COMPARATIVE CHARACTERISTICS OF ELITE NEW ZEALAND AND SOUTH AFRICAN U/16 RUGBY-PLAYERS WITH REFERENCE TO GAME-SPECIFIC SKILLS, PHYSICAL ABILITIES AND ANTHROPOMETRIC DATA

BY

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OPSOMMING

'N VERGELYKENDE STUDIE VAN SUID-AFRIKAANSE EN NIEU-SEELANDSE ELITE ONDER-16 RUGBYSPELERS MET VERWYSING NA SPELSPESIFIEKE VAARDIGHEDE, FISIEKE VERMOËNS, EN ANTROPOMETRIESE DATA

Gekoördineerde internasionale navorsing veral in spansporte word benodig om meer duidelikheid te verkry aangaande die karaktereienskappe van elite jong sportmanne (Spamer & Winsley, 2003a). Vier sleutel fases bepaal die pad na kwaliteit, -ideale en perfeksie. Hierdie fases kan beskryf word as waarneming, identifisering, seleksie en ontwikkeling (Reilly & Dust, 2005). Waarneming van talent is die raaksien van potensiële presteerders wat nie huidiglik aan 'n spesifieke sport deelneem nie. Identifisering van talent kan ook gesien word as deel van talent-ontwikkeling waarin identifisering voorkom op verskillende fases van hierdie proses. Talent-ontwikkeling impliseer dat atlete met 'n toepaslike leer-omgewing voorsien moet word sodat hulle die geleentheid het om aan hul potensiaal te voldoen (Reilly & Dust, 2005).

Die doel van hierdie studie is om spesifieke karaktereienskappe tussen elite onder 16 Nieu-Seeland en Suid-Afrikaanse rugby spelers te identifiseer en om 'n vergelyking tussen elite Nieu Seeland en Suid Afrikaanse 16-jarige spelers op te stel met verwysing na spelspesifieke, antropometriese en fisiek-motoriese veranderlikes.

Groepe van elite onder 16 rugbyspelers van Nieu-Seeland en Suid-Afrika het deelgeneem aan hierdie studie. Die een groep het bestaan uit die provinsiale Taranaki O/16 A-span (N = 24). Hare (1997) het 'n studie gedoen op 'n Suid-Afrikaanse groep wat bestaan het uit 43 top hoërskool rugbyspelers in die Noord-Wes Provinsie (Suid-Afrika). Die derde groep waarmee die Nieu-Seelandse groep vergelyk is, bestaan ook uit 'n Suid Afrikaanse groep (N = 21) (Noord-Wes Provinsie) wat aan die nasionale toernooi deelgeneem het (Van Gent 2003). Komponente waarna gekyk is, is spelspesifieke, antropometriese data en fisiek-motoriese veranderlikes.

Die spelspesifieke toetse wat gebruik is in hierdie studie was grondvaardighede, aftrappe, lug- en grondskoppe, aangee afstand, aangee akkuraatheid oor 4m en 7m, skopafstand en afskop vir afstand. Die onderskeidelike fisiek-motoriese toetse wat gebruik was, is die sit-en-reik toets, vertikale sprong, spoeduithouvermoë, sig-sag-hardloop, spoed oor 10m en 45.7m en gebuigde armhang. Die antropometriese veranderlikes was liggaamsmassa, liggaamslengte, velvoue (trisep-, pektorale-, subskapulêre-, midaksilêre-, supraspinale-, abdominale-, dy- en kuitvelvoue) en die voorarm-, gebuigde bo-arm-, enkel-, kuit- en bobeen omtrekke.

Die data was verwerk met die SAS-rekenaarprogram van die Noord-Wes Universiteit, (Potchefstroom kampus – SAS Instituut Inc, 1991), en die data van die Taranaki rugbyspan was statisties geanaliseer met beskrywende statistiek (gemiddeldes en standaarafwykings). Prakties, betekenisvolle verskille is bepaal met d-waardes (Cohen, 1988) om die Neeu Seelandse span met die Suid Afrikaanse spanne te vergelyk.

Die resultate toon dat die Nieu-Seelandse groep beter prestasies gelewer het in die 10m, 45.7m en die sig-sag hardloop, ten spyte daarvan dat hulle gemiddeld hoër waardes het vir liggaamsmassa, liggaamsomtrekke en velvoue. Dit sou aanvaar word dat die swaarder, groter speler stadiger sou wees as die kleiner, ligter speler, wat in hierdie geval nie so blyk nie.

In die spelspesifiek vermoëtoetse het die Nieu-Seelanders gemiddeld beter tellings gelewer vir die aangee- ($\overline{x}$ = 21.96), skop- ($\overline{x}$ = 40.9m) en afskop- ($\overline{x}$ = 37.59m) afstand toetse. In die spelspesifieke toetse waar akkuraatheid die bepalende faktor was (aangee akuraatheid oor 4m en 7m) het die Suid-Afrikaanse groepe beter tellings behaal, maar daar was geen prakties betekenisvolle verskille in enige van die akkuraatheidstoetse nie.

ABSTRACT

COMPARATIVE CHARACTERISTICS OF ELITE NEW ZEALAND AND SOUTH AFRICAN U/16 RUGBY-PLAYERS WITH REFERENCE TO GAME-SPECIFIC SKILLS, PHYSICAL ABILITIES AND ANTHROPOMETRICAL DATA

International collaboration in research, especially in team sports, is needed to get more clarity on the characteristics of elite youth athletes (Spamer & Winsley, 2003a). There are four key stages in the path to excellence that culminates in the ideal of 'perfection'. These stages can be described as detection, identification, selection and development (Reilly & Dust, 2005). Talent detection refers to the discovery of potential performers who are currently not involved in a specific sport. Talent identification also has been viewed as part of talent development in which identification may occur at various stages within the process. Talent development implies that players are provided with a suitable learning environment so that they have the opportunity to realize their potential (Reilly & Dust, 2005).

The aim of this study is to investigate specific characteristics among New Zealand elite under 16 rugby players and to draw a comparison between elite New Zealand and South African 16-year old rugby players with reference to game specific skills, physical and motor abilities ad anthropometrical variables.

Groups of elite 16-year old rugby players from New Zealand and South Africa participated in this study. The one group comprised of the Taranaki Provincial U/16 A-rugby team in New Zealand (N = 24). The second group comprised of 43 top high school rugby players in the North-West Province (South Africa) done by Hare (1997:6) and the third group comprised of 21 rugby players in the North West province competing in the national tournament (Van Gent, 2003:5). Components that

will be tested are game-specific variables, physical and motor abilities and anthropometric data.
The game specific skill variables that were used in this study were ground skills, side steps, air and ground kicks, passing distance, passing accuracy over 4m and 7m, kicking distance and kick-off for distance. The respective physical and motor abilities were the adapted sit and reach test, vertical jump, speed endurance, zig-zag run, speed over 10m and 45.7m and flexed arm hang. The anthropometrical variables were: body mass, body length, tricep, pectoral, sub-scapular, midaxilla, supra-spinal, abdominal, thigh and calf skinfolds, and the forearm, flexed upper arm, ankle, calf and upper leg girth measurements.

The data was processed with the SAS-computer programme of the North West University, Potchefstroom campus (SAS Institute Inc., 1991), and the data of the Taranaki team were statistically ananlysed with descriptive statistics (means and standard deviation). Practical significants were determined by d-values (Cohen, 1988) to compare New Zealand and South African teams.

The results showed that the New Zealand group had the fastest time over the 10m, 45.7m and the zig zag run although they possessed on average the highest values for body mass, girth measurements and skinfolds.

In the game specific skills tests the New Zealanders had on average better test results for the passing- ($\overline{X}$ = 21.96m), kicking- ($\overline{X}$ = 40.9m) and kick-off ($\overline{X}$ = 37.59m) for distance tests. In the game specific skill tests where accuracy were the determinant factor (passing accuracy over 4m and 7m) the South African groups had better scores than the New Zealand group, but there was no practical high significant differences in any of the accuracy tests.

INDEX

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

SCOPE AND AIM OF THE STUDY

1.1 INTRODUCTION

In sport, as in other domains such as science, music and arts, the attainment of excellence is the primary goal of many individuals. Spectators marvel at expert performance, coaches endeavour to nurture their protégés towards new heights of achievement and athletes aspire to reach 'greatness' (Williams & Reilly, 2000). As a consequence, the study of expertise in sport, together with the identification and development of future elite performers, are respected areas within the sport sciences.

Singer *et al*., (1993) is of the opinion that all the methods used in the identification of talent in sport have as their aim the prediction of future achievements based on the sportsperson's present abilities and the environment within which these abilities manifest themselves. Heilbrun (1966) supports the above statement by saying: "Talent identification actually evaluates that which exists in actuality, not in possibility".

The limited number of years during which a rugby player can play first class rugby has necessitated the early identification of potential rugby talent, as well as ways and means to improve the performance of rugby players from an early age. The lack of knowledge in this regard, as well as the non-availability of comparative data between countries hamper individual sportsmen and women to perform at their optimal potential.

1.2 REVIEW OF RELATED RESEARCH

Literature on talent identification among young sportsmen and women in specifically team sports is relatively limited. Besides a study on a comparison between South African and England rugby youth, and a comparison between New Zealand and South African 12-year old rugby players (Van der Westhuizen *et al*., 2004), no similar published data could be found comparing New Zealand and South African U/16 rugby players.

However, Hare (1997) came to the conclusion, after having researched the identification of rugby talent in the senior secondary school phase, that “All elite rugby players have certain anthropometrical components, rugby specific skills and physical and motor components that distinguish them from average players”.

Pienaar & Spamer (1995, 1996 & 1998a) and Spamer & Hare (2001) recently conducted several studies on potentially talented 12-year old South African rugby-players in order to examine

- which motor skills and physiological and anthropometrical factors distinguish above average rugby players from players who merely play socially;
- variables such as growth and development tendencies;
- predictive functions which can assist a coach to identify players who have talent.

Longitudinal studies were also carried out on 12-year-old rugby-players to determine the accuracy of early talent identification on later achievement (Pienaar & Spamer 1998a).

Similar tests and measurements in other rugby-playing countries were soon to follow. The characteristics of 12-year-old rugby-players from the Northern hemisphere, and specifically from England, were considered to be a good barometer for a comparative study in South Africa. The reason why England has been chosen is the fact that they have the biggest number of rugby players and is one of the top rugby playing countries in the world (Hare, 1999).

Spamer and Winsley (2003a) found that there were no significant differences of anthropometrical measurements between the two nations, except that the South African players "scored significantly higher in all the game specific variables". The same tendency was found in the physical and motor abilities of the young rugby players, with the exception that the differences in scores were not as large as in the case of the game-specific tests.

