhood.

For the purpose of this study, specialised movement skills as well as physical and motor characteristics of adolescents are discussed with particular reference to rugby. Although many perspectives exist on basic concepts of motor development, the motor development concept of world-renowned authors Gallahue and Ozmun is mainly concentrated on in this chapter.

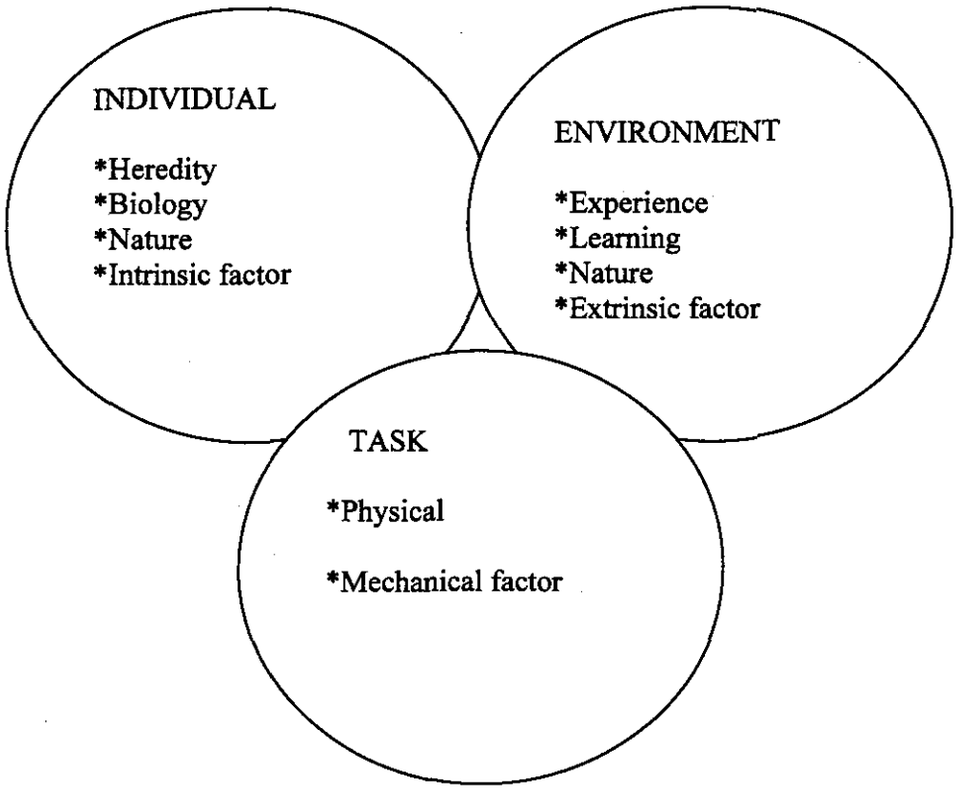
From the definitions mentioned on motor development, it is clear that this process is a lifelong experience, beginning at conception and ceasing at death. Motor development is influenced by various factors throughout life. According to Haywood (1986) genetic factors and environmental factors both influence motor development outcome. Environmental factors influencing growth and development patterns are nutrition, climate and exercise patterns. Gallahue and Ozmun (1995) developed a transactional model of the process of motor development, demonstrating the interaction of genetic and environmental factors.

An illustration of the model as well as a brief discussion follows.

Genotype or heredity is a component that an individual has to deal with. Very little can be done to change it. Biology, intrinsic factors and nature, also known as heredity, are components that an individual possesses in his/her genes. Progression of motor development during the first few years is rigid and predictable. For example, children worldwide will sit before they stand and walk before they start to run. Movements to better stability such as gaining head and trunk

control, manipulative tasks such as grasping and reaching, and locomotor movements of crawling and walking are influenced by heredity factors and differ in each individual.

A transactional view of causation in motor development (adapted Gallahue & Ozmun, 1995:6).



Environmental factors include experience, learning, climate, nutrition and extrinsic factors. These factors are external stimuli influencing motor development via the ecology of the environment, opportunity for practise and motivation and encouragement. Task-related factors are divided into physical factors, being movement pattern formation and mechanical factors. For example, as children refine throwing skills, they throw faster and more accurately.

From this model it is clear that interaction, but also transaction exists between individual, task-related and environmental factors (Gallahue & Ozmun, 1995). One of the concepts that Gallahue and Ozmun (1995:7) highlight is that motor development is age-related and not age-dependent.

Growth and development are basic characteristics of adolescence. The refinement and execution of new skills acquired during the adolescent growth phase are of particular importance to this study. In rugby, motor skills form the core of the game. If motor development is hampered, certain skills will not be formed. The adolescent with the best developed motor skills will achieve better results in sport (Hare, 1997:15). The next part of the discussion centres on specialised movement skills.

Improvement of basic skill performance is a direct result of improvement in mechanical efficiency. For example, by taking a step forward during a throwing action, the child will gain distance (Haywood, 1986). Gallahue and Ozmun (1995:225) state that the basis of motor development in children is the development of fundamental movement abilities. Fundamental locomotor movements enable the child to move effectively within an environment. Gallahue and Ozmun (1995:387) subdivide fundamental movement abilities into stability movements, locomotor movements and manipulative movements.

Stability movements are axial movements performed with a static posture.

- Stability movements include:
    - Bending
    - Stretching
    - Twisting
    - Turning
    - Swinging
    - One foot balance

Locomotor movements can be basic or a combination of two or more elements.

- Basic locomotion:
    - Running
    - Jumping vertically and horizontally
    - Walking
    - Hopping
- Combined locomotor movements:
    - Sliding
    - Slapping
    - Galloping

Locomotor and stabilising movements combined form patterns of manipulative movements. The manipulative patterns involve the athlete giving force to objects on receiving force from them, thus being propulsive or absorptive movement.

Manipulative movements are divided into:

- Propulsive manipulative movements are:
  - Throwing
  - Kicking
  - Striking
  - Bouncing
- Absorptive manipulative movements are:
  - Catching
  - Trapping (Gallahue & Ozmun, 1995)

"Specialised movement skills are mature fundamental movement patterns that have been refined and combined to form sport skills and other specific complex skills (Gallahue & Ozmun, 1995:386). To perform sport-related skills, the athlete must be able to adapt mature fundamental movement patterns to changing situations (Haywood, 1986). The mature stage of fundamental movement skills in children is normally reached by the age of six.

Because all movement involves stability, it is the most important component of fundamental movement. In the event of children not developing fundamental movement skills efficiently and effectively, their ability to apply the skills to games, sport or other childlike activities will be hampered (Gallahue & Ozmun, 1995:232).

Specialised movement skills are used in several sports, including rugby. In 1997 Spamer applied these fundamental movement skills to specialised movements (Pienaar, 2001:120). The following diagram will illustrate the application of fundamental movement to specialised movement skills in rugby.

Diagram 2.4.3.1: The application of fundamental movement to specialised movement skills in rugby (Pienaar, 2001:120-121).

FUNDAMENTAL MOVEMENTS	SPECIALISED MOVEMENT SKILLS
STABILITY	
Axial movements	Tackling, Passing in tackle,
Static and dynamic balance	Dodging a tackle, Pushing in a scrum, Rolling in a maul,
LOCOMOTION	
Running	Carrying the ball, Supporting ball carrier,
Sliding Jumping	Tackling, Side-stepping defence and in line outs,
MANIPULATION	
Throwing	Passing the ball, Throw-ins at line-out,
Kicking	Place kicking , conversion kick, Air and ground kicks,
Catching	Catching above hips (line-outs), Catching below hips (passing), Catching at hip height (one hand),

During the adolescent growth spurt body height, muscle enlargement and growth of internal organs create a bigger, stronger athlete capable of executing specialised movement skills better. Rugby is a physical sport combined with specialised movement skills. The adolescent needs refinement of the skills to achieve sporting excellence in competitive sport. However, non-competitive activities like fishing and jogging also involve specialised movement skills and are also beneficial to adolescents.

To conclude, the adolescent's growth, maturation and development will therefore have an effect on his physical and motor performance. The physical educator and coach need to recognise individual differences in growth, maturation and development, as this will influence the development and implementation of good physical and sport education programmes needed to assist the adolescent's physical ability and sport participation as well as a healthy life style.

CHAPTER 3

LITERATURE REVIEW

TALENT IDENTIFICATION AND DEVELOPMENT IN YOUTH RUGBY PLAYERS

CHAPTER 3

TALENT IDENTIFICATION AND DEVELOPMENT IN YOUTH RUGBY PLAYERS

3.1 INTRODUCTION

The discussion according to relevant literature reviews in this chapter will focus firstly on talent identification models in sport world-wide. Secondly, talent identification in youth sport will be discussed. Thirdly, models of talent identification used for rugby youth sport in South Africa will be reviewed. Lastly, anthropometric, motor and physical characteristics and game skills required for elite schoolboy rugby players will be discussed.

3.2 TALENT IDENTIFICATION MODELS

Children and adolescents are participating in organised competition world-wide. Participation of youth athletes on national and international level is ever-increasing. It is not uncommon to see female gymnasts and swimmers who are 12 and 13 years old, and male swimmers and track athletes of 15 and 16 years of age participating internationally (Malina & Bouchard, 1991d:443). For this reason it is important to consider the physical and motor characteristics of the youth athletes who excel in sport. Several factors influence the selection of young athletes. Skill requirements of a particular sport, physique of the athlete, parents, coaches and teacher motivation all influence the selection of young athletes in sport. Some children drop out of one sport due to boredom, changing interest or dislike of the coach, thus being selected for another sport. Economic reasons and, availability of training fields or equipment could also influence selection. Primarily selection is made based on skill and, often, physical characteristics, which give the child an advantage in sport participation and competition. The young athlete displaying certain skills and physical characteristics receives expert coaching and succeeds to national or

international competitions (Malina & Bouchard, 1991d:444). Sport plays an important role in society. In many countries the search for world class athletes starts at an early age. In a competitive society distinction is made between top-performers and mass participation (Malina & Bouchard, 1991d:445). According to Bloomfield *et al.* (1994:267), talent identification at an early age is important. Various authors share the same views regarding talent identification. The discussion that follows is dedicated to their views.

Talent identification is defined as "that process by which children are encouraged to participate in a sport at which they are most likely to succeed, based on results of selected parameters. These parameters are designed to predict performance capacity, taking into account the child's current level of fitness and maturity" (Peltola, 1992; Thomson and Beavis, 1985). Woodman's (1985:49) definition of talent identification is "the screening of young athletes to determine those most likely to succeed in sport and direct them towards the sport to which they are most suited". Salmela and Règnier (1983) state that talent identification is a long term process in which potential sportspeople are identified and developed in a specific kind of sport. Règnier *et al.*(1993) claim that talent identification methods of sportspeople are based on their present abilities and their abilities to achieve future success.

Literature proves that various talent identification models have evolved over the past decades. Sternberg, (1988:278) and Benbow and Lubinski (1993) support the view that talent is inherited and cannot be acquired. The model by Harre (1982) is based on training as the determinant of success and parents' involvement being an important factor in talent identification.

Ericsson and Charness (1995) maintain that innate characteristics influence different achievements, provided they are trained thoroughly, i.e. training is a determinant of success. Sloboda and Howe (1991) prove that parents and encouragement play an important role in the development of talented children. The model by Havlicek *et al.* (1982) has similarities with the model of Harre (1982). One aspect that he highlights is the principle that a sportsperson with a particular talent should be trained towards a specific sport.

Bompa (1985) in his talent identification model, emphasises that sport achievement is determined by motor skills, physiological capacity and morphological changes. He does not mention psychological variables.

Howe *et al.* (1998:2) suggest that properties of talent are inherited or at least partly innate. According to them only a minority of children are talented. If all children were talented, there would be no way to discriminate differential success. Although there may only be some indications of talent at an early age, trained people will be able to identify talent. Howe *et al.* (1998) is of the opinion that psychological factors, namely concentration, motivation, personality and enthusiasm also influence success in talented sportspeople.

Similarities exist between the above-mentioned talent identification models, but there are differences and shortcomings. In 1987, Règnier introduced a conceptual model for talent detection that addressed and made provision for several shortcomings in models prior to 1987. Règnier's (1987) conceptual model on talent identification has two essential phases. Phase one is identification of sport specific skills essential in guaranteeing success. Phase two includes the emphasis of morphological, psychological and environmental factors that contribute to game-specific achievement. The conceptual model of Règnier (1987) describes a step-by-step method on executing talent identification. The model has a multidisciplinary approach. The model includes morphological, physiological, psychological, environmental factors and sport-specific requirements. It also accounts for growth and development, specifically maturation aspects.

The researcher makes use of the so-called slide-population principle. This means that the process of measuring is monitored on different population groups instead of assessing the same population group from youth to adulthood. Each group is measured according to a specific battery of tests applicable to that group. The battery of tests establishes a target population, meaning that from the pool population certain sportspeople, who have the potential of becoming elite athletes in the age group, are selected. Taking Règnier's (1987) conceptual model into account, Du Randt and Headley (1993:316) summarise principles of a talent identification programme according to researchers as follows:

* Talent identification must be a continuous process because new norms are required every two to four years.
* General fitness implemented at school level must be encouraged on national and regional levels.
* Research models must consist of the following features:
    - provision for late developers to catch up,
    - multidisciplinary approach,
    - include as many participants from the community as possible,

- complement the coach,
- requirements must be age-specific.

* Test batteries need to be scientifically based, simple, practical and easy to administer.
* Talent identification processes should include trainers/coaches and national sporting bodies and provide training for them as well.
* Règnier's (1987) conceptual model is highly recommended.

Abbott and Collins (2002:174) advocate a talent identification model that combines talent identification and development processes. Abbott *et al.* (2002:7) state that talent identification is dependent on different variables such as genetics, environment, opportunity and encouragement. All these variables have an effect on the physical and psychological characteristics, and their interaction is an important factor in determining behaviour. It is therefore important that talent detection becomes a continuous process and that talent identification programmes be scientifically implemented.

From these views it is clear that talent identification involves an individual already participating in sport who possesses certain skills and physical characteristics in a particular sport. The talented individual is then directed into certain development programmes. Not only sport, but also art and music are all domains in which researchers are trying to find the best way of talent identification. The main aim of talent identification models is to provide a more accurate prediction of talented sportspeople to participate at world-class level (Abbot *et al.* 2002:25).

In the early 1970's, Central European and Eastern bloc countries initiated scientific talent detection and identification programmes. Anthropometrical and physical characteristics of elite youth athletes were used in the talent identification models (Bompa, 1994). The Eastern European athletes achieved success in the international arena, winning several medals at Olympic Games. For example, the Soviet Union (USSR) held the first position on the medal table from 1972 until 1992. Similarly, Germany (GDR) held the third or second position during the same period (Abbot *et al.*2002:35). Following the success of the Eastern bloc countries, the Western countries have only recently realised the importance of talent detection and the systems used by the Eastern bloc countries (Riordan, 1993; Du Randt & Headley, 1993).

A country's success in sport is often directly due to talent detection and talent identification models being in place. Riordan (1993), however, highlights that the talent identification processes

of the Eastern bloc countries are empirically flawed. His investigation discovered that in Eastern European countries like Russia, Poland and Bulgaria and to a lesser degree, Hungary and Romania, sport development was under central control. Potential champions in the USSR had been financially supported, allowing them to train full time. The conclusion can be made that the success in these countries is a result of their sporting culture, rather than talent identification procedures (Abbott, 2002:40).

Western countries realised the importance of talent identification procedures. The Australian Talent Search programme, launched in 1994, evaluates children in a systematic and objective way, using physical and performance factors associated with success in a specific sport. In Scotland, the Sport Interactive Model, which is based on the Australian Talent Search Model, was adopted in 1996. Again adolescents were measured on physical and performance tasks recognised for a specific sport (Hoare, 1996). During the evaluation of the Sport Interactive programme in Scotland, Abbott *et al.*(2002:173-174) discovered that growth and developmental changes of adolescents resulted in unstable scores on physical and task-related factors. For example, a child of 12 years old is advised to participate in the high jump because he/she has long legs. The child may be an early maturer, but he/she may not be able to maintain this characteristic to adulthood because of the growth spurt period and late maturers catching up. The conclusion derived from the investigation is that talent identification development procedures should be combined and that individual progress and behaviour within a development programme should be considered, and not only age group performance.

In the evaluation of the Australian Talent Search Model and the Scottish Sport Interactive Model, Abbott *et al.* (2002:40) make the following assumptions:

- Success in different sports is determined by specific anthropometrical and physical profiles particular to that sport.
- During adolescence, determinants of performance and future success are synonymous.
- Anthropometrical and physical profiles of adolescents definitely indicate potential talent within a specific sport.

In earlier reviews of literature, anthropometric, physical and physiological variables have been positively correlated with performance. However, Abbott *et al.* (2002:41) are of the opinion that the Scottish Sport Interactive Model and the Australian Talent Search Model do not take into

account that determinants of performance during potential at adolescence are likely to differ. As previously mentioned, during the growth spurt mature values are hard to predict due to their unstable nature. When only anthropometrical and physical characteristics are predictors of talent, early maturers will be selected for strength sports such as rugby due to their ability to overpower the opposition. Similarly, late maturers are likely to excel in co-ordination and gymnastic activities due to the biomechanical efficiency. However, in both these groups, no guarantee can be given that the individuals will maintain this physical profile into adulthood. Abbott *et al.* (2002:4) concluded that in the age group 16 to 18 most males are post-pubertal, and anthropometrical- and physiological factors will have stabilised, meaning that these factors will be carried into adulthood. The above statement is important in this study of 16- and 18-year-old schoolboy rugby players.

Literature reviews on talent identification models support the necessity of talent identification at an early age. According to Woodman (1985:49) the benefits of talent identification at an early age are:

- Relevant training programmes, which result in better achievement because the techniques developed in young potentially talented athletes will aid them in achieving a high level of performance.

- Economic advantages for parents, clubs and country. Expenditure can be focused on the development of a small number of talented athletes representing an effective financial investment.

- Talented athletes are guided to sports that they are physically best suited for.

Williams and Reilly (2000:655) support Woodman (1985) in that early indications form a platform for the likelihood of performance excellence. Williams and Reilly (2000:655) make a distinct difference between talent detection and talent identification. In their opinion, detection means the outcome of spotting talent, whereas identification is defined as the singling out of individual players for further specialised training programmes.

One of the shortcomings of the Australian Talent Search Model and the Scottish Sport Interactive Model identified by Abbott *et al.* (2002:44), is that in open skill sport, e.g. rugby, the significance of physique as a determinant of performance declines due to the dynamic and ever changing

environment. They suggest that multiple determinants of performance are to be included. Taking this into account, the conceptual model of Règnier (1987) is of more value due to its application in team sport.

Recent studies from Helsen *et al.*(2000) show that contributors of talent in sportspeople include early experiences, preferences, habits and training, and according to Starkes (2000), early maturation and motivation are important to excel in sport. Elaborating on early maturation aspects, Helsen *et al.* (2000) describe the linear relationship between month/date of birth and the proportion of soccer players in top leagues. Prior to 1997 the soccer season started in August. Youths born in the first quarter of the season showed a significant proportion of transfers. The following year, when the beginning of the season changed to January, immediate changes resulted in those soccer players perceived as talented. The reason why the date of birth makes an important contribution to a coach's selection of talented individuals is that players have up to a 12-month advantage in physical maturation over peers born later in the selection year. Late maturers could therefore be eliminated during adolescence and never have the opportunity to develop the required skills to be reselected into the sport once they reach physical maturation.

Advantages of a scientifically based talent identification programme according to Bompa (1999) are:

- Identifying talented athletes reduces time required in reaching performance excellence.
- The coach spends less energy and time training talented athletes.
- The athlete's confidence increases.
- Motivational aspects such as competitiveness and aspirations of reaching higher levels are enhanced, benefiting a national team's capability of competing internationally.
- Scientific training programmes are applied, motivating sport scientists to continuously monitor athletes' training.

The advantages mentioned above are applicable to the study group in this research. The research group was tested after selection, scientific training programmes were given and a second testing session was followed after six months of training. Both test sessions' results are analysed and discussed in chapter 5.

3.3 TALENT IDENTIFICATION IN YOUTH SPORT

Williams and Reilly (2000:657) are of the opinion that the importance of a talent identification model is to retain players on a long-term basis, keep them competitive and nurture the potentially elite players. They advocate a multidisciplinary approach to talent identification and suggest that physical, physiological, psychological and sociological measures should be included in the test battery.

According to Burgess (1996:7), talent identification programmes need to be scientifically based. Assessment should be done regularly to get the best value for a country's sporting achievements as well as an individual's future performance excellence. Howe *et al.* (1998) suggest that talented athletes should be monitored over a period of three to ten years. A scientific approach towards talent identification is an objective measurement of talent (Williams & Reilly, 2000). The above views thus support Règnier's (1987) conceptual model.

Numerous research studies were done on talent identification and talent development on individual types of sport and less attention was given to determinants of talent identification in team sports. Over the past ten years, several studies have been conducted in an attempt to determine variables that distinguish talented participants from less talented participants in youth team sport (Spamer & Winsley, 2003:189).

The Scottish Sport Interactive Model was evaluated by Abbott and Collins (2002). This talent identification programme matched young people to sports, based on proficiency in 11 physical and performances tasks. The study group involved 2498 children aged 10 to 14 years and consisted of females and males. The children in the study group were not necessarily all talented sportspeople.

The children's performance capabilities were assessed across 12 sports, which included individual and team sports. Rugby union was one of the 12 sports. The capabilities and characteristics that were assessed involved height, sitting height, weight and arm span. Later in this chapter, height and weight as part of anthropometric characteristics will be discussed. Catching and throwing are some game skills that were assessed. These game skills and others adapted to rugby union will feature later in the chapter. Physical abilities tested in the Scottish Sport Interactive Model were vertical jump, agility run, 40 m sprint and shuttle run. All these

variables are relevant to this study and will be discussed later in this chapter. They concluded that limitations exist on employing only physical and performance tasks. Abbott and Collins (2002:175) propose that development opportunities and focus between training and competition should also be taken into account when distinguishing between talented and less talented children.

A comparative study by Watson (1988) on successful schoolboy rugby players, successful schoolboy hurlers and non-team members involved a number of anthropometric measurements involving height, weight, muscle circumference and skinfolds. The result of the study is that team members in these sports have a definite range of physiques to distinguish them from non-team members (Watson, 1988:139). The assumption from this study can thus be made that physique is a valuable measurement to distinguish between talented and less talented sports people.

The following authors used physiological measures in their studies in an attempt to identify key predictors of performance. Jankovic *et. al.* (1997) in their study compared successful and less successful 15- to 17-year olds using measures of maximal oxygen uptake. Jankovic *et al.* (1997) established that 15- to 17-year old successful soccer players possessed better physiological fitness, i.e. an aerobic power, heart volume and maximal oxygen uptake than less successful soccer players.

In a study by Panfil *et al.* (1997) on elite 16-year olds, they recorded better performance in running and jumping in successful 16-year old soccer players compared to their less successful counterparts. Similarly, Janssens *et al.* (1998) revealed a distinct discrimination in short and prolonged shuttle running of talented versus less talented 11 to 12-year old soccer players. Numerous studies in South Africa by Pienaar and Spamer (1995, 1998); Spamer (2000); Hare (1997), Nieuwenhuis (2000), Badenhorst (1998) and Karstens (2002) were done to determine which variables distinguish between talented and less talented youth sports-people.

Spamer and Coetzee (2002), in their comparative study to investigate variables which distinguish between successful and less successful participants, focused on four team sports. Five studies were conducted and included the following team sports: rugby - 11 and 16-year olds, field hockey 15-year olds, soccer 16-year olds and netball 12-year olds. Talented players were at least in a team that was a league winner, whereas less talented players were in the school's third or fourth team. Variables used in this study comprised of game-specific skills, physical and motor abilities

and, anthropometric and psychological characteristics. A short summary of the research results follows.

The study by Pienaar and Spamer (1996) on 11- year old rugby players used 45 talented and 173 less talented players. A total of 35 tests were used comprising of six rugby skills tests, eight physical and motor tests, and 21 anthropometrical variables. In all the tests except one, motor ability test and nine of the 21 anthropometrical tests, the talented 11-year old players performed better than the less talented players did.

Similar findings resulted in the testing of the 16-year olds (Hare, 1997). A total of 62 different tests performed on 43 talented players and 41 less talented players revealed significant differences in all of the 24 anthropometrical variables. This proves a conclusive difference in body composition between the two groups. Five of the nine game-specific tests revealed significant differences between the two groups. The talented group performed better in ground skills, air and ground kicks, passing for distance and passing for accuracy 4m and 7m than the less talented group. The same tendency was found in physical and motor abilities.

In a study by Badenhorst (1998) 16-year old soccer players were tested using 20 talented and 17 less talented soccer players. The talented players scored better in all the tests, except the anthropometrical variables, where only six variables out of the 32 presented statistical significance between the talented vs. less talented players.

In field hockey (15-year olds), Nieuwenhuis's (2000) group of 25 talented and 27 less talented players were subjected to 43 different tests. The anthropometric results of the two groups were nearly even. The results of game-specific skills and physical and motor abilities differed significantly between the two groups. The talented group performed far better in all the game-specific skills.

Lastly, the study by Karstens (2002) tested netball players (12-year olds) where 21 talented and 20 less talented players were compared, the talented group scored significantly better on most of the skills tests and motor- and physical variables. The anthropometric data was very even.

To summarise, in all of the above studies the talented and less talented groups for all five sports showed significant differences relating to the game skills and motor- and physical abilities, but

were more evenly matched in anthropometric variables. The assumption can thus be made that motor, physical and game-specific skills are more important factors in talented youth sportsmen and sports-women compared to anthropometrical variables. This result supports Règnier's (1987) phase one of his conceptual model of talent identification that sport-specific skills are essential in guaranteeing success.

3.4 TALENT IDENTIFICATION IN SOUTH AFRICAN YOUTH SPORT

Sport is enjoyed world-wide and is part of modern society and the being of mankind irrespective of gender, culture or race (Headley, 1992:1). South Africa is no exception, taking into account the extensive media coverage of sport on television and in the press. Other factors that favour South Africa's sport culture are the climate, geographic location and multicultural nation (Van der Merwe, 1997:8).

During the isolation period of South Africa's sport, talent identification received little attention. Only after South Africa's re-admission to the international sport arena did sport governing bodies, sport administrators and sport scientists take note of the demands of international participation. The African National Congress (ANC), after their empowerment in 1994, decided that sport development in previously disadvantaged population groups was to receive high priority. In 1995 a national policy on sport was compiled emphasising, amongst others, the importance of research in sport (South Africa, 1996:32).

Currently in South Africa only a few sports are engaged in talent identification and talent development programmes. Prior to 1994, little scientific research was done in youth rugby (Hare, 1999:44). Pioneering research by Pienaar and Spamer (1995, 1996, 1997, 1998) contributed extensively towards the talent identification programmes of youth rugby players. The research study of Pienaar and Spamer (1995) was aimed at compiling a standardised test battery for 10-year olds, using a group of 10-year old boys with and without any previous rugby playing experience. All race groups were represented in the study and basic rugby skills e.g. throwing, catching, kicking, motor and physical abilities were tested.

The majority of talented 10-year old rugby players, according to the test battery of Pienaar and Spamer (1995), represented the North-West Province at the Craven Week for Primary Schools three years later (Pienaar *et al.* 2000). Coaches have benefited from the study by Pretorius (1997)

on the positional requirements and determinants of success in rugby in the 10-year old age group. Van der Merwe (1997) did research on 11-year old rugby players from previously disadvantaged groups, determining the effect of a development programme specific to rugby. He concluded that talented rugby players could be identified according to the game-specific determinants and they performed better in a development programme than less talented players did. The study by Hare (1997) documented the anthropometric characteristics, physical and motor abilities and rugby-specific skills required to identify talented 16-year old rugby players.

In another study over a period of six years, growth and development of talented 10-year old rugby players were monitored. They participated in a rugby development programme and were tested with three-year increments. Following the principles of the test battery of Pienaar and Spamer (1995), the talented 13-year olds participating in the Craven Week for Primary Schools were tested to establish if they still complied with the test standard. The next phase was to test the players at 16 years of age, using the test battery of Hare (1997).

Hare (1999:131-135) concluded that the talented 10-year old group, over a period of six years, was still the most successfully identified players according to the anthropometric characteristics, physical and motor abilities and game-specific skills tests, compared to the less talented group. The assumption can thus be made that South Africa's standardised talent identification battery of tests compiled by the afore-mentioned researchers is scientifically based and successfully used.

In a research study by Malan and Hanekom (2001), they compared the anthropometrical, physical and motor abilities and rugby-specific skills of the U/17 and U/19 groups of rugby players. Furthermore, their study aimed to determine the development of the relevant rugby-specific skills and physical attributes of junior rugby players and how these characteristics could indicate the junior players' readiness for selection in an older school team. The results of this study indicated no significant differences in most of the parameters between the two age groups. They concluded that as far as physical characteristics and rugby skills are concerned the junior players could be selected for the older team.

The findings of this study favourably concur with Hare (1999) that talented rugby players identified at an early age using the standardised test battery are still successful when comparing rugby-specific attributes when they are tested at an older age.

A comparative study by Spamer and Winsley (2003) on 18-year old elite South African and English rugby players demonstrated similar characteristics with reference to game-specific skills, physical abilities and anthropometric data. Slight differences in kicking and passing abilities were attributed to environmental circumstances. The South African boys were slightly leaner than the English boys were. This study shows the importance of international collaboration in research to gain more clarity on the characteristics of elite youth athletes (Spamer & Winsley, 2003:189).

A study by Adendorff (2003) revealed that talent identification variables, identified at an early age and regarded as important determinants in talented youth players, are deemed to be important in adult players as well and that the rugby-specific characteristics of youth and adult players closely resemble each other.

From this discussion it can be said that talent identification test batteries of South African researchers are scientifically based and that they are sound. Various studies have found that the rugby characteristics identified in youth rugby players deemed to be present at an older age as well. Of particular significance is the study by Hare (1997) of his talent identification test battery in 16-year old rugby players. The age groups in this study are 16 year and 18-year old talented schoolboy rugby players.

A brief discussion on current youth rugby development in South Africa will follow.

3.5 YOUTH RUGBY DEVELOPMENT IN SOUTH AFRICA

In this study, youth rugby is the sport that is being researched. The following discussion deals with current development trends in youth rugby in South Africa.

Rugby as we know it today has evolved slowly since 1823. In 1930 the way the game was played was standardised across the world. Rugby remained strictly an amateur sport and only in 1995 rugby became a professional sport, reimbursing players (SARFU, 2003d:7). Since 1995 new competitions were introduced such as the Vodacom Super 12, Vodacom Tri-Nations and the Heineken Championship in Europe (SARFU, 2003d:7). The introduction of professionalism as well as the new competitions, major tours and the World Cup increased the physiological demands on the elite player. The increase in physiological demands on the elite player warrants

the importance of improving the anthropometric and physiological characteristics of the players (Nicholas, 1997:375).

One of the reasons for rugby being such a unique sport is that players of all shapes and sizes can participate in it (SARFU, 2003d:11). Rugby is played in more than 100 countries world-wide. In several countries such as Australia, England, France and Scotland it may only be the third or fourth most popular sport, but in New Zealand, Tonga, Wales and South Africa it is a national sport. To remain such a popular sport in South Africa, the Springbok rugby team, South Africa's national team, needs to return to world-class excellence, meaning that the Springbok team at least has to be rated among the top three in the world (SARFU, 2003d:15). To be rated among the top three in the world, potential talented youth rugby players must be identified at an early age and be involved in development programmes.

During the eighties, when South Africa's sport was in isolation, scientific methods of talent identification did not match international standards (Du Randt, 1993). Pienaar and Spamer (1995, 1998) started research on talent identification in rugby in South Africa in 1994. Various studies by Hare (1997, 1999) and Spamer and Pienaar (1995, 1998) have been done in South Africa on talent identification, development of adolescent rugby players and physical, anthropometric and game-specific skill characteristics of the adolescent rugby player.

The South African Rugby Football Union (SARFU) launched a game development programme in 1993; the aim being access to all South Africans at all levels of the population (SARFU, 2003a:2). In 1994, South Africa's first democratic elections were held and the African National Congress (ANC) became the governing body. The ANC compiled a policy in 1995, highlighting the need and importance of a scientific identification and development programme of talented sportspeople (South Africa, 1996).

The SARFU Game development programme was successfully launched in 1993. Over the past ten years the development programme of SARFU has enabled the growth of the game rugby (SARFU, 2003a:2). The programme has ensured the ongoing growth of the game especially in local communities (SARFU, 2003a:2). Vision 2003 (adapted in 2001) by SARFU aims to transform South African rugby and sets out sport ideals for the future (SARFU, 2003d:14).

According to News24.com, "SARFU has identified the U/16-age group as the first level of national talent identification". According to a spokesperson of SARFU, "youth rugby is a critical part of our plans to make South Africa a winning nation, and this U/16 age group will help SARFU identify future national players" (SARFU,2003b). A U/16 rugby week (Grant Khomo week) has recently been introduced, running concurrently with the already existing U/18 rugby week (Craven Week for High Schools). At the conclusion of the U/16 and U/18 rugby week, a board of selectors selects 100 players from each group for the Green Squad programme. The Green Squad programme is a development initiative of SARFU and runs from U/16 level through to U/20 level. The Green Squad players are assessed, training programmes advised and details kept on a national database (SARFU, 2003d:15).

According to a SARFU spokesperson, the purpose of the Green Squad is to "identify talented players with the potential to excel in senior rugby and to provide them with the assistance they require to succeed. The objective is to develop the core competencies of these players" (SARFU, 2003b). The implication for SA Rugby is the improvement of rugby performance and guiding players to a successful rugby career.

From the U/18 age group squad a South African schools and academy team consisting of 22 players respectively is formed. The South African schools team of 22 players will represent South Africa internationally. Players from this team will also be selected for the International Amateur Rugby Federation's (FIRA) U/19 junior world championship (SARFU, 2003d:15). Potential future Springboks from the U/18, U/19 and U/20 players will be chosen by the selectors and placed in a national Gold Squad. The Gold Squad will comprise of 20 players of each of the U/18-, U/19-and U/20 age groups. The Gold Squad will receive a specialised training programme bi-monthly (Lillie, 2003).

This study aims to compile a profile of the U/16 and U/18 age groups, since they form part of the Green Squad programme. The following discussion will be dedicated to the requirements of elite schoolboy rugby players.

3.6. REQUIREMENTS FOR ELITE SCHOOLBOY RUGBY PLAYERS

From the previous discussion on various talent identification models, the conceptual model of Règnier (1987) is recommended. To recap, the conceptual model of Règnier (1987) consists of

two essential phases. Phase one comprises of a task analysis of the kind of sport to determine which variables play a role in guaranteeing success i.e. game-specific essentials. The second phase involves analysis of specific components, e.g. morphological, perceptual-motor, psychological and environmental factors influencing game-specific achievement. In this study it is important to discuss requirements that the game of rugby requires of the players, because the research group is an elite group.

A rugby team consists of 15 players. The rugby players are divided into two units namely forwards (numbers one to eight) and backs (numbers nine to fifteen). The forwards' main responsibility is to gain ball possession or retain ball possession until points are scored. They are normally the strongest and biggest players in the team. The back-line players' primary responsibility is to score points from the ball possession retained by the forwards. They are recognised by their leaner physique, speed and elusiveness (SARFU, 2003d:9).

Duthie *et al.* (2003) state that the fitness profile of elite rugby players is rapidly changing due to an increase in professionalism in rugby. This is one of the reasons for the refinement of standardised testing protocols. They reported on the significant differences in the anthropometric and physical characteristics between forwards and backs. Forwards tend to be heavier, taller and possess a higher percentage of body fat than backs. A study by Nicholas (1997: 375-376) proved that individuals in rugby union have unique anthropometrical and physiological characteristics. The positional role and playing standard of the players are factors that influence the anthropometric and physiological characteristics.

Quarrie *et al.* (1996) investigated anthropometric and physical performance characteristics of New Zealand rugby players of different ages and both sexes. Anthropometric data was collected followed by the assessment of six physical performance tests. Similarly to Nicholas (1997) and Duthie *et al.* (2003), differences between backs and forwards were noted. The forwards were taller and possessed bigger bodies. The backs presented leaner and performed better in the physical performance tests consisting of agility, speed, muscle endurance and fitness. According to them, the anthropometric and physiological characteristics of rugby players reflect the sport-specific demands.