In another study of Spamer and Winsley (2003b) they compared England and South African 18-year-old rugby-players, between a 1st XV rugby-team of a sports college in the Southwest of England and the Craven Week rugby-team of the Northern Bulls in South Africa. When the two 18-year-old groups were compared; they found that the SA group was more skilful in the tests for passing and kicking distance. Both groups were equally matched in aspects such as stepping dexterity and passing accuracy. The SA players were also faster and had greater arm and leg strength.

The differences in motor and physical abilities may be explained by the fact that the South African players were significant leaner than the English players, yet the difference in the game specific skills proficiency could not easily be explained by Spamer and Winsley (2003b).

From the literature survey that was done, it is clear that there are no published data on game-specific skills, physical abilities and anthropometrical data to compare New Zealand and South African elite U/16 rugby players. The results of this study will determining the differences between these two nations on U/16 level. It may also provide rugby coaches and sport scientists of both countries with valuable information regarding the physical profile of this age group. The knowledge obtained from this study should also assist future research in talent identification and development.

1.3 RESEARCH APPROACH

A combination of qualitative and descriptive research methods will be used in this study. Descriptive research presents a number of models which can be divided into; Questionnaire, Interview, Normative survey, Case study, Job analysis, Observational research, Developmental studies, Correlation studies and Epidemiological research (Thomas & Nelson, 2001). For the purpose of this study the researcher is going to use the **Normative survey** and the **Case study.**
The first phase in this study exists to investigate specific characteristics among New Zealand elite under 16 rugby players, in terms of anthropometric-, game specific skill- physical- and motor components, and the second phase will consist of comparing the elite South African and New Zealand u/16 rugby players with references to anthropometric-, game specific skills-, physical- and motor variables.

1.4 TYPE OF RESEARCH

The type of research that the researcher will mainly make use of in this study will be **qualitative research**. Qualitative research in physical education, exercise science, and sport science is still relatively new (Thomas & Nelson, 2001). Thomas and Nelson (2001) believes that the most significant feature of qualitative research is the interpretive content rather than an over concern about procedure, and also states that in qualitative research the researcher is the primary instrument for data collection and analysis.

In this study the researcher will interact with one of the three groups that participate in this study, and the researcher's sensitivity and perception are crucial in procuring and processing the observations and responses.

Other types of research that will be used in this study and that is applicable during certain phases of this study is **descriptive research;** the ***Normative survey*** and ***Case study.*** Thomas and Nelson (2001) states that the normative survey method is used when the researcher is establishing norms for abilities, performances, beliefs and attitudes. In this study the researcher will test a group of individuals and compare their results with two other groups' previously tested to identify certain characteristics and differences in the study population. The same test battery will be used for the groups for comparison so it will be important that the tests be administered in a rigid standardized manner.

In many ways, case study research is similar to other forms of research; it involves the identification of the problem, the collection of data, and the analysis and reporting of results (Thomas & Nelson, 2001). The case study is used to provide detailed information about an individual (or institution, community, etc.). It aims to determine unique characteristics about the subject or condition. The case study is also a technique used in qualitative research (Thomas & Nelson, 2001).

1.5 PROBLEM ANALYSIS AND PROJECT PLANNING

According to De Vos (1998) there are two factors involved in identifying a condition as a problem:
-Recognition that professional and/or community standards (or norms) exist ~ based on social values, that define given levels of behaviour or well-being as appropriate.
-Discrepancies between the standards or norms and the existing behaviour or states of well being of given individuals or groups.

Through problem analysis a problematic human condition can be identified that precede the development of technology to address it. Such analysis consists of determining one or more of the following (De Vos, 1998):

- the extent of the difficulty, such as its incidence or prevalence;
- the component aspects of the problem;
- the possible causal factors;
- the effects of the problem including the behavioural, social and economic accompaniments; and
- intervention shortcomings in how the problematic condition are confronted.

The next phase in this step is to determine the procedures of the intervention. It is necessary to determine whether relevant interventions already exist and, if so, whether further development is merited. (De Vos, 1998)

1.6 RESEARCH AIM

The aim of this study is:

1.2.1 to investigate specific characteristics among New Zealand elite under 16 rugby players, in terms of anthropometric-, game specific skill-, physical- and motor components.

1.2.2 a comparative study of elite South African and New Zealand u/16 rugby players with references to anthropometric-, game specific skills-, physical- and motor variables.

1.7 RESEARCH METHOD

1.7.1 Review of literature sources

The following databases were used:

- Sport Discuss
- Medline
- Internet e.g. EBSCOhost
- Relevant books and journals

1.8 EMPIRICAL INVESTIGATION

1.8.1 Study Population

Groups of elite U/16 rugby players from New Zealand and South Africa participated in this study. The one group comprised the Taranaki Provincial U/16 A-rugby team in New Zealand (n = 24). The second group comprised of 43 top high school rugby players in the North-West Province (South Africa) done by Hare (1997) and the third group comprised of 21 rugby players in the North West province competing in the national tournament (Van Gent, 2003). (New Zealand group, n = 24; South Africa group 1, n = 43; group 2, n = 22).

1.8.2 Test battery

The test protocol consisted of anthropometric measurements, rugby-specific skill tests and physical and motor ability tests.

The anthropometric measurements included the following:

- Body mass (Norton *et al.,* 1996)
- Stature (Norton *et al.,* 1996)
- Skinfolds (triceps, subscapular, midaxcilliary, pectoral, supraspinal, abdominal, thigh and calf skinfold for prediction of body fat and sum of skinfolds) (Norton *et al.,* 1996)
- Girths (flexed upper arm, forearm, thigh, calf and ankle) (Norton *et al.,* 1996)

The rugby-specific skills test were used to test the following components:

- Passing for accuracy over 4 m ability (Pienaar & Spamer, 1998a)
- Passing for accuracy over 7 m ability (AAHPER, 1966)
- Passing for distance ability (AAHPER, 1966)
- Kicking for distance ability (AAHPER, 1966)
- Kick-off ability (AAHPER, 1966)
- Air and ground kick ability (AAHPER, 1966)
- Ground skills ability (Australian Rugby Football Union, 1990)
- Side step ability (Cooke, 1984)

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

- Sprinting speed (AAHPER, 1966)
- Power (vertical jump) (Thomas & Nelson, 1985)
- Flexibility (adapted sit-and-reach) (Thomas & Nelson, 1985)
- Agility (zig-zag run) (AAPHER, 1966)
- Speed endurance (speed endurance test) (Hazaldine & McNab, 1991)

1.8.3 Procedures and research methods

Once approval had been granted by the Taranaki Rugby Union the evaluation took place at the start of the provincial season. Qualified sports scientists, trained in the correct methods for each test did the measurements and evaluation.

All the anthropometric and flexibility measurements were done first. After that the rugby players did a general warm-up consisting of jogging and stretching of all major muscle groups, as well as short sprints. All the physical, motor and rugby-specific test were done on a rotation basis. The speed endurance test was done last after the players had been allowed sufficient rest.

1.8.4 Statistical data processing

Data was processed with the SAS-computer programme of the North West University, Potchefstroom Campus (SAS Institute Inc., 1991), and the data of the Taranaki team was statistically analysed with descriptive statistics (means and standard deviation). Practical significants were determined by d-values (Cohen, 1988) to compare New Zealand and South African teams.

CHAPTER 2

LITERATURE SURVEY

2.1 INTRODUCTION

This chapter will focus on talent identification in young sportsman participating in rugby union, the characteristics of elite rugby players and the differences in game-specific skills, physical abilities and anthropometrical data of elite sportsmen.

There are four key stages in the path to excellence that culminate in the ideal of ‘perfection’. These stages can be described as detection, identification, selection and development (Reilly & Dust, 2005).
Talent detection refers to the discovery of potential performers who are currently not involved in a specific sport. Talent identification also has been viewed as part of talent development in which identification may occur at various stages within the process. Talent development implies that players are provided with a suitable learning environment so that they have the opportunity to realize their potential.

Williford et al. (1994) stated that successful sport participants on all levels of sport and competition have certain unique characteristics. These characteristics include anthropometrical, game-specific skills and physical and motor abilities. According to Hare (1997) "All elite rugby players have certain anthropometrical components, rugby specific skills and physical and motor abilities that distinguish them from average players".

The objective of this study is firstly to determine these characteristics (anthropometrical components, rugby specific skills and physical and motor abilities) of elite U/16 rugby players in New Zealand (top rugby playing nations), and secondly to compare these results with those of elite U/16 South African rugby players.

The results of such comparisons will contribute to the development of rugby on youth level, especially as far as the following aspects are concerned:

- talent identification at a relative early age
- coaching of a team to enhance individual performance
- sport scientists in rugby union to develop young players to an international standard so that the players are able to compete with top rugby playing nations such as Australia, New Zealand and England
- identifying potential elite rugby players at a young age and
- to determine where certain weak areas are in specific positions

Similar studies has been done by Spamer and Winsley (2003a), Plotz (2004) which compared South African and England rugby players, and Van der Westhuizen *et al.* (2004), which compared 12-year old New Zealand rugby players with 12-year old South African rugby players. More comparative studies between top rugby playing nations are necessary to be able to determine the characteristics of elite rugby players.

2.2 THE GAME OF RUGBY

Over the centuries, the ancient forms of rugby evolved into the modern game of today. As the nature of the ancient society changed, so did the sport which formed part of that society (Horne *et al.*, 2000).

The history of rugby can be divided into distinct phases:

- the folk game (Van der Merwe, 1999),
- the formalisation of the athleticist-amateurist football codes in the English public schools (Noakes & Du Plessis, 1996; Horne *et al.,* 2000),
- the split between association football and rugby football (Baker, 1988),
- the inter-war and post-war years of the 20th century (Baker, 1988; Van der Merwe, 1995),
- later within rugby itself – the years of further commercialisation of the game in the late 1900s (Horne *et al*., 2000),
- the emergence of the professional game in 1995 (Hattingh, 2003), and
- the more recent phases of further specialisation, sponsorship and media influences upon the game (Noaks & Du Plessis, 1996; Horne *et al*., 2000)

Many people believe that rugby originated form soccer. According to them it was William Web Ellis who in 1823 picked up the ball during a soccer game and started running with it (Van der Merwe, 1999). In truth, this is a supposition that can be rejected (Van der Merwe, 1999).

It is believed that rugby originated from the ancient games of *folk football*, which were already played as early as the late 13th and early 14th century (Baker, 1988; Van der Merwe, 1999). In some of these games it appeared that the ball was carried and passed from one player to another before being carried between the goal-posts. This game of folk football served as the common ancestor from which rugby, soccer and even hockey developed (Van der Merwe, 1999). During these games there were little if any rules regulating equipment, number of players and even way of transport (Noakes & Du Plessis, 1996). Some players "played" on horseback, while others carried swords, clubs and sticks.