According to Olds (2000:260) a physique and particularly a large body size are a predictor of success in rugby union. In South Africa, Pienaar and Spamer (1995,1998) started research on

talent identification in rugby in 1994. A thorough task analysis of the requirements for the game of rugby with youth rugby players was done in order to compile a relevant test battery. Basic skills needed were identified as handling, (catching and passing), running, kicking, speed, agility, strength and endurance (De Ridder, 1993; Strand and Wilson, 1993, Pienaar and Spamer, 1995). A thorough knowledge of sport-specific demands is necessary in talent identification and team selection.

In the development programme 2003 – 2015 of SARFU and the Green and Gold Squad programme, talent identification based on sport-specific demands plays a vital role, not only for team or player selection but also to better performance in rugby. Players in the programmes are monitored and assessed by regional assessors (Anon, 2003:13). Numerous researchers, (Rutherford, 1983; Van der Merwe, 1989; De Ridder, 1993; Pienaar and Spamer, 1998; Spamer, 2000; Hare, 1999 and Van Gent, 2003) are of the opinion that players should be identified according to playing position. The reason being that different physical demands and skills are required in different playing positions.

With specific positional selection and identification at an early stage, it is possible to determine which position the player is best suited for in terms of anthropometric, rugby-specific skills and physical and motor characteristics (Bloomfield *et al.* 1994:268). From a coaching point of view it becomes important since no time would be wasted on teaching the player skills that are not necessary for his position. Pienaar *et al.* (2000:32) state that the physical and rugby-specific profile of adult players are not necessarily the same as for youth players, thus playing position should be specific to age.

Studies by Pienaar and Spamer (1995, 1998) were the first scientific methods of talent identification among youth rugby players in South Africa. In these studies they developed a battery of tests for talent identification through which potentially talented 11-year old players could be identified for further and advanced rugby skills development. Although the results of the study on talented 10-year old players showed similarities to senior rugby players with regard to anthropometric characteristics and physical and motor abilities in certain player positions, the game-specific skills of 10-year old players did not exhibit a significant difference. The only game-specific skill that was noted as a significant difference was passing for distance (Pienaar *et al.*, 2000).

There are not many positional differences among 10-year old players according to these researches (Pienaar *et al,*. 2000), the reason being that they are young and beginners in the game. Pienaar *et al.* (2000) concluded that a prediction function for senior players and player position should be researched.

A study by Hare (1997) compiled a test-battery using physical-, motor- and game-specific skills and anthropometric characteristics to identify talented 16-year old rugby players. In this study the talent prediction formula for 11-year olds developed by Pienaar and Spamer (1995) was used. The conclusion of this study is that game-specific skills, physical- and motor abilities and certain anthropometric characteristics are important in the 16-year old rugby player (Hare, 1997:99).

Similarly studies by Malan and Hanekom (2001) identified which anthropometrical, physical and rugby-specific skills are important attributes for rugby match-play performance in 16 and 18-year old players. A more recent study by Van Gent (2003) identified the play position game-specific skills in U/13, U/16, U18 and U/19-year old rugby players.

In this study the profile of the U/16 and U/18 elite schoolboy rugby player will be compiled taking into account results of previous studies that were mentioned. According to the literature it appears that the following components and variables are important for top-level achievement in rugby. Anthropometrical components include height, weight, somatotyping and fat percentage. Physical abilities required for success in rugby are strength, endurance and flexibility. Motor abilities comprise of speed and agility. Rugby skills refer to handling and running skills, kicking skills and motor skills.

A brief discussion of the above-mentioned characteristics and skills will now follow.

3.6.1 Anthropometrics

An individual's basic physique is classified according to the fat percentage, muscle bulk and bone length (Gallahue & Ozmun 1995:218). The basic components of physique are classified, namely endomorphic, ectomorphic and mesomorphic.

- Endomorphic physique has a relative basis of body fat.
- Ectomorphic physique has rather tall, thin, lean body features.
- Mesomorphic physique is a more robust musculo-skeletal feature to body length.

In a study by Hare (1999:38) he supports Craven (1974:99) in that an individual with a mesomorphic physique is more suitable in a physical sport such as rugby. Rugby is a contact sport and an individual with a mesomorphic physique is more capable in a contact sport and sport involving power, speed and agility. In the process of anthropometry, the physique of the athlete is measured. De Ridder (1993:236-243) confirms that the majority of elite secondary school rugby players can be classified as mesomorphic. However, the forwards (44.2 %) have an endomorphic-mesomorphic physique compared to the backs (36.5 %) that are balanced mesomorphically.

- ***Body composition***

Body composition means the ratio of fat percentage to lean body mass. Research by De Ridder (1993:5-200) on secondary schoolboy rugby players noted that forwards have the highest fat percentage (24.1 %). The locks have a fat percentage of 17.4 % whilst the fullbacks and wings have the lowest fat percentage (13.5 %). Turnbull *et al.* (1995:29) suggested the following norm for junior rugby players regarding fat percentage, props 11 %, locks 10 %, loose forwards and hookers 10 % and backs 9 %.

- ***Height***

De Ridder (1993:165) recorded the senior secondary rugby player forwards as being on average 7.10 cm taller than backs. The locks were the tallest players at 191.60 cm followed by the eighth men (186.70 cm) and the loose-forwards (182.90 cm). The scrumhalfs (171.00 cm) presented as the shortest players followed by the hookers (174.90 cm) and the centres (177.00 cm)

- ***Weight***

The forwards of the senior secondary rugby players weighed the heaviest (96.40 kg) with the locks being second heaviest (90.00 kg). The lightest group was the scrumhalfs (67.80 kg) followed by the flyhalfs (72.90 kg) and the hookers (79.00 kg) (De Ridder, 1993).

- ***Skinfold thickness***

De Ridder (1993) reported that of all playing positions of primary and high school Craven Week rugby players, props had the highest mean sum of six skinfolds (102,2 mm and 117,9 mm respectively). Hare (1999) concluded that a small skinfold thickness measurement demonstrates an increase in cardio-respiratory fitness.

- ***Somatotype***

In the study by De Ridder (1993:236-243) on elite senior secondary rugby players, results showed most of the players (85,60 %) to be mesomorphic with a somatotype of 2.4/4.7/2.1, (endo-; meso-; ectomorphic), which classifies as an endomorphic mesomorphs somatotype, whilst the backs (36,50 %) were balanced mesomorphs.

3.6.2 Physical and motor abilities

Physical and motor abilities required for rugby as described by Hare (1999:62-66) are flexibility, explosive power, speed endurance, agility, speed and strength. All the above-mentioned abilities are necessary in the game to determine the players' ability to accelerate from a stationary position, to measure explosive leg power, the players' ability to change direction, maximal body strength and muscle endurance.

- ***Speed***

Defensive and attacking movements are situations in rugby that require speed (Van Gent, 2003:50). Nicholas (1997:388) emphasises the importance of speed necessary to accelerate from a stationary position. Short bouts of sprinting during the game require fast running speed.

- ***Explosive leg power***

Jumping in line-outs and scrumming require explosive leg power particularly in the forward players (Nicholas, 1997:388). The importance of explosive leg power and the relevance to physique assist the coach in player selection. The fullbacks and flyhalfs that do most of the kicking need explosive leg power (Hare, 1997:50). Backline players need explosive leg power to be able to accelerate to create opportunities for the wings (Craven, 1974).

- ***Agility***

Changing direction to beat the opponent, a player needs to be effective without slowing down too much. Agility involves endurance, flexibility of hip and knee flexors as well as explosive leg power (Hare 1997:47). Hanekom (2000) suggests that every player needs agility especially during defensive and attacking situations.

- ***Strength***

The nature of rugby being a contact sport requires strength, particularly in forward players involved in scrummaging and mauling (Nicholas, 1997:390). The backs, kickers and loose forwards involved in many running and tackling situations in game play need dynamic and explosive strength (Hare, 1997:50).

- ***Endurance***

Rugby involves short sprints and high power output in intervals. This means muscle and speed endurance. The player should be able to reproduce fast sprints and high intensity work with minimal loss of power (Nicholas, 1997:390). Muscle endurance, which is the ability to contract muscles repeatedly over a period of time, is an important component for all rugby players, because all players get involved in rucks and mauls (Hanekom, 2000:18).

- ***Flexibility***

Flexibility of muscle groups is an all-important component in rugby but receives little attention. Lack of flexibility leads to muscular strain and injury as well as a decrease in speed (Nicholas, 1997:391). Flexible muscles can produce more power for longer periods of time (Nicholas, 1997). Flexibility may also attribute to strength and power because more strength can be produced in a greater range of motion (Hanekom, 2000).

3.6.3 Game-specific skills

The following game-specific skills in rugby were identified and included in a battery of tests in research done by Pienaar and Spamer (1995, 1998) on talented 11-year old rugby players. The rugby-specific components include passing for accuracy over four metres and seven metres, kicking ability, catching while in forward motion and throw and catch over the crossbar, ground skills and running ability. The same game-specific skills are important in all other age groups.

- ***Ground skills***

The game of rugby involves many stages e.g. scrums, line-outs, rucks and mauls. In some instances the player cannot pass the ball to a team-mate, thus the ball is placed on the ground where the other player has to pick up the ball. The player's ability to combine pick-up and placing of a rugby ball whilst running is an important skill to ensure ball retention (Australian Rugby football union, 1990).

- ***Kick-off for distance***

At the start of the game or with a penalty kick, the ball is placed on a tee and the player kicks the ball as far as needed (AAPHER, 1966). Kicking for distance also involves explosive leg power. Leg muscle strength is important for gaining distance during kicking thus increasing territorial advantage (Hare, 1997).

- ***Side-step***

Every rugby player needs to run at a different pace during the game, but also needs to change direction suddenly in order to beat the opponent or avoid being tackled (Cooke, 1982).

- ***Passing for accuracy (4m)***

In attacking motion, the ball carrier, moves forward with the ball. When it becomes necessary to counter defend, the ball must be passed accurately. The importance of passing for accuracy over a short distance will gain ball retention and the opportunity for a team-mate to score. The player should be able to pass to the left and right to be able to score (Pienaar and Spamer, 1995).

- ***Passing for accuracy (7m)***

To enable the ball being carried forward faster and to counter the defence, a player should be able to pass accurately over a seven (7) m distance. Passing over a 7m distance is also important for a scrumhalf position when it is necessary to distribute the ball fast after a scrum. The pass should be to the left or the right (AAHPER, 1966).

- ***Passing for distance***

During the game it is sometimes necessary to skip a player whilst passing the ball, in other words, to distribute the ball faster to a player who is open to score. Passing for distance is a skill enabling a player to pass the ball through the air at a maximum distance especially at the beginning of counter-attacks (AAPHER, 1966).

- ***Kicking ability***

When a player kicks the ball the purpose is to gain distance, to assure ball retention or to get a better position to accumulate points. Kicking the ball is a controlled skill and distance needed for the ball to travel is determined by the skill and end goal, be it gaining distance or scoring of points (AAPHER, 1966). Strength and leg power thus plays an important role.

- ***Catch and throw***

Catching a ball is an important basic handling skill and so is throwing. Bad handling will result in loss of ball possession. In line-outs the hookers need to throw in the ball very accurately. This skill also involves strength (AAPHER, 1966). Locks need to catch the ball in line-outs.

To conclude, in this chapter talent identification models were discussed as well as research world-wide and in South Africa. Scientifically based studies revealed anthropometric characteristics, physical and motor abilities and game-specific skills needed by rugby players. Chapter 4 deals with the method and procedure used to test the U/16 and U/18-year old elite schoolboy rugby players in South Africa.

CHAPTER 4

EMPIRICAL STUDY

4.1 INTRODUCTION

4.2 STUDY POPULATION

4.3 TEST PROTOCOL

4.3.1 Anthropometry

4.3.2 Physical and Motor tests

4.3.3 Rugby-specific skill tests

4.4 STATISTICAL METHOD

CHAPTER 4
EMPIRICAL STUDY

4.1 INTRODUCTION

All elite rugby players have certain anthropometric characteristics, rugby-specific skills and physical and motor abilities that distinguish them from average players (Hare, 1999). The aim of this study is to compile a physical and game skills profile of the U/16 and U/18 elite South African schoolboy rugby player. The aim of this chapter is to explain all anthropometric measurements and techniques and also describe the physical and motor ability tests as well as the rugby specific skill test.

4.2 STUDY POPULATION

The research group consisted of U/16 (n = 93) and U/18 (n = 97) elite South African schoolboy rugby players, also known as the Green Squad of SARFU. The Green Squad players were chosen after the National U/16 rugby week (Grant Khomo week) and the U/18 rugby week (Craven Week for High Schools). Players of all 14 provinces were included in the Green Squad. Each player was tested according to a rugby protocol by SARFU in August 2003 with a second test done in February, 2004. SARFU compiled training programmes for each player after the first testing session. The training programmes were handed over to the provinces after the first testing session to be implemented. The provinces have the authority to manage and maintain the players.

4.3 TEST PROTOCOL

The test protocol consists of anthropometric measurements, rugby-specific skills tests and physical and motor tests. A first round of testing was done in August 2003, and the second testing session in February 2004. Regional assessors performed test and data input. The first round of testing was done at a national camp and supervised by members of the Sport Science Institute of South Africa. The data was sent to SARFU to be analyzed. Training programmes for each player were designed by SARFU after the first testing session and handed to the provinces to

be implemented. A second testing session in February 2004 was held at all the same centres. All tests were carried out on the same day and in the following order:

- Anthropometrics,
- Physical and motor abilities,
- Game-specific skills.

All players completed an informed consent form, signed by the parent/guardian.

The anthropometric measurements included the following:

- Body mass,
- Stature,
- Body fat percentage,
- Sum of seven skinfolds (sum of triceps, biceps, subscapular, supra iliac, calf, thigh and abdominal skinfolds),
- Girths (flexed upper arm, calf, sub-gluteal, midthigh, knee and, fore-arm).
- Breadths (humerus, femur),
- Muscle mass,
- Somatotype (Ross & Marfell-Jones, 1991; Lohman *et al.* 1988).

The physical and motor test were used to determine the following components:

- Speed (10 m and 40 m) (Hazeldine & McNab, 1991).
- Explosive leg power (vertical jump) (Thomas & Nelson, 1985).
- Agility (Illinois- and T-Test) (AAHPER, 1966).
- Strength (1RM bench-press, pull ups, push ups) (Thomas & Nelson, 1985).
- Speed endurance (Multistage shuttle run) (Lèger & Lambert, 1982).

The rugby-specific skill tests were used to determine the following abilities:

- Ground skills ability (Pick-up and place) (Australian Rugby Football Union, 1990).
- Passing for accuracy over 4m ability (Pienaar & Spamer, 1995).
- Passing for distance ability (AAPHER, 1966).
- Kicking ability (kicking for distance) (AAPHER. 1966).
- Catching ability (catch and throw over the cross-bar) (AAPHER, 1966).

The following discussion will be dedicated to a detailed description of each test.

4.3.1 Anthropometry

Anthropometry is the process of measuring physical dimensions of the human body. These measurements are then used to either describe size and proportions or to indirectly estimate body composition. Anthropometry can be used in sports science for evaluating the athletes' size, shape, body proportions, body composition and degree of asymmetry between the dominant and non-dominant limbs. This information can be used to customise training programmes and nutritional intervention. Although anthropometry has the potential to be a valuable tool in evaluation and monitoring the athlete, the measurements need to be accurate and done strictly according to the specified description (Ross & Marfell-Jones, 1991)

This section has been written with the aim of standardising the measurements used in anthropometry. The aim of this section is to describe each procedure in sufficient detail, including the calculation of the derived values, to ensure a high degree of consistency between measurers (SARFU, 2003c).

Fully qualified measurers that have adequate experience in anthropometry and could make repeated measurements with a low coefficient of variation did the anthropometry. This competency usually occurs after about 100 measurements for each site (Ross & Marfell-Jones, 1991). There are inconsistencies in the literature in describing the landmarks for the measuring sites. Therefore, the descriptions by Lohman, *et al.* (1988) and Ross and Marfell-Jones (1991) have been used as both these authors represent consensus views on anthropometry.

Descriptions of measurements

In anthropometry the errors associated with data collection fall into 2 categories;

- Recording errors
- Mislocated landmarks (Ross & Marfell-Jones, 1991). Obviously care should be taken to minimise each of these sources of error.

4.3.1.1 Body mass

Purpose:

Body mass is not a variable directly related to performance, but it is important in order to clarify anthropometric values and to classify the players that are over- or underweight.

Equipment:

Body mass should be recorded on a calibrated scale and recorded to the nearest 100g.

Procedure:

The subject should be weighed in underpants and without shoes, preferably before a large meal. Athletes tested regularly should be weighed at the same time of day for each test. The subject should stand barefoot with the arms hanging by the sides. The heels, buttocks, upper back and head should be in contact with the wall. Prior to measurement the subject should be instructed to look ahead and take a deep breath.

Scoring:

Body mass should be recorded to the nearest 100 g (Ross & Marfell-Jones, 1991; Lohman, *et al.* 1988).

4.3.1.2 Stature

Purpose:

This measurement is recorded as the height from the floor to the vertex of the head. The vertex is defined as the highest point on the skull when an imaginary line between the lower margin of the eye socket and the upper margin of the zygomatic bone is parallel to the ground.

Equipment:

Stadiometer

Procedure:

The subject should stand barefoot with the arms hanging by the sides. The heels, buttocks, upper back and head should be in contact with the wall. Prior to measurement the subject should be instructed to look ahead and take a deep breath. The recorder places the head-board firmly down

on the vertex, pressing down the hair as much as possible. The recorder watches that the feet do not come off the floor and that the position of the head is maintained. Measurement is taken.

Scoring:

The measurement should be recorded to the nearest mm. Measuring error <2 mm (Norton *et al.*, 1996).

4.1.3.3 Skinfold thickness

Purpose:

To measure all skinfolds.

Equipment:

Skinfold calipers

Method:

The skinfold calliper reading is a measurement of the compressed thickness of a double layer of skin and the underlying subcutaneous tissue, assumed to be adipose tissue. The skinfold thickness is measured by grasping a fold of skin and the underlying subcutaneous tissue between the thumb and forefinger, 1-2 cm above the site that is to be measured. The fold is pulled away from the underlying muscle and the jaws of the callipers are placed on either side of the site, at a depth of approximately 1 cm. The skinfold is held firmly throughout the application of the calliper and the reading is taken when the needle becomes steady after the full pressure of the calliper jaws has been applied. The callipers must be applied at right angles to the fold at all times. All measurements are recorded on the subject's right side except for the abdominal skinfold that is recorded on the subject's left side. The measurement is recorded in millimetres. (Durnin & Womersley, 1974).

Measuring error for skinfolds < 1.5 mm

- ***Triceps***

Measured from the back on the posterior surface of the arm midway between the top of the shoulder (acromion process) and the elbow (olecranon process). The upper limb should hang loosely by the side with the subject in a standing position.

- ***Biceps***

Measured from the front on the anterior surface of the arm midway between the top of the shoulder and the elbow. The subject stands in the same position as for the triceps measurement.

- ***Subscapular***

Measured just below the inferior angle of the scapula with the fold in an oblique plane descending laterally (outwards) and downwards at an angle of approximately 45° to the horizontal.

- ***Supra-illiac***

Measured 5cm above the illiac crest with the fold oblique, descending medially (inwards) and downwards at an angle of about 45° to the horizontal. The subject should stand erect with the upper limbs by the side and the abdominal muscles relaxed.

- ***Calf***

Measured on the medial surface of the calf at the level of the biggest calf circumference. The subject's weight must be placed on the other leg.

- ***Thigh***

Measured at the mid-point on the anterior surface of the thigh with the fold parallel to the long axis of the thigh. The subject's weight should be on the other leg so that the knee joint of the measured leg forms an angle of about 120°.

- ***Abdominal***

Measured in a vertical plane 5 cm to the left of the subjects' umbillicus.

4.3.1.4 Girth measurements

Purpose:

To measure all girths. These measurements are recorded to the nearest cm. The measuring error should be less than 1 cm.

Equipment:

Lufkin measuring tape.

Procedure:

The cross-hand technique is used for measuring all girths and the reading is taken from the tape where, for easier viewing, the zero is located more laterally the medially on the subject. In measuring girths, the tape is held at a right angle to the limb or body segment, which is being measured and the tension in the tape must be kept constant. When reading the tape, the measurer's eyes must be at the same level as the tape to avoid any error of parallax.

- ***Contracted arm***

The maximum girth of the arm with the biceps fully contracted. The subject's arm should be horizontal, fist clenched and elbow fully flexed.

- ***Calf***

Measured at the biggest circumference of the calf with the subject standing erect, legs slightly apart and with the weight distributed evenly between legs.

- ***Sub-gluteal***

Measured 1 cm below the gluteal fold. Weight must be distributed evenly on both legs.

- ***Mid-thigh***

Measured at the level at which the thigh skinfold was measured. Weight must be distributed evenly on both feet.

- ***Knee***

Measured 1 cm above the superior border of the patella.

- ***Forearm***

Measured at the maximal girth of the forearm when the arm is hanging relaxed by the side. Measured distal to the styloid processes (Norton *et al.*, 1996).

4.3.1.5 Diameter measurements (cm)

These measurements are recorded to the nearest cm.

Purpose:

To measure all the breadths. These measurements are recorded to the nearest cm.

Equipment:

Small sliding bone calipers.

Procedure:

- ***Humerus breadth***

Distance between the medial and lateral epicondyles of the humerus. The measurement is taken with the arm held forward and the forearm flexed to a right angle at the elbow. The callipers are placed directly on the epicondyles so that the arms of the callipers point upward at about 45° angle to the horizontal plane. (Measuring error < 1 mm).

- ***Femur breadth***

Distance between the medial and lateral epicondyles of the femur when the subject is seated and the leg flexed at the knee to form a right angle with the thigh. Place the caliper faces on the epicondyles so that the arms of the callipers point downwards at about 45° angle to the horizontal. (Measuring error < 2 mm) (Norton *et al*, 1996).

4.3.1.6 Derived measurements

* ***Body fat***

There is a tendency in laboratories around the world to move away from expressing body fat as a percentage, but rather to express body fat as a sum of skinfolds (mm). This is because the use of skinfold thickness to predict body fat percentage is a "doubly-indirect" procedure (Martin & Drinkwater, 1991) and therefore has inherent inaccuracies. For example, there are many assumptions associated with measuring skinfolds and it is assumed that the densities of the fat and fat-free mass are constant. These assumptions are not always met. It is recommended that the sum of skinfolds (7 sites) be used if the sportspersons are going to be monitored on a regular basis

through the season. Sum of skinfolds and body fat percentage can be measured if the assessment is done on one occasion, or if it is necessary to calculate the target mass of the athlete.

* ***Sum of skinfolds***

Body fat is described as the sum of the following skinfolds;

1. biceps,
2. triceps,
3. subscapular,
4. supra-illiac,
5. abdominal,
6. thigh,
7. medial calf (Martin & Drinkwater, 1991).

4.3.1.7 Body fat percentage

The Durnin and Womersley technique should be used to estimate body fat percentage (Durnin & Womersley, 1974). This is a general equation with limited population specificity since it was developed from a heterogeneous group of varying ages (n = 481). This technique does seem to over-estimate body fat percentage in physically active individuals who are older than 30 years. To prevent an over interpretation of results, the body fat percentages should always be expressed to a rounded whole number and as a value ± 1 %. The calculation of body fat % involves measuring 4 skinfold sites: triceps, biceps, subscapular and supra-illiac. Measure the 4 skinfold thickness (biceps, triceps, subscapular and supra-illiac), and substitute the log of their sum into one of the following equations;

Males

Age (years)	
- 17	D = 1.1533 – (0.0643 X L)
17 - 19	D = 1.1620 – (0.0630 X L)
20 - 29	D = 1.1631 – (0.0632 X L)
30 - 39	D = 1.1422 – (0.0544 X L)
40 - 49	D = 1.1620 – (1.1700 X L)
50+	D = 1.1715 – (0.0779 X L)

Females

Age (years)

- 16	D = 1.1369 – (0.0598 X L)
16 - 19	D = 1.1549 – (0.0678 X L)
20 - 29	D = 1.1599 – (0.0717 X L)
30 - 39	D = 1.1423 – (0.0632 X L)
40 - 49	D = 1.1333 – (0.0612 X L)
50 +	D = 1.1339 – (0.0645 X L)

where D = predicted density of the body (g/ml)

L = log of the total of the 4 skinfolds (mm)

Then calculate the predicted percent body fat by substituting it into the following formula (Brozek *et al.* 1963);

Predicted % body fat = 100(4.570/D – 4.142)

4.3.1.8 Muscle mass

The following measurements are needed for the anthropometric assessment of muscle mass (Martin *et al.* 1990):

1. stature
2. mid-thigh girth (cm),
3. mid-thigh skinfold (mm),
4. calf girth (cm),
5. calf skinfold (mm),
6. forearm girth (cm).

The technique was developed from measurements conducted on cadavers.

The equation is as follows;

Muscle mass (kg) = $(S(0.0553CTG^2 + 0.0987FG^2 + 0.0331CCG^2) - 2445)/1000$

Where; S = stature (cm)

CTG = corrected mid-thigh girth (cm)

FG = forearm girth (cm)

CCG = corrected calf girth (cm)

CTG = TG – π (mid-thigh skinfold/10)

CCG = CG –π (calf skinfold/10)

%Muscle mass = (muscle mass (kg) / body mass (kg)) x 100

4.3.1.9 Somatotype

Hippocrates differentiated between body types in 400BC. In 1921 Kretschmer classified individuals into asthenic (thin type), athletic (muscular type) and pyknic (fat type) categories. Sheldon refined this system of classification and related the development of each of the three embryonic layers – hence endomorphy, mesomorphy and ectomorphy. This was developed by Heath & Carter (1967) to its current form which expresses each component as a numerical rating. They defined the somatotype as "a description of present morphological conformation – a size dissociated descriptor of the shape and relative composition of the body".

Typically somatotypes are expressed as a three number unit e.g. 3.1 – 4.5 – 2.9.
The first rating refers to the relative fatness in an individual's physique (endomorphy). The second rating refers to the relative musculo-skeletal development (mesomorphy) and the third rating refers to the relative linearity of an individual (ectomorphy).

Although somatotyping is a valuable technique for describing shape characteristics of athletes, it cannot be used alone to identify talent without related data such as muscle strength and flexibility.

• Methods:

The measurements used to derive the three ratings are;

1 stature (cm),
2 mass (kg),
3 humerus bi-epicondylar diameter (cm),
4 femur bicondylar diameter (cm),
5 contracted arm girth (cm),
6 calf girth (cm),
7 subscapular skinfold (mm),
8 supra-illiac skinfold (mm),
9 calf skinfold (mm),
10 triceps skinfold (mm) (Heath & Carter, 1967).

- Calculations:

- ***Endomorphy***

Endo = [-0.7182 + 0.1451 (x)] - [0.00068(x^2)] + [0.0000014 (x^3)]

Where: endo = endomorphic component

X = sum of triceps, subscapular and supra-illiac skinfolds.

- ***Mesomorphy***

Meso = [(0.858 x H) + (0.601 x F) + (0.188 x AG) = (0.161 x CG)] –(S x 0.131) + 4.50

Where: meso = mesomorphic component

H = largest humerus diameter (cm)

F = largest femur diameter (cm)

AG = corrected arm girth (cm)

CG = corrected calf girth (cm)

S = stature (cm)

Note AG = largest contracted arm girth (cm) – tricep skinfold (cm)

CG = largest calf girth (cm) – calf skinfold (cm)

- ***Ectomorphy***

Ecto = (SMR x 0.732) – 28.38

Where: ecto = ectomorphic component

SMR = stature (cm)/mass$^{0.333}$ (kg)

[If SMR = 38.24 or less then ECTO = 0.1

If SMR is between 38.25 and 40.74 then ECTO = (SMR X 0.463) – 17.63]

4.3.2 Physical and motor tests

The following tests were done to assess the physical and motor abilities of the rugby players.

Speed

Purpose:

The purpose of these tests is to determine the players' maximum sprint speed and their ability to accelerate from a stationary position.

Equipment:

Photo-electric sensors, electronic sprint timer, marking cones, stop watch.

Procedure:

A thorough warm-up must be undertaken before this test, which requires the player to produce an all out effort. The intention of this warm-up is to give the player the opportunity to mimic briefly and become accustomed to the feeling and technique associated with the criterion performance task. It is strongly suggested that each player performs a minimum of 10 minutes of sub-maximal running, followed by an appropriate stretching regimen, and some acceleration sprints to pace. For indoor testing an electronic sprint timer with photo-electric sensors is set at chest height and placed at 10 m and 40 m intervals from the start line. The player is instructed to position himself, in a crouched start position, 30 cm from the start line. The player sprints maximally for 40 m through the sensors. The player completes two flat-out runs separated by a 5-10 minute recovery period. If a player is tested on a grass surface then boots must be used. For outdoor tests a stopwatch is used to time the player over the distance. No starting blocks are allowed. If indoor testing is done then running shoes should be used. Spikes are not allowed.

Scoring:

Record times for each 10 m and 40 m marks (Hazeldine & McNab, 1991).

Explosive leg power (Vertical jump)

Purpose:

The purpose of this test is to measure the subject's instantaneous explosive leg power.

Equipment:

Measurement tape, chalk

Procedure:

The subject stands, in athletic shoes, with his right side (hip) against a wall onto which a calibrated measuring board is mounted. The subject then reaches with the right/left hand to touch the board at the highest point possible (heels of the feet stay on the ground). This point is recorded as "standing height". The subject then places chalk on his fingertips (dominant hand)

and then, from a two-footed take-off position the subject flexes at the hip and knee joints and using his arms as momentum, attempts to extend as high as possible. At the top of the jump the subject touches and marks the board with his fingertips. The subject is allowed three attempts and the best one is recorded.

Score:

The score for the jump is the difference between the standing height and the jump height. The highest of three separate trials is recorded as the subject's maximum score. It should be noted that if the subject takes any form of step or shuffle prior to the jump, the score is rendered invalid. (Thomas & Nelson, 1985).

Agility (Illinois-test)

Purpose:

The purpose of this test is to measure the subjects ability to accelerate, decelerate and change direction. The test is set up as shown below:

Equipment:

Cones, whistle, tape-measure and photocells if possible otherwise hand timing will suffice.

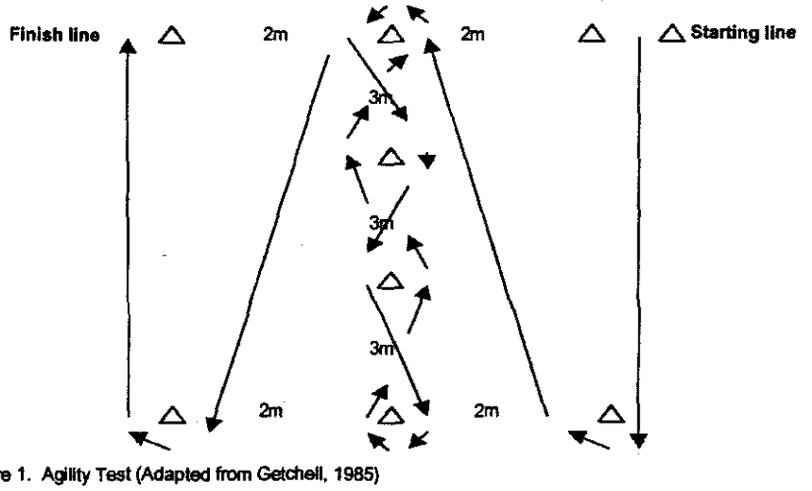


Figure 1. Agility Test (Adapted from Getchell, 1985)

Procedure:

The subject lies in the prone position with his chin touching the surface on the starting line. On the stimulus (whistle) he jumps up and accelerates towards and around the opposite cone. He then runs towards the starting lines middle cone, zig-zag through the cones downward and again upwards, sprints to the last cone on the far side and finishes at the finish line. If a player is tested on a grass surface then boots must be used. No starting blocks are allowed. If indoor testing is done then running shoes should be used.

Scoring:

The subject gets two chances of which the best time is taken and recorded in seconds (AAHPER, 1966).

Strength

- **1RM bench-press**

Purpose:

The purpose of these tests is to determine the players' maximal upper body (chest) strength.
The one repetition maximum (1RM) test is used to determine the players' maximal strength. These 1RM values are useful in prescribing correct loads in exercise programs and in evaluating strength improvements over time. Maximal strength tests, if performed incorrectly carry a high risk of injury. Never complete any exercise, which causes pain.
1RM Bench Press (absolute) – (kg).
1RM Bench Press (relative) – 1RM/(bodyweight x 0.57) (the athlete with the largest numerical index is considered the strongest body mass-adjusted lifter). The body weight is multiplied by a combination of the 2-power and 3-power (0.57) before it is divided into the strength.

Equipment:

Olympic bar
Weights
Three testing personnel for spotting

Procedure:

For this exercise, the player lies supine on a bench with his/her feet flat on the floor and his/her hips and shoulders in contact with the bench. An Olympic bar is gripped 5-10 cm wider than shoulder width, so that when the bar is placed on the chest, the elbow joints are flexed to approximately 90 degrees. The player commences this lift by lowering the bar, in a controlled manner, to the centre of the chest, touching the chest lightly (no bouncing the bar on the chest) and then extending upwards until the arms are in a fully locked position. The player is advised to inhale when lowering the bar and exhale when pressing it.

There are several reasons for disqualifying a lift, and these include:

1. lifting the buttocks, during the movement,
2. bouncing the bar off the chest,
3. uneven extension of the arms,
4. any touching of the bar by the spotter.

The following basics steps can be followed for 1RM testing:

1. Complete a light warm-up set of 10 repetitions using the 20 kg bar only
2. Complete 6-8 repetitions at approximately 30-40 % of the estimated 1RM
3. Complete a 2 minute stretching routine of shoulders and chest at rest
4. Increase the weight to 60 % of the estimated 1RM, complete six repetitions.
5. The player then rests for 3-4 minutes before attempting his 1RM
6. If step 5 was successful then the player takes a 5 minute rest period before increasing the resistance (used in step 5) by 2.5 % to 5 %.
7. If the subject cannot lift the weight, then use the previous successful weight lifted as his 1RM

Scoring:

The maximum amount of weight that can be lifted with one repetition. (Thomas & Nelson, 1985).

- **Underhand Pull-ups**

Purpose:

The objective of this test is to measure the athletes' upper body muscular endurance.

Equipment:

Pull-up bar

Chalk/rubber gripping/towel to ensure a secure grip on the bar.

Procedure:

An underhand grip is used with hands placed 10 cm apart. The subject must start from a hanging position (arms fully extended.). The subject's chin must reach above the bar on the ascent with arms fully extending (straightening) on the descent. A repetition is not valid if these requirements are not fulfilled. The subject must pull his/her knees up in front (of the body) during the movement in order to avoid arching the back. This is a maximal test with the subject continuing until he can no longer lift himself to the bar. The subject should warm up on the lateral pull-down machine and then rest and stretch for 2 – 3 min. prior to starting the test.

Scoring:

The amount of valid pull-ups completed from an extended arm position to where the chin touches the bar and back down (Thomas & Nelson, 1985).

- **Push-ups (Maximum in 60 seconds)**

Purpose:

The aim of this test is to measure the player's upper body strength and endurance.

Equipment:

Stopwatch.

Gymnastic mat.

Procedure:

The player assumes a position where his/her thumbs are shoulder-width apart. Keeping the back and body straight the player descends to the tester's fist, placed below the sternum and ascends until elbows are fully extended (straightened). If the player does not adhere to these specifications the repetition is not counted. Female players perform a modified push up from their knees. The back is kept flat and the hands are placed so that the thumbs are shoulder-width apart.

Scoring:

The number of push ups performed in one minute is recorded. The player may rest within the one-minute period (Thomas & Nelson, 1985).

Speed endurance

- **Multistage shuttle run (Bleep test)**

Purpose:

To enable an approximation of maximal oxygen uptake (VO^2 max). The maximal aerobic power (endurance fitness) of rugby players can be assessed by, a progressive multistage shuttle run according to the protocol of Lèger & Lambert (1982). This test has both excellent test – retest reliability ($r = 0.97$) and validity ($r = 0.84$) (Lèger & Lambert, 1982).

Equipment:

Audiocassette, portable cassette player, 20 m marked distance on a flat surface, stopwatch.

Procedure:

A 20 m distance is measured out and the players complete as many repetitions as possible at the speed set by a taped beep. Players should attempt to complete each 20 m distance (lap) and turn as each beep sounds. The time allowed to complete each 20 m decreases each 60 seconds. One foot must pass the marked line by the time the beep sounds. The players should continue until voluntary withdrawal when unable to keep up with the beep. In some cases a warning should be given if the player fails to complete the 20 m distance as the beep sounds for 2 consecutive laps. A second warning should be given if the athlete fails to catch up with the beep within the following 2 laps. Failure to keep up with the beep after 3 warnings results in the player dropping out. The score is taken at the last completed lap.

Scoring:

Measured as number of successfully completed shuttles of 20 m. This can be converted to give an approximation of the player's VO^2 max test.

4.3.3 Rugby-specific skill tests

Ground skills (Pick-up and place)

Purpose:

The purpose of this test is to measure the players' ability to complete a distance in the shortest period with a combined pick-up and placing of a rugby-ball.

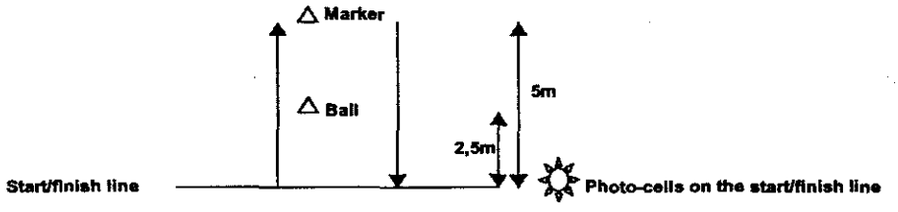


Figure 2. Pick and place test

Figure 2. Pick up and place test (Australian Rugby Football Union, 1990).

Equipment:

Photo-cells, cones and a rugby-ball

Procedure:

A rugby-ball is placed half-way between the starting-line and a marker which is placed 5 m from the starting-line. The subject starts running from the starting-line when the command is given. The ball is picked up with both hands and the subject then runs around the marker and puts the ball down where he picked it up. He keeps on running over the starting-line.

Scoring:

Each subject has three chances and the best time to the nearest 0.1 (one-tenth) of a second is measured (Australian Rugby Football Union, 1990).

Passing for accuracy over 4m

Purpose:

To measure the athletes' ability to pass accurately to the left and right.

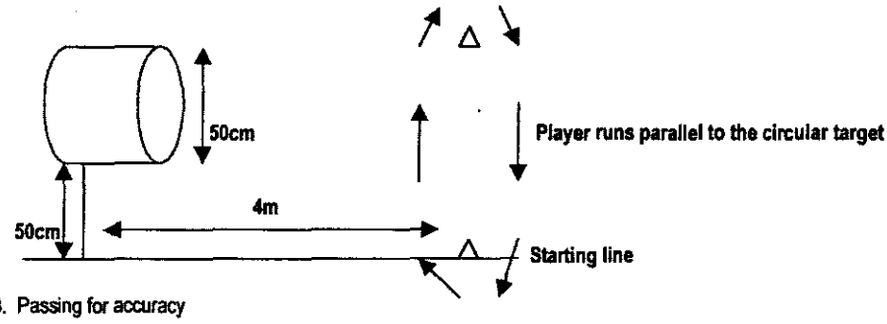


Figure 3. Passing for accuracy

Figure 3. Passing for accuracy (Pienaar & Spamer, 1995).

Equipment:

A metal circle with a diameter of 50cm is mounted on a vertical base 50 cm from the ground; (this is the target) and one rugby-ball is required.

Procedure:

While the player runs in a line parallel to the circle target he must pass the ball through the metal circle, which is 4 m away. The player runs back and forth around beacons that are 5 m apart. A pass through the circle is regarded as correct. The subject has five chances to pass the ball through the circle from the right and five from the left. The pass must be a traditional rugby pass to the side. The subject is allowed one practice go and then one attempt to score as many points as possible.

Scoring:

The subjects' total success-rate (1 point per successful pass) is noted (Pienaar & Spamer, 1995).

Passing for distance

Purpose:

To measure the maximum distance a player can pass a ball through the air. The pass must be a traditional below the shoulder rugby pass and not an American style football pass overhead.

Equipment:

50 m Tape measure and a rugby-ball.

Procedure:

The subject takes a rugby-ball with both hands and using the hand of preference passes forward as far as possible. The subject may use a short run-up. Two attempts are allowed.

Scoring:

The best attempt will be recorded (AAPHER, 1966).

Kicking ability (Kicking for distance)

Purpose:

To measure a players' ability to kick the ball as far as possible through the air.

Equipment:

100 m Tape-measure and a rugby-ball.

Procedure:

The subject takes the rugby-ball with both hands and using the foot of preference, tries to kick it forward as far as possible. The respondent may make use of a run-up. Two attempts are allowed.

Scoring:

The best of the two is recorded (AAPHER, 1966).

Catching ability (Catch and throw over the cross-bar)

Purpose:

The purpose of this test is to measure how many times a player can throw a ball over the crossbar and catch it in 30 seconds.

Equipment:

A rugby-ball and standard rugby-posts.

Procedure:

The respondent throws the ball over the crossbar of the rugby-posts and then moves under the crossbar to catch the ball again. Should the ball bounce on the crossbar and still be caught the attempt is regarded as successful. The respondent keeps on for 30 seconds.

Scoring:

The number of times the ball is caught is recorded (AAPHER, 1966).

4.4 STATISTICAL METHOD

Statistical software is used for the data analysis. The SAS- computer-program package of the North-West University, Potchefstroom campus (SAS Institute Inc., 1999) was used. Descriptive statistics ($\bar{x}$, standard deviation, minimum and maximum) were used as well as practical significant differences (d-values) (Cohen, 1988). To comment on practical significance, the standardised difference between the means of two populations, i.e. the difference between the two means divided by the estimate for standard deviation is used. The measure that was introduced is called the effect size. The effect size makes the difference independent of units and sample size, and relates with the spread of the data (Steyn, 1999, 2000).

Cohen (1988) uses the following formula to determine effect sizes of the differences between the means of the two groups.

$$d = \frac{\bar{x}_1 - \bar{x}_2}{s}$$

Where $\bar{x}1$ is the mean of group 1 and $\bar{x}2$ is the mean of group 2. S = ½ (S1 + S2), S1 and S2 being the standard deviation of the two groups.

Cohen (1988) gives the following guidelines for the interpretation of the effect size in the current case:

$d < 0.5$: small effect size with no practically significant effect.

$0.5 \leq d < 0.8$: medium practical effect that tends towards a practically significant difference.

$d \geq 0.8$: large effect that is a practically significant difference.

Thus, data with $d > 0.8$ is considered as practically significant, since it is the result of a difference having a large effect.

The following chapter consists of the results of the tests done on the U/16 and U/1/8 elite schoolboy rugby player.

CHAPTER 5

RESULTS AND DISCUSSION

5.1 INTRODUCTION

5.2 ANTHROPOMETRICAL CHARACTERISTICS OF U/16 AND U/18 ELITE RUGBY PLAYERS

5.3 PHYSICAL AND MOTOR ABILITIES OF U/16 AND U/18 ELITE RUGBY PLAYERS

5.4 GAME-SPECIFIC SKILLS OF U/16 AND U/18 ELITE RUGBY PLAYERS

5.5 SUMMARY

5.6 ANTHROPOMETRICAL CHARACTERISTICS OF U/16 ELITE RUGBY PLAYER POSITIONS

5.7 PHYSICAL AND MOTOR ABILITIES OF THE U/16 ELITE RUGBY PLAYER POSITIONS

5.8 GAME-SPECIFIC SKILLS OF U/16 ELITE RUGBY PLAYER POSITIONS

5.9 ANTHROPOMETRICAL CHARACTERISTICS OF U/18 ELITE RUGBY PLAYER POSITIONS

5.10 PHYSICAL AND MOTOR ABILITIES OF THE U/18 ELITE RUGBY PLAYER POSITIONS

5.11 GAME-SPECIFIC SKILLS OF U/18 ELITE RUGBY PLAYER POSITIONS

5.12 CONCLUSION OF COMPARISONS OF PLAYER POSTIONS IN U/16 AND U/18 ELITE RUGBY PLAYERS WITH REGARD TO ANTHROPOMETRICAL, PHYSICAL AND MOTOR- AND GAME-SPECIFIC SKILLS COMPONENTS.

5.13 RANKING ORDER OF PLAYER POSITIONS OF U/16 ELITE RUGBY PLAYERS WITH REGARD TO ANTHROPOMETRICAL CHARACTERISTICS PHYSICAL AND MOTOR ABILITIES AND GAME- SPECIFIC SKILLS.

5.14 RANKING ORDER OF PLAYER POSITIONS OF U/18 ELITE RUGBY PLAYERS WITH REGARD TO ANTHROPOMETRICAL CHARACTERISTICS, PHYSICAL AND MOTOR ABILITIES AND GAME-SPECIFIC SKILLS

5.15 BEST PLAYER POSITION OF GREEN SQUAD 2003/2004 SEASON

CHAPTER 5

RESULTS AND DISCUSSION

5.1 INTRODUCTION

The aim of this study is to compile a physical and game skills profile of the U/16 and U/18 South African elite schoolboy rugby player by using anthropometric characteristics, physical and motor abilities and game-specific skills.

In this chapter, the results of the empirical investigation are presented and discussed according to the results listed in Tables. The SAS-computer programme package of the North-West University, Potchefstroom campus (SAS Institute Inc., 1999) was used for data analysis.

This chapter consists firstly of descriptive statistics (mean ($\bar{x}$), standard deviation (sd), minimum (min), maximum (max) and practical significant differences (d-values) (Cohen, 1988) for the U/16 and U/18 elite rugby player during August 2003 and February 2004 for anthropometric, physical and motor and games-specific skill tests. Secondly, descriptive statistics (mean, $\bar{x}$ and practical significant differences, (d-values) for player positions of U/16 and U/18 elite rugby players are discussed. Thirdly a ranking order of player positions with regard to anthropometric characteristics, physical and motor abilities and game-specific skills of U/16 and U/18 elite rugby players is presented. Lastly statistical methods to determine the best player position of the Green Squad of 2003/2004 seasons are reported.

5.2 ANTHROPOMETRICAL CHARACTERISTICS OF U/16 AND U/18 ELITE RUGBY PLAYERS

According to Table 5.1 the height of the U/16 elite rugby player showed an increase from 2003 to 2004 although of low practical significance (d=0.34). The mean stature of the U/16 elite rugby player showed an increase from 175.41 cm in 2003 to 178.17 cm in 2004. In a study by Van Gent (2003:127) the mean stature of the U/16 elite provincial rugby players of North-West was recorded as 180.86 cm and the talented U/16 rugby players in a study by Hare (1997:88) the mean

stature was 177.63 cm. Table 5.1 also presents an increase in the mean weight (76.17 kg in 2003 and 79.50 kg in 2004) for U/16 Green Squad rugby players of low practical significance (d=0.24). In comparison with Van Gent's study (2003:127) the North-West provincial U/16 elite rugby player had a body mass of 76.64 kg and in Hare's study (1997.88) 72.82 kg. The mean percentage of body fat (14.33 % in 2003 and 15.04 % in 2004) was lower than the percentage of body fat for the U/16 (15.96 %) in Van Gent's study (2003:129) and the talented U/16 (18.77 %) players measured in Hare's study (1997:88). An increase in body fat percentage is not desirable, thus it is recommended that the training programmes should be reviewed. Another reason for the increase could be that during December 2003, the players did not adhere to the training programmes.

In Table 5.1 the sum of seven skinfolds of the Green Squad U/16 rugby players was 67.61 mm in 2003 and increased to 73.51 mm in 2004, whilst the elite provincial U/16 players in Van Gent's study (2003:128) recorded 57.68 mm for the sum of six skinfolds. The muscle percentage of the U/16 Green Squad rugby player in this study illustrates low practical significance (d=0.35) but the mean muscle percentage (63.53 % in 2003 and 61.34 % in 2004) shows a decline. It is expected that an increase in muscle percentage should be displayed since training programmes have been developed and applied from August 2003 to February 2004.

The elite U/16 players (Table 5.1) presented an endo-mesomorphic physique (2.91/5.48/2.11 in 2003 and 3.15/5.71/2.21 in 2004) (endo-meso-ectomorphic respectively). De Ridder (1993) also recorded a somatotype (2.9/4.7/2.1) of the secondary school rugby players, which indicated an endo-mesomorphic physique.

The comparisons revealed that, like body mass, stature also increased from 2003 to 2004 in the Green Squad U/16 player. The Green Squad U/16 players were taller and heavier than the talented U/16 in Hare's study (1997), heavier than their counterparts in Van Gent's study (2003) but the elite provincial rugby players in Van Gent's study (2003) were (1.69 cm) taller. The U/16 Green Squad rugby players in this study had a lower fat percentage than their counterparts in Van Gent's study (2003) and Hare's study (1997). It seems that the national elite players (Green Squad) have less body fat percentage than provincial elite players, as expected.

Table 5.2 illustrates an improvement in mean values of anthropometric variables in U/18 elite rugby players from 2003 to 2004. Low practical significance (d=0.02) with regard to height (180.27 cm in 2003 to 180.43 cm in 2004) is illustrated. The U/18 provincial rugby players

presented a taller stature (184.11 cm) in Van Gent's study (2003) as did the U/18 English players (185.61 cm) and Northern Bulls high school Craven Week U/18 players (181.9 cm) in a study by Spamer and Winsley (2003). The Ivybridge (English) U/18 players (181.86 cm) and the Blue Bulls U/18 Craven Week players (185.61 cm) also recorded taller statures than the Elite U/18 rugby players (Plotz, 2004:93). The body mass of the U/18 Green Squad rugby players of this study increased from 85.07 kg in 2003 to 86.83 kg in 2004. In a study by Van Gent (2003) the body mass of the U/18 players (84.78 kg) was lower (2.05 kg) than the Green Squad U/18 players of this study. A study by Spamer and Winsley (2003) however, found that the average body mass (87.8 kg) for the elite U/18 English players and Northern Bulls high school Craven Week team (87.4 kg) was higher than the U/18 players of this study. Similarly, the Blue Bulls U/18 (87.38 kg) and Ivybridge U/18 rugby players (87.84 kg) in Plotz's (2004) study were heavier than the Green Squad U/18 players in this study. The increase in body mass of the Green Squad U/18 players could be the result of the increase in stature.

The mean percentage of body fat (15.14 % in 2003 and 14.65 % in 2004) was lower than the U/18 players (18.55 %) in Van Gent's study (2003) as well as the English U/18 players (22.1 %) and Northern Bulls high school Craven Week team (15.8 %) in the study by Spamer and Winsley (2002). Although the body fat percentage of the Green Squad U/18 players in this study represents low practical significant (d=0.12) there was a decline in mean percentage of 0.4 % as expected. It seems that with regard to body fat percentage, the Green Squad U/18 players proved the best result. Table 5.2 illustrates a decrease in the sum of seven skinfolds (76.87 mm in 2003 to 70.76 mm in 2004) in the Green Squad U/18 rugby player. This correlates with the decline in body fat percentage in the same group which means that the amount of adipose fat has decreased. The U/18 Green Squad rugby players in this study presented with an endo-mesomorphic physique (3.23/5.82/1.86 in 2003), which decreased to (3.10/5.52/1.66 in 2004) (being endo-meso- & ectomorphic respectively).

In conclusion it seems that the elite U/18 rugby players in this study are shorter than their counterparts in Van Gent's (2003) and Spamer and Winsley's (2002) studies. The Green Squad U/18 players in this study are heavier than their counterparts in Van Gent's study (2003) but have lower fat percentage than their counterparts in Van Gent's (2003) and Spamer and Winsley's (2003) studies. It seems that in most anthropometrical measurements of U/16 and U/18 Green Squad rugby players changes occurred from 2003 to 2004 among adolescent rugby players, although there were low practical significant differences.

Table 5.1: Descriptive stastistics and practical significant differences (d- values) of the anthropometrical components of the under 16 elite rugby player

VARIABLES	2003					2004					Practical significance (d-values)
	n	$\bar{x}$	sd	min	max	n	$\bar{x}$	sd	min	max	
Height (cm)	67	175.41	8.09	150.30	195.00	75	178.17	7.57	154.8	198.00	0.34
Weight (kg)	67	76.17	11.74	45.20	110.50	75	79.50	13.63	46.20	115.00	0.24
Sum of 7 skinfolds (mm)	66	67.61	28.29	35.00	177.30	75	73.51	39.07	37.10	301.40	0.15
Muscle %	66	63.53	5.29	45.89	78.90	74	61.34	6.34	31.44	75.61	0.35
Body fat %	66	14.33	3.94	8.61	24.29	75	15.04	4.18	8.93	33.03	0.17
Endomorphy	66	2.91	1.28	1.40	6.80	75	3.15	1.52	1.48	10.69	0.16
Mesomorphy	66	5.48	1.17	3.51	9.87	39	5.71	1.24	3.25	9.18	0.19
Ectomorphy	67	2.11	1.01	0.10	4.36	75	2.21	1.08	0.10	4.46	0.09

Table 5.2: Descriptive stastistics and practical significant differences (d- values) of the anthropometrical components of the under 18 elite rugby player

VARIABLES	2003					2004					Practical significance (d-values)
	n	$\bar{x}$	sd	min	max	n	$\bar{x}$	sd	min	max	
Height (cm)	75	180.27	9.21	160.90	200.00	43	180.43	9.04	161.50	203.00	0.02
Weight (kg)	75	85.07	12.45	61.50	115.90	44	86.83	13.86	62.90	119.60	0.13
Sum of 7 skinfolds (mm)	72	76.87	28.31	36.80	194.70	42	70.76	36.80	39.50	211.80	0.17
Muscle %	72	62.04	7.41	31.33	85.53	41	61.80	3.53	53.68	70.14	0.03
Body fat %	74	15.14	3.40	9.04	26.41	43	14.65	4.06	9.46	27.87	0.12
Endomorphy	74	3.23	1.14	1.56	7.65	43	3.10	1.50	1.53	8.34	0.09
Mesomorphy	68	5.82	1.89	3.76	9.46	19	5.52	1.90	0.08	9.38	0.16
Ectomorphy	75	1.86	1.06	0.10	4.12	43	1.66	1.11	0.10	3.99	0.18

High practical significance : $d \geq 0.8$
Medium practical significance: $d \geq 0.5$
Low practical significance : $d < 0.5$

5.3 PHYSICAL AND MOTOR ABILITIES OF U/16 AND U/18 ELITE RUGBY PLAYERS

Table 5.3 illustrates an improvement in all physical and motor components of the U/16 Green Squad rugby players from 2003 to 2004 except in the agility Illinois test. More players were tested in speed components in 2004 than in 2003, that could influence results. The physical and motor abilities of the U/16 Green Squad rugby players presented low (d=0.33) to medium (d=0.73) practical significant differences over the testing period.

The U/16 Green Squad players presented medium practical significance in speed over 10m (d=0.67) and speed over 40m (d=0.55). Special mention can be made of an increase in speed over 10m from 1.90 sec. in 2003 to 1.84 sec. in 2004 amongst the U/16 Green Squad rugby players. The U/16 Green Squad rugby players in this study were faster over 10m than the U/16 (1.89 sec.) provincial rugby players in Van Gent' study (2003) and faster than the U/17 (2.21 sec.) in Hanekom's (2000) study. According to Table 5.3 the U/16 Green Squad rugby players presented an increase in speed over 40m (5.54 sec. in 2003 to 5.42 sec. in 2004). Similarly better performances of medium practical significance (d=0.50) was recorded in speed endurance (shuttle run) from mean 81.41 in 2003 to mean 91.00 in 2004. The increase in speed and speed endurance from 2003 to 2004 could be due to training programmes that these players have followed.

Although the U/16 Green Squad rugby players in this study recorded a decline (15.07 sec. in 2003 to 15.43 sec. in 2004) in the agility Illinois test of medium practical significance (d=0.50), they still presented better results compared to the U/16 provincial rugby players (18.01 sec) in Van Gent's (2003) study. Increases in strength components namely bench press (75.52 kg in 2003 to 82.89 kg in 2004) and push ups (38.84 in 2003 and 48.20 in 2004) were recorded with and medium low practical significance of d=0.46 and d= 0.73 respectively. Previous studies did not include bench press or push ups tests, so comparisons could not be made. The increase in physical and motor abilities could be due to the training programmes that the players followed but also due to adolescent growth.

According to Table 5.4 the physical and motor abilities of the U/18 Green Squad rugby players illustrated an improved performance in speed over 10m (1.87 sec. in 2003 to 1.85 sec. in 2004) and strength components namely bench press (95.24 kg in 2003 to 105.94 kg in 2004), pull ups (10.40 in 2003 to 12.41 in 2004) and push ups (50.74 in 2003 to 58.19 in 2004). Although speed

over 40m (5.43 sec in 2003 and 5.45 sec in 2004), agility Illinois (14.97 sec in 2003 and 15.36 sec in 2004) and speed endurance test (96.00 in 2003 and 93.07 in 2004) presented a decline from 2003 to 2004, the results were of low practical significance (d=0.06, d=0.41, d=0.17 respectively). The U/18 Green Squad rugby players (1.85 sec in 2004) did, however, outperform the U/18 provincial rugby players (2.02 sec.) in Van Gent's (2003) study and U/19 players (2.31 sec.) in Hanekom's (2000) study in terms of speed over 10m. The U/18 Green Squad rugby players recorded faster times (15.36 sec in 2004) than the U/18 provincial rugby players (17.15 sec) in Van Gent's (2003) study with reference to agility Illinois test. Taking the improvement in strength components into consideration, it seems that muscle development had increased amongst the U/18 Green Squad rugby players and that this could be due to better physical conditioning programmes.

The U/16 Green Squad rugby players in this study recorded faster times in speed over 10m (1.84 sec) and speed over 40m (5.42 sec) than the U/18 Green Squad rugby players (1.85 sec and 5.45 sec respectively) at the beginning of the 2004 season. The U/18 Green Squad rugby players in this study recorded better results in all the other physical and motor components.

It seems that physical and motor abilities improved with age as is the case with the U/18 Green Squad players except in speed over 10m and 40m, but the improvement amongst the U/16 Green Squad players could be due to the training programmes that were followed.

5.4 GAME-SPECIFIC SKILLS OF U/16 AND U/18 ELITE RUGBY PLAYERS

According to Table 5.5 the U/16 Green Squad rugby players improved in their game-specific skills from 2003 to 2004 with the exception of ground skills ability. However tests presented low or medium practical significance.

The U/16 Green Squad players recorded medium practical significance (d=0.68) in catching and throwing skills but the mean result (12.82 in 2003) increased to (15.22 in 2004). Although the U/16 Green Squad players recorded a slower time (3.12 sec in 2003 compared to 3.18 sec in 2004) with regard to ground skills, they performed better than the talented U/16 rugby players (5.68 sec.) tested by Hare (1997) and the U/16 provincial rugby players (3.62 sec.) tested by Van Gent (2003).

In this study, passing for accuracy over 4m was recorded as results out of five attempts in passing to the right and left respectively. Studies by Van Gent (2003) and Plotz (2004) recorded results out of ten, thus it is difficult to compare the results of this study to other studies. Although an improvement was recorded (Table 5.5) from 2003 to 2004 season in passing for accuracy over 4m to the left (2.45 in 2003 and 2.79 in 2004) and to the right (2.29 in 2003 and 2.51 in 2004) it had low practical significance (d=0.26 to the left and d=0.18 to the right).

The kicking for distance test revealed that the U/16 Green Squad rugby players in this study (42.85 m in 2003 to 45.13 m in 2004) presented better results than the U/16 provincial rugby players (41.41 m) tested by Van Gent (2003) and the talented U/16 rugby players (38.02 m) tested by Hare (1997). Table 5.5 also revealed that passing for distance showed medium practical significance (d=0.68) with a distance of 25.39 m in 2003 and 27.95 m in 2004. The U/16 Green Squad rugby players of this study performed much better (27.95 m in 2004) than the U/16 rugby players (21.14 m) in Van Gent's (2003) study and the U/16 talented rugby players (19.95 m) tested by Hare (1997). It can be noted that passing for distance and kicking for distance also involves muscle strength and that the improvement in these skills could be due to training programmes and growth.

Illustrated in Table 5.6. the U/18 Green Squad rugby players presented with an improvement in only two game-specific skills namely passing for distance and kicking for distance from 2003 to the 2004 season. The other components recorded poorer results but this could be due to far less players being tested in 2004 compared to 2003.

Even though the U/18 Green Squad players recorded a slower time (3.18 sec in 2004), with reference to ground skill it had low practical significance (d=0.24). The U/18 Green Squad rugby players of this study presented a much better time (3.13 sec. in 2003 and 3.18 sec. in 2004) with regard to ground skills than the U/18 players (3.59 sec) tested by Van Gent (2003) as well as the Blue Bulls U/18 players (3.43 sec), Ivybridge (English) U/18 (3.79 sec) and the Leopards U/18 players (3.28 sec) in a study by Plotz (2004).

Table 5.3: Descriptive statistics and practical significant differences (d-values) for physical- and motor abilities of the under 16 elite rugby players.

VARIABLES	2003					2004					Practical significance (d-values)
	n	$\bar{x}$	sd	min	max	n	$\bar{x}$	sd	min	max	
Speed (sec) 10m	51	1.90	0.09	1.77	2.22	64	1.84	0.07	1.72	2.02	0.67
Speed (sec) 40 m	50	5.54	0.21	5.16	6.23	64	5.42	0.22	5.09	5.96	0.55
Agility Illinois (sec)	50	15.07	0.96	13.93	19.51	65	15.43	1.09	13.92	18.88	0.33
Speed endurance (n)	34	81.41	19.09	43.00	122.00	44	91.00	17.00	56.00	129.00	0.50
Bench press absolute (kg)	58	75.52	1.50	50.00	115.00	55	82.89	15.87	40.00	125.00	0.46
Pull ups (n)	63	9.46	1.08	0	18.00	64	11.33	4.72	2.00	25.00	0.40
Push ups (n)	73	38.84	11.18	12.00	69.00	56	48.20	12.87	21.00	77.00	0.73

Table 5.4: Descriptive statistics and practical significant differences (d-values) for physical- and motor abilities of the under 18 elite rugby players.

VARIABLES	2003					2004					Practical significance (d-values)
	n	$\bar{x}$	sd	min	max	n	$\bar{x}$	sd	min	max	
Speed (sec) 10m	75	1.87	0.11	1.72	2.18	57	1.85	0.08	1.70	2.02	0.18
Speed (sec) 40 m	76	5.43	0.33	4.97	6.23	57	5.45	0.28	4.98	6.58	0.06
Agility Illinois (sec)	44	14.97	0.72	13.94	17.27	32	15.36	0.95	13.80	18.35	0.41
Speed endurance (n)	62	96.00	17.37	63.00	133.00	46	93.07	16.79	54.00	130.00	0.17
Bench press absolute (kg)	85	95.24	18.58	50.00	155.00	68	105.94	21.38	60.00	165.00	0.50
Pull ups (n)	81	10.40	5.45	1.00	34.00	71	12.41	5.32	2.00	28.00	0.37
Push ups (n)	73	50.74	27.28	16.00	96.00	63	58.19	14.12	32.00	109.00	0.27

High practical significance : $d \geq 0.8$
Medium practical significance: $d \geq 0.5$
Low practical significance : $d < 0.5$

The U/18 Green Squad players recorded poorer results with regard to passing for accuracy over 4m from 2003 (2.81 to the left and 2.68 to the right) to 2004 (2.12 to the left and 2.46 to the right). The decline in the results passing for accuracy over 4m, showed a medium practical significance (d=0.57 left) and low practical significance (d=0.16 right). Good handling skills are an important requirement in rugby, thus passing for accuracy over 4m should receive definite attention in the training programmes.

The kicking for distance test presented low practical significance (d=0.24) and revealed that the U/18 Green Squad rugby players in this study improved (42.77 m in 2003 to 44.71 m in 2004). Van Gent's (2003) research revealed that the average kicking distance for U/18 provincial rugby players was 37.84 m. The average kicking distance for the Blue Bulls U/18 players (48.42 m) in a study by Plotz (2004) was further than the U/18 Ivybridge (English) players (33.26 m) and the Leopards U/18 players (47.22 m) in the same study, thus the U/18 Green Squad rugby player in this study performed poorer than the Blue Bulls U/18 and the Leopards U/18 but better than the Ivybridge (English) U/18 players and the U/18 provincial players in Van Gent's study (2003).

The U/18 Green Squad rugby players also improved with regard to passing for distance (24.39 m in 2003 to 26.23 m in 2004) and showed medium practical significant differences (d=0.79). Although they recorded poorer distances than the Blue Bulls U/18 players (28.41 m) tested by Plotz (2004), the U/18 Green Squad players of this study performed better (26.23 m in 2004) than the provincial U/18 players (23.99 m) tested by Van Gent (2003), the Ivybridge (English) U/18 players (19.66 m) and the Leopards U/18 (25.50 m) players in Plotz's study (2004).

Similar to the U/16 Green Squad players in this study, the U/18 Green Squad players performed better in passing for distance and kicking for distance from 2003 to the 2004 season, which could be due to an improvement in physical ability, growth and training programmes. The U/16 Green Squad players also recorded an improvement in the catching and throwing and passing for accuracy over 4m tests.

Table 5.5: Descriptive statistics and practical significant differences (d-values) of game-specific skills of the under 16 elite rugby players

VARIABLES	2003					2004					Practical significance (d-values)
	n	$\bar{x}$	sd	min	max	n	$\bar{x}$	sd	min	max	
Catching ability (catch & throw over crossbar) (n)	55	12.82	2.94	3.00	18.00	23	15.22	3.55	9.00	22.00	0.68
Ground skills (pick up & place) (sec)	41	3.12	0.18	2.81	3.60	44	3.18	0.20	2.73	2.52	0.30
Passing for accuracy Left (L)	51	2.45	1.19	0	5.00	57	2.79	1.33	0	5.00	0.26
(4m) (n) Right(R)	51	2.29	1.22	0	5.00	57	2.51	1.20	0	5.00	0.18
Passing for distance (m)	19	25.39	2.56	21.29	31.90	46	27.95	3.74	19.80	40.50	0.68
Kicking for distance (m)	51	42.85	7.08	24.48	59.50	42	45.13	6.33	34.00	59.30	0.32

Table 5.6: Descriptive statistics and practical significant differences (d-values) of game-specific skills of the under 18 elite rugby players

VARIABLES	2003					2004					Practical significance (d-values)
	n	$\bar{x}$	sd	min	max	n	$\bar{x}$	sd	min	max	
Catching ability (catch & throw over crossbar) (n)	54	13.94	3.27	6.00	19.00	5	13.80	3.11	6.00	10.00	0.04
Ground skills (pick up & place) (sec)	46	3.13	0.20	2.70	3.84	12	3.18	0.21	2.89	3.60	0.24
Passing for accuracy Left (L)	53	2.81	1.16	1.00	5.00	26	2.12	1.33	1.00	5.00	0.57
(4m) (n) Right(R)	53	2.68	1.37	0	5.00	26	2.46	1.20	1.00	5.00	0.16
Passing for distance (m)	14	24.39	2.69	19.90	28.70	16	26.23	2.37	22.80	31.50	0.79
Kicking for distance (m)	49	42.77	16.00	9.78	60.00	16	44.71	4.66	36.10	51.43	0.24

High practical significance : $d \geq 0.8$
Medium practical significance: $d \geq 0.5$
Low practical significance : $d < 0.5$

5.5 SUMMARY

In conclusion it is noted that the U/16 Green Squad rugby players showed an increase in all anthropometrical components except muscle percentage compared to the U/18 Green Squad rugby players in this study that recorded an increase in stature and body mass from 2003 to 2004. It can be highlighted that the Green Squad U/16 rugby players (73.51 mm) had a bigger measurement with reference to skinfold thickness than the U/18 Green Squad rugby players (70.76 mm) at the beginning of 2004. In terms of body fat percentage the Green Squad U/16 rugby players (15.04 %) had a higher measurement than the Green Squad U/18 rugby players (14.65 %) in 2004. It is of some concern that the U/16 Green Squad rugby players exhibit such a large body fat percentage and skinfold thickness. This factor should be attended to. Although the changes were of low and medium practical significance, the increase in anthropometrical components coincides with a vigorous growth period of the adolescent.

With regard to physical and motor abilities the U/16 Green Squad rugby players presented poorer results in the agility Illinois test whereas the U/18 Green Squad rugby players recorded poorer results in speed over 40m, agility Illinois and shuttle run test in the 2003/2004 season. All the other physical and motor components improved from 2003 to 2004 in both the groups, however, not with a high practical significance. When comparing U/16 Green Squad rugby players to the U/18 Green Squad rugby players with regard to physical and motor components, the U/16 Green Squad rugby players (5.42 sec) were faster over 40m than the U/18 Green Squad rugby players. The U/16 Green Squad rugby players (1.84 sec) also presented better times in speed over 10m than the U/18 Green Squad rugby player (1.85 sec) at the beginning of the 2004 season. This could be due to better physical conditioning and training programmes that were developed and applied for these Green Squad groups.

The game-specific skills of the U/16 Green Squad rugby players improved from 2003 to 2004 with the exception of ground skills tests. In the U/18 Green Squad rugby player only passing for distance and kicking for distance presented better results from 2003 to 2004.

It is evident from this study that the U/16 Green Squad players (27.95 m in 2004) outperformed the U/18 Green Squad players (26.23 m in 2004) in passing for distance. The U/16 Green Squad players (45.13 m in 2004) showed better results than the U/18 Green Squad players (44.71 m in

2004) with regard to kicking for distance. In terms of ground skills both groups were evenly matched (3.18 sec) in 2004.

The U/16 Green Squad players recorded a better performance (15.22) in 2004 than the U/18 Green Squad players (13.80) in the catching and throwing over the crossbar test and passing for accuracy (2.79 left and 2.51 right) compared to (2.12 left and 2.46 right) respectively. It seems that game-specific skills do not necessarily improve with advancing age and might be more influenced by experience in rugby and training.

5.6 ANTHROPOMETRICAL CHARACTERISTICS OF U/16 ELITE RUGBY PLAYER POSITIONS

- **Introduction**

Descriptive statistics was used to establish significant differences between player positions in terms of anthropometrical characteristics, physical and motor abilities and game-specific skill components. The effect size of the differences between the means of 2003 and 2004 season are described as the d-value, ($d < 0.5$ is of low practical significance, $d \geq 0.5$ has medium practical significance and $d \geq 0.8$ has high practical significance). Only player positions that reflect more or less the same number of players tested in 2003 and 2004 are discussed. It must be noted that in some components, which compare positional groups, the small numbers within each classification may limit the power of statistical analysis.

- ***Anthropometric characteristics***

In Table 5.7(a) all player positions in the U/16 Green Squad rugby player group increased in height from 2003 to 2004. Although low (d=0.03) to medium (d=0.78) practical significant differences were recorded, it can be noted that the locks were the tallest players (190.73 cm) in 2004. The locks being the tallest players correlates with literature (Nicholas, 1997:377) stating that height is an advantage together with jumping ability for this position in order to gain possession in line-outs. Even though the scrumhalfs presented the shortest players (167.48 cm in 2004), their stature increased the most (6.63 cm) from 2003 to 2004.

The findings in Table 5.7(b) show an increase in body mass in all player positions except the hookers The increase in body mass revealed low (d=0.06) to medium (d=0.68) practical significance as did the decrease in body mass of the hookers (d=0.10). The props and locks presented the highest body mass (90.94 kg) and the scrumhalfs were the lightest (62.00 kg) in 2004.