The peasants at that time had few rights, but considered their right to play an integral part of their birthright (Baker, 1988). In the course of time, the human body started to become the object of scientific interest (Baker, 1988), while urbanisation led to a greater interest in organised sport (Armitage, 1977). As the medieval world gave way to the early modern age, the nature of the ancient games also changed.

Among the different schools, Rugby School was the first to allow "handling" of the ball (Noaks & Du Plessis, 1996; Van der Merwe, 1999). The original rule stated that a player who caught a ball cleanly from the air had to retreat a few metres before he was allowed to kick the ball. In 1823 William Web Ellis was the first player – instead of retreating and kicking – to run forward after such a catch.

Firstly in 1863 the Football Association was bon and the game was officially known as "association football". Although this game basically consisted of scrum play, it was more closely related to modern soccer (Van der Merwe, 1999). Running with the ball was only allowed if a player caught the ball in the air. If the player was caught, he was not allowed to pass, and another scrum was formed. Points were scored by dribbling the ball forward from the scrum, through the opponents goal posts. On 26 January 1871 new rules as well as the rugby equivalent of the Football Association, called the Rugby Football Union (rugby union) were established (Horne *et al*., 2000). In 1880 the backline consisted of a single player, by the year 1883 the backline expanded to seven players, and passing between backline players became common.

In the early days of the 20th century, the game still differed much from today. During this time, it seems to have been a sport played by big, strong often fast and talented, but relatively unfit, players who saw little need to train specifically for the game (Noakes & Du Plessis, 1996). After the early 1980's this started to change when physical educators and coaches of New Zealand, England (Hazeldine & McNab, 1991; Noakes & Du Plessis, 1996) and Australia (Noakes & Du Plessis, 1996) popularised the idea that rugby players could benefit from increased levels of physical fitness. An important development was that training programmes were made specific to the requirements of the particular game, namely rugby, and scientifically designed for the exact requirements of each individual playing position.

Another turning point regarding competitiveness and the need for further *specialisation* in the game came with the explosion of worldwide media sport and, in 1995, the change to full professionalism (Hattingh, 2003). The effect of increased competitiveness and specialisation is still visible in present-day games and training methods. One of the factors that change rugby from the old to the new is the number of games per season (Quarrie *et al*., 1996). Gareth Edwards, former Wales and Lions player, averaged 16.25 games over 12 months. In contrast, Dallaglio, a later Lions player and England captain, averaged 35 games (Wilson, 2000). Yet another consequence of increased competitiveness and the need for continued specialisation is the progress in the development of very specialised training methods. According to David Young, former captain of Wales, players today spend hours improving their fitness, strength and speed (Wilson, 2000). These players do not only spend more time in the gym than before, they also follow specific training programmes to develop very specialised speed, agility, strength, flexibility, endurance and anthropometric components (Quarrie *et al*., 1995; Nicholas, 1997).

Although this specialisation process demanded heavier and stronger forwards than before, it also meant that players who were not involved in certain phases of the game were now exposed to these phases for the first time (Noaks & Du Plessis, 1996). Early in the 20^{th} century, the loose forwards were primarily involved in the scrums, line-outs, and mainly the rucks and mauls. Due to the continued specialisation over the last few decades their tasks now also include cross-defending and applying pressure on the half-back pairing. Additionally, players today need to be faster in order to cross the advantage line and avoid defenders and cross-defenders (Noaks & Du Plessis, 1996). Because players are under more pressure, they too have to speed up their play. All these increases in speed mean that if current-day players collide, it will be with increased momentum.

During the early years of the modern game, the game consisted of picking up the ball, passing and catching the ball, kicking the ball accurately, good running abilities, backing up during attacking movements, low and powerful tackles, strong defence and linking up with team mates (Craven, 1977; Joynson, 1978). The present-day rugby players still need the same basic skills that were required in the past (Van Gent, 2003; Luger & Pook, 2004), the only difference from the past being that some skills – like different tackle situations – are emphasised more.

In the future, the size, speed and fitness of rugby players may increases even further, while exercise methods will probably become more position- and game-specific. If rugby union is to compete successfully with other rugby codes, it must continue to develop into a game in which the ball is in play for much longer periods (Noaks & Du Plessis, 1996).

2.3 MODERN DEVELOPMENTS IN RUGBY WITH REFERENCE TO TALENT IDENTIFICATION

In the current way rugby is played it calls for players who can cope with the specific requirements of the modern game. Therefore it is important to discuss what the modern game of rugby requires of its players.

Coaches have constantly been searching for players who can measure up to the requirements of the game (Hanekom, 2000). Therefore it is important to identify these game-specific requirements. Some previous researchers were of the opinion that despite time and motion analyses of the game of rugby, attempts to quantify the physiological demands of the game have been inconclusive (Docherty *et al*., 1988; McLean, 1992; Quarrie *et al*., 1995). However, more recent match analysis together with conclusive observations regarding metabolic requirements during the game does exist (Nicholas, 1997).

It is well known that rugby players need to master a wide range of activities such as running, tackling, kicking, passing catching, sidestepping and jumping. Because of professionalism, the modern game also requires improved components of morphology, physical and motor abilities and skills to excel (Nicholas, 1997). Through research it has been confirmed that the following morphological, physical and motor components have an important influence on the modern game of rugby (Quarrie *et al.*, 1996; Nicholas, 1997; Hazeldine & McNab, 1998):

- Morphology (anthropometric components like stature, body mass, percentage body fat and somatotoype)
- Physical and motor abilities
    - Flexibility
    - Strength
    - Power
    - Aerobic capacity

- o Anaerobic capacity (speed endurance and muscle endurance)
- o Speed
- o Agility

From this literature it is clear that, to achieve success in the today's game, players need to measure up to the different ut specific requirements of the modern game (Quarrie *et al.*, 1996; Nicholas, 1997; Hazeldine & McNab, 1998). According to Hanekom (2003), the rugby player of the future will have to prepare in a scientific way or else will not be able to adapt to the requirements of the modern game. Scientifically evaluating players with regard to all the above-mentioned components play an integral role in monitoring and developing these components among modern rugby players (Hanekom, 2003).

All the above-mentioned morphological, physical and motor requirements will also be utilised in the design of this study and will therefore be explained further in this study.

2.4 TALENT IDENTIFICATION

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, 1991b). 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, 1991b). According to Bloomfield *et al*. 1994), talent identification at an early age is important. Various authors share the same views regarding talent identification.

In earlier reviews of literature, anthropometric, physical and physiological variables have been positively correlated with performance. However, Abott & Collins (2002) 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. 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 mature will be selected for strength sports such as rugby due to their ability to overpower the opposition. Similarly, late matures 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. Abott & Collins (2002) 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-year-old schoolboy rugby players.

In this chapter different talent identification programmes that were carried out internationally in a number of sport codes like soccer, gymnastics, field hockey, netball and, specifically rugby union, will be investigated.

2.4.1 Talent Identification Internationally

Talent identification in any sport, and especially amongst young participants, is of importance to make sure athletes are guided to the kind of sport which will suit them best. If potential athletes can be identified at an early age as potential stars in a particular sport, it will allow coaches and sport scientists to spend more time and effort on these individual athletes to give them the opportunity to become elite sportsmen in the sport in which they have the best opportunity to excel. Bloomfield *et al.* (1994) stated that, with identification of talent, good results are achieved and that pleasure, experience and participation are involved. Potgieter (1993) maintains that it is essential that talent in sport be identified at an early age in order to make certain that the correct exercise and training methods are employed to ensure peak performance at a later stage.

Abbott and Collins (2002) acknowledged that appropriate support and training are essential if talented individuals are to fulfil their potential. Partly for that reason, the early identification of talented athletes is an increasingly important consideration for researchers and practitioners alike. Once potential talented individuals have been detected, crucial but limited support resources can be optimally deployed to further refine and develop these talents. Without such support however, the needs of talented children may not be met and their gifts remain undeveloped. Consequently, an effective talent identification system is an essential precursor to talent development, as it will direct support to those individuals who have the greatest potential to achieve senior international success in sport (Abbott & Collins, 2002).

Talent identification through competition has been operating ever since organized competitive sport began; systematic talent identification has only recently become a part of sport around the world (Burgess, 1996). Eastern bloc countries like the former German Democratic Republic, the Soviet Union, Bulgaria and Romania are examples of countries that implemented state run, systematic talent identification programs as early as the 1960s and 70s (Bompa, 1994). The sporting success achieved by Eastern Europe has led to the increased deployment of systematic talent identification processes worldwide (e.g. the Australian Talent Search program). A review of the typical procedures adopted by these nations highlights a talent identification approach that promotes systematic and objective measures based on physical and performance factors perceived to be correlated with success in sport (Abbott & Collins, 2002). Consequently we will take a closer look at the following talent identification programmes.

- **Australian Talent Search Program:**

In 1988, a historic talent identification project on rowing was instigated by Dr Allan Hahn and colleagues at the Australian Institute of Sport (AIS). This rowing program was an outstanding success, fast-tracking representatives to the 1992 and 1996 Olympic Games, including gold medallist Megan Still (Australian Institute of Sport, 2005).

Inspired a number of sports, including cycling, athletics and canoeing took it upon themselves to systematically look for talented athletes in their sport. In 1993, a track cycling talent identification project unearthed three Junior World Champions in South Australian secondary schools, which included Alayna Burns.

However, these programs at the time were labour intensive, involving repeated mass screening in schools. In many instances, a number of sports conducted similar tests resulting in much duplication and a drain on school resources and time. The implementation of the Talent Search in 1994 alleviated many of these problems as it was the first coordinated, national effort between different sport codes and it necessitated testing of students only once.

In 1994, following the announcement of Sydney as host venue for the 2000 Olympics and the subsequent Olympic athlete program, the Federal Government allocated $500,00 a year for two years for a national talent identification program which became known as the Talent Search. The aim was for this program to coordinate existing talent identification schemes conducted by individual sports, and provide for any additional sport codes that were considered appropriate. The major focus for this funding was an ambitious attempt to identify talent and fast-track athletes for the 2000 Olympic Games (Australian Institute of Sport, 2005).

Eight sports were chosen for the involvement in the mainstream talent identification program. These were athletics, cycling, canoeing, swimming, rowing, triathlon, water polo and weight lifting.

The age range for testing was 14 – 16 years. This meant that the athletes would be 20 – 22 years old by the time of the Sydney Olympics. In addition, the age range reduced some of the maturational influences on performance and some of the philosophical challenges associated with testing young children.