Descriptive statistics and practical significant differences (d-values) for player position of the under 16 elite rugby player with regard to anthropometric characteristics

Table 5.7(a): Height (cm)

Positions	2003		2004		Practical significance d-values
	n	$\bar{x}$	n	$\bar{x}$	
Centre	8	172.29	8	174.50	0.03
Flanker	6	179.82	9	180.47	0.12
Flyhalf	6	172.50	5	175.24	0.50
Fullback	6	178.03	8	179.87	0.35
Hooker	7	173.41	5	175.56	0.69
No. 8	4	179.95	6	183.55	0.78
Prop	7	175.38	8	179.84	0.75
Scrumhalf	4	160.75	5	167.48	0.71
Lock	8	187.01	8	190.72	0.60
Wing	11	171.58	13	173.25	0.29

Table 5.7(b): Weight (kg)

Positions	2003		2004		Practical significance d-values
	n	$\bar{x}$	n	$\bar{x}$	
Centre	8	69.21	8	72.86	0.36
Flanker	6	80.44	9	82.20	0.21
Flyhalf	6	69.48	5	73.32	0.68
Fullback	6	74.98	8	76.56	0.24
Hooker	7	79.50	5	78.84	0.10
No. 8	4	81.60	6	83.32	0.21
Prop	8	90.34	8	103.61	0.36
Scrumhalf	4	57.37	5	62.00	0.51
Lock	8	87.34	8	90.94	0.36
Wing	11	68.80	13	69.22	0.06

High practical significance : $d \geq 0.8$
Medium practical significance: $d \geq 0.5$
Low practical significance : $d < 0.5$

Table 5.7(c): Sum of 7 skinfolds (mm)

Positions	2003		2004		Practical significance d-values
	n	$\bar{x}$	n	$\bar{x}$	
Centre	8	47.76	8	59.68	1.05
Flanker	6	65.27	9	63.31	0.09
Flyhalf	6	62.20	5	58.56	0.35
Fullback	6	52.83	8	59.40	0.37
Hooker	7	73.18	5	70.38	0.45
No. 8	4	68.40	6	70.63	0.12
Prop	7	110.78	8	149.24	0.55
Scrumhalf	4	53.79	5	51.28	0.12
Lock	8	78.45	8	78.24	0.01
Wing	10	55.87	13	64.89	0.41

Table 5.7(d): Body fat (%)

Positions	2003		2004		Practical significance d-values
	n	$\bar{x}$	n	$\bar{x}$	
Centre	8	11.30	8	13.70	1.44
Flanker	6	14.90	9	13.68	0.39
Flyhalf	6	13.30	5	14.28	0.49
Fullback	6	11.94	8	13.25	0.41
Hooker	7	16.40	5	15.45	0.40
No. 8	4	14.29	6	14.97	0.20
Prop	7	18.97	8	23.04	0.80
Scrumhalf	4	14.16	5	12.27	0.38
Lock	8	15.15	8	15.17	0.07
Wing	10	12.92	13	14.11	0.35

Table 5.7(e): Muscle (%)

Positions	2003		2004		Practical significance d-values
	n	$\bar{x}$	n	$\bar{x}$	
Centre	8	63.27	7	57.28	0.65
Flanker	6	63.26	9	59.34	0.37
Flyhalf	5	63.66	5	61.93	0.57
Fullback	6	64.27	8	65.28	0.19
Hooker	7	62.51	5	61.68	0.20
No. 8	4	65.90	6	58.41	1.74
Prop	7	63.19	8	59.70	0.47
Scrumhalf	4	57.28	5	60.48	0.36
Lock	8	63.51	8	63.57	0.01
Wing	11	65.70	13	63.42	0.33

The scrumhalfs recorded the most increase in body mass (5.62 kg) from 2003 to 2004. With regard to weight, findings in this study correlate with literature (Nicholas 1997:382-383) that props are the heaviest forwards, while scrumhalfs are the lightest. A similar tendency, was recorded by Van Gent (2003), the props being the heaviest players (88.00 kg) and the scrumhalfs the lightest (68.00 kg).

According to Table 5.7(c) the centres presented a high practical significance (d=1.05) in skinfold thickness. The props recorded the highest measurement (149.24mm) in skinfold thickness at the beginning of the 2004 season. The centres (11.92 mm), fullbacks (6.57 mm), eighth men (2.23 mm), wings (9.02 mm) and props (38.82 mm) presented an increase in skinfold thickness from 2003 to 2004 with the props recording the highest increase. In a study by Van Gent (2003:145) the mean sum of six skinfolds of the backline players was (49.88 mm) and the props (84.67 mm) compared to the U/16 Green Squad rugby players centre playing position (59.68 mm) and props (149.24 mm) in this study.

De Ridder (1993) reported that amongst playing positions of Primary and High School Craven Week rugby players, props had the highest mean of six skinfolds (102.2 mm and 117.9 mm) respectively. Similarly the props in this study had the highest mean of seven skinfolds (149.24 mm) and the locks second highest (78.24 mm). Table 5.7(d) illustrates high practical significant differences with regard to body fat percentage in the U/16 Green Squad rugby player positions, centres (d=1.44) and props (d=0.80). These results correlate with the increase in skinfold thickness in both player positions as mentioned previously, thus illustrating an increase in adipose fat. The props recorded a higher increase in body fat percentage (4.06 %) than centres (2.43 %) from 2003 to 2004. The Green Squad U/16 centres in this study had a lower body fat percentage (13.70 %) than the mean body fat percentage (14.52 %) of the U/16 centres tested by Van Gent (2003). The U/16 props in this study, however, had a higher body fat percentage (23.04 %) than the U/16 props (20.78 %) in Van Gent's study (2003). The body fat percentage (23.04 %) of the props in the U/16 Green Squad seems exceptionally high and should be attended to. Research by De Ridder (1993:5-200) on secondary provincial schoolboy rugby players noted that the forwards had the highest fat percentage whilst fullbacks and wings had the lowest fat percentage. Similarly, studies by Nicholas (1997) recorded forwards to have a greater percentage of body fat than backs. In this study the props recorded the highest body fat percentage (23.04 %) and the scrumhalfs recorded the lowest body fat percentage (12.27 %). According to Table 5.7(e) the eighth men in this study presented a high practical significance (d=1.74) in terms of muscle

percentage. Only the fullbacks (65.28 %), scrumhalfs (60.48 %) and locks (63.57 %) recorded higher muscle percentage at the beginning of the 2004 season. This could be due to growth and the training programmes that were followed. In Table 5.7(f) the centres showed a high practical significance in endomorphy (d=1.33). This is to be expected when taking into account the results of their body fat percentage (13.70 %) and skinfold thickness (59.68 mm). The props recorded medium practical significance (d=0.67) in endomorphy. The U/16 Green Squad flankers (d=1.03) presented high practical significance in Table 5.7(g) with regard to mesomorphy. With the exception of scrumhalfs, flyhalfs and eighth men, all player positions had an increase in mesomorphic physique at the beginning of the 2004 season.

Table 5.7(f): Endomorphy

Positions	2003		2004		Practical significance d-values
	n	$\bar{X}$	n	$\bar{X}$	
Centre	8	1.94	8	2.50	1.33
Flanker	6	3.14	9	2.77	0.41
Flyhalf	6	2.58	5	2.65	0.12
Fullback	6	2.31	8	2.61	0.31
Hooker	7	3.60	5	3.29	0.39
No. 8	4	2.97	6	3.12	0.16
Prop	7	4.63	8	6.15	0.67
Scrumhalf	4	1.86	5	2.11	0.68
Lock	8	3.36	8	3.27	0.06
Wing	10	2.42	13	2.78	0.35

Table 5.7(g): Mesomorphy

Positions	2003		2004		Practical significance d-values
	n	$\bar{X}$	n	$\bar{X}$	
Centre	8	5.08	4	5.77	0.52
Flanker	6	4.78	7	5.95	1.03
Flyhalf	6	5.28	2	5.14	0.07
Fullback	6	5.03	3	5.18	0.09
Hooker	7	6.20	1	6.90	1.13
No. 8	4	5.82	4	4.88	0.79
Prop	7	7.06	8	7.34	0.17
Scrumhalf	4	5.40	4	4.74	0.55
Lock	8	5.23	3	5.52	0.29
Wing	10	5.11	5	5.21	0.11

Table 5.7(h): Ectomorphy

Positions	2003		2004		Practical significance d-values
	n	$\bar{x}$	n	$\bar{x}$	
Centre	8	2.50	8	2.33	0.14
Flanker	6	2.23	9	1.94	0.26
Flyhalf	6	2.40	5	2.32	0.11
Fullback	6	2.58	8	2.70	0.19
Hooker	7	1.22	5	1.61	0.64
No. 8	4	2.05	6	2.47	0.16
Prop	7	0.82	8	0.49	0.51
Scrumhalf	4	2.19	5	2.68	0.51
Lock	8	2.58	8	2.78	0.17
Wing	11	2.36	13	2.59	0.27

In this study of the U/16 Green Squad players the front row forwards displayed endo-mesomorphic somatotypes. The back row forwards displayed endo-mesomorphic somatotypes but had less endomorphic characteristics than the front row forwards. The backs had mesomorphic somatotypes and recorded higher ectomorphic components than the forwards. A study by De Ridder (1993:236-243) on secondary school provincial rugby players revealed that forwards had an endo-mesomorphic physique compared to backs who were balanced mesomorfic.

5.7 PHYSICAL AND MOTOR ABILITIES OF U/16 ELITE RUGBY PLAYER POSITIONS

All player positions illustrated an improvement in speed over 10m from 2003 to 2004 (Table 5.8(a)). The wings (d=0.83), the scrumhalfs (d=1.43) and eighth men (d=1.60) recorded high practical significant differences and the scrumhalfs were also fastest (1.77 sec) over 10m at the beginning of the 2004 season. Similar findings, were presented by the U/16 provincial halfs (1.75 sec) in Van Gent's study (2003). The flyhalfs in this study were second fastest (1.79sec) in speed over 10m. The flyhalfs (0.11 sec) and scrumhalfs (0.10 sec) presented the best improvement (0.05) from 2003 to 2004. The props recorded the slowest time (1.95 sec).

According to Table 5.8(b) all player positions improved in speed over 40m from 2003 to 2004. The scrumhalfs (d=1.38) and flyhalfs (d=0.83) reported high practical significance. The U/16

Green Squad scrumhalfs (5.27 sec) and fullbacks (5.27 sec) were the fastest over 40m in 2004 whilst the scrumhalfs improved the most (0.22 sec). Again the props presented the slowest time (5.79 sec) at the beginning of the 2004 season.

In rugby union, to achieve the fastest possible running speed either from a stationary or a moving start is an important motor component (Hazeldine & McNab, 1991). The improvement of speed over 10m and 40m in this group could be due to the training and conditioning programmes.

The purpose of the agility Illinois test is to measure the rugby players' ability to accelerate, decelerate and change direction. In Table 5.8(c) only the centres recorded an improvement in the agility Illinois test from 2003 to 2004 but it is of low practical significance (d=0.20) It can be noted that the hookers showed a decline in agility Illinois test of high practical significance (d=0.85). The results could be due to the difference in numbers of rugby players tested in 2003 and 2004 and due to certain positional requirements needing more agility than others.

Descriptive statistics and practical significant differences (d-values) for player position of the under 16 elite rugby player with regard to physical and motor abilities

Table 5.8(a): Speed 10 m (sec)

Positions	2003		2004		Practical significance d-values
	n	$\bar{x}$	n	$\bar{x}$	
Centre	7	1.83	7	1.82	0.40
Flanker	6	1.88	9	1.87	0.11
Flyhalf	2	1.90	4	1.79	0.62
Fullback	2	1.81	7	1.81	0.17
Hooker	4	1.91	6	1.88	0.27
No. 8	4	1.92	6	1.83	1.60
Prop	9	2.02	6	1.95	0.78
Scrumhalf	3	1.87	3	1.77	1.43
Lock	5	1.90	6	1.89	0.17
Wing	9	1.85	10	1.80	0.83

High practical significance : $d \geq 0.8$
Medium practical significance: $d \geq 0.5$
Low practical significance : $d < 0.5$

Table 5.8(b): Speed 40 m (sec)

Positions	2003		2004		Practical significance d-values
	n	$\bar{x}$	n	$\bar{x}$	
Centre	7	5.31	7	5.29	0.43
Flanker	6	5.48	8	5.47	0.14
Flyhalf	2	5.49	4	5.34	0.83
Fullback	2	5.35	7	5.27	0.56
Hooker	4	5.60	6	5.60	0.17
No. 8	6	5.56	6	5.37	0.58
Prop	8	5.85	6	5.79	0.33
Scrumhalf	3	5.49	4	5.27	1.38
Lock	5	5.64	6	5.57	0.27
Wing	9	5.39	10	5.28	0.58

The results in Table 5.8(d) of the shuttle run test, illustrated the maximal aerobic power and speed endurance of the rugby players. All player positions except the eighth men recorded an improvement with regard to speed endurance at the end of 2004. The poorer results of the eighth men (105.00 in 2003 and 96.00 in 2004) were of low practical significance (d=0.28). The hookers (d=2.63) and scrumhalfs (d=0.92) showed high practical significance as well as the props (d=1.09). The fullbacks' result (d=2.04) cannot be commented on as only one player was tested in 2003. The eighth men had the best result (105.00) in 2003 whilst the flankers scored the best result (98.60) in 2004. The improvement could be due to the training programmes and due to the growth spurt of the adolescent when the internal organs' increase size and muscle enlargements take place, thus improving endurance and aerobic capacity.

The strength components of rugby players, involves fitness concerned with the ability to repeat muscular contraction over a period of time (Hazeldine & McNab 1991). Reflected in Table 5.8(e) all player positions except scrumhalfs and props recorded an improvement in bench press results from 2003 to 2004. The improvement by flyhalfs (d=1.12), fullbacks (d=1.79), flankers (d=0.82) and hookers (d=0.80) illustrated high practical significance. The flankers presented the best mean result (101.0 kg) in maximal upper body strength in 2004 followed by the rest of the forward players; locks (93.75 kg), props (90.00 kg), hookers (95.00 kg) and eighth men (85.00 kg) as expected since the forward players spent most of their time in rucking, mauling and scrummaging.

According to Table 5.8(f) all player positions showed an improvement in upper body muscular endurance in terms of pull ups from 2003 to 2004 except the scrumhalfs and props. Although the mean results recorded illustrate an improvement, no player positions recorded values of high practical significance. The centres, however, did the most pull ups (13.57) at the beginning of the 2004 season. In a study by Van Gent (2003) the halfs recorded the best mean result (12.50) for pull ups.

Table 5.8(c): Agility Illinios (sec)

Positions	2003		2004		Practical significance d-values
	n	$\bar{x}$	n	$\bar{x}$	
Centre	7	15.26	6	14.89	0.20
Flanker	6	15.11	8	16.23	0.72
Flyhalf	2	14.50	5	14.66	0.53
Fullback	2	14.37	7	14.83	1.02
Hooker	4	14.75	6	15.35	0.85
No. 8	4	15.25	6	15.62	0.36
Prop	9	15.73	5	16.86	0.72
Scrumhalf	2	14.26	4	14.57	0.61
Lock	5	15.25	6	15.64	0.39
Wing	9	14.65	12	15.34	0.73

Table 5.8(d): Speed Endurance (Shuttle run result) (n)

Positions	2003		2004		Practical significance d-values
	n	$\bar{x}$	n	$\bar{x}$	
Centre	5	80.40	5	84.20	0.17
Flanker	6	89.50	5	98.60	0.34
Flyhalf	0	.	4	94.75	.
Fullback	1	71.00	3	95.67	2.04
Hooker	3	84.33	3	97.33	2.63
No. 8	3	105.00	3	96.00	0.28
Prop	8	66.12	4	88.00	1.09
Scrumhalf	2	82.50	3	89.67	0.92
Lock	3	79.33	3	87.33	0.26
Wing	3	86.00	11	87.36	0.08

Table 5.8(e): Bench Press Absolute (kg)

Positions	2003		2004		Practical significance d-values
	n	$\bar{x}$	n	$\bar{x}$	
Centre	7	70.71	7	77.86	0.39
Flanker	7	82.14	5	101.00	0.82
Flyhalf	3	68.33	3	80.00	1.12
Fullback	5	71.00	6	80.83	1.79
Hooker	5	83.00	5	95.00	0.80
No. 8	1	80.00	5	85.00	0.71
Prop	6	91.67	5	90.00	0.08
Scrumhalf	4	63.75	5	63.40	0.02
Lock	8	87.12	4	93.75	1.41
Wing	12	68.75	104	74.20	0.49

Table 5.8(f): Pull ups (n)

Positions	2003		2004		Practical significance d-values
	n	$\bar{x}$	n	$\bar{x}$	
Centre	7	11.28	7	13.57	0.55
Flanker	5	7.80	8	12.12	0.72
Flyhalf	4	11.00	3	14.00	0.57
Fullback	6	9.33	7	11.14	0.77
Hooker	6	8.83	6	10.00	0.31
No. 8	3	8.33	5	12.40	0.59
Prop	6	6.67	6	5.50	0.19
Scrumhalf	4	13.25	5	12.20	0.28
Lock	9	6.67	6	8.17	0.33
Wing	13	11.31	11	13.45	0.55

Table 5.8(g): Push ups (n)

Positions	2003		2004		Practical significance d-values
	n	$\bar{x}$	n	$\bar{x}$	
Centre	9	39.22	6	45.17	0.33
Flanker	7	38.28	4	54.00	0.91
Flyhalf	5	44.20	3	53.33	0.97
Fullback	7	35.28	5	45.20	1.43
Hooker	6	44.33	5	60.00	1.11
No. 8	3	36.00	5	53.60	1.97
Prop	8	32.37	7	41.86	0.95
Scrumhalf	5	44.40	4	47.00	0.18
Lock	9	40.67	7	46.43	0.40
Wing	14	37.50	10	45.20	0.90

Table 5.8(g) illustrates upper body strength and endurance (push-ups). All player positions improved from 2003 to 2004. The fullbacks (d=1.43), hookers (d=1.11), eighth men (d=1.07), props (d=0.95), flankers (d=0.91) and wings (d=0.90) presented high practical significance. Although the eighth men's mean result (36.00 in 2003 and 53.60 in 2004) improved the most (17.60), the hookers could do the most push ups (60.00) at the beginning of the 2004 season.

The backline presented significant differences in more components than the forwards, which suggests that backline players need specific physical and motor characteristics. The forwards performed best in physical components, which is expected due to their positional requirements.

5.8 GAME-SPECIFIC SKILLS OF U/16 ELITE RUGBY PLAYER POSITIONS

Catching and throwing the ball over the crossbar is a measure of the rugby player's basic handling skills and it involves quick responses. According to Table 5.9(a) all player positions improved in this game-specific skill from 2003 to 2004 except for the flankers. The centres (d=1.09) and wings (d=0.88) illustrated high practical significance. The locks presented the best result (22.0) in 2004 for the number of times they did catching and throwing over the crossbar while the flankers reported the lowest score (11.50). Normally the flankers have good handling skills as recommended by SARFU (1998:26). In a study by Van Gent (2003:227) the U/16 provincial flankers also had poor scores in handling skills. A player's ability to combine pick-up and placing of a rugby ball whilst running is an important skill to ensure ball retention. Table 5.9(b) illustrate the results of ground skills. From 2003 to 2004 the eighth men (3.25sec in 2003 and 3.02sec in 2004) and flyhalfs (3.06sec in 2003 and 3.04sec in 2004) improved whilst the other player positions recorded slower times in completing this test. The flankers (d=0.94), eighth men (d=1.35) and scrumhalfs (d=1.40) recorded a poorer performance of high practical significance at the beginning of 2004 with reference to ground skills. The props presented the slowest time (3.47 sec) whilst, the fastest time (3.02 sec) was recorded by the eighth men at the end of 2004 season. Van Gent (2003:231) noted that the U/16 provincial rugby players' eighth men presented ground skills to be important. According to SARFU (1998:26) eighth men need good handling skills. They use this skill quite often when picking up a ball at the back of a scrum.

In both passing for distance and kicking for distance a strength component as well as eye-hand-ball co-ordination is important. According to Table 5.9(c), all player positions improved the passing for distance skill from 2003 to 2004 except for the fullbacks. The eighth men (d=1.61) and props (d=1.81) recorded high practical significance. The eighth men presented best result (34.27 m) in 2004 with regard to passing for distance. In a study by Van Gent (2003) the halfs (21.38 m) presented best results in passing for distance. The eighth men in Van Gent's study (2003:231) presented with good results in passing for distance. It seems that both forward and backline players need to develop this skill.

Descriptive statistics and practical significant differences (d-values) for player position of the under 16 elite rugby player with regard to game-specific skills

Table 5.9(a): Catching and throwing over crossbar (n)

Positions	2003		2004		Practical significance d-values
	n	$\bar{x}$	n	$\bar{x}$	
Centre	5	13.00	3	14.67	1.09
Flanker	6	13.50	4	11.50	0.73
Flyhalf	4	12.75	1	14.00	0.81
Fullback	4	14.00	2	17.50	0.95
Hooker	5	10.80	1	12.00	0.42
No. 8	5	13.00	2	17.50	1.84
Prop	9	12.00	3	14.67	0.72
Scrumhalf	4	14.00	0	.	.
Lock	7	13.71	1	22.00	3.24
Wing	6	12.00	6	16.33	0.88

High practical significance : $d \geq 0.8$
Medium practical significance: $d \geq 0.5$
Low practical significance : $d < 0.5$

Table 5.9(b): Ground skills (sec)

Positions	2003		2004		Practical significance d-values
	n	$\bar{x}$	n	$\bar{x}$	
Centre	4	3.04	5	3.15	0.26
Flanker	6	3.08	5	3.25	0.94
Flyhalf	1	3.06	3	3.04	0.14
Fullback	2	3.10	4	3.18	0.43
Hooker	3	3.16	4	3.20	0.17
No. 8	3	3.25	5	3.02	1.35
Prop	8	3.24	4	3.47	1.92
Scrumhalf	3	2.93	3	3.07	1.40
Lock	4	3.03	3	3.17	0.48
Wing	7	3.09	7	3.18	0.28

Table 5.9(c): Passing for distance (m)

Positions	2003		2004		Practical significance d-values
	n	$\bar{x}$	n	$\bar{x}$	
Centre	1	22.77	5	27.95	1.01
Flanker	3	24.04	6	28.75	1.99
Flyhalf	1	24.40	3	27.77	1.93
Fullback	2	29.80	5	28.02	0.39
Hooker	1	24.70	4	26.30	1.05
No. 8	2	27.30	3	34.27	1.61
Prop	4	25.55	5	27.04	1.81
Scrumhalf	0	.	3	24.43	.
Lock	2	27.30	3	29.20	0.35
Wing	3	25.96	9	26.34	0.13

Table 5.9(d): Kicking for distance (m)

Positions	2003		2004		Practical significance d-values
	n	$\bar{x}$	n	$\bar{x}$	
Centre	5	46.64	4	43.47	0.37
Flanker	6	40.57	6	45.17	0.54
Flyhalf	3	51.39	3	49.07	0.25
Fullback	3	40.53	3	51.90	0.79
Hooker	5	41.92	4	40.87	0.29
No. 8	4	42.95	5	49.11	1.05
Prop	8	40.98	4	42.68	0.36
Scrumhalf	4	39.12	2	38.60	0.13
Lock	6	40.42	3	47.07	1.01
Wing	7	46.40	8	43.70	0.34

In Table 5.9(d), five player positions showed an improvement in kicking for distance from 2003 to 2004, namely flankers, fullbacks, eighth men, props and locks. The eighth men (d=1.05) illustrated high practical significance. The fullbacks could kick the farthest (51.90 m) in 2004. In this study the U/16 Green Squad scrumhalfs presented the poorest result (38.60m) in 2004. Again it seems as if kicking for distance is a skill that improved amongst forward players as well as fullbacks. This could be due to the training programmes and the changing requirements of certain player positions in the rugby game of today. Often forward players are seen in the backline.

Table 5.9(e): Passing for Accuracy 4m (n)

Positions		2003		2004		Practical significance d-value
		n	x̄	n	x̄	
Centre	L	5	2.80	6	3.00	0.11
	R	5	2.00	6	1.83	0.09
Flanker	L	6	2.83	8	2.88	0.03
	R	6	2.50	8	2.63	0.15
Flyhalf	L	2	2.50	4	3.75	0.83
	R	2	1.41	4	3.50	1.06
Fullback	L	5	3.80	6	2.83	0.75
	R	5	1.60	6	3.00	1.23
Hooker	L	4	2.50	5	1.40	0.66
	R	4	2.50	5	2.00	0.39
No. 8	L	5	2.00	4	2.75	0.78
	R	5	2.80	4	2.75	0.05
Prop	L	8	1.75	5	3.20	1.13
	R	8	1.63	5	2.00	0.26
Scrumhalf	L	3	1.67	4	3.50	1.06
	R	3	3.67	4	4.00	0.40
Lock	L	6	2.00	4	2.50	0.45
	R	6	2.50	4	2.25	0.18
Wing	L	7	2.71	11	2.55	0.12
	R	7	2.43	11	2.09	0.23

According to SARFU (1998:26) a fullback needs to be good at kicking. Craven (1974:106) reported that a fullback should be a second flyhalf. It can be noted that the scrumhalfs' poor kicking distance of 38.60 m should be attended to.

To enable ball retention and scoring of points, the rugby player needs to accurately pass or distribute the ball. Passing for accuracy 4m should be done with the left and right hand respectively on top of the ball. In this study the results recorded were out of 5 attempts to the left and right respectively. The player positions that improved from 2003 to 2004 (Table 5.9(e)) are centres (3.00 left), flankers (2.88 left and 2.63 right), flyhalfs (3.75 left and 3.50 right), fullbacks (3.00 right), eighth men (2.75 left), props (3.20 left and 2.00 right), scrumhalfs (3.50 left and 4.0 right) and locks (2.50 left). The fullbacks (d=1.23 right), flyhalfs (d=0.83 left and d=1.06 right), props (d=1.19 left) and scrumhalfs (d=1.06 left) presented high practical significance. The scrumhalfs scored the best result (4.0 right) and the flyhalf (3.75 left) in 2004. Passing for accuracy 4m is especially important in scrumhalfs as they are the link between the forwards and the backs, and behind the scrum they make decisions to which side the ball is distributed. It is desirable that scrumhalfs should be equally skilled to the left and to the right. The results of the U/16 Green Squad group were poor with regard to passing for accuracy 4m and should be addressed in the training programmes. Van Gent (2003) stated that in her study of the U/16 provincial rugby players, the backline players presented more rugby-specific skill components than the forwards. In this study it seems that game-specific skills are equally important in forwards and backs.

5.9 ANTHROPOMETRICAL CHARACTERISTICS OF U/18 ELITE RUGBY PLAYER POSITIONS

In Table 5.10(a) an increase in stature is noted amongst all player positions from 2003 to 2004. The fullbacks presented a high practical significance (d=0.97) and their increase in height (10.20 cm) was the most from 2003 to 2004. Similar to the U/16 Green Squad rugby players, the locks of the U/18 Green Squad rugby players were the tallest (194.16 cm). The U/18 provincial rugby player locks in Van Gent's study (2003) measured 189.33 cm in height, thus the U/18 locks in this study were taller than their counterparts in Van Gent's (2003) study. According to SARFU (1998:26) a primary requirement for a lock position is length and good jumping ability. The eighth men in this study presented second tallest stature (181.47 cm) and the props (181.22cm) third tallest at the end of the 2004 season compared to the U/18-year old flankers in Van Gent's

(2003) study that recorded the tallest players (190.50cm). The scrumhalfs in this study were the shortest players (168.16cm) at the beginning of the 2004 season. In a study by De Ridder (1993), scrumhalfs were also the shortest players (171.00 cm).

According to Table 5.10(b) only the locks, props and eighth man illustrated an increase in body weight from 2003 to 2004; however, it revealed low practical significance (d< 0.5). The only position that presented with high practical significance was the fullbacks (d=1.72), although there was a decrease in body mass (82.20 kg in 2003 and 74.90 kg in 2004). The heaviest players were the props (103.20 kg in 2004). Similar results were found by De Ridder (1993), where the props were the heaviest and presented with a mean body mass of 96.4kg as well as by Van Gent (2003) where the props were 96.57 kg. The scrumhalfs in this study presented the lightest players (69.62 kg in 2004) and correlates with studies by De Ridder's (1993) scrumhalfs (67.80 kg) and Van Gent's (2003) scrumhalfs (68.67 kg). The U/18 Green Squad scrumhalfs displayed a heavier body mass (69.62 kg) than the other studies' scrumhalfs.

Table 5.10(c) illustrates an increase in skinfold thickness from 2003 to 2004 in all player positions except for scrumhalfs. The only player position that presented high practical significance was the flyhalfs (d=1.01) with an increase in skinfold thickness (56.97 mm in 2003 to 71.97 mm in 2004). The props in this study presented the highest result (147.07 mm) in terms of skinfold thickness and the scrumhalfs the smallest measurement (55.42mm) at the end of the 2004 season. Van Gent (2003) recorded the props (100.00 mm) in the U/18 provincial eight man with the highest sum of six skinfolds. A skinfold thickness of 147.07 mm (props) is too high and should be addressed in the training programmes.

According to Table 5.10(d) all players recorded an increase in body fat percentage from 2003 to 2004 with the exception of the flankers and scrumhalfs. The results are of low and medium (d < 0.5 and d ≥ 0.5) practical significance. The props in this study presented the highest body fat percentage (22.72 %) in 2004 with the same tendency in Van Gent's (2003) study where the props recorded the highest body fat percentage and had a mean body fat percentage of 26.66 %, and by De Ridder (1993) where the props had a body fat percentage of 24.10 %. Although the props in this study recorded a lower body fat percentage than their counterparts in Van Gent's (2003) and De Ridder's (1993) studies, a 22.20 % of body fat is too high and should be looked into.

Descriptive statistics and practical significant differences (d-values) for player position of the tested 65 elite rugby players with regard to anthropometrical characteristics

Table 5.10(a): Height (cm)

	2003		2004		Practical significance d-values
	n	$\bar{x}$	n	$\bar{x}$	
Centre	12	176.78	7	180.60	0.23
Fullback	7	179.80	6	181.00	0.18
Flyhalf	6	177.23	3	177.45	0.03
Halfback	2	170.40	2	180.60	0.97
Hooker	5	178.82	0	.	.
No. 8	6	177.00	1	181.47	0.70
Prop	11	180.08	6	181.22	0.01
Scrumhalf	7	168.00	4	168.16	0.03
Lock	11	192.99	8	194.16	0.03
Wing	8	174.67	6	177.17	0.30

Table 5.10(b): Weight (kg)

	2003		2004		Practical significance d-values
	n	$\bar{x}$	n	$\bar{x}$	
Centre	12	83.73	7	81.88	0.16
Fullback	7	86.91	6	86.95	0.19
Flyhalf	6	70.53	3	72.33	0.54
Halfback	2	82.20	2	74.90	1.72
Hooker	5	93.10	0	.	.
No. 8	6	86.28	2	88.95	0.16
Prop	11	99.14	6	103.20	0.04
Scrumhalf	7	69.93	4	69.62	0.05
Lock	11	95.23	8	95.50	0.03
Wing	8	79.43	6	73.62	0.49

High practical significance : $d \geq 0.8$
Medium practical significance: $d \geq 0.5$
Low practical significance : $d < 0.5$

Table 5.10(c): Sum of 7 skinfolds (cm)

Positions	2003		2004		Predicted
	n	x̄	n	x̄	
Centre	11	63.73	7	65.40	
Flanker	7	61.80	5	65.56	
Flyhalf	6	56.97	3	71.67	
Fullback	2	60.80	2	64.10	
Hooker	5	80.72	0		
No. 8	6	64.68	1	69.70	
Prop	10	110.17	6	147.07	
Scrumhalf	7	59.13	4	55.92	
Lock	10	68.09	8	71.79	
Wing	8	56.16	6	58.80	

Table 5.10(d): Body fat (%)

Positions	2003		2004		Predicted
	n	x̄	n	x̄	
Centre	11	13.75	7	13.83	
Flanker	7	13.88	5	13.95	
Flyhalf	6	13.40	3	15.97	
Fullback	2	12.75	2	13.60	
Hooker	5	15.34	0		
No. 8	6	14.17	1	15.34	
Prop	11	19.72	6	22.72	0.11
Scrumhalf	7	12.98	4	12.64	
Lock	11	14.24	8	14.68	0.15
Wing	8	12.92	6	13.92	0.17

Table 5.10(e): Muscle (%)

Positions	2003		2004		Predicted
	n	x̄	n	x̄	
Centre	11	65.45	7	62.67	
Flanker	7	57.62	5	64.91	
Flyhalf	6	57.92	3	59.66	
Fullback	2	63.35	2	61.77	
Hooker	5	60.55	0		
No. 8	6	64.07	1	62.26	
Prop	10	59.18	6	61.87	
Scrumhalf	7	65.32	4	61.49	
Lock	10	59.94	7	61.63	
Wing	8	64.55	6	62.90	

Table 5.10(f): Endomorphy

[illegible]	2003		2004		Practical significance d-values
[illegible]	n	x̄	n	x̄	
[illegible]	11	2.75	7	2.71	0.05
[illegible]	7	2.79	6	2.73	0.10
[illegible]	6	2.65	3	3.10	0.59
[illegible]	2	2.60	2	2.68	0.06
[illegible]	5	3.33	0	.	.
[illegible]	6	2.91	1	3.22	0.45
[illegible]	11	4.90	6	6.09	0.14
[illegible]	7	2.56	4	2.28	0.38
[illegible]	11	2.91	8	3.04	0.15
[illegible]	8	2.50	6	2.64	0.20

Table 5.10(g): Mesomorphy

[illegible]	2003		2004		Practical significance d-values
[illegible]	n	x̄	n	x̄	
[illegible]	11	6.18	1	5.83	2.43
[illegible]	7	5.73	4	6.35	0.36
[illegible]	6	4.49	2	5.23	0.29
[illegible]	2	5.14	2	5.79	0.57
[illegible]	4	6.54	0	.	.
[illegible]	6	5.69	0	.	.
[illegible]	9	6.97	3	7.74	0.08
[illegible]	7	5.54	2	7.50	2.11
[illegible]	11	5.50	1	4.57	0.08
[illegible]	7	4.60	4	4.12	0.03

Table 5.10(h): Ectomorphy

[illegible]	2003		2004		Practical significance d-values
[illegible]	n	x̄	n	x̄	
[illegible]	12	1.63	7	2.18	0.50
[illegible]	7	1.44	6	1.43	0.01
[illegible]	6	2.61	3	2.80	0.35
[illegible]	2	2.61	2	1.32	0.51
[illegible]	5	0.67	0	.	.
[illegible]	6	1.56	0	.	.
[illegible]	11	0.66	6	0.41	0.25
[illegible]	7	1.64	4	1.63	0.08
[illegible]	11	2.64	8	2.76	0.07
[illegible]	8	1.68	6	2.21	0.37

It seems that the high measurement in skinfold thickness and body fat percentage could indicate a high amount of adipose fat. In Table 5.10(e) the flankers, flyhalfs, props and locks showed an increase in muscle percentage from 2003 to 2004. Low (d< 0.5) and medium (d> 0.5) practical significant differences were found in terms of muscle percentage. The flankers displayed medium practical significance (d=0.65). However, they had the biggest increase in muscle percentage (6.39 %) from 2003 to 2004. This could be due to growth and the training programmes that were followed.

In Table 5.10(f) six player positions namely flyhalfs, fullbacks, eighth men, props, locks and wings illustrated an increase in endomorphy from 2003 to 2004. The props were the most endomorfic (6.09) at the beginning of 2004 with the scrumhalfs being the least endomorphic (2.28). All player positions illustrated (Table 5.10(g)) a high mesomorphic result (4.12 to 7.74 in 2004) and low ectomorphic characteristics (1.33 to 2.80 in 2004). In terms of somatotype, a low value indicates a body mass that is relatively high in relation to stature, whereas a high value in ectomorphy is an indication of low body mass in relation to stature. In Table 5.10(g) positions with low ectomorphic values are: flankers (1.43), fullbacks (1.33), props (1.42) and scrumhalfs (1.64). The props displayed an endo-mesomorphic physique (6.09/7.74/1.42) and the scrumhalfs a mesomorphic physique (2.28/7.50/1.64) (endo-/meso-/ectomorphy respectively).

In conclusion, the forward players seem to present more changes with regard to anthropometrical components than backline players. From these results it is evident that the U/18 Green forward players in this study continue an adolescent growth period although less vigorous than the U/16 Green Squad players in this study. The results demonstrate that the U/18 Green forward and back players have unique anthropometric characteristics, which depends on positional role.

5.10 PHYSICAL AND MOTOR ABILITIES OF THE U/18 ELITE RUGBY PLAYER POSITIONS

According to Table 5.11(a) seven player positions improved speed over 10m from 2003 to 2004; the flyhalfs showed poorer results and the eighth men and locks' results remained unchanged. The hookers recorded high practical significance (d=1.42) and were the fastest players (1.74 sec) over 10m at the end of 2004. However, this is not as expected. The props were the slowest (1.87sec) and the wings presented the second fastest times over 10m (1.77sec) at the beginning of the 2004 season.