Three phases were identified for the Talent Search program:

- Phase 1: School screening
- Phase 2: Sport-specific testing
- Phase 3: Talent development

The first phase consisted of screening in the school environment using a test battery of eight physical and physiological tests. In most cases, physical education teachers conducted the tests with the assistance of state coordinators. Results were compared with a national database and some students were then selected to participate in Phase 2 testing. In general, students needed to be in the top 2% in any one of the eight tests in order to be invited to participate in Phase 2 (Australian Institute of Sport, 2005).

Phase 2 testing refined the accuracy of some phase 1 tests and incorporated sport-specific laboratory tests. Following phase 2 testing, students identified with talent for a specific sport were invited to join a talented athlete program organised by the state and/or national sporting organisation (Phase 3) (Australian Institute of Sport, 2005).

The program associated height and weight negatively and upper body strength, leg power, and agility positively with performance in gymnastics. In contrast, hand-eye coordination, upper body strength, leg power and agility are all positively associated with performance in volleyball. However, even if the physical variables being assessed are advantages to performance in a specific sport (and some concerns are apparent here), research has clearly shown that relative values are highly unstable throughout adolescence (Ackland & Bloomfield, 1996). Late maturers are likely to excel in co-ordination and gymnastics activities due to the biomechanical efficiency resulting from short levers. For example, a smaller, lighter body in gymnastics and diving would reduce the whole-body moment of inertia, allowing quicker completion of twists and somersault revolutions (Abbott & Collins, 2002).

- **Woman Field Hockey:**

Anthropometrical and physiological attributes of various athlete groups have been extensively examined in field hockey. These studies have demonstrated that a battery of field-based tests can distinguish between players of different ability in the same sport (Rigg & Reilly, 1988; Thissen-Milder & Mayhew, 1991; Keogh, 1999). Similarly, differences in anthropometric and physiological parameters have been reported for field hockey players of varying standards (Bale & McNaught-Davis, 1983; Ready & van der Merwe, 1986). However, these studies have focused on only a few anthropometric or physiological characteristics such as body composition, aerobic power, and muscular power and strength, whereas sprinting speed, agility and repeated-sprint ability have been largely ignored.

Keogh *et al*. (2003) found that only a specific number anthropometric, physiological and skill-related field tests are required to adequately distinguish between female field hockey players of different ability. Female field hockey players share similarities with Australian Rules football (Keogh, 1999), Rugby Union (Rigg and Reilly, 1988) and volleyball athletes (Thissen-Milder & Mayhew, 1991), wherein a number of anthropometric and physiological characteristics have been shown to distinguish between players of varying standards. Based on the results of Keogh *et al.,* (2003) as well as findings reported in previous research, assessments of % body fat, sprinting speed, aerobic power, lower body muscular power, agility, dribbling control, and shooting accuracy are required in order to effectively distinguish between players of varying standards. Thus, these characteristics may be the most important physical attributes for successful performance in female field hockey, and these are the ones that should be assessed to identify talent and monitor player programs.

- **Soccer:**

Reliable identification of future elite soccer performers at an early age would permit clubs to focus their expenditure on the development of a small number of young players, representing an effective financial investment. Many people associated with youth development in sport, including soccer, seek any insights into talent identification that science can offer. In some sports, there are obvious physical or physiological variables that are important to successful involvement, such as height in basketball players, long levers in rowers and aerobic capacity in endurance athletes. Even objectively measurable variables like height can only be predicted within a range, from adolescence to adulthood (Morris, 2000).

In a number of athletic activities, motor skills such as hand-eye coordination, timing and anticipation are thought to be crucial, although the evidence for 'hardware' advantages is not compelling (Morris, 2000). At sub-elite standard and below, there are many tall basketball players and aerobically outstanding distance runners who will never excel. It is recognized that psychological factors often distinguish those successful at the highest standard from their less successful counterparts (Morgan, 1979). Identification of the psychological characteristics that distinguish outstanding performers from their peers has been a goal of sports administrators and coaches in soccer, as in other sports.

Because professional soccer clubs can withhold a player's registration at the completion of his contract, the flow of players across national borders caused inflationary pressure on wages and transfer fees. It is necessary, therefore, for clubs to retain the services of their most talented players on a long-term basis and to balance the inflow and outflow of players so that the stability in performance of the team is not adversely affected (Williams & Reilly, 2000). To remain competitive, clubs endeavour to invest significant amounts of money in attempting to identify and nurture potentially elite players. Identifying soccer potential at an early age ensures that players receive specialized coaching and training to accelerate the talent development process. The reliable identification of future elite players permits clubs to focus their expenditure on developing a smaller number of players, representing a more effective management of their resources.

According to Williams and Reilly (2000) research concerned with the physical and physiological predictors of soccer talent has highlighted a number of potentially important measures such as somatotype, aerobic capacity and anaerobic power. Fitness and anthropometric profiling can generate a useful database against which talented players may be compared to identify strengths and weaknesses. Conclusions about young talented male soccer players can be generalized to females (Williams & Reilly (2000). It is likely that the growth in female participation in soccer will continue well into the future. It is important, therefore, that research into talent identification and development is extended to address issues related to young female soccer players.

Other specific aspects that was focused on in soccer and that can play a role in talent identification are, nature versus nature, birth date, social factors and skilled perception.

- ***Nature versus nature:***

The age-old question is whether talented footballers are born such or whether footballing talent is developed with practice. Genes can also play an important role in talent identification. To better understand the roles of genes and the environment, consider their effects on three factors: physical activity, fitness, and health. The genotype (total combination of the thousands of genes within the body) can influence the extent to which one is physically active, physically fit, and healthy. Environment (physical and social environment, as well as one's lifestyle) also can affect activity, fitness, and health (Skinner, 2002). In addition, there is an interaction among these factors because:

1) activity can affect fitness,
2) fitness can affect activity,
3) activity can affect health,
4) health can affect activity,
5) fitness can affect health, and
6) health can affect fitness.

The genotype influences these interactions, e.g., how much and how fast physical activity affects fitness or health (Skinner, 2002).

Genes have a large effect on height, length of trunk, and length of arms and legs, for example tall parents tend to have tall children. In contrast there is only a small to moderate effect of genes on circumferences, girths, and breadths of various body parts because the environment can play a larger role in determining these measures, for example diet or exercise can change circumference and weight training or inactivity can change muscle size (Skinner, 2002). Genes have a large influence on muscle size and composition (percentage of fast-twitch and slow-twitch fibres). Because muscle strength is closely related to fibre composition, genes also have a large effect on strength. On the other hand, the activities of enzymes that are important in energy metabolism and the number of mitochondria within a given amount of muscle tend to be less influenced by genes because they can be modified by different types and amounts of physical activity (Skinner, 2002).

In summary, genes do influence the initial level of one's characteristics (phenotypes), as well as how fast and how much these phenotypes can change in response to training, nutrition, and other environmental factors. Athletes who have immediate success in a new sport probably have relatively high qualities of at least some of the genetically determined phenotypes required to be a champion in that sport (Skinner, 2002). Superior responders to sports participation probably have early success and positive feedback from competition. It is not possible to predict who will be a champion. Nevertheless, coaches can and do select candidates based on the characteristics required for success in that sport. Genes do not affect tactics and technique, and genetically gifted athletes who are talented in tactics and technique may be successful at non-elite levels of competition (Skinner, 2002).

In a study on soccer done by Reilly and Dust (2005) they found that in the case of maximal oxygen uptake, the variability within the population is greater than the expected improvements from an optimal training programme, and that the influence of heredity is strong in an anthropometrical measure such as height. Coaches in soccer academies may wish to predict adult stature when dealing with underage players. Physiological measures such as maximal oxygen uptake have been successful in distinguishing between expert and intermediate young players, but they may not be sensitive enough to distinguish players already selected and exposed to systematise training for national teams (Reilly & Dust, 2005). Physiological measurements may be useful alongside subjective judgements of playing skills for initial detection of talent, but such measures do not appear sensitive performance indicators on a global basis and cannot be used reliably on their own for purposes of talent identification and selection. Research has indicated that although physiological characteristics are highly genetically predisposed, appropriate training may still have a pronounced influence on eventual performance (Bouchard *et al.*, 1997).

- ***Birth date:***

Many psychological, psychiatric and sociological researches have shown relation between human behaviour and time of birth (month of birth) (Serovic, 2005). In a sport like soccer, where there are age categories and competition begins at an early age, there is a distinct advantage for children whose birth date falls near the beginning of the competitive season (Helsen *et al.*, 2000). When the beginning of the season was August (in the Northen hemisphere), a significant proportion of youth were born in the first quartile of the season. When the beginning of the competitive season was changed to January, there was an immediate change in those perceived as 'talented' (born in August). In contrast, those born in the last quartile of the competitive season are more likely to drop out, and this was the case from as early as 12 years. The relative number of competitors (16 years) is low, because many athletes in the last birth-date quartile have already dropped out (Helsen *et al.,* 2000).

Helsen *et al.* (2000) suggests that the reason that birth date makes such an important contribution to coaches' assessment of talent is the relative benefit it affords in terms of physical maturation. A one-year difference in birth date, especially at a young age creates substantial variation in physical precocity or maturation. Coaches' determination of talent seems to be heavily weighted in terms of physical maturation and not technical skill or team play. As long as standard of competition in soccer is tied to birth-date-determined age categories, this unfairness is likely to persist (Helsen *et al.,* 2000).

In the study of Serovic (2005) he found that there is a significant statistical difference between birth distribution of every single category of athletes and the general population they come from. Most of the sport population is born in the winter months of the year while in general population more persons are born in the summer and autumn months.

- ***Skilled Perception – determinant of sport expertise:***

According to Starkes and Allard (1993) skilled perception is an important determinant of sports expertise. This is certainly the case in soccer, where players are confronted with a complex and rapidly changing environment. Players must pick up information from the ball, teammates and opponents before deciding on an appropriate response based upon current objectives (e.g. strategy, tactics) and action constraints (e.g. technical ability, physical capacity). Such decisions are often made under pressure, with opponents trying to restrict the 'time' and 'space' available to perform. This 'temporal pressure' suggests that a player's ability to anticipate future events, from early components of an action sequence, is an integral part of skilled soccer performance (Williams, 2000).

Soccer is not the only sport for which an outcome approach is used to assess the potential of talented youngsters in the UK. Moore *et al*. (1993) reported that performance in trials was used to select and identify 80% of the elite sportsmen and women in 12 major English sports (athletics, cricket, cycling, gymnastics, hockey, judo, netball, rowing, rugby league and union, sailing and swimming).