In Van Gent's study (2003) the U/18 provincial centres recorded 1.83 sec in speed over 10m and the wings 1.83 sec. It seems that the U/18 Green Squad players in this study are faster than their counterparts in Van Gent's study. Illustrated in Table 5.11(b), only the hookers and scrumhalfs improved their times over 40m in 2004 than in 2003. The scrumhalfs presented high significant differences (d=0.82) but the wings were the fastest players over 40m (5.14 sec) at the beginningend of 2004. According to Craven (1974:96-98) and SARFU (1998:26), scrumhalfs need the ability to accelerate and need sprinting speed as well as agility, but the wings need maximum speed. The wings in the U/18 Green Squad group displayed this speed.

With regard to agility, Table 5.11(c) illustrates that only the scrumhalfs recorded an improvement (15.83 sec in 2003 and 14.74 sec in 2004). The number of scrumhalfs tested, in 2003 were five, compared to only two tested in 2004. Player position flankers (d=1.09), flyhalfs (d=2.31), props (d=0.66) and wings (d=1.30) presented high practical significance, however, these positions showed poorer times in 2004. The most agile players were the centre and scrumhalfs (14.74 sec) in 2004. According to Craven (1974) the scrumhalf position requires extreme agility. De Ridder (1997) states that fullbacks also require agility. In this study the scrumhalfs measured up to the positional requirements as described in previous studies.

According to Table 5.11(d) speed endurance results improved in player positions centres (93.00 to 97.00), fullbacks (94.00 to 102.00), hookers (90.20 to 111.50), eighth men (93.50 to 109.00) and props (90.20 to 93.00) from 2003 to 2004. The flankers (d=0.94) and fullbacks (d=5.67) presented high practical significant differences, but the flankers presented a poorer result in 2004 than in 2003. The scrumhalfs presented the best results (127.25) in 2003 and the hookers (111.50) in 2004. Player positions flankers, flyhalfs, scrumhalfs, locks and wings showed poorer results in 2004 than in 2003. According to Noakes and De Plessis (1996:184) the props, hookers, locks and flankers especially need speed endurance. The game of rugby has become faster due to rule changes (Hanskom 2000:13), therefore forwards need to be mobile and have a high working rate.

The flexibility measurement bench press (Table 5.11(e)) illustrates an improvement in all positions from 2003 to 2004 except for the centres. Player positions fullbacks (d=1.06), props (d=0.91), scrumhalfs (d=1.39) and locks (d=0.82) presented high practical significance. The improvement in bench press results could be attributed to the training programmes that were followed.

In rugby union, strength is an important component of power and strength endurance, especially amongst forwards who spend much time in scrummaging and mauling situations (Hazeldine & McNab: 1991). The hookers (125.00 kg) and props (121.70 kg) presented best results for bench press in 2004 whilst the flyhalfs scored the poorest result (86.43 kg).

In terms of pull ups all player positions displayed an improvement in the 2003 / 2004 season except for the centres (Table 5.11(f)). The flankers (d=0.96) and hookers (d=1.51) presented high practical significant differences. The scrumhalfs recorded the best result (18.40) in 2004. This could be due to the lighter body weight ratio to upper body strength of the scrumhalfs. The flyhalfs had the poorest result (7.50). In a study by Van Gent (2003:233) the scrumhalfs displayed [illegible] as an important component in positional role.

According to Table 5.11(g), all player positions improved during the 2003/2004 season with regard to push ups. The flankers (d=0.89), fullbacks (d=1.82), hookers (d=1.23) and [illegible] (d=1.36) presented high practical significance. This could be due to the training programmes that were followed. The hookers presented the best results (75.00) in 2004. Upper body strength is an important requirement for forward players as these players are wrestling for the ball during a maul, or driving forwards in a scrum (Hazeldine & McNab, 1991).

The improvement in physical and motor components could be due to the training programmes that were applied and followed. In conclusion it seems that differences of low practical significance exist between playing groups in terms of physical and motor components. This could be attributed to all players being well conditioned at this age.

[illegible] and practical significant differences (d-values) for player position of [illegible] rugby player with regard to physical and motor abilities.

Table 5.11(a): Speed 10 m (sec)

Positions	2003		2004		Practical significance d-values
	n	$\bar{x}$	n	$\bar{x}$	
[illegible]	9	1.83	8	1.81	0.20
[illegible]	9	1.88	9	1.86	0.29
[illegible]	6	1.84	5	1.85	0.17
[illegible]	4	1.80	2	1.78	0.25
[illegible]	5	1.92	2	1.74	1.42
No. 8	6	1.82	3	1.82	0.00
Prop	10	2.03	7	1.96	0.78
Scrumhalf	7	1.81	3	1.80	0.13
[illegible]	12	1.89	11	1.89	0.00
Wing	8	1.79	7	1.77	0.29

Table 5.11(b): Speed 40 m (sec)

Positions	2003		2004		Practical significance d-values
	n	$\bar{x}$	n	$\bar{x}$	
[illegible]	9	5.28	8	5.32	0.31
[illegible]	9	5.14	9	5.47	0.26
[illegible]	6	5.39	5	5.42	0.25
[illegible]	4	5.28	2	5.26	0.00
Hooker	5	5.55	2	5.33	0.57
No. 8	6	5.39	3	5.45	0.43
Prop	10	5.90	7	5.92	0.06
Scrumhalf	7	5.36	3	5.23	0.82
[illegible]	12	5.42	11	5.56	0.27
Wing	8	5.14	7	5.14	0.00

[illegible] practical significance : $d \geq 0.8$
[illegible] practical significance: $d \geq 0.5$
Low practical significance : $d < 0.5$

Table 5.11(c): Agility Illinios (sec)

Positions	2003		2004		Practical
	n	$\bar{x}$	n	$\bar{x}$	
Centre	7	14.39	8	14.74	0.35
Flanker	4	14.73	2	15.0	0.27
Flyhalf	2	14.32	3	15.0	0.68
Fullback	1	14.50	2	15.2	0.70
Hooker	3	14.90	6		
No. 8	3	14.97	3		
Prop	6	15.91	4	15.0	0.09
Scrumhalf	5	15.63	2	14.7	0.93
Lock	9	15.39	7	15.2	0.17
Wing	4	14.29	3	14.8	0.51

Table 5.11(d): Speed endurance (Shuttle Run Result) (n)

Positions	2003		2004		Practical
	n	$\bar{x}$	n	$\bar{x}$	
Centre	9	93.00	6	97.00	4.00
Flanker	7	100.00	7	87.86	12.14
Flyhalf	5	101.60	3	97.33	4.27
Fullback	4	94.00	2	102.50	8.50
Hooker	5	90.20	2	111.50	21.30
No. 8	4	93.50	2	109.50	16.00
Prop	7	78.28	6	83.00	4.72
Scrumhalf	4	127.25	3	96.33	30.92
Lock	11	91.00	5	88.60	2.40
Wing	6	108.00	7	93.57	14.43

Table 5.11(e): Bench Press Absolute (kg)

Positions	2003		2004		Practical
	n	$\bar{x}$	n	$\bar{x}$	
Centre	12	95.83	8	95.25	0.58
Flanker	9	98.89	10	110.00	11.11
Flyhalf	7	83.57	7	88.43	4.86
Fullback	3	91.67	5	105.00	13.33
Hooker	7	103.57	2	125.00	21.43
No. 8	6	105.00	2	115.00	10.00
Prop	12	98.75	10	121.70	22.95
Scrumhalf	7	79.28	6	101.17	21.89
Lock	12	96.42	9	110.56	14.14
Wing	10	95.50	9	101.11	5.61

Table 5.11(f): Pull ups (n)

	2003		2004		Practical significance d-values
	n	x̄	n	x̄	
	12	12.58	9	12.22	0.09
	9	10.67	10	15.40	0.96
	9	8.57	7	10.71	0.59
	9	10.67	5	12.20	0.38
	7	10.71	2	16.50	1.15
	6	10.50	3	14.33	0.51
	15	6.08	10	7.50	0.33
	5	15.83	5	18.40	0.24
	10	7.90	11	9.73	0.34
	9	13.44	9	14.55	0.19

Table 5.11(g): Push ups (n)

	2003		2004		Practical significance d-values
	n	x̄	n	x̄	
	10	53.80	8	59.13	0.39
	8	47.37	8	56.75	0.89
	6	55.50	6	56.83	0.08
	3	46.67	3	56.33	1.82
	2	61.00	2	75.00	1.23
	6	63.80	3	69.33	0.51
	12	46.67	10	53.20	0.29
	5	52.67	5	66.60	0.74
	10	43.40	10	55.10	1.36
	6	47.67	8	56.87	0.50

5.11 GAME-SPECIFIC SKILLS OF U/18 ELITE RUGBY PLAYER

POSITIONS

The results recorded in this study are data from the test sessions in 2003 and 2004. It seems that in the U/18 Cross Border rugby player group fewer players turned up and fewer were tested at the 2004 testing sessions, thus it was difficult to compare the data in some of the tests.

In Table 5.12(a) fewer players were tested in 2004 than in 2003 in terms of catching and throwing over the distance. In 2003 the fullbacks presented the best result (16.50) and the flyhalfs showed

the best results (16.00) in 2004. As expected the backline players presented the best results. Craven (1974:106) suggests that the fullback is like a second flyhalf, who must possess good handling and kicking skills. According to SARFU (1998:26) all backline players should possess good handling skills. No other studies tested catching and throwing over the shoulder, thus no comparison could be made. According to Table 5.12(b) the scrumhalfs presented the best results (2.89sec in 2004) with regard to ground skills. Fewer players were retested in 2004 thus no practical significance can be discussed.

With regard to passing for distance (Table 5.12(c)), the flyhalfs recorded best results (27.80 m in 2004) and the centres (27.80 m) were second best. All the player positions that were tested improved in passing for distance from 2003 to 2004. In a study by Van Gent (2003:234) the flyhalfs also recorded excellent handling skills as a positional requirement. The centres in Van Gent's (2003) study recorded 25.13 m in passing for distance, thus the centres in this study presented better results.

In Table 5.12(d) all player positions that were tested illustrated an improvement in kicking distance from 2003 to 2004 except for the eighth men. The flyhalfs recorded high practical significant differences (d=2.46). Due to only one player tested in 2004, the other values of high practical significance will not be discussed. The flankers kicked the furthest (51.43 m in 2004) and the scrumhalfs had the second best mean result (48.50 m in 2004). In Van Gent's (2003) study, the flankers presented kicking ability but the backline players had the best results. It is expected that the backline players (SARFU 1998:26) should possess better kicking skills than forwards.

Passing for accuracy test over 4m in this study is recorded as the best result out of five attempts. Previous studies recorded results out of 10, thus this study cannot compare results with previous research. According to Table 5.12(e) the fullbacks (4.00 right in 2004) and the wings (3.80 left in 2004) displayed the best results in passing for accuracy 4m test. SARFU (1998:26) and Van Gent (2003:234) suggest that passing for accuracy is an important handling skill especially in backline players. The poor results recorded at the end of the 2004 season in passing for accuracy should be addressed in the training programmes.

[illegible] and practical significant differences (d-values) for the player position of the senior B rugby player with regard to game-specific skills

Table 5.13(d): Catching and throwing over crossbar (n)

Positions	2003		2004		Practical significance d-values
	n	$\bar{x}$	n	$\bar{x}$	
Centre	9	15.44	0	.	.
[illegible]	4	16.25	1	15.00	0.26
[illegible]	3	16.00	1	16.00	.
[illegible]	2	16.50	0	.	.
Hooker	2	13.00	0	.	.
No. 8	4	11.75	0	.	.
[illegible]	2	10.50	2	13.50	0.53
Scrumhalf	6	14.00	0	.	.
Lock	11	13.73	0	.	.
Wing	6	14.00	1	11.00	1.50

Table 5.13(b): Ground skills (sec)

Positions	2003		2004		Practical significance d-values
	n	$\bar{x}$	n	$\bar{x}$	
[illegible]	5	3.03	4	3.33	0.37
[illegible]	8	3.04	0	.	0.54
[illegible]	3	3.12	3	3.12	0.25
[illegible]	3	3.01	0	.	0.79
Hooker	5	3.33	0	.	0.29
No. 8	4	3.28	0	.	1.05
Prop	8	3.33	4	3.23	0.36
[illegible]	4	3.06	2	2.89	0.13
Lock	6	3.15	3	3.03	1.01
Wing	7	2.95	8	3.07	0.34

[illegible]: d ≥ 0.8
[illegible]: d ≥ 0.5
Low practical significance: d < 0.5

Table 5.12(c): Passing for distance (m)

Positions	2003		2004		
	n	$\bar{x}$	n	$\bar{x}$	
Centre	2	25.95	2	27.60	
Flanker	2	24.97	1	26.10	
Flyhalf	0	.	2	27.63	5.35
Fullback	0	.	0	.	.
Hooker	2	25.63	0	.	.
No. 8	1	22.53	1	27.70	.
Prop	5	22.89	1	25.06	0.67
Scrumhalf	0	.	1	26.60	.
Lock	2	25.68	4	26.45	0.31
Wing	0	.	4	24.85	.

Table 5.12(d): Kicking for distance (m)

Positions	2003		2004		
	n	$\bar{x}$	n	$\bar{x}$	
Centre	8	45.19	2	46.90	0.21
Flanker	4	47.15	1	51.43	0.52
Flyhalf	2	43.15	2	47.60	2.46
Fullback	2	51.95	0	.	.
Hooker	2	45.50	0	.	.
No. 8	3	43.50	1	38.30	1.31
Prop	7	37.67	1	45.21	1.15
Scrumhalf	5	43.08	1	48.50	1.85
Lock	11	43.32	4	45.40	0.38
Wing	5	35.62	4	40.60	0.31

		2003		2004		Practical significance d-values
		n	$\bar{x}$	n	$\bar{x}$	
Cuing	L	8	3.00	3	2.33	0.63
	R	8	3.13	3	2.67	0.40
Flanker	L	5	2.80	4	2.00	0.62
	R	5	2.60	4	2.25	0.26
Flyhalf	L	3	3.00	3	2.00	0.50
	R	3	3.00	3	3.33	0.29
Fullback	L	.	.	2	3.00	2.13
	R	.	.	2	4.00	.
Hooker	L	4	2.25	.	.	.
	R	4	2.75	.	.	.
No. 8	L	5	2.00	1	1.00	1.41
	R	5	3.00	1	2.00	0.53
Prop	L	10	3.40	1	1.00	1.78
	R	10	2.50	1	2.00	0.27
Scrumhalf	L	5	2.60	2	2.00	0.53
	R	5	2.20	2	3.50	0.61
Lock	L	10	2.80	5	2.00	0.66
	R	10	2.80	5	2.00	0.78
Wing	L	3	2.67	5	2.40	0.14
	R	3	1.67	5	1.60	0.03

5.12 CONCLUSION OF COMPARISONS OF PLAYER POSITIONS IN U/16 AND U/18 ELITE RUGBY PLAYERS WITH REGARD TO ANTHROPOMETRICAL, PHYSICAL AND MOTOR AND GAME SPECIFIC SKILL COMPONENTS

- **Anthropometrical components**

In this study the locks were the tallest players in the U/16 and U/18 Green Squad rugby player groups whilst the scrumhalfs were the lightest players. Similar findings exist in Van Gent's (2003) study. The props presented the highest body mass and skinfold thickness in both U/16 and U/18 groups. Forward players in U/16 and U/18 recorded an endo-mesomorphic physique compared to backline players who were more mesomorphic. The U/18 forward players presented more changes in terms of anthropometrical variables than the backline players. Although body fat percentage recorded in U/16 and U/18 props was lower than in previous studies, it is of some concern that the body fat percentage is so high. In this study, similar data with regard to positional role were recorded and compared to a study by De Ridder (1993).

- **Physical and motor components**

Similar to Van Gent's (2003) study, scrumhalfs in this study were fastest over 10m and recorded high practical significance in speed over 40m. Results recorded illustrate that backline players and halfs had the best performance in motor components and that the forward players and backline players performed equally in physical tests. In this study the scrumhalfs measured up to the positional requirements as described in previous studies.

Little differences existed between U/18 Green Squad player positions with regard to physical and motor components. This could be due to conditioning and the training programmes that were applied. It can be noted that the U/16 Green Squad flyhalfs and props were faster over 10m than their U/18 Green Squad counterparts. The U/18 Green Squad scrumhalfs, locks, hookers and wings were faster than their U/16 counterparts in speed over 40m. The other U/18 Green Squad player positions scored poorer specific results than the U/16's Green Squad in speed over 40m, thus speed as a positional requirement is important in both age groups.

The results of this study revealed that forward and backline players required game-specific skills in equal amounts of importance. In the U/18 Green Squad rugby player group the backline players presented best results in the game-specific tests except for the flankers who recorded the best results in kicking for distance. Of some concern is the poor results presented in passing for accuracy 4m test. Good handling skill is needed in rugby and in the U/16 Green Squad and U/18 Green Squad group only the U/16 scrumhalfs scored 4 out of 5 to the right and the fullbacks scored 4 out of 5 to the right. The handling skills should be given attention in the training programme.

5.13 RANKING ORDER OF PLAYER POSITIONS OF U/16 ELITE RUGBY PLAYERS WITH REGARD TO ANTHROPOMETRICAL CHARACTERISTICS, PHYSICAL AND MOTOR ABILITIES AND GAME-SPECIFIC SKILLS

The following discussion deals with the ranking order of player positions according to the mean values of each player position with regard to anthropometrical, physical and motor and game-specific skill components. It can be noted that no previous study could be found using this classification to compare player positions.

Anthropometrical components

According to Table 5.13(a) and Table 5.13(b) the locks presented the tallest stature (190.72 cm) in 2004. The scrumhalfs were the shortest players (167.48 cm in 2004) and recorded the lightest body mass (62.00 kg in 2004). The props presented the largest body mass (103.61 kg in 2004) and held the same position from 2003 to 2004 in the components skinfold thickness (149.24 mm) (no. 10), largest body fat percentage (23.04 %)(no. 10), endo-mesomorphic physique (6.15/7.34)(no. 1) and the least ectomorphique results (0.49)(no. 10). All the results reported, represent the 2004 season.

Table 5.13(a): Ranking order and mean values for player position with regard to anthropometric variables of the under 16 elite rugby player

2003

Position	Height (cm)	Weight (kg)	Sum of 7 skinfolds (mm)	Muscle (%)	Body fat (%)	Endomorphy	Mesomorphy	Ectomorphy
Centre	8 (172.29)	8 (69.21)	1 (47.76)	6 (63.27)	1 (11.30)	9 (1.94)	8 (5.08)	3 (2.50)
Flanker	2 (179.82)	4 (80.44)	6 (65.27)	7 (63.26)	7 (14.90)	4 (3.14)	10 (4.78)	6 (2.23)
Flyhalf	7 (172.50)	7 (69.48)	5 (62.20)	4 (63.66)	4 (13.30)	6 (2.58)	5 (5.28)	4 (2.40)
Fullback	4 (178.03)	6 (74.98)	2 (52.83)	3 (64.27)	2 (11.94)	8 (2.31)	9 (5.03)	1 (2.58)
Hooker	6 (173.41)	5 (79.50)	8 (73.18)	9 (62.51)	9 (16.40)	2 (3.60)	2 (6.20)	9 (1.22)
Lock	1 (187.01)	2 (87.34)	9 (78.45)	5 (63.51)	8 (15.15)	3 (3.36)	6 (5.23)	2 (2.58)
No. 8	3 (179.95)	3 (81.60)	7 (68.40)	1 (65.90)	6 (14.29)	5 (2.97)	3 (5.82)	8 (2.05)
Prop	5 (175.38)	1 (90.34)	10 (110.78)	8 (63.19)	10 (18.97)	1 (4.63)	1 (7.06)	10 (0.82)
Scrumhalf	10 (160.75)	10 (57.37)	3 (53.79)	10 (57.28)	5 (14.16)	10 (1.86)	4 (5.40)	7 (2.19)
Wing	9 (171.58)	9 (68.80)	4 (55.87)	2 (65.70)	3 (12.92)	7 (2.42)	7 (5.11)	5 (2.36)

Table 5.13(b)

2004

Position	Height (cm)	Weight (kg)	Sum of 7 skinfolds (mm)	Muscle (%)	Body fat (%)	Endomorphy	Mesomorphy	Ectomorphy
Centre	[illegible] (174.5[illegible])	8 (72.[illegible])	4 ([illegible])	10 (57.2[illegible])	4 (13.[illegible])	9 (2.50)	4 (5.[illegible])	[illegible] (2.5[illegible])
Flanker	[illegible] (180.4[illegible])	4 ([illegible])	6 (63.[illegible])	[illegible]	[illegible] (13.[illegible])	[illegible] (2.77)	3 ([illegible])	[illegible] (1.[illegible])
Flyhalf	[illegible] (178.2[illegible])	7 (73.[illegible])	2 ([illegible])	4 ([illegible])	[illegible] (14.[illegible])	7 ([illegible])	8 (5.[illegible])	7 (2.[illegible])
Fullback	[illegible] (179.[illegible])	6 ([illegible])	3 (56.4[illegible])	1 ([illegible])	2 (13.[illegible])	[illegible]	7 ([illegible])	[illegible]
[illegible]	[illegible] (176.[illegible])	[illegible]	7 (70.[illegible])	[illegible]	[illegible] (15.[illegible])	[illegible]	2 ([illegible])	[illegible]
[illegible]	[illegible]	2 ([illegible])	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	3 ([illegible])	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	1 ([illegible])	10 ([illegible])	[illegible]	[illegible]	[illegible]	1 ([illegible])	[illegible]
[illegible]	[illegible]	10 ([illegible])	[illegible]	[illegible]	[illegible]	10 ([illegible])	10 ([illegible])	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

With regard to height all the forwards were ranked in the first six positions with only the fullbacks ranked 4th in 2003 and 3rd in 2004) of the backline players, displaying height as an important anthropometrical component. Most of the forwards displayed an endo-mesomorphic physique . In 2003 the forwards were ranked no. 1 to no. 5 and no. 1 to no. 3 with regard to endo-mesomorphy respectively. At the beginning of 2004 season the forwards were ranked no. 1 to no. 4 and no. 1 to no. 3 with regard to endo-mesomorphy respectively.

The following results are comparisons of player positions ranking with a change in four or more ranking positions either from 2003 to the 2004 season. The flankers dropped four positions (7 to 3) with the increase in body fat percentage and seven positions (10 to 3) with the increase in mesomorphic physique. Although the hookers' muscle percentage decreased (62.51 % in 2003 to 61.68 % in 2004), their position improved (from 9 to 5). In contrast though, the eighth men who presented no. 1 (60.90%) for muscle percentage dropped to no. 9 (58.41%) and were ranked no. 3 (5.82) for mesomorphy and dropped to no. 9. The scrumhalfs' ranking position changed the most of all player positions from 2003 to 2004. The scrumhalfs' positions improved from no. 10 to no. 6 in terms of muscle percentage. The scrumhalfs recorded a lower body fat percentage in 2004 (12.27 %) than in 2003 (14.16 %) and thus moved in ranking order from 5th to position first. The scrumhalfs presented least mesomorphic characteristics; position no. 4 (5.40) to position no. 10 (4.74), however may be described as a mesomorph.

The no. 1 ranking position held in 2003 for the average of all anthropometrical components was by the fullbacks with the locks second. In 2004 the locks held first position and the fullbacks were second. It appears that anthropometrical components play an important role in certain player positions and are more prominent requirements in forwards than in backline players.

□ Physical and motor components

Table 5.13(a) and Table 5.14(a) illustrate that the forward players were ranked no. 1 to no. 5 in 2003 and 2004 with regard to the physical component, bench press. However, the backline players scored the best results in pull ups, ranking no. 1 to no. 5 in 2003 and no. 1 to no. 3 in 2004. The props (91.67kg in 2003) and flankers (101.00 kg in 2004) scored best results in bench press. The scrumhalfs (13.25 in 2003) and flyhalfs (14.00 in 2004) presented best results in pull-ups. The props (no. 9 in 2003 and no. 10 in 2004) and locks (no. 10 in 2003 and no. 9 in 2004) showed poorest performance in pull ups.

The results recorded for push ups another upper body strength component were equally important in backline- and forward players. The scrumhalfs presented best results (44.00 in 2003) and the hookers (60.00 in 2004) but the props were in last position (32.33 in 2003 and 41.86 in 2004). It seems that certain physical components are more important in forward participation in backline players but that all players require upper body strength for their respective playing positions.

In speed over 10m, the backline players were ranked no. 1 to no. 4 in 2003 and no. 1 to no. 5 in 2004 with the fullbacks the fastest players (1.81 sec) in 2003 and the centres (1.77 sec) in 2004. The props recorded the slowest time in the 2003 (2.02 sec) and 2004 (1.95 sec) season and were ranked no. 10.

Results for speed over 40m showed position no 1 to 3 held by backline players and the flankers ranked no. 4 in 2003. The fullbacks again recorded the fastest time (5.35 sec) over 40m in 2003 and (5.27 sec) in 2004 respectively. In 2004 the backline players held the first 5 positions. Similar to results in speed over 10m, the props displayed poorer performances in speed over 40m (5.85 sec and 5.79 sec) in 2003 and 2004 respectively.

As expected the scrumhalfs were the most agile players (14.26 sec in 2003 and 16.57 sec in 2004), which correlates with literature (Craven 1974), and the props were ranked 10th (19.21 sec) in 2003 and 16.86 sec in 2004. Speed endurance (shuttle run test) rated high (no. 1 and no. 2) amongst the forward players. The eighth men presented best results (105.00 in 2003) and the flankers recorded second best results (89.50 in 2003). The flankers improved their results to first position (98.60 in 2004) and the hookers were second (97.33 in 2004). The ranking order no. 1 to no. 5 included forward- and backline players (2003 and 2004). It seems that speed endurance is a positional requirement for forward and backline players. Although Nosiko and Du Plessis (1996) noted that speed endurance is more important in forward than backline players, the results of this study differ. The following results are comparisons of player position ranking order with a change in four or more ranking positions from 2003 to the 2004 season.

The centres dropped from second to fifth position in speed over 10m and from ninth to eighth position in shuttle run test, however, they improved in agility from ninth to fourth position. The flankers performed better, no. 6 in 2003 to no. 2 in 2004 with regard to push ups. The flyhalfs moved up five positions (no. 7 to no. 2) in speed over 10m. The fullbacks performed better (no. 8

Table 5.14(a): Ranking order and mean values for player position with regard to physical- and motor abilities of the under 16 elite rugby player

2004

Position	Bench Press Absolute (kg)	Pull-ups (n)	Push-ups (n)	Speed 10 m (sec)	Speed 40 m (sec)	Agility Illinios (sec)	Speed endurance Shuttle run (n)
Centre	7 (77.86)	3 (13.57)	9 (45.17)	5 (1.82)	4 (5.29)	4 (14.89)	10 (84.20)
Flanker	1 (101.00)	6 (12.12)	2 (54.00)	7 (1.87)	7 (5.47)	9 (16.23)	1 (98.60)
Flyhalf	7 (80.00)	1 (14.00)	4 (53.33)	2 (1.79)	5 (5.34)	2 (14.66)	5 (94.75)
Fullback	6 (80.83)	7 (11.14)	8 (45.20)	4 (1.81)	1 (5.27)	3 (14.83)	4 (95.67)
Hooker	2 (95.00)	8 (10.00)	1 (60.00)	8 (1.88)	9 (5.60)	6 (15.35)	2 (97.33)
Lock	3 (93.75)	9 (8.17)	6 (45.43)	9 (1.89)	8 (5.57)	8 (15.64)	9 (87.33)
No. 8	5 (85.00)	4 (12.40)	3 (53.60)	6 (1.83)	6 (5.37)	7 (15.62)	3 (96.00)
Prop	4 (90.00)	10 (5.50)	10 (41.86)	10 (1.95)	10 (5.79)	10 (16.86)	7 (88.00)
Scrumhalf	10 (63.40)	5 (12.20)	5 (47.00)	1 (1.77)	2 (5.27)	1 (14.57)	6 (89.67)
Wing	9 (74.20)	3 (13.45)	7 (45.20)	3 (1.80)	3 (5.28)	5 (15.34)	8 (87.36)

Table: 5.14(b)

2004

Position	Bench Press Absolute (kg)	Pull-ups (n)	Push-ups (n)	Speed 10 m (sec)	Speed 40 m (sec)	Agility Illinios (sec)	Speed endurance Shuttle run (n)
Centre	8 (77.86)	2 (13.57)	9 (45.17)	5 (1.82)	4 (5.29)	4 (14.89)	10 (84.20)
Flanker	1 (101.00)	6 (12.12)	2 (54.00)	7 (1.87)	7 (5.47)	9 (16.23)	1 (98.60)
Flyhalf	7 (80.00)	1 (14.00)	4 (53.33)	2 (1.79)	5 (5.34)	2 (14.66)	5 (94.75)
Fullback	6 (80.83)	7 (11.14)	8 (45.20)	4 (1.81)	1 (5.27)	3 (14.83)	4 (95.67)
Hooker	2 (95.00)	8 (10.00)	1 (60.00)	8 (1.88)	9 (5.60)	6 (15.35)	2 (97.33)
Lock	3 (93.75)	9 (8.17)	6 (45.43)	9 (1.89)	8 (5.57)	8 (15.64)	9 (87.33)
No. 8	5 (85.00)	4 (12.40)	3 (53.60)	6 (1.83)	6 (5.37)	7 (15.62)	3 (96.00)
Prop	4 (90.00)	10 (5.50)	10 (41.86)	10 (1.95)	10 (5.79)	10 (16.86)	7 (88.00)
Scrumhalf	10 (63.40)	5 (12.20)	5 (47.00)	1 (1.77)	2 (5.27)	1 (14.57)	6 (89.67)
Wing	9 (74.20)	3 (13.45)	7 (45.20)	3 (1.80)	3 (5.28)	5 (15.34)	8 (87.36)

in 2003 to no. 4 in 2004) in the speed endurance test. The eighth men climbed four positions (no. 8 in 2003 to no. 3 in 2004) in terms of push ups. The scrumhalfs presented poorer results (no.1 to no. 5) in pull-ups and (no.1 to no.5) in push-ups. Although the wings improved in the speed endurance test (86.00 in 2003 to 87.36 in 2004) they moved down in ranking order from no.3 to no. 8. The no. 1 ranking position held in 2003 and 2004 for the average of all physical and motor components was by the scumhalf.

In conclusion, certain physical components seem to be more important requirements in forward players than in backline players, whereas some motor components features more in backline players than in forward players. However, it seems that over the past few years physical and motor components have become equally important in all player positions.

- **Game-specific skills components**

According to Table 5.15(a) the fullbacks presented with good handling skills and ranked no. 1 in catching and throwing over the crossbar (14.00), passing for accuracy 4m to the left (8.00) and passing for distance (29.80m) in the 2003 season. The scrumhalfs were ranked 1st in passing for accuracy 4m (7.50) in 2004. The locks presented best result in catching and throwing in 2004 (22.00).

The flyhalfs (51.39 m) and fullbacks (51.90 m) presented best results in kicking for distance in 2003 and 2004 respectively. The fullbacks improved this skill as they were ranked in 8th position in 2003 and first in 2004. The scrumhalfs had poorest performance in kicking for distance (39.12 m in 2003 and 38.60 m in 2004). According to literature Craven ((1974) and SARFU (1998)) fullbacks and flyhalfs need good kicking skills. Craven (1974) suggests that scrumhalfs also need good kicking skills but it is in contrast with the results of this study thus, the kicking skills of the scrumhalfs need attention.

The scrumhalfs (2.93 sec in 2003) and eighth men (3.02 sec in 2004) were ranked in first position respectively in terms of ground skills. This correlates with literature (Craven (1974) and SARFU (1998)) stating that the scrumhalfs and eighth men need to have good handling skills behind the scrum. The eighth men displayed the most improvement from 2003 (10th position) to 2004 (first position) with regard to ground skills. The following results are comparisons of player position ranking order with changes in four or more ranking positions from 2003 to the 2004 season.

The centres dropped four positions (no. 2 in 2003 to no. 6 in 2004) with regard to kicking for distance, but performed better (no. 9 in 2003 and no. 5 in 2004) with passing for distance. The flankers were ranked lower (no. 4 in 2003 and no. 9 in 2004) in catching and throwing over the crossbar and in ground skill tests, but climbed 4 positions (no. 7 in 2003 to no. 3 in 2004) with regard to passing for distance.

The fullbacks showed improvement in ranking position with regard to kicking for distance (no. 8 to no. 1). This is expected as the fullbacks are like a second flyhalf and should possess good handling and kicking skills. To obtain a better idea of passing for accuracy 4m, both of the mean results left and right were added for a result out of 10. The fullbacks were ranked 1st (5.40) in 2003 and the scrumhalfs were best in 2004 (7.50).

The eighth men improved the most in ground skills (no. 10 in 2003 to no. 1 in 2004) and were ranked first in the passing for distance test in 2004. This is expected, as the eighth men should be able to fulfill the scrumhalf's role especially behind a scrum. According to Table 5.15(b) the scrumhalfs held the first position in 2004 in terms of passing for accuracy 4m. A scrumhalf needs good handling skill, as the position requires passing to both sides.

The locks improved ranking position in kicking for distance from no.9 in 2003 to no.4 in 2004. Good kicking skills are not necessarily a requirement for locks, playing position. The wings produced better performance (no. 9 in 2003 to no. 4 in 2004) with regard to catching and throwing but recorded poorer results (no. 4 to no. 8) in passing for accuracy 4m and passing for distance (no. 5 to no. 9) from 2003 to the 2004 season.

The no. 1 ranking position in 2003 for the average of all, game-specific skill components, was held by the flankers and in 2004 by the eighth men. In conclusion, game-specific skills seem to be equally important in backline and forward U/16 Green Squad rugby players. It can be noted that nine player positions improved the ranking positions with regard to handling skills (only the hookers did not) and two player positions (fullbacks and locks) recorded a higher ranking position in kicking skills.

Table 5.15(a): Ranking order and mean values for player position with regard to game specific skills of the elite U/16 rugby player

2003

Position	Catching & throwing over crossbar (n)	Kicking for distance(m)	Ground skills (sec)	Passing for Accuracy (4m) (n)	Passing for distance (m)
Centre	5 (13.00)	2 (46.64)	5 (3.04)	6 (4.80)	9 (22.77)
Flanker	4 (13.50)	7 (40.57)	4 (3.08)	3 (5.33)	7 (24.04)
Flyhalf	7 (12.75)	1 (51.39)	3 (3.06)	8 (4.50)	6 (24.40)
Fullback	1 (14.00)	8 (40.53)	7 (3.10)	1 (5.40)	1 (29.80)
Hooker	10 (10.80)	5 (41.92)	8 (3.16)	7 (4.66)	5 (24.70)
No. 8	6 (13.00)	4 (42.95)	10 (3.25)	5 (4.80)	2 (27.30)
Prop	8 (12.00)	6 (40.98)	9 (3.24)	10 (3.37)	4 (25.55)
Scrumhalf	2 (14.00)	10 (39.12)	1 (2.93)	2 (5.34)	8 (23.82)
Lock	3 (13.71)	9 (40.42)	2 (3.03)	9 (4.50)	
Wing	9 (12.00)	3 (46.40)	6 (3.09)	4 (5.14)	3 (25.96)

Table 5.15(b)

2004

Position	Catching & throwing over crossbar (n)	Kicking for distance(m)	Ground skills (sec)	Passing for Accuracy (4m) (n)	Passing for distance (m)
Centre	5 (14.67)	7 (43.45)	4 (3.15)	7 (4.83)	5 (27.35)
Flanker	9 (11.50)	5 (45.13)	9 (3.25)	5 (5.49)	3 (28.75)
Flyhalf	7 (14.00)	3 (49.07)	5 (3.04)	2 (7.25)	6 (27.77)
Fullback	2 (17.00)	4 (47.00)	7 (3.08)	3 (5.83)	4 (28.16)
Hooker	8 (12.20)	8 (40.85)	8 (3.20)	10 (3.20)	10 (23.30)
No. 8	3 (17.00)	2 (49.13)	6 (3.12)	4 (5.50)	1 (29.67)
Prop	4 (14.67)	6 (45.10)	10 (3.47)	8 (4.20)	8 (27.00)
Scrumhalf	10 (10.00)	10 (39.00)	3 (3.07)	1 (7.50)	7 (24.43)
Lock	1 (22.00)	9 (41.07)	1 (3.17)	6 (4.75)	2 (28.20)
Wing	4 (16.33)	8 (45.70)	2 (3.06)	9 (4.63)	9 (25.34)

5.14. RANKING ORDER OF PLAYER POSITIONS OF U/18 ELITE RUGBY PLAYERS WITH REGARD TO ANTHROPOMETRICAL CHARACTERISTICS, PHYSICAL AND MOTOR ABILITIES AND GAME SPECIFIC SKILLS

The following discussion reports on ranking order changes, of more than 4 positions in ranking order from 2003 to the 2004 season.

a) Anthropometrical components

According to Table 5.16(a) and Table 5.16(b) the locks were the tallest players (193.99 cm in 2003 and 194.16 cm in 2004). The scrumhalfs were the shortest players (168.00 cm in 2003 and 168.16 cm in 2004). Forward players held the first four positions in the 2003 and 2004 season in terms of weight. Similar to the U/16 props of the Green Squad the U/18 props of the Green Squad were the heaviest (98.61 kg in 2003 and 103.20 kg in 2004) and they had the highest measurement in skinfold thickness (110.17 mm in 2003 and 147.07 mm in 2004) and recorded the highest body fat percentage (19.72 % in 2003 and 22.72 % in 2004). The scrumhalfs weighed the least (69.29 kg in 2003 and 68.62 kg in 2004). The forwards were ranked no. 1 to no. 4 in 2003 and 2004 with regard to body mass. The centres held first position (65.45 %) in terms of muscle percentage and the flankers were ranked first in 2004 (64.01 %). The flankers improved the most (57.62 % in 2003) from tenth position to first position (64.01 % in 2004).

The props displayed an endo- mesomorfic physique (4.90/6.97 in 2003 and 6.09/7.74 in 2004). As found in the U/16 Green Squad rugby players' player positions, the U/18 Green Squad rugby players' player positions with reference to the forwards need specific anthropometrical components for positional requirements.

b) Physical and motor abilities

Table 5.17(a) and 5.17(b) illustrate that the forward players are ranked no. 1 to no. 4 with regard to bench power results (2003) and no. 2 to no. 5 (2004). The eighth men performed best (105.00 kg in 2003) and the hookers (125.00kg in 2004). The scrumhalfs had the poorest performance (79.28 kg in 2003) and in the 9th position the flyhalfs (83.57 kg in 2003) whilst the flyhalfs were ranked

last (86.43 kg in 2004) and the centres second last (95.25 kg in 2004) with reference to bench press results. The scrumhalfs recorded best results in pull ups (15.83 in 2003 and 18.40 in 2004) whilst the wings (13.44 in 2003) and the hookers (16.50 in 2004) ranked second. The eighth men (63.80 in 2003) had best results and second best (69.33 in 2004) in the push ups test. Similarly the hookers were ranked second (61.00 in 2003) and first (75.00 in 2004) in push ups tests. The props recorded poorest performance in terms of pull ups (6.08 in 2003 and 7.50 in 2004) and in push ups (53.20 in 2004).

With regard to motor components the wings held first position in 2003 for speed over 10m (1.79 sec), speed over 40m (5.14 sec) and the agility Illinois test (14.29 sec). This result is supported by literature (Craven, 1974). The props were ranked slowest in 2003 for speed over 10m (2.08 sec), speed over 40m (5.90 sec) and the agility Illinois test (15.91 sec).

In 2004 the hookers had best results in speed over 10m (1.74 sec), the wings had best results in speed over 40m (5.14 sec) and the centres were most agile (14.74 sec) in the agility Illinois test.

The props were ranked last in 2004 with regard to speed over 10m (1.96 sec), speed over 40m (5.92 sec) and the agility Illinois test (16.96 sec). The U/18 Green Squad members in this study, however, were the best players on average in the physical and motor tests as they were ranked first in bench press, second best in pull ups (16.50), best in push ups (75.00), fastest over 10m (1.74) and best score in the shuttle run test (111.50). The scrumhalfs had best results in speed endurance (127.25 in 2003) followed by the wings (108.00 in 2003). Best performance with regard to speed endurance (shuttle run) in 2004 was by the hookers (111.50) with second best the eighth men (109.00). It seems that physical and motor components are important for positional role as hooker. The props presented poorest results in 2003 (78.28) and in 2004 (83.00) in terms of speed endurance.

In conclusion, the motor abilities were more prominent in backline players except for the hookers presenting best results in 2004 in speed over 10m and speed endurance. The props showed poorest performance in most physical and motor components except bench press (2003 & 2004) and push-ups (2003). It seems that forward players need good upper body strength and backline players require speed and agility, with the exception of the hookers who exhibited good scores in physical and motor components.

Table 5.16(a) Ranking order and mean values for player position with regard to anthropometric variables of the under 16 elite rugby player

2003

Position	Height (cm)	Weight (kg)	Sum of 7 skinfolds (mm)	Muscle (%)	Body fat (%)	Endomorphy	Mesomorphy	Ectomorphy
Centre	[illegible]	6 ([illegible])	6 ([illegible])	1 ([illegible])	[illegible]	6 (2.75)	3 (6.16)	5 ([illegible])
Flanker	[illegible]	4 ([illegible])	[illegible]	10 ([illegible])	6 ([illegible])	5 (2.79)	8 (5.73)	8 (1.44)
Flyhalf	[illegible]	9 ([illegible])	2 ([illegible])	9 ([illegible])	4 ([illegible])	7 (2.65)	9 (4.49)	2 (2.61)
Fullback	5 ([illegible])	7 (82.26)	4 ([illegible])	5 ([illegible])	1 ([illegible])	8 (2.60)	5 (5.14)	3 (2.01)
Hooker	4 ([illegible])	3 (93.16)	9 ([illegible])	6 ([illegible])	9 ([illegible])	2 (3.33)	2 (6.54)	9 ([illegible])
Lock	1 ([illegible])	2 (95.23)	8 (65.09)	7 ([illegible])	8 (14.24)	4 (2.91)	7 (5.50)	1 (2.84)
No. 8	7 ([illegible])	5 (86.26)	7 ([illegible])	4 (64.07)	7 (14.17)	3 (2.91)	4 (5.89)	6 ([illegible])
Prop	2 ([illegible])	1 (99.41)	10 (110.17)	8 (59.15)	10 (19.72)	1 (4.90)	1 (6.97)	10 ([illegible])
Scrumhalf	10 ([illegible])	10 (69.95)	3 (59.13)	2 ([illegible])	3 (12.96)	9 (2.58)	6 (5.54)	7 (1.54)
Wing	8 ([illegible])	8 (79.43)	1 (56.16)	3 (64.55)	2 (12.92)	10 (2.50)	10 (4.00)	4 ([illegible])

Table 5.16(b)

2004

Position	Height (cm)	Weight (kg)	Sum of 7 skinfolds (mm)	Muscle (%)	Body fat (%)	Endomorphy	Mesomorphy	Ectomorphy
Centre	6 (180.60)	5 (81.86)	5 (65.40)	2 (62.67)	4 (13.83)	6 (2.71)	4 (5.83)	4 (2.18)
Flanker	4 (181.00)	4 (86.95)	4 (65.38)	1 (64.01)	5 (13.85)	5 (2.73)	3 (6.35)	6 (1.43)
Flyhalf	7 (177.45)	8 (72.33)	8 (71.97)	9 (59.58)	7 (15.07)	3 (3.10)	6 (5.23)	1 (2.80)
Fullback	5 (180.60)	6 (74.90)	3 (64.10)	6 (61.77)	3 (13.50)	7 (2.68)	5 (5.79)	7 (1.32)
Hooker								
Lock	1 (194.16)	2 (95.50)	7 (71.79)	7 (61.63)	6 (14.58)	4 (3.04)	7 (4.57)	2 (2.76)
No. 8	2 (181.47)	3 (88.95)	6 (69.70)	3 (62.25)	8 (15.54)	2 (3.22)		8 (0.66)
Prop	3 (181.22)	1 (103.20)	9 (147.07)	5 (61.87)	9 (22.72)	1 (6.09)	1 (7.74)	9 (0.41)
Scrumhalf	9 (168.16)	9 (69.62)	1 (55.42)	8 (61.49)	1 (12.64)	9 (2.28)	2 (7.50)	5 (1.63)
Wing	8 (177.17)	7 (73.62)	2 (58.60)	4 (62.00)	2 (13.32)	8 (2.64)	8 (4.12)	3 (2.21)

Table 5.17(a): Ranking order and mean values for player position with regard to physical- and motor abilities of the under 18 elite rugby player

2003

Position	Bench Press Absolute (kg)	Pull ups (n)	Push ups (n)	Speed 10 m (sec)	Speed 40 m (sec)	Agility Illinios (sec)	Speed endurance Shuttle run (n)
Centre	5 (95.83)	3 (12.58)	4 (53.80)	5 (1.83)	3 (5.28)	3 (14.39)	7 (93.00)
Flanker	3 (98.89)	4 (10.87)	7 (47.37)	7 (1.88)	7 (5.14)	5 (14.73)	4 (100.00)
Flyhalf	9 (83.57)	8 (8.57)	3 (55.50)	6 (1.84)	6 (5.39)	2 (14.31)	3 (101.60)
Fullback	8 (91.67)	6 (10.67)	9 (45.67)	2 (1.80)	2 (5.28)	4 (14.50)	5 (94.00)
Hooker	2 (103.57)	5 (10.71)	2 (61.00)	9 (1.92)	9 (5.55)	6 (14.90)	9 (90.20)
Lock	7 (95.42)	9 (7.90)	10 (43.40)	8 (1.89)	8 (5.42)	9 (15.39)	8 (91.00)
No. 8	1 (105.00)	7 (10.50)	1 (63.80)	4 (1.82)	5 (5.39)	7 (14.97)	6 (93.50)
Prop	4 (98.75)	10 (6.06)	8 (46.67)	10 (2.03)	10 (5.90)	10 (15.91)	10 (78.28)
Scrumhalf	10 (79.28)	1 (15.83)	5 (52.67)	3 (1.81)	4 (5.36)	8 (15.03)	1 (127.25)
Wing	6 (95.50)	2 (13.44)	6 (47.87)	1 (1.79)	1 (5.14)	1 (14.28)	2 (108.00)

Table 5.17(b)

2004

Position	Bench Press Absolute (kg)	Pull ups (n)	Push ups (n)	Speed 10 m (sec)	Speed 40 m (sec)	Agility Illinios (sec)	Speed endurance Shuttle run (n)
Centre	9 (95.25)	6 (12.22)	4 (58.12)	5 (1.81)	4 (5.32)	1 (14.74)	5 (97.00)
Flanker	5 (110.00)	3 (15.40)	7 (56.75)	8 (1.86)	8 (5.47)	7 (15.96)	9 (87.86)
Flyhalf	10 (86.43)	8 (10.71)	6 (56.83)	7 (1.85)	6 (5.42)	4 (15.09)	4 (97.33)
Fullback	6 (105.00)	7 (11.20)	8 (55.38)	3 (1.76)	3 (5.28)	5 (15.44)	3 (102.00)
Hooker	1 (126.00)	2 (16.50)	1 (75.00)	1 (1.74)	1 (5.33)		1 (111.50)
Lock	4 (110.00)	9 (9.73)	9 (55.16)	9 (1.88)	9 (5.56)	9 (15.48)	8 (95.50)
No. 8	3 (115.00)	5 (14.33)	2 (69.33)	6 (1.82)	7 (5.45)		2 (102.00)
Prop	2 (121.00)	10 (7.50)	10 (53.70)	10 (1.96)	10 (5.92)	8 (15.66)	10 (68.00)
Scrumhalf	7 (101.17)	5 (15.40)	3 (66.00)	4 (1.80)	2 (5.23)	2 (14.74)	6 (96.33)
Wing	8 (101.11)	4 (14.55)	5 (56.87)	2 (1.77)	1 (5.14)	3 (14.88)	7 (93.57)

- **Game-specific skills**

According to Table 5.18(a) and 5.18(b) the fullbacks displayed good handling skills with regard to catching and throwing over the crossbar (16.50 in 2003) whilst the flyhalfs were the best (16.00) in 2004. The flankers were ranked second in 2003 (16.25) and in 2004 (15.00). With the exception of the flankers, the forward players scored the lowest results in 2003 with the props ranking last (10.86). The fullbacks presented the best results in kicking for distance (51.95 m in 2003) and the flankers were the best in 2004 (51.43 m). The wings (35.62 m in 2003) and eighth man (38.30 m in 2004) were ranked last respectively in terms of kicking for distance.

The wings performed the best (2.95 sec in 2003) with regard to ground skills and third best (3.09 sec) in 2004. The hookers were ranked last (3.33 sec in 2003) in ground skills ability whilst the centres had the poorest performance in 2004 (3.33 sec). The centres (25.95 m in 2003) and flyhalfs (27.83 m in 2004) were the best with regard to passing for distance, whilst the eighth man (22.53 m in 2003) and the wings (24.55 m in 2004) were ranked last.

In terms of passing for accuracy (4m), the centres (6.12 in 2003) and fullbacks (7.00 in 2004) performed the best. The fullbacks ranked no. 1 in 2003 and 2004 overall with regard to game skills. However, the fullbacks only completed three tests in 2003 and 2 tests in 2004.

To conclude it seems that game-specific skills are equally important amongst backline and forward U/18 Green Squad rugby players. It should be noted that very few players completed the game-specific skills tests in 2004.

A detailed discussion of specific positional requirements will follow in Chapter 6.

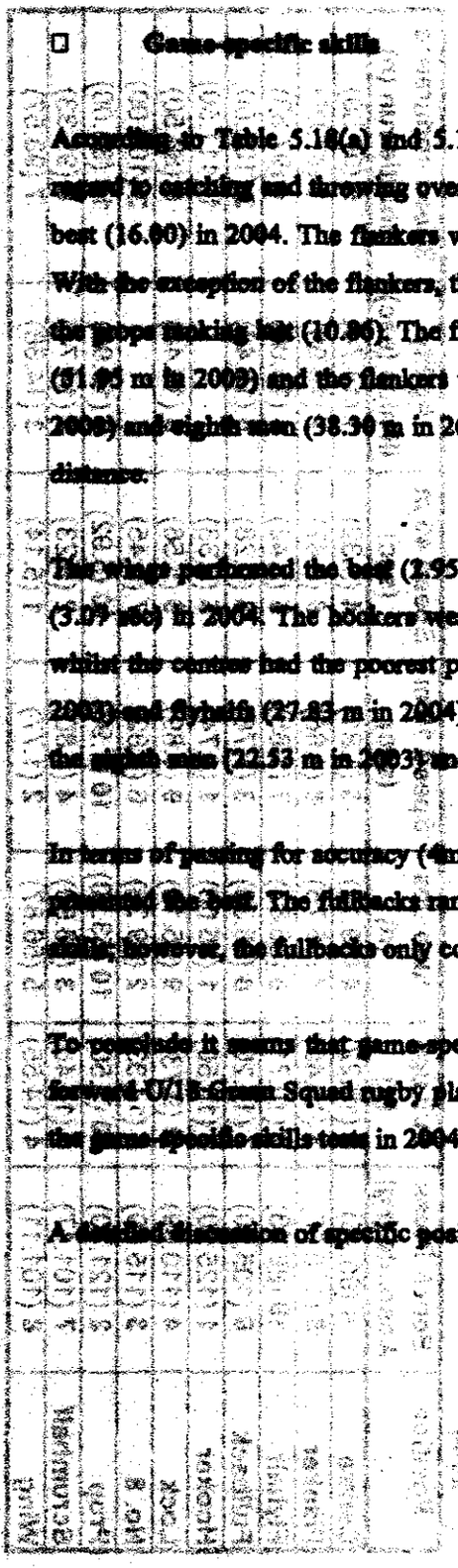


Table 5.18(a): Ranking order and mean values for player position with regards to game-specific skills of the elite U/18 rugby player

2003

Position	Catching & throwing over crossbar (n)	Kicking for distance(m)	Ground skills (sec)	Passing for Accuracy (4m) (n)	Passing for distance (m)
Centre	4 (15.44)	4 (45.19)	3 (3.03)	1 (6.12)	1 (25.95)
Flanker	2 (16.25)	2 (47.15)	4 (3.04)	5 (5.40)	4 (24.97)
Flyhalf	3 (16.00)	7 (43.15)	6 (3.12)	2 (6.00)	
Fullback	1 (16.50)	1 (51.95)	2 (3.01)		
Hooker	8 (13.00)	3 (45.50)	10 (3.33)	6 (5.00)	3 (25.63)
No. 8	9 (11.75)	5 (43.50)	8 (3.28)	7 (5.00)	6 (22.53)
Prop	10 (10.86)	9 (37.67)	9 (3.33)	3 (5.90)	5 (22.89)
Scrumhalf	5 (14.00)	8 (43.06)	5 (3.05)	8 (4.80)	
Lock	7 (13.73)	6 (43.32)	7 (3.15)	4 (5.60)	2 (25.68)
Wing	6 (14.00)	10 (35.82)	1 (2.95)	9 (4.34)	

Table 5.18(b)

2004

Position	Catching & throwing over crossbar (n)	Kicking for distance(m)	Ground skills (sec)	Passing for Accuracy (4m) (n)	Passing for distance (m)
Centre		4 (45.90)	6 (3.33)	4 (5.80)	2 (27.80)
Flanker	2 (15.00)	1 (51.43)		6 (4.25)	6 (25.10)
Flyhalf	1 (16.00)	3 (47.06)	4 (3.12)	3 (5.33)	1 (27.83)
Fullback				1 (7.80)	
Hooker					
No. 8		8 (39.30)		8 (3.80)	3 (27.70)
Prop	3 (13.50)	9 (35.27)	5 (3.23)	9 (3.60)	7 (25.06)
Scrumhalf		2 (49.56)	1 (2.89)	2 (5.80)	4 (26.50)
Lock		6 (45.46)	2 (3.03)	5 (4.80)	5 (26.45)
Wing	4 (11.00)	7 (40.00)	3 (3.07)	7 (4.00)	8 (24.55)

5.15 BEST PLAYER POSITION OF GREEN SQUAD 2003/2004 SEASON

The forecasting of best player position was to indicate that statistical methods exist in which players can be classified as no. 1 player according to the scores they achieved in the test battery. The data was analysed by means of Statsoft Inc. (2003) Statistica. The method of principal components analysis (PCA) was used (Bartholomew *et al* 2002).

This method aims to combine correlated variables in such a way that the first principal component explains the maximum possible of the total variance and the second principal component explains the maximum possible of the remaining variance and so forth. The full set of principal components fully explains the total variance, i.e. there are as many principal components as there are variables. PCA transforms the set of correlated variables to a set of uncorrelated variables called principal components. If the first two principal components explain enough variance, then only two principal components are used instead of the total number of components.

Of the U/16 (n=93) and U/18 (n=97) Green Squad South African schoolboy rugby players combined, only 60 players completed all the tests in 2003 and 2004. The following results are representative of these 60 players only. In table 5.19, the results of the principal components are illustrated. Principal component no. 1 represents 27.21 % of the total variance and principal component no. 2 represents 14.42 % of the total variance. The cumulative value of these two components is 41.63 %. Table 5.20 illustrates factor loading i.e. factor co-ordinates of the variables based on correlations.

Principal component (Factor) 1 represents anthropometrical variables; height, weight and body fat, physical and motor components; bench press, speed 10m, speed 40m and agility and game-specific skills namely ground skills as the correlations of these items with factor 1 is large. Principal component 1 thus represents a general profile of the rugby player. Large scores for this factor correspond with a good player according to the general profile.

Principal component (Factor) 2 represents physical and motor components; bench press, pull ups, push ups, agility and speed endurance and the game-specific skills component as well as passing for distance, as these items all have a large negative correlation with factor 2. A large negative score for this factor thus represents a player with good physical and motor characteristics.

Diagram 5.1 displays factor loading of the two principal components. It is clear that anthropometric variables and certain physical and motor components represent principal component 1 and that principal component 2 is represented by physical and motor components and two game skills components namely passing for distance and kicking for distance. From diagram 5.1 follows that most of the game skills components are reflected around the origin 0 and are not represented by these two principal components. More game-specific skills components would be represented if more principal components were taken into account but the more principal components, the more complicated the interpretation of the data becomes.

With regard to principal component 1, the top five best player positions are four props and one hooker. The best player position was a prop. With regard to principal component 2, the top five best player positions were two flankers, one hooker, one eighth man and one centre. The best player position was a flanker. In conclusion, it seems as if the props presented the best results with regard to anthropometrical and certain physical and motor components and that the loose forward players presented the best results in terms of physical and motor components.

Another statistical method to determine ranking order of player performance where all the tests are evenly matched regarding importance. According to this method the players are ranked from best performance to the poorest performance with reference to each variable. Points are allocated to the players i.e. the best performer receives the lowest points and the points increase as the players are ranked lower according to their performance, thus the player with the poorest performance receives the highest points. This procedure is repeated with reference to each variable. The points obtained by the player for each variable are added up. The player with the lowest total of points is ranked in first position and the player with the highest points is ranked last.

This statistical method and process was done on 28 of the U/18 Green Squad players and 32 of the U/16 Green Squad players in this study as these players were the only players who completed the total test battery of tests (2003 & 2004). The results of this procedure will be kept on a database and assessed over a five-year period to monitor the players' performance and achievements. It can be noted that of the 28 U/18 Green Squad players, two centres and one each of the hookers, flankers and scrumhalfs position were ranked in the top five positions. The prop and hookers of the U/18 Green Squad group of 28 players held the last five positions. It seems

that the back-line players performed better than the forward players with reference to the total battery of tests when this method is applied to determine ranking order.

In the U/16 Green Squad player group of 32 players, the top five positions were held by a centre, flyhalf, eighth man, hooker and lock whilst the last five positions were also different positions namely; one flanker, centre, scrumhalf, hooker and prop. It can be derived from the result that amongst the U/16 Green Squad players, the top performers are represented in the forward as well as the back-line players.

Table 5.19: Results of principal components

	Eigenvalues of correlation matrix, and related statistics			
Value number	Eigenvalue	% Total variance	Cumulative Eigenvalue	Cumulative %
1	4.359823	27.21140	4.35382	27.2114
2	2.307761	14.42351	6.66158	41.6349
3	2.052896	12.83060	8.771448	54.4655
4	1.475974	9.22484	10.19045	63.6903
5	1.163993	7.27496	11.35445	70.9653
6	0.908151	5.67594	12.26260	76.6412
7	0.833022	5.20639	13.09562	81.8476
8	0.721103	4.50690	13.81672	86.3545
9	0.538976	3.36860	14.35570	89.7231
10	0.447763	2.79852	14.80346	92.5216
11	0.406800	2.54250	15.21026	95.0641
12	0.281168	1.75730	15.49143	96.8214
13	0.139671	1.32261	15.70305	98.1441
14	0.139671	0.87295	15.84272	99.0170
15	0.114193	0.71370	15.95691	99.7307
16	0.043088	0.26930	16.00000	100.0000

Table 5.20: Principal component loading

Variable	Factor coordinates of the variables	
	Factor 1	Factor 2
Height	0.520095	-0.270592
Weight	0.834460	-0.325441
B fat	0.805058	-0.007546
Bench Press Absolute	0.506111	-0.569088
Pull ups	-0.523530	-0.573608
Push ups	-0.032961	-0.686014
C and T	-0.387197	0.027686
KfD	-0.353670	-0.362078
PaP	0.499576	-0.070694
PfAL	-0.064366	-0.154186
PfAR	0.018176	-0.217621
PfD	-0.355388	-0.440539
Speed 10 m	0.770819	0.059087
Speed 40 m	0.795953	0.198955
Agility Illinois Result	0.498641	-0.457407
Shuttle Run Result	0.275434	-0.592202

0 = no correlation **+ 1 or – 1 = good correlation**

B fat: **Body Fat**

PfD: **Passing for distance**

KfD: **Kicking for distance**

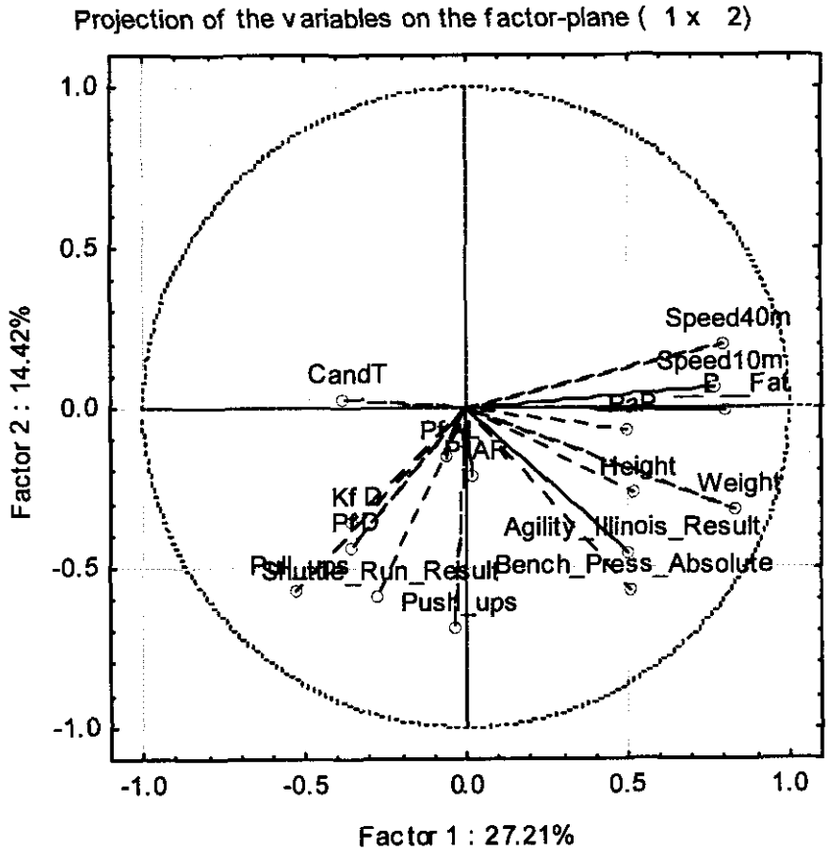
PaP: **Picking up and placing the ball**

C and T: **Catching and throwing over crossbar**

PfAL: **Passing for accuracy(left)**

PfAR: **Passing for accuracy(right)**

Diagram 5.1



B fat:	**Body Fat**
PfD:	**Passing for distance**
KfD:	**Kicking for distance**
PaP:	**Picking up and placing the ball**
C and T:	**Catching and throwing over crossbar**
PfAL:	**Passing for accuracy(left)**
PfAR:	**Passing for accuracy(right)**

CHAPTER 6

SUMMARY AND CONCLUSION AND RECOMENDATIONS

CHAPTER 6

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 INTRODUCTION

In this chapter the following discussion is firstly dedicated to a summary of the literature review of chapters two and three as well as the protocol that was used in the empirical investigation. Secondly a physical and game skills profile of the U/16 and U/18 Green Squad rugby players is given according to the conclusions found in this study and verified literature. Lastly specific recommendations with reference to this study are made.

6.2 SUMMARY OF LITERATURE REVIEW

Rugby is a major sport in South Africa compared to other playing countries such as Australia, England, France, Ireland and Scotland where it is only the third, fourth or fifth most popular sport. To remain a national sport, the Springbok Rugby team needs to be rated amongst the top three in the world (SARFU, 2003d:11). The need for talented players at an early age is essential for the national team of a country to be successful. To achieve this, SARFU into 2003 identified the U/16 age group schoolboys as the first level of talent identification (SARFU, 2003b:1). A national U/16 rugby week was introduced running simultaneously with the already existing U/18 Craven Week for High Schools (SARFU, 2003b:1). The squad chosen at the end of the national rugby week included 100 players of each of the U/16 and U/18 age groups and was named the Green Squad. The Green Squad had representation in all 14 provinces (SARVU, 2003a:2)

The aim of talent identification and development programmes/systems in sport is to predict future sport achievements of athletes based on their abilities (Singer *et al.* 1993). In chapter three various talent identification models were discussed. Sternberg (1988:278) and Benbow and Lubinski (1993) supported the view that talent is inherited and cannot be acquired. Training as the determinant of success and parents' involvement with the talented sportsperson, is a model advocated by Harre (1982). The talent identification model of Bompa (1985) emphasises that sport achievement is determined by motor skills, physiological capacity and morphological changes.

Abbott and Collins (2002:174) suggested talent identification model, which combines talent identification and development processes. This is of particular importance in this study as the U/16 and U/18 elite rugby players are still in the adolescent phase. Numerous research studies have been done on talent identification and talent development on individual types of sport, but there is still a lack of research on team sport. Over the past ten years several studies have been conducted in an attempt to determine variables that distinguish talented participants from less talented participants in youth team sport (Spamer & Winsley, 2003:189). In South Africa studies by Pienaar and Spamer (1995,1998); Spamer (2000); Hare (1997); Nieuwenhuis (2000); Badenhorst (1998) and Karstens (2002) were done to determine which variables distinguish between talented and less talented youth team sports players.

From the literature review it appears that the following components and variables are important for top talent achievement in rugby. Anthropometrical components include height, weight, somatotyping and body fat percentage. Motor abilities comprise of speed and agility, whilst physical components include strength, endurance and flexibility. Game-specific skill in rugby refers to handling (catching and passing), running and kicking skills.

According to Olds (2000:260) and Nicholas (1997) a strong physique and particularly a large body size is a predictor of success in rugby union. In South Africa a thorough task analysis of the requirements for the game of rugby with youth rugby players was done in order to compile a relevant test battery. Basic game skills needed were identified as handling skills (catching and passing), running, kicking, speed, agility, strength and endurance (De Ridder, 1993; Pienaar & Spamer, 1995; Hare 1997).

The problem statement of this study is that at present little is known about elite schoolboy rugby players in South Africa and internationally. The aim in this study is thus to compile a status profile of the U/16 and U/18 elite rugby player in South Africa referring to physical and game skills. Furthermore, the results of this study will be compared to existing data available nationally and internationally. The compilation of such a profile of the U/16 and U/18 elite rugby player will serve as a guide to school and provincial coaches on team selection and individual training programmes.

SARFU compiled a battery of tests, which was applied at two testing sessions in August 2003 and February 2004 when the Green Squad players were tested. The U/16 elite rugby players consisted

of (n=93) players and U/18 (n=97) and represented all 14 provinces in South Africa. The anthropometrical test battery was compiled according to the International Group on Kinanthropometry (Ross & Marfell-Jones, 1991, and Lohman *et al.* 1988). The anthropometrical components included; stature, body mass, body fat percentage, muscle percentage, skinfold thickness and somatotyping. The physical and motor tests that were used included speed (10m and 40m) and speed endurance tests (Hazeldine & McNab, 1991; Leger & Lambert, 1982), the agility Illinois test (AAHPER, 1966) and the physical components test (Thomas & Nelson, 1985). Both groups were tested with regard to game-specific skill in catching skills, kicking ability (AAPHER, 1966) and passing for accuracy over 4m (Pienaar & Spamer, 1995). After the first testing session, training programmes were developed for each player and implemented by the provinces. In February 2004 a second testing session was done.

Descriptive statistics ($\bar{x}$, standard deviation, minimum and maximum) were used as well as practical significant differences (d-values) (Cohen, 1988). The method of principal components analysis (PCA) and correlations were used to determine best player position of the Green Squad 2003/2004 season (Bartholomew *et al.* 2002).

6.3 CONCLUSION OF THE STUDY

The conclusion of this study is based on the results presented in the literature review and the empirical investigation of this study according to the objectives set out in chapter 1. There are some studies that were done among adolescents, but literature on elite youth rugby players is limited in terms of anthropometrical, rugby-specific, physical and motor components necessary for each age group and for each position.

The research of De Ridder (1993) tried to establish the morphological profile of U/18 Craven Week (provincial elite) rugby players according to position. Hare (1997) compiled differences between talented and less talented U/16 players, though not according to positions. Hanekom (2000) found differences between advantaged and previously disadvantaged U/17 and U/19 rugby players. However he only referred to three positional groups namely, tight and loose forwards and back-line players. Spamer and Winsley (2003) compared elite U/18 English rugby players with the U/18 Craven Week team of the Northern Bulls, but no reference was made to position.

Van Gent's (2003) research was done on U/13, U/16, U/18 and U/19 rugby players to determine a test battery for positional requirements. The study populations consisted of North-West elite provincial rugby players. Plotz (2004) did a comparative study of U/18 English players from Ivybridge-Sport School, U/18 Northern Blue Bulls Craven Week players and U/18 Leopards Craven Week team, though not according to position. It is thus clear from these studies that a need exists to establish a status profile and the positional characteristics of elite adolescent rugby players. However these literature findings will be used to verify the results of this study.

6.3.1 Status profile of the U/16 elite rugby players.

Aim 1: To compile a status profile of the U/16 and U/18 elite rugby player in South Africa with regard to anthropometrical, physical and motor and game-specific skill components. This aim concentrates on players in general and does not refer to playing position. Aim 2 concentrates on positions.

- **Anthropometrical components**

The U/16 elite rugby players recorded low practical significance in anthropometrical variables during the 2004 season. The U/16 Green Squad players of this study were taller and heavier than their counterparts in Hare's (1997) study and heavier, but shorter than the U/16 provincial rugby players in Van Gent's (2003) study. The U/16 Green Squad rugby players in this study had a lower body fat percentage than the provincial rugby players in van Gent's (2003) study and Hare's study (1997). The Green Squad U/16 rugby players recorded an endo-mesomorphic physique although of low practical significance.

In summary the results the anthropometrical data illustrate differences that exist between Green Squad U/16 rugby players and U/16 provincial rugby players according to Van Gent's (2003) study and the talented U/16 players in Hare's (1997) study. This is to be expected because all the Green Squad rugby players in this study (Green Squad) are competing at national level.

- **Physical and motor components**

Research by Hare (1997) and Van Gent (2003) contained data of physical and motor components for 16-year olds, but only Van Gent's (2003) study had data on positional player differences. The

U/16 Green Squad players in this study were faster over 10m than their counterparts in Van Gent's (2003) study. The U/16 players of the Green Squad outperformed their counterparts in Van Gent's (2003) study in terms of agility and strength. With the exception of pull ups, speed endurance and speed over 10m, the physical and motor components tests in the SARFU protocol did not include similar tests as mentioned in previous studies so further comparisons could not be made. It seems as if the U/16 elite rugby players displayed a spurt in speed performance as supported by literature (Malina & Boucard, 1991b).

- **Game-specific skill components**

Studies on rugby-specific skills components for U/16 players are rare and the only data that could be found was that of Hare (1997) and Van Gent (2003). The Green Squad U/16 rugby players performed better in kicking for distance than their counterparts in Hare's (1997) study, Van Gent's (2003) study. The U/16 Green Squad rugby players also outperformed their counterparts in Van Gents (2003) and Hare's (1997) study in terms of passing for distance, passing for accuracy (4m) and ground skills. To conclude, the U/16 Green Squad rugby players possessed better game-specific skills in most of the tests than the provincial U/16 rugby players. The better performance could be due to more experience in rugby, the training programmes that were followed or the Green Squad rugby players being more talented than the provincial players.

6.3.2 Status profile of the U/18 elite rugby players

- **Anthropometrical components**

The U/18 Green Squad rugby players presented low practical significant differences ($d<0.5$) in anthropometrical variables at the beginning of the 2004 season, which means that their body composition did not change very much. The provincial U/18 rugby players (Van Gent, 2003), U/18 English rugby players, the Northern Bulls High School Craven Week U/18 players (Spamer & Winsley, 2003), Blue Bulls U/18 and Ivybridge U/18 players (Plotz, 2004) were taller than the U/18 Green Squad rugby players in this study with an average difference of 3.44cm. A next conclusion is that the U/18 players in Spamer and Winsley's (2003) and Plotz's (2004) studies were heavier and the U/18 players in Spamer and Winsley's (2003) study also had a higher body fat percentage than the Green Squad U/18 rugby players. The U/18 provincial rugby players in

Van Gent's (2003) study had a lower body mass and higher body fat percentage in comparison to the U/18 Green Squad rugby players.