- ***Social factors:***

According to Reilly and Dust (2005), having supportive parents, a stimulating and permissive coach and the dedication and commitment to spend many hours practising and refining skills are the real determinants of excellence. Players should be provided with access to appropriate facilities and opportunities for meaningful practice. Investment in high quality coaches and coach education systems is crucial. Technical support in terms of sports science and sports medicine is essential to ensure that players have the opportunity to fulfil their potential (Reilly & Dust, 2005).

Conclusion:

In designing and developing talent identification models, a key question is, which characteristics indicate that an individual has the potential to develop in sport and become a successful senior athlete? Sport Scotland did an evaluation of the Sport interactive talent identification program among Scottish girls and boys, and found that the presented data clearly highlight the limitations of employing either physical or performance tasks, or a combination of both, as the main criteria to identify children for, or eliminate children from, talent identification programs. Abbott and Collins (2002) found that talent identification programs that emphasize the physique and performance capacities of adolescents continue to receive substantial support despite these obvious limitations.

A shift in emphasis needs to occur if talent identification programs are to be effective. Key indicators of the capacity an individual needs to develop, appear to be psycho-behavioural in nature. Regardless of their physical and skill prowess, an individual will only successfully develop in sport if she/he optimises the available development opportunities by adopting an appropriate focus within and between training and competition (Abbott & Collins, 2002).

Burgess (1996) argued that competition itself might very well be the best form of talent identification, with competition seeing the best or most talented athletes rise to the top in their chosen sport (Peltola, 1992). However the many athletes that do not succeed in the particular sport they have chosen, along with many that do achieve a degree of success, may be better suited to a different sport and never realise it (Peltola, 1992). With this in mind and considering that without talent development talent identification would be a waste of time (Jarver, 1982).

2.4.2 Talent Identification in South Africa

Sport is enjoyed world-wide and is part of modern society and the being of mankind irrespective of gender, culture or race (Headley, 1992). 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).

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). Pioneering research by Pienaar and Spamer (1995, 1996, 1998a, 1998b) contributed extensively toward 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. 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. The study done 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 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. 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.

In the next section different talent identification studies in South Africa, which include individual sport sorts like soccer, gymnastics, field hockey, netball and rugby, will be discussed.

Du Randt and Headley (1993) did a study on talent identification and development as well as related issues in different countries. They described the principles of talent identification as follows:

- The identification of talent must be an on-going process because test results are valid only for 2 to 4 years before new norms are required.
- National and regional programs with the primary emphasis on general fitness must be encouraged.
- Research models must emphasise the following: they must be complementary to the trainer and take into consideration that requirements must be met according to age. Provision must be made for late developers to catch up, involve as many participants as possible from the community and be of a multi-disciplinary nature.
- The battery of tests for initial selections must be simple and practical, easily administered and always scientifically based.
- Trainers and national sporting bodies must be trained and be a part of the process of talent identification

Similar programs as in Australia have been started in South Africa to identify and search for new talent. In October 1998, track and field athletics development in Northern Kwazulu-Natal received R3-million. The sponsorship, over three years, was aimed at a programme of talent identification and development in the rural areas of the region. The project was part of ASA'a national talent identification and development programme, which was aimed at making South Africa one of the world's top athletics nations (Sunday Times, 1998). The programme also focused on developing administrators and coaches to ensure that the programme was ongoing in all the important facets of successful athletics.

- **Soccer**

Few studies on talent identification were done in South Africa. For example in a study on 16 year-old soccer players by Badenhorst (1998), she compared talented soccer players to those who are less talented. The top soccer team in the North West Province was used together with the two teams who ended last in the league. The results of the best team were used as a criterion of soccer talent at the age of sixteen. A test battery of seven soccer skills, 33 kinanthropometrical tests and 12 physical and motor abilities was administered to these selected subjects. The results of this study showed that the talented group were better according to game-specific skills, physical and motor abilities as well as kinanthropometrical characteristics. At the age of sixteen the talented group tested better in soccer skills, aerobic and anaerobic capacity, they were quicker, more agile and muscular.

- **Gymnastics**

In a sport like gymnastics, girls need to start early and participate for many years if success is to be attained. If a coach can predict the ability of a child, he or she will be able to work more dedicatedly towards the goals set for each child according to his or her abilities. Pienaar (1987) composed a selection model for 6 to 9 year female gymnasts where she administered a test battery of ten motor and thirty kinanthropometrical tests to 74 participants, of which 41 formed the test group and 33 the control group. The test group consisted of girls who started gymnastics at the beginning of the year. After nine months of participation in gymnastics, the test group was enrolled in a gymnastics competition from which the mark they received was used as a criterion for ability (Pienaar, 1987). She developed two multiple regression equations that could predict ability.

- **Field Hockey**

In the North West Province, Nieuwenhuis *et al.* (2002) did a study on 15 year-old field hockey players where two top girls' field hockey teams as well as the two teams who ended at the bottom of the league were exposed to a test battery. The aim of this study was to find the differences in achievement between successful and less successful 14 to 15 year old female field hockey players regarding kinanthropometrical, physical-motor, psychological and game-related (field hockey skills) tests, and secondly to find the composition of a prediction function based on the mentioned set of variables in order to distinguish between successful and less successful 14 to 15 year old female field hockey players.

The study of Nieuwenhuis *et al.* (2002) took a large set of variables from various scientific domains. The composition of the prediction function, combining variables from each of the domains included in the study, suggests that it would have been erroneous if one of the domains had been left out. The composition of the prediction function shows how easily selectors might make mistakes if they select potential talent on the basis of having seen them in a game situation. This study of Nieuwenhuis *et al.* (2002) illustrates the relevance of taking into account information from such diverse domains as the physical-motor, the kinanthropometric, the psychological and the game-specific motor skills. Taking the results together, clear differences between successful and less successful female field hockey players are evident. The successful female field hockey player at 14 to 15 years of age passes the ball more accurately over a distance, is faster in covering a short distance, has a broader humerus and femur, and experiences the competitive situation more positively. Thus, this study came to the conclusion that with a little help from scientific tests one can very effectively distinguish successful players from those who are less successful.

- **Netball**

Studies of young netball players and research related to talent identification in netball are limited (Barham & Maylor, 1996). Research deals mainly with the physiological characteristics of players and the effect of training on such physiological variables. In England talent identification is used to identify netball players between the ages of nine and twelve years and subsequently accommodate talented players in development programs. The players are, however, selected according to the subjective appraisal of coaches and teachers and not according to scientifically founded methods (Barham & Maylor, 1996).

Karstens (2002) did a study on 12 year-old netball players where the results of a number of talented and less talented were compiled. The three top u/12 netball teams that participated in the North West Province u/12 league were used, together with 21 girls who do not play netball. A test battery consisting of 19 kinanthropometrical variables, 12 physical and motor abilities and 6 game-specific skills was compiled. In this study of Karstens (2002) he found differences between talented and less talented netball players according to netball skills, physical, motor and kinanthrophometrical characteristics. His conclusion is that it is important to be able to catch and throw a ball, as well as to be fast and agile.

Thus, this study on the 12 year-old netball players showed that coaches can identify talented 12 year-old netball players by means of anthropometrical components, physical and motor abilities and game specific skills components. The differences with regards to the above-mentioned components are of such a nature that the achievement of these variables can be successfully employed to classify 12-year-old netball players as talented or less talented.

Growth and development in a 12 year old child are enormous and therefore it must be kept in mind that the prediction function will only have application value on 12-year-old netball players (Spamer & Karstens, 2001). Spamer and Karstens (2001) suggested that similar models should be developed for younger and older netball players in order to do justice to the development of netball potential in young players.

2.4.3 Talent Identification in Rugby Union

Since 1995 new competitions were introduced such as the Vodacom Super 12, Vodacom Tri-Nations and the Heineken Championship in Europe (SARFU, 2003). The Introduction of professionalism as well as the new competitions, major tours and the World Cup increased the physiological demand on the elite player. The increase in physiological demands on the elite players warrants the importance of improving the anthropometric and physiological characteristics of the players (Nicholas, 1997).

One of the reasons for rugby being such a unique sport is that players of all shapes and sizes can participate in it (SARFU, 2003). 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 (de la Port, 2005). 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 be rated among the top three in the word (SARFU, 2003). To be rated among the top three in the word, potential talented youth rugby players must be identified at an early age and be involved in development programmes (De la Port, 2005).

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, 2003). 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, 2003).

In the next section we will discuss different studies done on talent identification in Rugby Union.

Hare (1997) did a study on 16 year-old rugby players to create a talent identification test battery, which included game specific skills, physical and motor abilities, anthropometrical and psychological variables. The results showed that the talented rugby players scored better in 5 of the 9 rugby-specific skill variables (ground skills; air and ground kicks; passing for distance; passing for accuracy – 4m and passing for accuracy – 7m), in 9 of the 13 physical and motor abilities (vertical jump; zig-zag run; speed (15m and 45.7m); back, leg and arm strength as well as left and right grip strength (Hare, 1997). The talented rugby players scored better in all 24 anthropometrical variables (Hare, 1997). In the psychological variables the talented rugby players tested better in all the psychological abilities. Significant differences were found only in self-believe between the two groups (Hare, 1997). Thus, Hare (1997) came to the conclusion that to test players on various game specific skills, physical and motor abilities, anthropometrical and psychological variables, it is possible to identify talented rugby players at a young age.

Hare (1999) did a study on talented youth rugby players where his first objective was to establish the effect that growth had over a period of six years on ten year-old rugby players who have been identified as talented. Secondly he determined whether the initial successful group (thirteen year-olds), after a further three years still gave the best performance with regard to game-specific, physical and motor and psychological components according to specific tests and measurements. Thirdly he made a comparison after a period of six years between the initial successful ten year-old rugby players with another sixteen year-old group of rugby players who have been identified as talented.

In the results for game-specific skills, Hare (1999) found that the increase in growth and development (physical, motor and anthropometrical characteristics), as well as the development program they followed, had a positive influence on rugby-specific skills. According to the physical and motor components only two of the variables increased in performance (speed and bent arm hang). Thus the increase in strength because of growth and the development program that the rugby players followed played an important role in performance – more strength causes more speed and better performance (Hare, 1999)

The findings in the longitudinal study of Spamer and Hare (2001), justified the supposition that growth and development improve the achievement of talented youth rugby players favourably over a period of five years. A further conclusion that may be drawn from the results is that growth and development make a definite contribution to the improvement in performance of the talented and identified group's game specific skills, physical and motor abilities and anthropometrical variables (Spamer & Hare 2001).