The conclusion that can be made from this study is that in some anthropometrical components the Green Squad U/18 players recorded lower values than their provincial counterparts in Van Gent's (2003), Spamer and Winsley's (2003) and Plotz's (2004) studies and this might be due to the fact that most of the Green Squad U/18 players had finished their growth spurt. The U/18 Green Squad rugby players in this study were also shorter and had a lower measurement in body fat percentage than their counterparts in studies by Van Gent (2003), Spamer and Winsley (2003) and Plotz (2004). The U/18 Green Squad rugby players in this study are heavier than the U/18 provincial players in Van Gent's (2003) study and the Leopard U/18 players in Plotz's study (2004). The U/18 Green Squad rugby players in this study can be classified as having an endo-mesomorphic physique.

- **Physical and Motor Components**

With reference to speed over 10m, agility Illinois test and pull ups, the U/18 Green Squad rugby players recorded better results than the U/18 provincial players in Van Gent's (2003) study. Previous studies included different physical and motor tests than the SARFU test protocol of this study, thus more comparisons could not be made. To summarise, the U/18 Green Squad players in this study were faster, displayed more agility and had more upper body strength than the provincial U/18 players in Van Gent's (2003) study. The U/18 Green Squad rugby players' better performance in physical and motor components could be due to the training programmes that were followed.

- **Game-specific skills components**

Literature for reference to rugby-specific skill components was found in Van Gent (2003) and Plotz's (2004) studies. Although the SARFU test protocol only included five game-specific skills tests, only ground skills tests, kicking for distance, passing for accuracy (4m) and passing for distance could be compared. The U/18 Green Squad players scored faster times in ground skills than the U/18 provincial players in Van Gent's (2003) study, the Northern Bulls and English U/18 players in Spamer and Winsley's (2003) study and the U/18 Blue Bulls, Leopards and Ivybridge players in Plotz's (2004) study. In terms of passing for accuracy (4m), the U/18 Green Squad

rugby players in this study only outperformed the U/18 Leopards and Ivybridge rugby players in Plotz's (2004) study but the U/18 players in Van Gent's (2003) study and the U/18 Blue Bulls in Plotz's (2004) study scored better results than the U/18 Green Squad players. With regard to passing for distance, the U/18 Green Squad rugby players in this study presented better results than the Blue Bulls U/18 rugby players in Plotz's (2004) study.

To summarise, the U/18 Green Squad rugby players, in comparison with other literature performed best in ground skills, passing for distance and kicking for distance. With reference to passing for accuracy (4m) they only performed better than the English U/18 and Leopard U/18 provincial rugby players. It can be deduced that the Green Squad U/18 players need more training in passing for accuracy (4m) and it could be that the training programmes they followed did not consist of enough passing skills. It seems that as far as the other variables are concerned the training programme was up to standard. With reference to the first aim of this study, it can be concluded that the Green Squad U/18 player is characterized by certain anthropometrical, game-specific skill and physical and motor characteristics.

6.3.3. Status profile of the different player positions of the U/16 and U/18 elite rugby players

Aim: 2 The second aim of this study was to compile a physical and game skills profile for the different playing positions of the U/16 and U/18 elite rugby player in South Africa with reference to anthropometrical, physical and motor and game-specific skill components.

Comparisons with relevant literature will be made however, it must be emphasised that not many studies exist in terms of positional components for each player at different ages.

- ***Props***

Literature suggests that body mass is an important anthropometrical component for props (De Ridder, 1993; SARFU, 1998; Nicholas, 1997). All the props in this study (U/16 and U/18) recorded higher body mass than the rest of the player positions. Van Gent (2003) found that U/16 props were also the tallest. In this study, the U16 and U/18 Green Squad props presented fourth and third tallest stature respectively. Van Gent (2003) established skinfold thickness and body fat

percentage to be an important anthropometrical component as was the case in both age groups in this study. With reference to the characteristics of props, supported by literature, the U/16 and U/18 Green squad props were the heaviest players compared to the rest of the Green Squad players; they had the largest measurement of skinfold thickness as well as the largest fat percentage. Thus it seems that the props in this study revealed similar characteristics as recorded in literature. Similarly to the study by De Ridder (1993), the U/16 and U/18 props in this study presented an endo-mesomorphic physique.

With reference to physical and motor abilities, literature suggests that props should possess speed, speed endurance, agility and strength (SARFU, 1998; Noakes & Du Plessis, 1996; Van Gent, 2003). In this study the props of both player groups (U/16 and U/18) recorded the slowest times in speed, poor results in agility and speed endurance and only one strength component (bench press) revealed importance. It seems that the U/16 and U/18 Green Squad props recorded poor physical and motor ability results, compared to literature. This could mean that the physical conditioning programmes of the props should be adjusted.

With reference to game-specific skill components, literature mentions handling skills as important for props (SARFU, 1998 and Van Gent, 2003). In this study the U/16 Green Squad props recorded poor results in all the game-specific skill tests whilst the U/16 players in Van Gent's (2003) study recorded good results in passing for accuracy 4m, passing for distance and catching while running. The Green Squad U/18 props in this study presented catching and throwing over the crossbar ($\bar{x}$= 13.50) as important requirements. It is clear from these results that the U/16 Green Squad props need more game-specific skill training.

- ***Hookers***

In literature De Ridder (1993) reported that hookers are short in stature and have the lightest body mass. In Van Gent's (2003) study U/16 hookers presented body mass and stature as important components whilst the U/18 hookers recorded body mass only as an important characteristic. In this study the Green Squad U/18 hookers presented weight as a relevant characteristic at the end of the 2003 season and were not retested in 2004 with regard to anthropometrical components. With reference to body fat percentage and sum of skinfolds the hookers tested in Van Gent's (2003) study presented these components as relevant for positional selections as did the U/18 Green Squad hookers. The U/16 Green Squad hooker in this study only revealed body fat

percentage as relevant to positional selection. The U/16 and U/18 Green Squad hookers somatotype was recorded as an endo-mesomorphic physique. Although the Green Squad hookers revealed an endo-mesomorphic physique, it seems as if body fat percentage (U/16), skinfold thickness (U/18) and body mass (U/18) were the only relevant characteristics.

A hooker should possess speed, agility, strength, power and speed endurance in terms of physical and motor components (Craven, 1974; Nicholas, 1997 and Hare, 1997). The U/16 hookers in this study presented strength components and speed endurance as important positional requirements whereas the U/18 Green Squad hookers revealed strength, speed over 10 m and speed endurance to be important. Thus the U/16 Green squad hookers had good upper body strength and speed endurance but were amongst the slower players in their age group compared to the U/18 Green Squad hookers who were fastest, had best results in speed endurance and very good upper body strength. The U/18 Green Squad hookers compared favourably to the characteristics of hookers as supported by literature.

In terms of game-specific skill components, a hooker should present good handling skills (Hare, 1997; SARFU, 1998; Van Gent, 2003). In this study the Green Squad U/18 hookers (2003) presented kicking for distance as relevant characteristics. The U/16 Green squad hookers though recorded poor performance in all game-specific skills. It can be noted that the U/18 Green Squad hookers recorded good performance in kicking and passing for distance, which also involves upper body strength and leg power whilst the U/16 Green Squad hookers need more attention with regard to game-specific skill training.

- ***Locks***

The most important anthropometrical components for locks according to literature are stature, body mass, skinfold thickness and body fat percentage (De Ridder, 1993; SARFU, 1998). In Van Gent's study the U/16 players presented stature as an important feature but not the U/18 players. Body mass and skinfold thickness were presented by the U/18 players but not the U/16 players (Van Gent, 2003). In this study, stature, body mass, skinfold thickness, muscle percentage and body fat percentage revealed by the Green Squad U/16 locks were relevant requirements for positional selection and the Green Squad U/18 locks in this study revealed stature, body mass and skinfold thickness as supported by literature to be important characteristics.

Literature reveals that locks should have power, strength, speed and agility (Craven, 1974; Noakes & Du Plessis, 1996). Van Gent reported speed and agility to be relevant in the U/16 and U/18 locks in her study. In this study the Green Squad U/16 locks presented upper body strength (bench press) as a relevant component to positional selection but recorded poor performance in speed, speed endurance and agility. The U/18 Green Squad locks presented poor performance in all the physical and motor components thus not measuring up to the standard as stated by literature. The conditioning and training programmes for the U/18 Green Squad locks should therefore be adjusted.

Locks should possess good ball-handling skills in terms of game-specific skill components (Craven, 1974; Hanekom, 2000; SARFU, 1998). In Van Gent's study all the locks presented some form of ball-handling skill. In this study the U/16 locks presented good ball-handling skills in catching and throwing over the crossbar ($\bar{x}$ = 22.00) and passing for distance ($\bar{x}$ = 29.20 m) whereas the U/18 Green Squad locks recorded poor performance in all the game-specific skill tests. The U/18 Green Squad locks' training programme with regard to game-specific skills needs attention.

- ***Flankers***

Literature regards stature, body mass, skinfold thickness and body fat percentage to be the most important anthropometrical components (De Ridder, 1993; SARFU, 1998). The Green Squad U/18 flankers in this study presented muscle percentage as an important requirement whilst the U/16 Green Squad flankers did not record any specific anthropometrical characteristic. Compared to literature the Green Squad flankers did not present anthropometric characteristics for positional selection.

Flankers need speed, agility and speed endurance in terms of physical and motor components (Craven, 1974; SARFU, 1998). The U/18 flankers in Van Gent's (2003) study presented speed to be important. In this study the Green Squad U/16 flankers revealed strength (bench press and push ups) and speed endurance as important characteristics whilst the U/18 flankers presented one strength component (pull ups) as important. Although the Green Squad flankers revealed some strength characteristics they presented poor performance with reference to speed components. The flankers are amongst the loose forwards where speed, according to literature, is

an important requirement in regaining ball possession, thus the conditioning programmes that were followed need to be adjusted.

The game-specific skills that should be important for flankers include ball handling (Craven, 1974; SARFU, 1998). The U/18 flankers in Van Gent's (2003) study presented with kicking and ball-handling skills. The Green Squad U/16 flankers recorded passing for distance as an important requirement. The Green Squad U/18 flankers presented handling (catching and throwing over the crossbar) and kicking for distance as relevant characteristics. It can be expected that the Green Squad flankers should possess more handling skills, as these players need to be good at mauling and scrummaging.

- ***Eighth men***

According to De Ridder (1993), the most important anthropometrical components for eighth men are stature, body mass, skinfold thickness and body fat percentage whilst Van Gent's (2003) study revealed that body fat percentage was a characteristic presented by the U/16 and U/18 players. In this study the Green Squad U/16 eighth men recorded stature, body mass and skinfold thickness as important features. The U/18 Green Squad eighth men presented stature, body mass, muscle percentage and body fat percentage as important characteristics. It can be derived that the Green Squad eighth men presented most of the anthropometrical variables as relevant characteristics.

Literature suggests speed, agility, strength and speed endurance as important physical and motor components for eighth men (Hare, 1997; SARFU, 1998). The U/18 eighth men in Van Gent's (2003) study showed speed and agility as important components. The U/16 and U/18 Green Squad players presented strength and speed endurance as important requirements as supported by literature.

In terms of game-specific skill components, literature states that ball-handling skills are important characteristics for eighth men (SARFU, 1998). The U/16 eighth men in a study by Van Gent (2003) presented ground skills and ball-handling skills to be important whereas the U/18 eighth men revealed ball-handling skills important as requirements. The Green Squad U/18 eighth men revealed passing for distance ($\bar{x} = 27.70$ m) as the only relevant characteristic and recorded poor performance in passing for accuracy 4m and kicking for distance. The U/16 Green Squad eighth

men recorded best performance in ground skills and passing for distance and presented good results in kicking for distance and catching and throwing over the crossbar. Thus the U/16 Green Squad eighth men in this study possessed characteristics relevant to positional role as supported by literature.

- ***Scrumhalfs***

According to literature, important requirements for the scrumhalf position include body mass, stature, skinfold thickness and body fat percentage (Quarrie, *et al.* 1996; Nicholas, 1997; De Ridder, 1993). Van Gent (2003) recorded the U/16 scrumhalfs' values in body mass, stature, skinfold thickness and body fat percentage to be important components whilst the U/18 players revealed stature to be important. As supported by literature the Green Squad U/16 and U/18 scrumhalfs presented stature, body mass, skinfold thickness and body fat percentage as important characteristics thus illustrating that anthropometrical components were relevant to positional selection.

In terms of physical and motor components, the scrumhalfs should be fast, agile and possess strength and speed endurance (Craven, 1974; SARFU, 1998). The U/16 and U/18 players in Van Gent's (2003) study recorded speed endurance and pull ups as an important component. The U/18 players also possessed agility. The U/16 Green Squad scrumhalfs in this study presented speed over 10 m and 40 m and agility as important characteristics whilst the U/18 Green Squad scrumhalfs recorded strength (pull ups and push ups), speed over 40 m and agility as important positional characteristics for selection. The Green Squad U/16 and U/18 scrumhalfs matched the requirements of their playing positions with reference to physical and motor components as stated in literature.

According to literature scrumhalfs should present game-specific skill components, namely good handling skills and kicking abilities (Craven, 1974; Van Gent, 2003). The Green Squad U/16 scrumhalfs revealed good handling skills namely; passing for accuracy 4m and ground skills. The Green Squad U/18 scrumhalfs had good handling skills with regard to passing for accuracy and ground skills and recorded good performance with regard to kicking for distance. Thus the Green Squad U/18 and U/16 scrumhalfs revealed good game-specific skills.

- ***Flyhalfs***

Literature suggests that important anthropometrical components for flyhalfs are stature, body mass, skinfold thickness and body fat percentage (De Ridder, 1993). In this study the U/16 Green Squad flyhalfs recorded skinfold thickness to be a relevant characteristic as well as muscle percentage. The U/18 Green Squad flyhalfs in this study revealed body mass and skinfold thickness as important requirements. Although body fat percentage did not feature strongly in the Green Squad flyhalfs, other anthropometrical characteristics as recorded in literature were presented.

In terms of physical and motor components, the flyhalfs should present speed, agility and strength (De Ridder, 1993; Hanekom, 2000). In Van Gent's (2003) study the U/16 flyhalfs recorded speed and strength as an important component and the U/18 flyhalfs presented speed endurance and speed as important components. The U/16 Green Squad flyhalfs in this study recorded strength (pull ups), agility and speed over 10 m as important characteristics whereas the U/18 Green Squad flyhalfs had poor performance in all of the physical and motor components tests. The training and conditioning programmes that were followed by the U/18 Green Squad flyhalfs should therefore be re-evaluated and adjusted.

Game-specific skill components that are important for flyhalf positional role are kicking skills, handling skills and running skills (Craven, 1974; SARFU, 1998). The flyhalfs in Van Gent's (2003) study presented handling and kicking skills. In this study the Green Squad U/16 flyhalfs recorded good results with reference to kicking for distance, ground skills and passing for accuracy (4m). In comparison the U/18 Green Squad flyhalfs reported good results in all of the game-specific skill components. It seems that the Green Squad flyhalfs presented good handling and kicking skills as recorded in literature.

- ***Centres***

Anthropometrical components that literature suggests as important for centres include body mass, stature, skinfold thickness and body fat percentage (De Ridder, 1993). Van Gent (2003) established the same characteristics but body fat percentage was only recorded by the U/18 centres as relevant. The U/16 Green Squad centres were amongst the shorter players ($\bar{x}$= 174.50 cm) with a lighter body mass ($\bar{x}$= 72.86 kg) in their age group whereas the U/18 Green Squad

centres recorded a muscle percentage of ($\bar{x}$= 62.67 %) as the only relevant characteristic. It seems as if anthropometrical variables did not play an important role with reference to positional selection in the Green Squad centres.

Physical and motor components suggested by literature as important components for centres are speed, agility, strength, power and speed endurance (Craven, 1974; SARFU, 1998). In Van Gent's (2003) study speed, strength and agility were recorded by the U/16 players as important whilst, the U/18 players presented speed endurance as an important component. The Green Squad U/16 centres recorded one strength component (pull ups) as a positional characteristic but the U/18 Green Squad centres presented best performance with reference to agility. In comparison to literature, the Green Squad centres recorded poor performance with reference to physical and motor components.

According to literature, the centres need good handling skills, running skills and kicking skills in terms of game-specific skills (De Ridder, 1993; Craven, 1974; SARFU, 1998). The U/18 players in Van Gent's (2003) study presented good kicking skills and the U/16 players presented good handlings skills. The U/16 Green Squad centres had a poor performance in all the game-specific skill components whilst the U/18 Green Squad centres recorded second best results in passing for distance. It seems as if the Green Squad centres need a lot more training with regard to game-specific skills.

- ***Wings***

Literature suggests that body mass, stature, skinfold thickness and body fat percentage are important anthropometrical components for wings (De Ridder, 1993). The U/16 and U/18 wings in Van Gent's (2003) study presented body mass and stature as important components whilst the U/18 wings also recorded skinfold thickness as a positional requirement. The Green Squad U/16 players revealed stature, body mass and muscle percentage as important characteristics. The U/18 wings of the Green Squad showed stature, skinfold thickness and body fat percentage to be important components as supported by literature. In the U/16 and U/18 Green Squad players the wings were amongst the shorter players and also had a small body mass.

According to literature, the physical and motor components required by the wings are speed, speed endurance, agility and strength (Craven, 1974; SARFU, 1998). In Van Gent's (2003)

study, the U/16 and U/18 wings presented speed, agility and strength as important components and the U/18 wings also recorded speed endurance as a positional requirement. The Green Squad U/16 wings in this study presented one strength component (pull ups) and speed over 10m and 40m important characteristics and the Green Squad U/18 wings in this study presented speed and agility as a positional requirement. It is obvious that the wings in this study did not score high in strength components, which is an aspect that should be attended to.

The game-specific skill components that are important requirements for wings include handling skills, running skills and kicking skills (Craven, 1974; SARFU, 1998). The U/16 and U/18 wings in Van Gent's (2003) study revealed kicking skills as important components but only the U/16 wings recorded handling skills as a positional requirement. In this study the U/16 Green Squad wings did not present game-specific skills as an important component. However, the U/18 Green Squad wings recorded ground skills as a positional requirement. It seems as if the Green Squad wings need more training with reference to game-specific skills.

- ***Fullbacks***

Literature suggests that body mass, stature, skinfold thickness and body fat percentage are important anthropometrical components for the fullbacks (De Ridder, 1993). In Van Gent's (2003) study the U/16 fullbacks presented stature as important. The U/16 Green Squad fullbacks in this study showed stature, skinfold thickness, muscle percentage and body fat percentage to be important characteristics. The U/18 Green Squad fullbacks in this study presented skinfold thickness and body fat percentage as important. It seems that the U/16 Green Squad fullbacks were in the growth spurt phase, which explains the importance of anthropometrical characteristics presented in this study. However, the U/18 Green Squad fullbacks might have reached the end of the growth spurt, therefore no significant differences were noted in terms of anthropometrical components.

The physical and motor components needed by the fullbacks include speed, agility, strength and speed endurance (De Ridder, 1993). Van Gent (2003) established that speed and agility were important in U/16 and U/18 players. The U/18 fullbacks in her study also presented strength and speed endurance as important characteristics. In this study the U/16 Green Squad fullbacks recorded speed and agility as important characteristics whilst the U/18 Green Squad fullbacks in this study presented speed and speed endurance as positional requirements. Strength components

of the Green Squad fullbacks did not feature as an important characteristic and need to be addressed in the training programmes.

In terms of game-specific skill components every fullback should possess handling and kicking skills (Craven, 1974; SARFU, 1998). Both the U/16 and U/18 fullbacks in Van Gent's study (2003) presented all handling and kicking abilities. In this study the U/16 Green Squad fullbacks presented two handling skills (catching and throwing and passing for accuracy over 4m) and kicking for distance as important characteristics. The U/18 Green Squad fullbacks in this study performed best with reference to passing for accuracy over 4m, and recorded very good results in ground skills and kicking for distance. To conclude, as supported by literature the Green Squad fullbacks presented most characteristics with reference to game-specific skills.

- ***Conclusion***

It seems that player positions as investigated in this study revealed more or less the same characteristics with reference to anthropometrical components, game-specific skills and physical and motor components as suggested by previous literature. However, in this study explosive leg power and running abilities were components not included in the test protocol of SARFU and flexibility and grip strength tests were poorly recorded. According to literature these components are also important characteristics. Positional selection of players and age groups with reference to anthropometrical, physical and motor and game skill components is important in talent identification programmes. The second aim of this study was to compile a physical and game skills profile of different player positions of the U/16 and U/18 Green Squad schoolboy rugby player in South Africa with reference to anthropometrical, physical and motor and game-specific skill components. The Diagram 6.3.1 and 6.3.2 reflects the characteristics important for positional selection in the Green Squad with reference to anthropometrical, physical and motor and game-specific skills

It can be noted that the South African Schools team (22 players) chosen in July 2004 included one U/16 Green Squad player of 2003/2004 and nine U/18 Green Squad players of 2003/2004. The Academy team (22 players) chosen in July 2004 after completion of the U/18 Craven Week for High Schools and the U/16 Grant Khomo Week included four U/16 Green Squad players of 2003/2004 and two U/18 Green Squad players of 2003/2004. The provisional U/19 South African rugby squad chosen in August 2004 to represent South Africa at the U/19 World Cup

Championships in 2005 included 13 of the 2003/2004 U/18 Green Squad players and eight of the 2003/2004 U/16 Green Squad players. It seems that the talent identification and selection criteria used as well as the training programmes that were followed contributed to the selection of the Green Squad.

6.3.4 SUMMARY OF THE CONCLUSION OF THE RESULTS

In diagrams 6.3.1 and 6.3.2 a summary is given of the profile of the different player positions that was compiled according to the conclusion of the results in this study on the SARFU Green Squad. Not all the results but only those displaying relevant characteristics were reported. The diagrams consist of the following data:

- a comparison of the results of a specific position with other positions in the Green Squad team. This was done according to the results found in Tables 5.13 to 5.18.
- the average score ($\bar{x}$) that was obtained for all the players in that specific position in the SARFU Green Squad (Tables 5.13 to 5.18).
- the average score ($\bar{x}$) by previous national and international literature for these different battery of tests (chapter 5) depending on whether the data was recorded.

Diagram 6.3.1: PHYSICAL AND GAME-SPECIFIC PROFILE OF PLAYER POSITIONS FOR U/16 ELITE RUGBY PLAYERS WITH REFERENCE TO ANTHROPOMETRICAL, PHYSICAL AND MOTOR AND GAME-SPECIFIC COMPONENTS

POSITION	ANTHROPOMETRICAL COMPONENTS	PHYSICAL & MOTOR COMPONENTS	GAME-SPECIFIC SKILLS COMPONENTS
Prop	* Endo-mesomorphic physique ($\bar{x}$=2.11/4.74/2.68) (1) * Stature ($\bar{x}$=179.84 cm) (1) ($\bar{x}$=179.00 cm) (2) * Heaviest body mass ($\bar{x}$=103.61 kg) (1) ($\bar{x}$= 88.00 kg) (2) * Highest skinfold thickness ($\bar{x}$=149.24 mm) (1) ($\bar{x}$=84.67 mm) (2) * Highest body fat percentage ($\bar{x}$=23.04 %) (1) ($\bar{x}$=20.78 %) (2)	* Slowest over 10 m ($\bar{x}$=1.95 sec) (1) ($\bar{x}$=1.84 sec) (2) * Slowest over 40 m ($\bar{x}$=5.79 sec) (1) * Poorest agility ($\bar{x}$=16.86 sec) (1) ($\bar{x}$=19.15 sec) (2) * Weakest in pull ups ($\bar{x}$=5.50) (1) ($\bar{x}$=5.00) (2) * Weakest in push ups ($\bar{x}$=41.86) (1)	* Poor performance in passing for accuracy (4 m) ($\bar{x}$=5.20) (1) ($\bar{x}$=2.67) (2) * Poorest result in ground skills ($\bar{x}$=3.47 sec) (1) ($\bar{x}$=3.75 sec) (2)
Hooker	* Endo-mesomorfic physique ($\bar{x}$=3.29/6.90) (1) * Second highest body fat percentage ($\bar{x}$=15.45 %) (1)	* Second slowest over 40 m ($\bar{x}$=5.60 sec) (1) * Second best in speed endurance ($\bar{x}$=97.33) (1) * Best score in push ups ($\bar{x}$=60.00) (1) * Second best in bench press results ($\bar{x}$=95.00 kg) (1)	* Poorest result in passing for accuracy (4 m) ($\bar{x}$=3.40 sec) (1) * Poorest result in passing for distance ($\bar{x}$=26.30 m)

(1) = SARFU'S GREEN SQUAD (2003/2004) **(2) = OTHER LITERATURE**

Lock	* Endo-mesomorphic physique ($\bar{x}$=3.27/5.52) (1) * Tallest player ($\bar{x}$=190.72 cm) (1) ($\bar{x}$=191.25 cm) (2) * Second heaviest body mass ($\bar{x}$=90.94 kg) (1) ($\bar{x}$=84.50 kg) (2) * Second highest skinfold thickness ($\bar{x}$=78.24 mm) (1) ($\bar{x}$=67.63 mm) (2) * Second highest muscle percentage ($\bar{x}$=63.57 %) (1) * Third highest body fat percentage ($\bar{x}$=15.17 %) (1) ($\bar{x}$= 18.24 %) (2)	* Third best result in bench press ($\bar{x}$=93.75 kg) (1) * Speed over 10 m ($\bar{x}$=1.89 sec) (1) ($\bar{x}$=2.03 sec) (2)	* Best in catching and throwing over the crossbar ($\bar{x}$=22.00) (1) * Second best in passing for distance ($\bar{x}$=29.20 m) (1) ($\bar{x}$=22.10 m) (2)
Flanker	* Endo-mesomorphic physique ($\bar{x}$=2.77/5.95) (1) * Third smallest body fat percentage ($\bar{x}$=13.68 %) (1)	* Best result in bench press ($\bar{x}$=101.00 kg) (1) * Second most push ups ($\bar{x}$=54.00) (1) * Best in speed endurance ($\bar{x}$=98.60) (1)	* Third best result in passing for distance ($\bar{x}$=28.75 m) (1)

No 8	* Endo-mesomorphic physique ($\bar{x}$=3.12/4.88) (1) * Second tallest player ($\bar{x}$=183.55 cm) (1) * Third heaviest body mass ($\bar{x}$=83.32 kg) (1) * Third highest skinfold thickness ($\bar{x}$=70.63 mm) (1)	* Third most push ups ($\bar{x}$=53.60) (1) * Third best in speed endurance ($\bar{x}$=96.00) (1)	* Best result in ground skills ($\bar{x}$=3.02 sec) (1) * Best result in passing for distance ($\bar{x}$=34.27 m) (1) * Second best result in kicking for distance ($\bar{x}$=49.11m) (1) * Third best in catching and throwing over the crossbar ($\bar{x}$=17.50) (1)
Scrumhalf	* Ectomorphic physique ($\bar{x}$=2.68) (1) * Shortest player ($\bar{x}$= 67.48 cm) (1) ($\bar{x}$=172.50 cm) (2) * Lightest body mass ($\bar{x}$=62.00 kg) (1) ($\bar{x}$=68.00 kg) (2) * Smallest measurement of skinfold thickness ($\bar{x}$=51.28 mm) (1) ($\bar{x}$=38.50 mm) (2) * Smallest body fat percentage ($\bar{x}$=12.27 %) (1) ($\bar{x}$=12.77 %) (2)	* Fastest over 10 m ($\bar{x}$=1.77 sec) (1) ($\bar{x}$=1.75 sec) (2) * Second fastest over 40 m ($\bar{x}$=5.27 sec) (1) * Most agile player ($\bar{x}$=14.57 sec) (1) ($\bar{x}$=17.60 sec) (2) * Poorest result in bench press ($\bar{x}$=63.40 kg) (1)	* Best result in passing for accuracy (4 m) ($\bar{x}$=7.50) (1) ($\bar{x}$=5.00) (2) * Third best result in ground skills ($\bar{x}$=3.07 sec) (1) ($\bar{x}$=3.44 sec) (2)

Flyhalf	* Ectomorphic physique ($\bar{x}$=2.70) (1) * Second smallest measurement on skinfold thickness ($\bar{x}$=58.56 mm) (1) ($\bar{x}$=38.50 mm) (2)	* Best result in pull-ups ($\bar{x}$=14.00) (1) ($\bar{x}$=12.50) (2) * Second fastest over 10 m ($\bar{x}$=1.79 sec) (1) ($\bar{x}$=1.75 sec) (2) • Second most agile player ($\bar{x}$=14.66 sec) (1) ($\bar{x}$=17.60 sec) (2)	* Second best result in passing for accuracy (4 m) ($\bar{x}$=7.25) (1) ($\bar{x}$=5.00) (2) * Second best result in ground skills ($\bar{x}$=3.04 sec) (1) ($\bar{x}$=3.44 sec) (2) * Third best result in kicking for distance ($\bar{x}$=49.07 m) (1) ($\bar{x}$=59.50 m) (2)
Centre	* Third shortest player ($\bar{x}$=174.50 cm) (1) ($\bar{x}$=186.00 cm) (2) * Third lightest body mass ($\bar{x}$=72.86 kg) (1) ($\bar{x}$=80.50 kg) (2) * Smallest muscle percentage ($\bar{x}$=57.28 %) (1)	* Second most pull-ups ($\bar{x}$=13.57) (1) ($\bar{x}$=9.50) (2) * Poorest result in speed endurance ($\bar{x}$=84.20) (1)	* Fourth best in ground skills ($\bar{x}$=3.15 sec) (1) ($\bar{x}$=3.65 sec) (2)
Wing	• Second shortest player ($\bar{x}$=173.25 cm) (1) ($\bar{x}$=175.50 cm) (2) * Second lightest body mass ($\bar{x}$=69.22 kg) (1) ($\bar{x}$=67.00 kg) (2) * Third most muscle percentage ($\bar{x}$=63.42 %) (1)	* Third fastest over 10 m ($\bar{x}$=1.80 sec) (1) ($\bar{x}$=1.91 sec) (2) • Third fastest over 40 m ($\bar{x}$=5.28 sec) (1) * Third most pull-ups ($\bar{x}$=13.45) (1) ($\bar{x}$=6.50) (2)	* Second poorest result in passing for accuracy (4 m) ($\bar{x}$=4.63) (1) ($\bar{x}$=4.50) (2)

Fullback	* Ectomorphic physique ($\bar{x}$=2.70) (1) * Third tallest player ($\bar{x}$=179.87 cm) (1) ($\bar{x}$=177.00 cm) (2) * Second lowest body fat percentage ($\bar{x}$=13.25 %) (1) ($\bar{x}$=15.30 %) (2) * Highest muscle percentage ($\bar{x}$=65.28 %) (1)	* Fastest over 40 m ($\bar{x}$=5.27 sec) (1) * Third most agile player ($\bar{x}$=14.83 sec) (1) ($\bar{x}$=16.22 sec) (2)	* Second best in catching and throwing over the crossbar ($\bar{x}$=17.50) (1) * Best in kicking for distance ($\bar{x}$=51.90 m) (1) * Third best result in passing for accuracy (4 m) ($\bar{x}$=5.83) (1) ($\bar{x}$=6.00) (2)

Diagram 6.3.2: PHYSICAL AND GAME-SPECIFIC PROFILE OF PLAYER POSITIONS FOR U/18 ELITE RUGBY PLAYERS WITH REFERENCE TO ANTHROPOMETRICAL, PHYSICAL AND MOTOR AND GAME-SPECIFIC COMPONENTS

POSITIONS	ANTHROPOMETRIC CHARACTERISTICS	PHYSICAL-AND MOTOR COMPONENTS	GAME-SPECIFIC SKILLS
Prop	• Endo-mesomorphic physique ($\bar{x}$=6.09/7.74/0.41) (1) * Third tallest player ($\bar{x}$=181.22 cm) (1) ($\bar{x}$=186.67 cm) (2) ($\bar{x}$=180.60 cm) (2) * Heaviest body mass ($\bar{x}$=103.20 kg) (1) ($\bar{x}$=105.33 kg) (2) * Highest skinfold thickness ($\bar{x}$=147.07 mm) (1) ($\bar{x}$= 117.90 mm) (2) * Highest body fat percentage ($\bar{x}$ =22.72 %) (1) ($\bar{x}$= 26.66 %) (2)	* Slowest over 10 m ($\bar{x}$=1.96 sec) (1) ($\bar{x}$=2.17 sec) (2) * Slowest over 40 m ($\bar{x}$=5.92 sec) (1) * Poorest speed endurance ($\bar{x}$=83.00 sec) (1) * Poorest result in Pull ups ($\bar{x}$=7.50) (1) • Poorest result in Push ups ($\bar{x}$=53.20) (1)	* Third best in catching and throwing over the crossbar ($\bar{x}$=13.50) (1) * Poorest result in passing for accuracy (4 m) ($\bar{x}$=3.00) (1) ($\bar{x}$=4.67 (2)

(1) = SARFU'S GREEN SQUAD (2003/2004) (2) = OTHER LITERATURE

Hooker	* Endo-mesomorphic physique ($\bar{x}$=3.33/6.54) (1) * Third heaviest body mass ($\bar{x}$=93.10 kg) (1) ($\bar{x}$=79.00 kg) (2) * Second highest skinfold thickness ($\bar{x}$=80.72 mm) (1) (2003) ($\bar{x}$=71.50 mm) (2) * Second highest body fat percentage ($\bar{x}$=15.34 %) (1) ($\bar{x}$=17.2 0%) (2)	* Best result in bench press ($\bar{x}$=125.00 kg) (1) * Second most pull ups ($\bar{x}$=16.50) (1) * Most push ups ($\bar{x}$=75.00) (1) * Best in speed endurance ($\bar{x}$=111.50) (1) * Fastest over 10 m ($\bar{x}$=1.74 sec) (1) ($\bar{x}$=2.27 sec) (2)	* Third best result in passing for distance ($\bar{x}$=25.63 m) (1) ($\bar{x}$=20.50 m) (2) * Slowest in ground skills ($\bar{x}$=3.33 sec) (1) ($\bar{x}$=3.76 sec) (2) * Third best result in kicking for distance ($\bar{x}$= 45.50 m) (1) ($\bar{x}$= 46.25 m) (2)
Locks	* Endo-mesomorphic physique ($\bar{x}$=3.04/4.57/2.76) (1) * Tallest player ($\bar{x}$=194.16 cm) (1) ($\bar{x}$=189.33 cm) (2) ($\bar{x}$=191.60 cm) (2) * Second heaviest body mass ($\bar{x}$=95.50 kg) (1) ($\bar{x}$=82.67 kg) (2) ($\bar{x}$=90.00 kg) (2)	* Second poorest result in pull ups ($\bar{x}$=9.73) (1) * Second poorest result in push ups ($\bar{x}$=55.10) (1) * Second slowest in speed over 10 m ($\bar{x}$=1.89 sec) (1) ($\bar{x}$=1.95 sec) (2) * Second slowest in speed over 40 m ($\bar{x}$=5.56 sec) (1)	* Second best in ground skills ($\bar{x}$=3.03 sec) (1) ($\bar{x}$=4.14 sec) (2) ($\bar{x}$=3.79 sec) (2)

Flanker	* Mesomorphic physique ($\bar{x}$=6.35) (1) * Highest muscle percentage ($\bar{x}$=64.01 %) (1)	* Third most pull ups ($\bar{x}$=15.40) (1) * Second poorest result in speed endurance ($\bar{x}$=87.86) (1) * Third slowest in speed over 10 m ($\bar{x}$=1.86 sec) (1) ($\bar{x}$=2.02 sec) (2)	* Second best in catching and throwing over the crossbar ($\bar{x}$=15.00) (1) * Best in kicking for distance ($\bar{x}$=51.43 m) (1) ($\bar{x}$=32.65 m) (2)
No. 8	* Second tallest ($\bar{x}$=181.47 cm) (1) ($\bar{x}$=186.70 cm) (2) ($\bar{x}$=185.50 cm) (2) * Third heaviest body mass ($\bar{x}$=88.95 kg) (1) ($\bar{x}$=85.10 kg) (2) ($\bar{x}$=88.00 kg) (2) * Second highest body fat percentage ($\bar{x}$ =15.54 %) (1) ($\bar{x}$= 15.70 %) (2) ($\bar{x}$ =19.06 %) (2)	* Third best result in bench press ($\bar{x}$=115.00 kg) (1) * Second most push ups ($\bar{x}$=69.33) (1) * Second best in speed endurance ($\bar{x}$=109.00) (1)	* Poorest result in kicking for distance ($\bar{x}$=38.30 m) (1) ($\bar{x}$=39.31 m) (2) * Second poorest result in passing for accuracy (4 m) ($\bar{x}$=9.00 m) (2) ($\bar{x}$=3.00 m) (1) * Third best in passing for distance ($\bar{x}$=29.65 m) (2) ($\bar{x}$=27.70 m) (1)

Scrumhalf	* Mesomorphic physique ($\bar{x}$ = 7.50) (1) * Shortest player ($\bar{x}$=168.16 cm) (1) ($\bar{x}$=171.00 cm) (2) * Lightest body mass ($\bar{x}$=69.62 kg) (1) ($\bar{x}$=67.80 kg) (2) * Smallest measurement of skinfold thickness ($\bar{x}$=55.42 mm) (1) ($\bar{x}$=58.40 mm) (2) * Smallest body fat percentage ($\bar{x}$=12.64 %) (1) ($\bar{x}$=14.30 %) (2)	* Most pull ups ($\bar{x}$=18.40) (1) * Third most push ups ($\bar{x}$=66.60) (1) * Second fastest over 40 m ($\bar{x}$=5.23 sec) (1) * Second most agile ($\bar{x}$=14.74 sec) (1) ($\bar{x}$=16.39 sec) (2)	* Second best result in kicking for distance ($\bar{x}$=48.50 m) (1) ($\bar{x}$=39.20 m) (2) * Best in ground skills ($\bar{x}$=2.89 sec) (1) ($\bar{x}$=3.20 sec) (2) * Second best in passing for accuracy (4 m) ($\bar{x}$= 5.50) (1) ($\bar{x}$= 6.67) (2)
Flyhalf	* Second lightest body mass ($\bar{x}$=72.33 kg) (1) ($\bar{x}$=72.90 kg) (2) * Second highest skinfold thickness ($\bar{x}$=71.97 mm) (1) * Lowest muscle percentage ($\bar{x}$=59.56 %) (1) * High ectomorphic value ($\bar{x}$=2.80) (1)	* Poorest result in bench press ($\bar{x}$=86.43 kg) (1)	* Best in catching and throwing over the crossbar ($\bar{x}$=16.00) (1) * Best result in passing for distance ($\bar{x}$=27.83 m) (1) ($\bar{x}$=25.42 m) (2) * Third best result in kicking for distance ($\bar{x}$=47.05 m) (1) ($\bar{x}$=39.20 m) (2) * Fourth best in ground skills ($\bar{x}$= 3.12 sec) (1) ($\bar{x}$= 3.20 sec) (2)

Centre	* Second highest muscle percentage ($\bar{x}$=62.67 %) (1)	* Most agile player ($\bar{x}$=14.74 sec) (1) ($\bar{x}$=16.68 sec) (2) * Second poorest result in bench press ($\bar{x}$=95.25 kg) (1)	* Second best in passing for distance ($\bar{x}$=27.80 m) (1) ($\bar{x}$=25.13 m) (2)
Wing	* Second smallest skinfold thickness ($\bar{x}$=58.60 mm) (1) ($\bar{x}$=55.25 mm) (2) ($\bar{x}$=51.20 mm) (2) * Second lowest body fat percentage ($\bar{x}$=12.64 %) (1) ($\bar{x}$=13.50 %) (2) ($\bar{x}$=10.21 %) (2)	* Second fastest over 10 m ($\bar{x}$=1.77 sec) (1) ($\bar{x}$=2.03 sec) (2) * Fastest over 40 m ($\bar{x}$=5.14 sec) (1) * Third most agile player ($\bar{x}$=14.88 sec) (1) ($\bar{x}$=17.16 sec) (2)	* Third best in ground skills ($\bar{x}$=3.07 sec) (1) ($\bar{x}$=6.00 sec) (2) * Poorest result in passing for distance ($\bar{x}$=24.55 m) (1) ($\bar{x}$=23.20 m) (2)
Fullback	* Third lowest measurement of skinfold thickness ($\bar{x}$=64.10 mm) (1) ($\bar{x}$=54.70 mm) (2) * Third smallest body fat percentage ($\bar{x}$=13.50 %) (1) ($\bar{x}$=13.20 %) (2)	* Third best in speed over 10 m ($\bar{x}$=1.78 sec) (1) ($\bar{x}$=1.86 sec) (2) * Third best in speed over 40 m ($\bar{x}$=5.28 sec) (1) * Third best in speed endurance ($\bar{x}$=102.00 sec) (1)	* Best in passing for accuracy (4 m) ($\bar{x}$=7.00) (1) ($\bar{x}$=5.75) (2)

Firstly coaches of SARFU can use the results in these diagrams to evaluate the Green Squad according to position of individual players as well as the content of the development programme. Secondly, school coaches can use the norms to evaluate potential talented players compared to their abilities. Thirdly, future researchers can use these norm scales to see how the score on different variables have changed and to draw up new norm scales, because the more the process of talent identification becomes scientific, the more the variables will be adapted.