Van der Westhuizen *et al.* (2004) did a comparative study on 12 year-old New Zealand and South African rugby players. The data were obtained from two groups of 12 year-old players namely: various rugby clubs in Invercargill, New Zealand and Potchefstroom, South Africa. The players were tested on 9 anthropometrical, 5 game-specific and 4 motor and physical abilities. They came to a conclusion that although the New Zealand players possessed practically significant higher skinfold measurements at four sites (indicating higher subcutaneous fat) as well as larger girths, they ran practically significantly faster times in the sprint and zig-zag run when compared to their counterparts. However, the South African players achieved practically significant higher performances regarding passing distance to the preferred side, passing accuracy over 7 meters and vertical jumping when compared to New Zealand players.

A comparative study of British and South African 12 year-old rugby players with reference to game-specific, physical and motor- and anthropometrical variables was done by Spamer and Winsley (2003a). They found that there weren't significant differences between the British and South African 12 year-old rugby players. A possible reason for the similarity between the groups may be because the tests were done at the start of the season and that the conditions of the players as well as their skills weren't developed to their maximum yet (Spamer & Winsley 2003a).

Plotz (2004) compared U/18 English (Ivybridge Sport School) and South African (Leopards and Blue Bulls Cravenweek teams) elite rugby players with reference to game-specific skills, physical and motor abilities and anthropometrical variables. He found that there were no significant differences in the anthropometrical variables, but that the English group only scored better in two of the eight game specific skills (side-step and air and ground kicks) and in none of the physical and motor abilities tests. The Leopards group only scored better in one game specific skill (ground skills), and the Blue Bulls scored better in all the other tests (passing for distance, passing for accuracy over 4m and 7m, kicking distance as well as kick-off distance) (Plotz, 2004).

Spamer and Winsley (2003b) compared elite English and South African 18-year-old rugby players with reference to game-specific skills, physical abilities and anthropometrical data. When the two 18-year-old groups were compared, they found that both groups of players were remarkably similar. The South African boys were slightly leaner than their English counterparts. When comparing the South African group and the English group in game specific skills, they scored equally in five of the game specific skills, with the South Africa players scoring significantly better in four of the tests (passing for distance, passing accuracy, kicking for distance and kick-off for distance). Slight differences in kicking and passing abilities are thought to be more attributable to environmental factors than physical characteristics.

According to the physical and motor abilities the South African group scored significantly better in all tests, except for zig-zag run where the English players had a better score. Thus growth and development had a significant influence on the performance of talented rugby players over a period of six years (Hare, 1999).

In a study done by Spamer and De la Port (2005) their aim was to compile a status profile of the under 18 elite rugby player in South Africa with reference to physical and game-specific skills. The research group consisted of the top 97 elite South Africa rugby players as identified by the South African Rugby Football Union during 2003. A number of seven physical and motor abilities, eight anthropometrical variables and six game-specific skills were tested. The group was tested in 2003 and 2004, they compiled a physical and game-skills profile for each position, which coaches can use as a norm to identify potentially talented players.

The two positions Spamer and De la Port (2005) discuss in their article are props and scrumhalves. According to them the anthropometrical measurements of the props showed a better profile than other research that has been done, physically and motorically very few results of other studies of the same age group are available and as far as game-specific skills are concerned, they certainly need more training in passing for accuracy. With reference to anthropometrical data, scrumhalves are the shortest, lightest and have the smallest body fat percentage of all playing positions (Spamer & De la Port, 2005). According to literature, the profile of scrumhalves requires specific anthropometrical measurements: they must be fast, agile and possess strength and speed endurance, as well as good handling skills and kicking abilities (Spamer & De la Port, 2005).

The NZRU (New Zealand Rugby Union) established a 'blueprint' of the basic skills a player needs to perform at top level in the specific positions. Following is the position by position needs for rugby players as described in the Principles of Rugby Coaching – Stage Two, NZRU (2002).

Not all of the components in table 2.1 can be measured, but this study can help to identify individuals to establish if the players does have the skill, whether it is sport specific skills, physical and motor abilities or anthropometrical components, and if the individual does not match the 'blueprint' in table 2.1, what the coach or fitness conditioner can do to get the player to the required level to perform at a high level in rugby.

TABLE 2.1: POSITION BY POSITION NEEDS FOR RUGBY PLAYERS

(Principles of Rugby Coaching – Stage Two, NZRU 2002)

Outside Backs	**Mid Field**
- Safe under the high ball - Sound tackler - Acceleration and top end speed - Understand role in defence - Able to communicate and organise back 3 - High work rate in cover defence, counter attack and backline entry - Vision, running lines and timing for backline penetration (extra man) - Strength in the tackle – able to stay on feet - Provide threat on blind side	- Accurate passing skills - Vision - Strong, accurate, intimidating tackler - Strength for go-forward and able to stand in tackle - Straightness in attack - Able to confront/commit opponent and get ball away under pressure - Able to kick accurately off either foot - Excellent communication/ organisational skills - Understand/read the game - Speed to make outside break - High work rate in support play

TABLE 2.1: POSITION BY POSITION NEEDS FOR RUGBY PLAYERS (cont.) (Principles of Rugby Coaching – Stage Two, NZRU 2002)

Inside backs	**Loose Forwards**
- Understand the game tactically - General awareness - Excellent vision - Good communication/organisational skills - Able to 'call the shots' - Decisive - Accurate passer and kicker off either hand/foot - Good tackler - Acceleration to make initial break - Organise defence - Able to withstand pressure	- High work rate in support/cover - Speed to breakdown/speed endurance - Good running and linking skills - Strong tackles/understand role in defensive pattern - Able to drive ball carrier back around fringes and turn ball over in tackles - Know running lines in attack/defence - Win ball on ground - Exceptional fitness levels - Relentless – not intimidated - Good all round skills
Locks	**Props**
- Win own lineout ball/contest on opponent - Strong and durable - Agile in air, good hands - Strength in scrum - Low body position in contact and pushing - Able to concentrate on set phases first, then get quickly to breakdown - Strong in tackle - Able to pick and go through middle of ruck - Relentless – never give in	- Strong scrummager, technically correct - Strong at supporting/lifting in line-outs - Mobile/quick to breakdown - Low body position in contact, scrum, ruck - Very strong in upper body and legs - Durable/mental tough - Agile/explosive for pick and go - Good tackler - Not intimidated

TABLE 2.1: POSITION BY POSITION NEEDS FOR RUGBY PLAYERS (cont.) (Principles of Rugby Coaching – Stage Two, NZRU 2002)

Hooker
- Accurate thrower in line-out
- Strong scrummager
- General awareness at line-out and second phases
- Strong tackler
- Exceptional fitness levels
- Able to apply pressure physically and psychologically
- Strong in upper body and legs
- Able to catch, pass and run effectively with ball
- Accurate in ball retention

2.4.4 Requirements for elite schoolboy rugby players

A study done by Manlan 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, U/18 and U/19-year old rugby players. In this study the profile of the U/16 elite rugby player will be compiled taking into account results of previous studies. 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 handing and running skills, kicking skills and motor skills (De la Port, 2005).

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

2.4.4.1 Anthropometrics

An individual's basic physique is classified according to the fat percentage, muscle bulk and bone length (Gallahue & Ozmun 1995). 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 done by Hare (1999) he supports Craven (1974) in that an individual with a mesomorpic 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) confirms that the majority of elite secondary school rugby players can be classified as mesomorphic. However, the forwards have an endomorphic-mesomorphic physique compared to the backs that are balanced mesomorphically.

- ***Body composition***

Body composition means the ratio of fat percentage to lean body mass. Research by De Ridder (1993) 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) 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) recorded the senior secondary rugby player forwards as being on average 7.10cm taller than backs. The locks were the tallest players at 191.60cm followed by the eighth men (186.70cm) and the loose-forwards (182.90cm). The scruhalfs (171.00cm) presented as the shortest players followed by the hookers (174.90cm) and the centres (177.00cm).

- ***Weight***

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

- ***Skinfolds***

De Ridder (1993) reported that of all playing positions of primary and high school Craven Week rugby players, props have the highest mean sum of six skinfolds (102.2mm and 117.9mm 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) on elite senior secondary rugby players, results showed most of the players to be mesomorphic with a somatotpe of (end-;meso-;ectomorphic), which classifies as an endomorphic mesomorphs somatotype, whilst the backs were balanced mesomorphs.

2.4.4.2 Physical and motor abilities

Physical and motor abilities required for rugby as described by Hare (1999) 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 accelarate 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). Nicholas (1997) emphasises the importance of speed necessary to accelerate form 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). 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). 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). Hankom (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 scrimmaging and mauling (Nicholas, 1997). The backs, kickers and loose forwards involved in many running and talking situations in game play need dynamic and explosive strength (Hare, 1997).

- ***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). 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).

- ***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). Flexibility 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).

2.4.4.3 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, 1998a, 1998b) 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.

- ***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 & 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-meter distance (7m). Passing over 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 (De la Port, 2005). 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 (AAHPER, 1966). Thus strength and leg power plays an important role.

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

At the stat of the game or wit 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 kicking thus increasing territorial advantage (Hare, 1997).

- ***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.

- ***Ground skills***

The game of rugby involves many stage e.g. scrum, 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).

- ***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, 1984).

Next a discussion will follow on physical and motor characteristics of 16 year-old elite sportsmen as well as the effects of rugby injuries on the physical and motor characteristics.

2.4.5 Physical and motor characteristics of 16 year-old elite sportsmen.

Because of stiff pre-season games and competition for secondary schools, schoolboys will experience more pressure to be competitive (Nathan *et al.*, 1983). Talented boys are increasingly being offered large bursaries to play for prestigious schools. This, together with teams sponsored by major companies, are part of a multi-million rand school rugby industry (KaMathanda, 2002). The increased practice and playing time combined with additional pressure to perform will certainly contribute to the rise in injury epidemiology visible at South African school level (Strydom, 1992).

- ***Injuries***

A study done by Hatting (2003) found that the majority of injuries for both 15 and 18-year-old rugby players occurred among the forwards. Older research showed no practical significant differences between forward and back line players at school level, as reported by Davidson (1987). The possible reason for this tendency reported by Davidson (1987) could be the change in laws brought about in 1988 to control the fixed phases of the game and a second possible reason could be the evolution of the game towards open (general) play. Garraway and MaCleod (1995) also stated that the law changes are a possible reason for this tendency, which forced the game to be mostly played in the second and third phases. If further subdivided, the loose forwards recorded the highest percentage of injuries for both the 15 and 18 year-olds. This correlated with the recordings of Roux *et al*. (1987) who found loose forwards and back line, with the exception of the scrum-half to be the most dangerous player positions. The player position most at risk was that of the flanker among the 15-year-olds.

Something has to be done to curb the injury incidence of all schoolboys at risk. Research state that the majority of sports injuries are sustained during and shortly after the growth spurt of boys (Caine & Maffulli, 1989; Stanistski, 1989). The most aggressive growth period of most boys only ends in the region of 15 or 16 years of age (Gallahue & Ozmun, 1995). It has already been proven that those highest at risk of injury are the fifteen to nineteen-year-old A team rugby players (CHIRPP – Canadian Hospital Injury Reporting Prevention Programme, 1995; Noakes & Du Plessis, 1996).

Thus, it is important to know and understand the physical and motor characteristics of 16 year-old boys, to prevent injuries and develop possibilities of identifying positional requirements by using a scientifically compiled test battery. By performing tests at the end of a rugby season you will be able to pick up if a player is prone to injuries in a specific area, for example, weak stabilizer which can lead to groin injuries. This will give the coach and players adequate time for rehabilitation and strengthening of injury prone areas and therefore eliminate the chance for injuries in the next rugby season.

It is necessary for every coach to know and understand the growing sportsman, as well as how the general and physiological profile of the growing sportsman looks like.

- ***Growth***

Growth in adolescence is that stage when body length and body mass increase, but body length precedes body mass (Hare, 1999). A rapid increase in body length (skeletal growth) and body mass during adolescence in called the growth spurt (Gouws *et al.,* 2000). 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). According tho Gouws *et* al. (2000), the growth spurt in males starts between ages nine and a half and 14; and males reach their mature length at 21 years.

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). 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) and an increase in body weight (Southmayd & Hoffman, 1981). 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). 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).

Incorrect diet and nutrition, have harmful effects on growth from childhood to adolescence (Gallahue & Ozmun, 1995). According to Gouws *et al.* (2000), illness, decrease work capacity and lack of cognitive development result from nutritional deficiencies. During mid-adolescence (15 – 18 years), nutrition is of utmost importance. Nutrition and specifically micronutrients are important to ascertain a satisfactory state of growth and to be a healthy person (Gouws *et al.* 2000).

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 improves and stature increases. These characteristics influence the adolescent player's ability in a competitive sport such as rugby (De la Port, 2005). According to Nicholas (1997), rugby players have unique anthropometric characteristics such as body size and composition. Nicholas (1997) 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.

- ***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). According to Malina and Bouchard (1991b), motor development and the accompanying refinement of skill is a major development task of childhood. 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. From this model it is clear that interaction, but also transaction exists between individual, task-related and environmental factors (Gallahue and Ozmun, 1995). One of the concepts that Gallahue and Ozmun (1995) highlight is that motor development is age-related and not age-dependent.

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)

Children are growing and maturing, and their physical and motor needs and capabilities change as they progress through life (Armstrong & McManus, 1996). The fundamental movement skills are in most individuals fully developed by the age of 6 years (Gallahue & Ozmun, 1995). Malina and Bouchard (1991a) suggest that age-related trends in strength, motor performance and aerobic power accelerate in growth during adolescence in males. Most performance tasks show a clear adolescent spurt in boys (Malina & Bouchard, 1991a). According to Malina and Bouchard (1991a) sportsmen that develop earlier than their counterparts will have an edge on late developers, therefore the earlier developed players will receive more time and effort from their coach at a young age in developing their sporting skills, so the possibility is there for earlier developers to become elite sportsmen.

For example, speed improves as the sportsman becomes older. According to Malina and Bouchard (1991a) and Haywood (1986), running speed improves linearly from 5 to 17 years in males with no clear indication of an adolescent growth spurt. This could be due to the child's growing, which results in bigger and stronger stride length and an improvement in the ability to exert power (van Gent, 2003). It appears though that speed tasks (running speed in the shuttle run and speed of upper limb movement in plate tapping) reach maximum velocities before peak high velocity (Malina & Bouchard, 1991a). On the other hand when Armstrong and McManus (1996) examine anaerobic endurance, which is the energy used to perform high-intensity activities of short duration, they found that the data on children and adolescents are very limited because of its difficulty to assess.

Haywood (1986) found in his study that the anaerobic power of adolescents is lower than those of adults. The reason for this can be because adolescents have less muscle mass than adults. Anaerobic performance in boys increases with age from childhood through to adulthood (Armstrong & McManus, 1996). According to Van Gent (2003) most cross-sectional and longitudinal studies have consistently confirm an increase in peak or mean anaerobic power of at least 150% at the ages of 8-16 years in boys (Van Gent, 2003).

Muscle strength plays an important role in the life of a growing sportsman. Muscle strength is the ability of a muscle group to exert force against resistance in one maximal effort (Armstrong & McManus, 1996). Whether muscle strength is expressed in terms of an isolated muscle (grip strength) or as a composite (total strength scores from several different muscle groups), it increases linearly with advancing age, until 13 or 14 years of age, followed by a slower increase into the early or mid twenties (Armstrong & McManus, 1996; Armstrong & Welsman, 1997). Due to the fact that muscle strength correlates highly with body size, the pubertal spurt in strength is also much less accentuated and values reach a plateau by the age of 15 years (Armstrong & Welsman, 1997). The adolescent spurts in strength appear to begin about 1.5 years prior to peak high velocity and reach a peak about 0.5 to 1.0 year after peak high velocity (Malina & Bouchard, 1991a). Thus it is important to focus on the development of muscle strength after the age of 15 when strength reaches a plateau. On the other hand muscle endurance (the ability to apply force repeatedly over a period of time) improves linearly with age from 5 to 13 or 14 years of age in boys, followed by a spurt (Malina & Bouchard, 1991a).

The most reliable clinical methods to estimate strength is to test one's grip strength. Grip strength is an important measure of general health and is often estimated in screenings of normal motor function. It is also regarded as one of the most reliable clinical methods for estimation of strength and is used extensively on adults (Thorngren & Werner, 1979). Hager-Ross and Rosblad (2002) tested a total of 530 Swedish 4-16 year-olds with the Grippit instrument. This instrument estimates peak grip strength over a 10 second period, and sustained grip strength averaged across the 10 seconds. Strong correlations existed between grip strength and the anthropometric measures weight, height and, in particular, hand length. These anthropometrical measurements increase with age and the conclusion can be make that grip strength will also increase with age.

When evaluating grip strength in left-handed children both hands should be assumed to be about equally strong, while right-handed children are expected to be up to 10% stronger with their right hand (Hager-Ross & Rosblad, 2002). The results of this study showed that grip strength gradually increase with age, after 10 years of age the boys displayed a steeper increase in their grip strength year by year.

Subsequently studies of successful athletes were undertaken providing evidence that inheritance was a major determinant of athletic success (Beunen & Thomis, 2000). Strength characteristics are not only relevant phenotypes that underlie success in sport but are also essential in daily life activities throughout the life span (Roubenoff, 2000). Beunen *et al*. (2003) measured 105 twin pairs in different strength tests. Static strength was measured with the arm pull test and explosive strength measured by vertical jump. Average static strength scores (arm pull) increase gradually, but from 12 years onwards the increase is steeper. Also for power or explosive strength there is a gradual increase until 13 years followed by a more steep increase. The results of 16 year-old boys are shown in table 2.2.

TABLE 2.2: MEAN GROWTH VALUES FOR STATIC AND EXPLOSIVE STRENGTH OF 16 YEAR-OLD BOYS (Beunen *et al.*, 2003)

TEST	**RESULT**
Static Strength (Arm pull)	575 N
Explosive strength, power (Vertical jump)	47 cm

Maximal and explosive muscle strength (power) is important characteristics of neuromuscular performance, which changes throughout the years of growth, particularly during puberty (Blimkie, 1989). The increase in maximal strength of the muscles during puberty is often associated with increase in muscle mass (Malina, 1986) or cross-sectional area (Kanehisa *et al.*, 1995). Some investigations demonstrated a significant increase in muscle strength in relation to body mass between 8-years-old and 13-14-years-old children (De Ste Croix, et al., 1999). The knee extensor muscles play an important role in many movement activities. These muscles have a great importance in the function and stability of the knee joint as well as prevention of the knee injuries (Pääsuke et al., 2001).

Pääsuke *et al.* (2001) compare the isometric and isokinetic strength of the knee extensor muscles and vertical jumping performance in pre- (11-year-old) and post- (16-year-old) pubertal boys. They examined maximal isometric force and rate of force development as well as isokinetic peak torque of the knee extensor muscles and jumping height in squat, counter movement, and drop jumps in 16-year-old boys. A squat jump consists of a concentric muscle action of the leg extensor muscles, while counter-movement jump, drop jump (i.e., jumping down from a height), and performing a maximal vertical jump upon landing, consists of an eccentric-concentric muscle action (stretch-shortening cycle). According to Pääsuke *et al.* (2001) the results in table 2.3 can be used as averages for physical characteristics of a 16 year-old boy.

Flexibility (the range of possible movement available in a joint or groups of joints) is classified as one of the most important components in sport performance although it is frequently been neglected (Armstrong & McManus, 1996). The limited data available on flexibility of adolescents as well as the inadequate methods of testing flexibility have resulted in difficulties when comparing data (van Gent, 2003). There is little scientific evidence to support the fact that flexibility declines with age or that there is a critical period during which flexibility is maximal (Armstrong & McManus, 1996).

TABLE 2.3: PHYSICAL CHARACTERISTICS, MUSCLE STRENGTH AND VERTICAL JUMPING RESULTS OF 16-YEAR-OLD BOYS (Pääsuke *et al.*, (2001)

TEST	RESULT
Height (cm)	164 cm
Body mass (kg)	67.8 kg
Maximal isometric force (N)	690 N
Isokinetic concentric peak torque 60º (N.m)	220 N.m
Isokinetic concentric peak torque 180º (N.m)	135.2 N.m
Isokinetic concentric peak torque 240º (N.m)	90 N.m
Squat jump (cm)	32.30 cm
Countermovement jump (cm)	35.24 cm
Drop jump (cm)	36.11 cm

In general, flexibility has been found to increase between the age of 7 and 11 years and recent evidence from children engaged in formal sports training supports the view that the flexibility of older children can be increased with training (Armstrong & McManus, 1996). The spurt in performance of flexibility usually occurs before peak high velocity (Malina & Bouchard, 1991a). Another important component of sport performance is agility, which is the ability to change direction with no loss of speed or control. Agility also improves with age. There is a marked improvement in agility among boys form 5 to 8 years, and it then improves at a lesser rate in boys up to 18 years (Malina & Bouchard, 1991a; Armstrong & McManus, 1996).