6.4 RECOMMENDATIONS

From the results and conclusion in this study, the following recommendations can be made.

1. Coaches can successfully implement the test battery to compile a physical and game skills profile of the elite South African schoolboy rugby player. The test battery for anthropometrical, game-specific skill and physical and motor components provide norms for 16 and 18-year-olds. These norms can be used to monitor selected potentially talented players and player progression in specific player positions.

2. SARFU, provincial unions and specifically school coaches can use the physical and game skills profile that was compiled to help adjust their training programmes because it identifies the components that are important to develop in each position.

3. The selection of new Green Squad groups should be tested regularly to a battery of tests that are representative of the majority of anthropometrical, physical and motor and game-specific skill variables. This could help researchers to adapt regularly to the physical profile of elite players and help to establish norms that can be used to identify and develop elite youth players.

4. More research and longitudinal studies must be done on talented youth rugby players nationally and internationally. This must be done for different age groupers. With this data available, an international profile can be compiled for different player positions to help identify talented youth players. Further research should also include an injury status report of each player because valuable information regarding a player's performance could reflect from an injury sustained. Testing and training programmes could be adjusted with regard to the specificity of the injury.

5. Physical education as a school subject should be reintroduced because it remains an important nurturing ground for fundamental, locomotor and specialised locomotor movements. The movements are part of the fundamental components in the process of talent identification and research in youth sport.

The shortcomings of this study are:

- Not all the Green Squad players were tested at both the sessions (2003 & 2004), which could influence the norms. To develop scientific norms it is essential that the elite players participate throughout the research. SARFU needs to implement a database for each player and regularly test the players to keep the records up to date.
- The SARFU test battery had several shortcomings eg. tests that were not executed in this study but are important according to literature namely vertical jump, kick off for distance and air and ground kicks. Grip strength and flexibility were two tests that were poorly recorded. The SARFU test battery should be expanded to be more meaningful in order to be compared with test batteries in literature. A more complete test battery will be especially beneficial to the school coaches in phase one of the process of talent identification.
- The programme that was followed by the Green Squad showed shortcomings for game-specific skills. This should be addressed.

To summarise, this study succeeded in compiling a status profile of the elite youth rugby player with reference to physical and game-specific variables. It adds an enormous amount of knowledge on talent identification of youth elite rugby players.

REFERENCES

AAHPER see AMERICAN ALLIANCE FOR HEALTH, PHYSICAL EDUCATION AND RECREATION

AAHPERD see AMERICAN ALLIANCE FOR HEALTH, PHYSICAL EDUCATION AND RECREATION AND DANCE

ABBOTT, A. & COLLINS, D. 2002. A theoretical and empirical analysis of a 'state of the art' talent identification model. *High ability studies,* 13(2):157-178.

ABBOTT, A., COLLINS, D., MARTINDALE, R. & SOWERBY, K. 2002. Talent identification and development: an academic review. Edinburgh : Sport Scotland. (A report for Sport Scotland by the University of Edinburgh.) 96 p.

ADENDORFF, L. 2003. Die effek van groei en ryping op potensieel talentvolle rugbyspelers: 'n opvolgondersoek. Potchefstroom : PU vir CHO. (Verhandeling - MA.) 124 p.

ALEXANDER, K., TAGGART, A. & THORPE, S. 1995. Government and school contexts for the development of sport education in Australian schools. *ACHPER healthy lifestyles journal,* 42(4):4-5.

AMERICAN ALLIANCE FOR HEALTH, PHYSICAL EDUCATION AND RECREATION (AAHPER). 1966. AAHPER skill test manual for football. Washington, D.C. : AAHPER. 184 p.

AMERICAN ALLIANCE FOR HEALTH, PHYSICAL EDUCATION AND RECREATION AND DANCE (AAHPERD). NATIONAL ASSOCIATION FOR SPORT AND PHYSICAL EDUCATION. 1995. Moving into the future: national standards for physical education. 2nd ed. [Web:] http://www.ichpersd>org/i/children.htm [Date of access: 17 Aug. 2004].

ANON. 2002. Health and physical education in the New Zealand curriculum. (2 p.). [Web:] http://www.tki.org.nz/health/curriculum/statement/toc.e.php [Date of access: 23 Nov. 2003].

ANON. 2003. Rande in rugby: so het die Groenspan ontstaan. *Finansies & tegniek; Bylae*:13, Oktober.

ASSOCIATED PRESS WIRE SERVICE. 2000. Study. Teens need more exercise: physical education in the news. (1 p.). [Web:] http://www.pelinks4u.org/naspe/penewsl.htm [Date of access: 15 Aug. 2004].

AUSTRALIAN CAPITAL TERRITORY GOVERNMENT. 1994. Health and physical education. (Paper based on ACT Health and physical education curriculum framework.) (5 p.). [Web:] http://www.decs.act.gov.au [Date of access: 15 Aug. 2004].

AUSTRALIAN RUGBY FOOTBALL UNION. 1990. Australian rugby skills test. Sydney : Australian Rugby Football Union. 52 p.

BADENHORST, E. 1998. 'n Keuringsmodel vir talentidentifisering by 16-jarige sokkerspelers. Potchefstroom : PU vir CHO. (Skripsie - MSc.) 100 p.

BARTHOLOMEW, D.J., STEELE, F., MOUTSAKI, I. & GALBRAITH, J.I. 2002. The analysis and interpretation of multivariate data for social scientists. Boca Raton : Chapman & Hall / CRC. 263 p.

BENBOW, C.P. & LUBINSKI, D. 1993. Psychological profiles of the mathematically talented: some sex differences and evidence supporting their biological basis. (*In* Bock, G.R. & Ackrill, K., *eds*. The origins and development of high ability. New York : Wiley. Ciba Foundation, Symposium 178.

BLOOMFIELD, J., ACKLAND, T.R. & ELLIOTT, B.C. 1994. Applied anatomy and biomechanics in sport. Melbourne : Blackwell Science. 374 p.

BOSHOFF, B. 1976. Die adolessent: sy ontwikkeling en ontwikkelingstake. Stellenbosch : Universiteitsuitgewery.

BOMPA, T.O. 1985. Talent identification. *Sports science periodical on research and technology in sport,* GN-1:1-11, Feb.

BOMPA, T.O. 1994. Theory and methodology of training: the key to athletic training. Champaign, Ill. : Human Kinetics Publishers.

BOMPA, T.O. 1999. Periodization: theory and methodology of training. Champaign, Ill. : Human Kinetics Publications.

BROZEK, J., GRANDE, F., ANDERSON, J.T. & KEYS, A. 1963. Densitometric analysis of body composition: revision of some quantitative assumptions. *Annals of the New York Academy of Sciences,* 110:113-140.

BUKATKO, D. & DAEHLER, M.W. 1995. Child development: a thematic approach. Boston, Mass. : Houghton Mifflin Company.

BURGESS, R. 1996. Talent identification. (Retrieved from Faccioni, Speed and conditioning consultancy publication.) [Web:] http://www.faccioni.com/Reviews/ talentid.htm [Date of access: 28 Aug. 2003].

CLINTON, W.J. 2000. Memorandum from the President: enhancing efforts to promote the health of young people. *Physical education in the news,* September. (3 p.). [Web:] htpp://www.pelinks4u.org/ naspe/penewsl.htm [Date of access: 15 Aug. 2004].

COBB, N. 2000. Adolescence: continuity, change, and diversity. Mountain View, Calif. : Mayfield Publishers.

COETZEE, G. 1978. Die liggaamlike opvoedkunde as keusevak vir die Seniorsertifikaateksamen. Pretoria : Universiteit van Pretoria. (Verhandeling - MA.)

COETZEE, G. 2004. Kabinet hersien sportbeleid - S.A. se "Olimpiese agterstand": skole in visier. *Beeld*:2, 18 Aug.

COHEN, J. 1988. Statistical power analysis for behavioural sciences. 2nd ed. Hillsdale, N.Y. : Erlbaum.

COLE, L. & HALL, I.N. 1970. Psychology of adolescence. 7th ed. New York : Holt, Rinehart and Winston.

COOKE, G. 1982. Rugby union. Yorkshire : EP Publishing.

CRAIG, G.J. 1992. Human development. 6th ed. Upper Saddle River, N.J. : Simon & Schuster. 434 p.

CRAVEN, D.H. 1974. Patroon vir rugby: 'n praktiese handleiding oor grondbeginsels, vaardighede, spelsette en oefenmetodes. Kaapstad : Tafelberg. 204 p.

DASBERG, L. 1981. Het kinderboek als opvoeder: twee eeuven padagogiscke normen en waarden in het historische kinderboek in Nederland. Assen : Von Gorcum. 422 p.

DAVIS, D. 1992. Fitness for life, book 1: Health, personal development and physical education. Melbourne : MacMillan Education Australia. 224 p.

DE RIDDER, J.H. 1993. 'n Morfologiese profiel van junior en senior Cravenweek rugbyspelers. Potchefstroom : PU vir CHO (Proefskrif – D.Phil.) 310 p.

DICK, F.W. 1992. Sports training principles. 2nd ed. London : A & C Black. 228 p.

DU RANDT, R. 1993. Sport talent identification and development and related issues in selected countries. Port Elizabeth: University of Port Elizabeth.

DU RANDT, R. & HEADLEY, N. 1993. Guidelines and recommendations. (*In* Singer, R.N., Murphey, M. & Tennant, L.K., *eds.* Handbook of research on sport psychology,

sponsored by the International Society of Sport Psychology. New York : Maxwell Macmillan International. p. 315-321.)

DURNIN, J.V.G.A. & WOMERSLEY, J. 1974. Body fat assessed from the total body density and its estimation from skinfold thickness: measurements on 481 men and women aged from 16 to 72 years. *British journal of nutrition,* 32:77-97.

DUTHIE, G., PYNE, D. & HOOPER, S. 2003. Applied physiology and game analysis of rugby union. *Sports medicine,* 33(13):973-991.

DYCK, N. 2000. Games, sport and cultures. Oxford : Berg. 246 p.

ELLIS, S.M. & STEYN, H.S. 2003. Practical significance (effect sizes) versus or in combination with statistical significance (p-values). *Management dynamics,* 12(4):51-53.

ERICSSON, K.A. & CHARNESS, N. 1995. Abilities: evidence for talent or characteristics acquired through engagement in relevant activities. *American psychologist,* 50:803-804.

GABBARD, C. 2000. The new P.E.: physical education in the news. [Web:] http://www. pelinks 44. org/naspe/penews1.htm [Date of access: 15 Aug. 2004].

GALLAHUE, D.L. & OZMUN, J.C. 1995. Physical development of children. (*In* Gallahue, D.L. & Ozmun, J.C., *eds.* Understanding motor development: infants, children, adolescents, and adults. 3rd ed. Madison, Wis. : Brown & Benchmark. p. 2 – p. 440

GETCHELL, B. 1985. Physical Fitness: A way of life. 3rd ed. Macmillan Publishing Co., New York.

GILBERT, M. 2004. Dis die fout in SA rugby: Heyneke sê kondisionering van spelers is afgeskeep. *Beeld*:22, Mrt. 18.

GOUWS, E. & KRUGER, N. 1994. The adolescent: an educational perspective. Durban : Butterworths. 203 p.

GOUWS, E., KRUGER, D. & BURGER, S. 2000. The adolescent. 2nd ed. Johannesburg : Heinemann. 204 p.

HANEKOM, A.J. 2000. Antropometriese, fisieke, motoriese en vaardigheids-eienskappe van senior sekondêre skoolrugbyspelers in die Noordwesprovinsie. Potchefstroom : PU vir CHO. (Verhandeling – MA.) 115 p.

HARE, E. 1997. Die identifisering van rugbytalent by seuns in die senior sekondêre skoolfase. Potchefstroom : PU vir CHO. (Verhandeling - M.Ed.) 120 p.

HARE, E. 1999. Longitudinale studie van talentvolle jeugrugbyspelers met verwysing na vaardigheid, groei en ontwikkeling. Potchefstroom : PU vir CHO. (Proefskrif - D.Phil.) 152 p.

HARRE, D. 1982. Trainingslebre. Berlin : Sportverlag.

HARRISON, G.A., TANNER, J.M., PILBEAM, D.R. & BAKER, P.T. 1990. Human biology: an introduction to human evolution, variation, growth, and adaptability. 3rd ed. Oxford : Oxford Science. 503 p.

HAVLICEK, I., KOMADEL, L., KOMARIK, E. & SIMKOVA, N. 1982. Principles of the selection of youth talented in sport. (Paper presented at the International conference on the selection and preparation of sport talent.) Bratislava, Czechoslovakia.

HAYWOOD, K.M. 1986. Life span motor development. Champaign, Ill. : Human Kinetics Publishers. 164 p.

HAZELDINE , R. & McNAB, T. 1991. Fit for rugby. London : Kingswood Press. 128 p.

HEADLEY, N. 1992. Sports talent identification and development: a situational analysis. Port Elizabeth : University of Port Elizabeth. (Dissetation - MA.) 312 p.

HEATH, B.H. & CARTER, J.E.L. 1967. A modified somatopype method. *American journal of physical anthropology,* 27:57-74.

HELSEN, W.F., HODGES, N.J., VAN WINCKEL, J. & STARKES, J.L. 2000. The roles of talent, physical precocity and practice in the development of soccer expertise. *Journal of sports sciences,* 18:727-736, April.

HOARE, D. 1996. The Australian national talent search programme. *Coaching focus,* 31:3-4.

HOUSEHAM, K.C. 1991. Normal growth and development in infancy and childhood. (*In* Kibel, M.A. & Wagstaff, L.A., *eds*. Child health for all: a manual for southern Africa. Cape Town : Oxford University Press. p. 18-26.)

HOWE, M.J.A., DAVIDSON, J.W. & SLOBODA, J.A. 1998. Innate talents: reality or myth? *Journal behavior and brain sciences*, 21:339-442.

JANKOVIC, S., MATKOVIC, B.R. & MATKOVIC B. 1997. Functional abilities and process of selection in soccer. (Communication to the 9th European Congress on sports medicine, Porton, Portugal, 23-26 Sept.)

JANSSENS, M., VAN RENTERGHEM, B., BOURGOIS, J. & VRIJENS, J. 1998. Physical fitness and specific motor performance of young soccer players aged 11-12 years. (Communication to the 2nd Annual Congress of the European College of Sport Science.) *Journal of sport sciences,* 16:434-435.

KARSTENS, A. 2002. Die opvoedkundige taak van die skool ten opsigte van die identifisering van talent met verwysing na 12-jarige netbalspeelsters. Potchefstroom : PU vir CHO. (Skripsie - M.Ed). 117 p.

KHUMALO, M. 1999. School sport: a hidden problem. *Indicator South Africa,* 16(4): 61-65, Summer.

KROGMAN, W.M. 1980. Child growth. Ann Arbor, Mich. : University of Michigan Press.

LèGER, L.A. & LAMBERT, J. 1982. A maximal 20m shuttle run to predict VO^2 max. *European journal of applied physiology,* 49:1-5.

LILLIE, J. 2003. Blueprint for future Boks. *Fifteen*:112-113.

LOHMAN, T.G., ROCHE, A.F. & MARTARELL, R., *eds.* 1988. Anthropometric standardization reference manual. Champaign, Ill. : Human Kinetics Books.

LOUW, D.A. 1994. Menslike ontwikkeling. 2de uitgawe. Pretoria : Haum-Tersiêr.

LOUW, D.A., GERDES, L.C. & MEYER, W.F. 1985. Menslike ontwikkeling. Pretoria : Opvoedkundige Uitgewery.

MAARMAN, J. 2004. Sport en politiek soos siamese sussies. *Rapport*:21, Sept. 5.

MacPHAIL, A., KIRK, D. & KINCHIN, G. 2004. Sport education: promoting team affiliation through physical education. *Journal of teaching in physical education,* 23(2): 106-122.

MALAN, D.D.J. & HANEKOM, A.J. 2001. Anthropometric, physical and skill characteristics of young rugby players in the North-West Province. *African journal for physical, health education, recreation and dance,* 17(1):14-22.

MALAN, M. 2004. 66% kinders te onfiks vir sport. Klem op prestasie lei tot fisieke agteruitgang. *Rapport*:13, 26 Sept.

MALINA, R.M. 1997. Youth sports and the growth of children. *Spotlight*, Summer. (4 p.). [Web:] www.ed_web3.edu.msu.edu/ysi/spotlight1997/growth.html [Date of access: 18 Aug. 2004].

MALINA, R.M. & BOUCHARD, C. 1991a. Introducing the basics of growth, maturation, and physical activity. (*In* Malina, R.M. & Bouchard, C., *eds.* Growth, maturation, and physical activity. Champaign, Ill. : Human Kinetics Books. p. 3-10.)

MALINA, R.M. & BOUCHARD, C. 1991b. Strength and motor performance during growth. (*In* Malina, R.M. & Bouchard, C., *eds.* Growth, maturation, and physical activity. Champaign, Ill. : Human Kinetics Books. p. 187-203.)

MALINA, R.M. & BOUCHARD, C. 1991c. Biological maturation: concept and assessment. (*In* Malina, R.M. & Bouchard, C., *eds.* Growth, maturation, and physical activity. Champaign, Ill. : Human Kinetics Books. p. 231-249.)

MALINA, R.M. & BOUCHARD, C. 1991d. Characteristics of young athletes. (*In* Malina, R.M. & Bouchard, C., *eds.* Growth, maturation, and physical activity. Champaign, Ill. : Human KineticsBooks. p. 443-463.)

MALINA, R.M. & BOUCHARD, C. 1991e. Growth, maturation, and physical activity, Champaign, Ill. : Human Kinetics Books.

MALINA, R.M. & BOUCHARD, C. 1995. Growth, maturation, and physical activity. Champaign, Ill. : Human Kinetics Books.

MARTIN, A.D., SPENST, L.F., DRINKWATER, D.T. & CLARYS, J.P. 1990. Anthropometric determination of muscle mass in men. *Medicine and science in sports and exercise*, 22:729-733.

MARTIN, A.D. & DRINKWATER, D.T. 1991. Variability in the measures of body fat: assumptions or technique? *Sports medicine,* 11:277-288.

MWAMWENDA, T.S. 1995. Educational psychology: an African perspective. 2nd ed. Durban : Butterworths.

MWAMWENDA, T.S. 1996. Educational psychology: an African perspective. Isando : Heinemann. p. 21-81.

NASPE see NATIONAL ASSOCIATION OF SPORT & PHYSICAL EDUCATION

NATIONAL ASSOCIATION OF SPORT & PHYSICAL EDUCATION (NASPE). 1995. Moving into the future: national standard for physical education. A guide to content and assessment. Reston, Va. : NASPE.

NICHOLAS, C.W. 1997. Anthropometric and physiological characteristics of rugby football players. *Sports medicine,* 23(6):375-396, June.

NIEUWENHUIS, C.F. 2000. Talent identifisering en ontwikkeling van.14-15 jarige hokkie speelsters. Potchefstroom : PU vir CHO. (Proefskrif – Ph.D.)

NOAKES, T. & DU PLESSIS, M. 1996. Rugby without risk: a practical guide to the prevention and treatment of rugby injuries. Pretoria : Van Schaik. 351 p.

NORTON, K.I., OLDS, T.S., OLIVE, S.C. & CRAIG, N.P. 1996. Anthropometry and sport performance. (*In* Norton, K.I. & Olds, T.S., *eds*. Anthropometrica: a textbook of body measurements for sports and health courses. Sydney, Australia : UNSW Press. p. 287-364.)

O'DEA, J. 2003. Calcium, growth and health in children and adolescents. *Nutridate,* 14(4):4-7, Aug.

OLDS, T. 2000. The evolution of physique in male rugby union players in the twentieth century. *Journal of sport sciences,* 19:253-262, Apr.

OLMEDILLA, B. & GRANADO, F. 2000. Growth and micronutrient needs of adolescents. *European journal of clinical nutrition, Suppl. 1,* 54(3):S11-S15.

PANFIL, R., NAGLAK, Z., BOBER, T. & ZATON, E.W.M. 1997. Searching and developing talents in soccer: a year of experience. (*In* Bangsbo, J., Saltin, B., Bonde, H, Hellsten, Y., Ibsen, B., Kjaer, M. & Sjegaard, G., *eds*. Proceedings of the 2nd Annual Congress of the European College of Sport Science. Copenhagen : HO Storm. p. 649-650.)

PELTOLA, E. 1992. Talent Identification. *New studies in athletics,* 7(3):7, Sept.

PIENAAR, A.E. 2001. Perseptueel-motoriese leer: teorie en praktyk. Potchefstroom : PU vir CHO. 180 p.

PIENAAR, A.E. & SPAMER, E.J. 1995. A scientific approach towards identifying and developing of rugby talent among ten year old-boys. (*In* Proceedings of the 1995 AISEP World Congress Wingate Institute for Physical Education, Wingate, Israel. p. 283-291.)

PIENAAR, A.E. & SPAMER, E.J. 1996. A scientific approach towards identifying and developing of rugby talent among ten and eleven year-old boys. *Kinesiology,* 28(1):48-53, Jun..

PIENAAR, A.E. & SPAMER, E.J. 1998. A longitudinal study of talented young rugby players as regards their rugby skills, physical and motor abilities and anthropometric date. *Journal human movement studies,* 34:13-32.

PIENAAR, A.E., SPAMER, E.J. & PRETORIUS, J.H. 2000. Veranderlikes wat onderskei tussen suksesvolle en minder suksesvolle tienjarige rugby spelers in geselekteerde spel - spesifieke posisies. *SA journal for research in sport, physical education and recreation,* 22(2):23-35.

PLANNED PARENTHOOD ASSOCIATION OF SOUTH AFRICA (PPASA). 1998. (*In* Greathead, E. Responsible teenage sexuality. 2nd ed. Pretoria : Van Schaik. p. 1-61.)

PLOTZ, A.F. 2004. 'n Vergelykende studie van Suid-Afrikaanse en Engelse adolessente elite rugby spelers met verwysing na spel-spesifieke antropometriese en fisiek-motoriese veranderlikes. Potchefstroom : Noordwes-Universiteit (Potchefstroom kampus). (Verhandeling - M.Ed.).

PPASA see PLANNED PARENTHOOD ASSOCIATION OF SOUTH AFRICA

PREISSERS, D. 2000. Puberty and sexuality in teens. *Developmental psychology. Students newsletter.* (5 p.). [Web:] http://www.mc.maricopa.edu/dept/d46/psy/dev/ spring00/teens/html [Date of access: 14 Nov. 2003].

PRETORIUS, J.H. 1997. Talent identifisering in geselekteerde spelspesifieke posisie by 10-jarige rugbyspelers. Potchefstroom : PU vir CHO. (Verhandeling - MA.) 87 p.

PUTTER, J. 2001. Wie wen ... ek of my kind? Pretoria : Lapa. 111 p.

QUARRIE, K.L., HANDCOCK, P., WALLER, A.E., CHALMERS, D.J., TOOMEY, M.J. & WILSON, B.D. 1996. The New Zealand rugby injury and performance project, IV: Anthropometric and physical performance comparisons between positional categories of senior A rugby players. *British journal of sport medicine,* 30:53-56.

RAO, S., JOSHI, S. & KANADE, A. 1998. Growth in some physical dimensions in relation to adolescent growth spurt among rural Indian children. *Annals of human biology,* 27(2):127-138.

RAPPOPORT, L. 1972. Personality development: the chronology of experience. Glenview, Ill. : Scott, Foresman. 448 p.

RATLIFFE, T. & RATLIFFE, L.M. 1994. Teaching children fitness: becoming a master teacher. Champaign, Ill. : Human Kinetics Publishers. 119 p.

RéGNIER, G., SALMELA, J. & RUSSEL, F.J. 1993. Talent detection and development in sport. (*In* Singer, R.N., Murphy, M. & Tennant, L.K., *eds.* Handbook on research on sport psychology. New York : Macmillan. p. 190-313.)

RèGNIER, G. 1987. Un modéle conceptual pour la detection du talent sportif. (A conceptual model for talent detection.) [French]. Unpublished doctoral dissertation, University of Montreal.

RIORDAN, J. 1993. Rewriting Soviet sports history. *Journal of sport history*, 20(2): L247-L258.

ROSS, W.D. & MARFELL-JONES, M.J. 1991. Kinanthropometry. (*In* MacDougall, J.D., Wenger, H.A. & Green, H.J., *eds.* Physiological testing of the high-performance athlete. Champaign, Ill.: Human Kinetics Books. p. 233-309.)

ROY, H. 1971. Physical fitness for schools. London : Pelham Books. 198 p.

RUTHERFORD, D. 1983. International rugby: for players, coaches and spectators. London : Heinemann. 143 p.

SALDI, F. 2001. Physical growth and development: psychosocial consequences of early and late maturation. (39 p.). [Web:] http//www.commed.hku.hk/class2003/wholeclass/ wcs1999_2000_v3.htm [Date of access: 14 Nov. 2003].

SALMELA, J.H. & RèGNIER, G. 1983. A model for sport talent detection. *Science periodical on research and technology in sport,* (gy-1):1-8.

SARFU see SOUTH AFRICAN RUGBY FOOTBALL UNION

SAS INSTITUTE Inc. 1999. SAS Institute Inc., SAS Onlinedoc®, Version 8, Cary, NC.

SIEDENTOP, D. 1994. Sport education: quality PE through positive sport experiences. Champaign, Ill. : Human Kinetics Publishers. 141 p.

SIEDENTOP, D. 2002. Sport education: a retrospective. *Journal of teaching in physical education,* 21:409-418.

SINGER, R., MURPHEY, M. & TENNANT, L.K. 1993. Handbook of research on sport psychology. New York : Macmillan.

SLOBODA, J.A. & HOWE, M.J.A. 1991. Biographical precursors of musical excellence: a review study. *Psychology of music,* 19:3-21.

SORENSON, R. 1962. Youth's need for challenge and place in society. *Children,* 9: 131-138.

SOUTH AFRICA. Department of Sport and Recreation. 1996. Draft White paper on Sport and recreation in South Africa: a national policy framework. Pretoria : Government Printer. (WPJ-1996.)

SOUTH AFRICAN RUGBY FOOTBALL UNION (SARFU). 1995. Beginners afrigterskursus. Kaapstad : SARFU.

SOUTH AFRICAN RUGBY FOOTBALL UNION (SARFU). 1998. Beginsels vir suksesvolle afrigting. Kaapstad : SARFU.

SOUTH AFRICAN RUGBY FOOTBALL UNION (SARFU). 2003a. Green squads: introduction. (2 p.). [Web:] http://wwww.health24.co.za/fitness/Rugby-World-Cup/16-1062-1089,24976.asp [Date of access: 1 Des. 2003].

SOUTH AFRICAN RUGBY FOOTBALL UNION (SARFU). 2003b. New rugby week launched: new under –16 annual tournement. *News24.com.* (1 p.). [Web:] .http://www. wheels24.co.za/News24/Sport/Rugby/o, 2-9-838_1372261,00.html. [Date of access: 26 Aug. 2003].

SOUTH AFRICAN RUGBY FOOTBALL UNION (SARFU). 2003c. Rugby protocol: field testing version. Kaapstad : SARFU.

SOUTH AFRICAN RUGBY FOOTBALL UNION (SARFU). 2003d. Winning: the game of life. Cape Town : Erli Interactive. 246 p.

SOUTHMAYD, W. & HOFFMAN, M. 1981. Sports health. (The complete book of athletic injuries.) New York : Putnam. 459 p.

SPAMER, E.J. 2000. A comparison of rugby skills, physical and motor abilities and anthropometric data of national-, provincial- and school talented youth rugby players. *Journal of kinesiology*, 32(1):47-54.

SPAMER, E.J. & COETZEE, M. 2002. Variables which distinguish between talented and less talented participants in youth sport: a comparative study. *Journal of kinesiology* 34(2):141-151.

SPAMER, E.J. & WINSLEY, R.J. 2003. Comparative characteristics of elite English and South-African 18-year-old rugby-players with reference to game-specific skills, physical abilities and anthropometric data. *Journal of human movement studies,* 45:187-196.

STARKES, J. 2000. The road to expertise: is practice the only determinant? *International journal sport psychology*, 31:431-451.

STATSOFT, INC. 2003. STATISTICA (data analysis software system), version 6. [Web:] www.statsoft.com.

STERNBERG, R.J. 1988. The nature of creativity: contemporary psychological perspectives. Cambridge: Cambridge University Press. 454 p.

STEYN, H.S. (jr.). 1999. Praktiese beduidenheid: die gebruik van effekgroottes. Potchefstroom : Potchefstroom Universiteit vir CHO. (Wetenskaplike bydraes van die PU vir CHO, Reeks B. Natuurwetenskappe, nr. 117.)

STEYN, H.S. (jr.). 2000. Practical significance of the difference in means. *Journal of industrial psychology,* 26(3):1-3.

STRAND, B.N. & WILSON, R. 1993. Assessing sport skills. Champaign, Ill. : Human Kinetics Publishers. 165 p.

TAGGART, A. & SHARP, S. 1997. Adolescents and sport: determinants of current and future participation. Perth : Sport and Physical Health Activity research center, Edith Cowan University. (53 p.). [Web:] htt.//www.aare.edu.au/97pap/ tagga342.htm [Date of access: 15 Aug. 2004].

THOMAS, J.R. & NELSON, J.K. 1985. Introduction to research in health, physical education, recreation, and dance. Champaign, Ill. : Human Kinetics Publishers. 414 p.

THOMSON, R.W. & BEAVIS, N. 1985. Talent identification in sport. (Unpublished report prepared on behalf of the Otago University and Community Sports Trust for the New Zealand Sports Foundation Inc. and the Department of Internal Affairs.)

THORNBURG, H.D. 1975. Development in adolescence. Monterey, California: Brooks/Cole Publishing Company.

TINNING, R. & FITZCLARENCE, I. 1992. Postmodern youth culture and the crisis in Australian secondary school physical education. *Quest*, 44(3):287-304.

TURNBULL, R., COETZEE, D. & McDONALD, T. 1994. Rugby: fitness testing and training. Pietermaritzburg : City Printing Works.

VAN DER MERWE, C.A. 1989. 'n Ontleding van die bewegingsverloop in rugby op seniorklubvlak. Potchefstroom : PU vir CHO. (Verhandeling - MA.)

VAN DER MERWE, C.A. 1997. Talent identifisering en -ontwikkeling by elfjarige swart seuns in rugby. Potchefstroom : PU vir CHO. (Proefskrif - Ph.D.)

VAN DEVENTER, K.J. 1998. The state of participation in physical activities by high school learners: a survey in some Western Cape schools involving learners, teachers and parents. *SA journal of research in sport, physical education and recreation,* 21(2):89.

VAN GENT, M.M. 2003. A test battery for the determination of positional requirements in adolescent rugby players. Potchefstroom : PU for CHE. (Thesis – Ph. D.)

VISAGIE, E. 2003. Groepe lewer môre se bokke: plan om SA rugby talent vroeg te eien en te ontwikkel. *Beeld*:19, Nov. 25.

WATSON, A.W.S. 1988. Discriminant analysis of the physiques of schoolboy rugby players, hurlers and non-team members. *Journal of sports sciences,* 6:131-140.

WILLIAMS, A.M. & REILLY, T. 2000. Talent identification and development in soccer. *Journal of sports sciences,* 18:655-667.

WOODMAN, L. 1985. Talent identification: is competition enough? *Sports coach*, 9(1): 49-57.

YOUNG, J.C. 1997. Why should physical education be taught in schools? Washington, D.C. : ERIC clearinghouse on teaching and training. (4 p.). [Web:] http.//www.ericfacility. net/ericdigests/ed406361.html [Date of access: 15 Aug. 2004].

ZAKRAJSEK, D. 1991. Sport: bringing good things to life. (Paper presented to the Korean Society of Education, International Sports Science Seminar.) *International journal of physical education,* 28(3):10-14.