In another study Cooley and McNaughton (1999) determine the aerobic fitness of Tasmanian secondary school children aged 11 to 16 years. Aerobic fitness is a major determinant of over-all fitness. It is well accepted that directly measured maximal oxygen uptake (VO_2max) is the most accurate method for determining aerobic capacity (Coonan & Dwyer, 1983). According to these test Cooley and McNaughton (1999) found that older boys ran farther than younger children. The 16 year-old group of boys tested by Cooley and McNaughton (1999) estimated VO_2 max were 50.4ml.kg-1.min.-1, and the most shuttles completed were 11.5. The comparison of the Tasmanian secondary school children with other studies showed they are well below the average (Binkhorst *et al*., 1984). According to Binkhorst *et al.* (1984) study, boys aged 16 years mean VO_2max value is 55.7 ml.kg-1.min.-1. Thus how older one get the better his VO_2max.

In a physiological profile of different age-group wrestlers Terbizan and Seljevold (1996) tested body weight, body composition – sum of skinfolds (pectoral; subscapular; tricep; suprailiac; abdominal and thigh skinfold), aerobic power (where the wrestlers did a 1.5-mile run), grip strength (with a handgrip dynamometer, to determine finger and forearm flexor strength), sit-ups (in 30 seconds), maximum push-ups, and the sit-and-reach flexibility test. They also use 23 kg to bench press as many repetitions as possible and for anaerobic capacity they did the 30-second Wingate anaerobic test. The results of their tests are shown in table 2.4.

TABLE 2.4: TEST RESULTS FOR 16 YEAR-OLD WRESTLERS

(Terbizan & Seljevold, 1996)

TEST	*MEAN RESULTS*
Body Weight	66.80kg
Percent body fat	8.53%
Sum of skinfolds	60.85mm
1.5 Mile run	9.95min
Grip strength	46.92kg
Sit-ups (30sec)	31.56
Push-ups (max)	49.76

According to the study done by Terbizan and Seljevold, (1996) the values in table 2.4 can be use can be use as a prediction to identify talented wrestlers, although more data will be needed to make better comparisons between different groups of wrestlers. Predicting success in young wrestlers can be difficult. If certain physiological capabilities can be found as predictors for success, it will be beneficial to educate and train young wrestlers to improve these capabilities (Terbizan & Seljevold, 1996).

In conclusion most of the physical and motor components increase with age and plateau or increase slower, after the age of 14-15 years. Therefore it is important for coaches and sport scientists to focus on all these aspects to make sure all the components are still developed and improved.

2.4.6 Status profile of the U/16 elite players

De la Port (2005) did a study to compile a status profile of rugby players in South Africa with regard to anthropometrical, physical and motor and game-specific skill components.

De la Port (2005) noted that the U/16 Green Squad rugby players (Table 2.5) showed an increase in all Anthropometrical components except muscle percentage compared to the U/18 Green Squad (Table 2.6) rugby players in the 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.

With regard to physical and motor abilities (Table 2.7) De la Port (2005) concluded that the U/16 Green Squad rugby players presented poorer results in the agility Illinois test whereas the U/18 Green Squad rugby players (Table 2.8) 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.

De la Port (2005) came to the conclusion that the game-specific skills (Table 2.9) 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 players (Table 2.10) only passing for distance and kicking for distance presented better results from 2003 to 2004.

TABLE 2.5 DESCRIPTIVE STATISTICS AND PRACTICAL SIGNIFICANT DIFFERENCES (d-value) OF THE ANTHROPOMETRICAL COMPONENTS OF THE UNDER 16 ELITE RUGBY PLAYER (De la Port, 2005).

VARIABLES	2003					2004					Practical significance (d-values)
	n	$\overline{X}$	sd	min	max	n	$\overline{X}$	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
Ectomrphy	67	2.11	1.01	0.10	4.36	75	2.21	1.08	0.10	4.46	0.09

TABLE 2.6 DESCRIPTIVE STATISTICS AND PRACTICAL SIGNIFICANT DIFFERENCES (d-value) OF THE ANTHROPOMETRICAL COMPONENTS OF THE UNDER 18 ELITE RUGBY PLAYER (De la Port, 2005).

VARIABLES	2003					2004					Practical significance (d-values)
	n	$\overline{X}$	sd	min	max	n	$\overline{X}$	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	76.86	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
Ectomrphy	75	1.86	1.06	0.10	4.12	43	1.66	1.11	0.10	3.99	0.18

TABLE 2.7 DESCRIPTIVE STATISTICS AND PRACTICAL SIGNIFICANT DIFFERENCES (d-value) FOR PHYSICAL AND MOTOR ABILITIES OF THE UNDER 16 ELITE RUGBY PLAYER (De la Port, 2005).

VARIABLES	2003					2004					Practical significance (d-values)
	n	$\overline{X}$	sd	min	max	n	$\overline{X}$	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) 40m	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	4.00	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 2.8 DESCRIPTIVE STATISTICS AND PRACTICAL SIGNIFICANT DIFFERENCES (d-value) FOR PHYSICAL AND MOTOR ABILITIES OF THE UNDER 18 ELITE RUGBY PLAYER (De la Port, 2005).

VARIABLES	2003					2004					Practical significance (d-values)
	n	$\overline{X}$	sd	min	max	n	$\overline{X}$	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) 40m	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

TABLE 2.9 DESCRIPTIVE STATISTICS AND PRACTICAL SIGNIFICANT DIFFERENCES (d-value) OF GAME-SPECIFIC SKILLS OF THE UNDER 16 ELITE RUGBY PLAYER (De la Port, 2005).

VARIABLES		2003					2004					Practical significance (d-values)
		n	$\overline{X}$	sd	min	max	n	$\overline{X}$	sd	min	max	
Catching ability (catch and 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 - 4m (n)	Left	51	2.45	1.19	0	5.00	57	2.79	1.33	0	5.00	0.26
	Right	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 2.10 DESCRIPTIVE STATISTICS AND PRACTICAL SIGNIFICANT DIFFERENCES (d-value) OF GAME-SPECIFIC SKILLS OF THE UNDER 18 ELITE RUGBY PLAYER (De la Port, 2005).

VARIABLES		2003					2004					Practical significance (d-values)
		n	$\overline{X}$	sd	min	max	n	$\overline{X}$	sd	min	max	
Catching ability (catch and throw over crossbar) (n)		54	13.94	3.27	6.00	19.00	5	13.80	3.11	6.00	10.00	0.00
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 - 4m (n)	Left	53	2.81	1.16	1.00	5.00	26	2.12	1.33	1.00	5.00	0.57
	Right	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

2.5 THE ROLE OF PHYSICS versus ABILITY

Physical law places absolute limits on what players can and can't do. Physics can be used to understand why the tried-and-true, basic advice that coaches give to their players about technique works so well in rugby (Evert, 2006). It is possible to use physics to reveal just how incredibly talented rugby union players have to be to do what they do, and in such spectacular fashion. But when one gets into the detailed differences between the running ability of two players, for example, or try to analyse why a poorer team beats a good one, it becomes increasingly difficult to make definitive statements (Evert, 2006). According to Evert (2006) part of the problem is that human beings are extremely complicated biomechanical machines. The attempt to make a detailed analysis of how humans move, especially with regard to sports activities is the area of kinesiology. One of the main goals of kinesiology is the develop guidelines for what is and isn't good technique in a given sports activity (Evert, 2006).

Although the contracting of players will ultimately determine the quality, size, strength, speed and explosiveness of the players, this aspect can also be improved through the continued use of effective strength and conditioning programs (Evert, 2006).

If one considers that the game is ultimately one where the strongest and most powerful teams tend to be the most successful, it becomes increasingly obvious that the aspect of creating a unique breed of rugby player is crucial in the continued success of any team that wishes to dominate world rugby. The key however is the effective coaching of the players so that they are able to apply this strength in a rugby situation (Evert, 2006). Often teams are filled with huge players but they either don't know how to apply this strength or they don not possess the inherent desire required to be aggressive and determined to dominate the opposition in all the physical aspects of the game (Evert, 2006).

Rugby is a physical game, and no amount of strength or speed can factor out desire. Even the smallest player with the necessary desire will stop a bigger player with any means at his disposal, even if it means allowing the huge ball carrier to fall over him.

Stopping the opposition is key, whichever way you choose (Evert, 2006). The same desire is applicable for the ball carrier. A decision has to be made that irrespective of how many defenders are in front of him, how many defenders are clinging to him or how big or powerful the defender is, if the ball carrier wants to dominate the collision and press forward he can and he must (Evert, 2006).

2.6 CONCLUSION

As Willford *et al.* (1994) and Hare (1997) stated that successful sport participants on all levels of sport and competition have certain unique characteristics that include anthropometrical, game-specific skills and physical and motor abilities and that all elite rugby players have certain characteristics that distinguish them from average or less talented rugby players.

Comparisons of elite rugby players in top rugby playing nations such as South Africa, New Zealand, England and Australia can help coaches and sport scientists to identify talented rugby players at a younger age and to develop these players to a higher standard to be competitive on an international basis.

Most of the game related skills, anthropometrical, and physical and motor abilities change during the development years of young sportsmen. These changes can be due to the physiological changes a young sportsman undergoes during his/her development years (years 8-18). Abilities such as speed, anaerobic endurance, strength, muscle endurance, power, flexibility, agility, aerobic fitness and maximal strength and power all increase as the sportsman's age increases. Talent identification is done at a young age, but Willford *et al.,* (1994) stated that successful sport participants on all levels of sport and competition have certain unique characteristics and these characteristics include anthropometrical, game-specific skills and physical and motor abilities.

The information in this chapter will help us in the research aim of this study to investigate specific characteristics among New Zealand elite under 16 rugby players, in terms of anthropometric-, game specific skill-, physical- and motor variables, and have a better understanding of talent identification and development of youth athletes.

CHAPTER 3
EMPIRICAL INVESTIGATION

3.1 INTRODUCTION

All elite rugby players have certain anthropometric components, game-specific skills and physical and motor components that distinguish them from average players (Hare, 1997). The aim of this study is to investigate specific characteristics among New Zealand elite under 16 rugby players, in terms of anthropometric, game-specific skills, physical and motor components and to do a comparative study of elite South African and New Zealand u/16 rugby players with reference to anthropometric, game-specific skills, physical and motor variables.

The aim of this chapter is to explain all anthropometric measurements and techniques, describe the game-specific skill tests, and the physical and motor tests.

3.2 STUDY POPULATION

Groups of elite 16-year old rugby players from New Zealand and South Africa participated in this study. The one group comprised of the Taranaki Provincial U/16 A-rugby team (New Zealand). The other group comprised of the top high school rugby players in the North-West Province (South Africa). (New Zealand group, n = 24; South Africa group 1, n = 43; group 2, n = 21).

3.3 TEST PROTOCOL

The test protocol consisted of anthropometric measurements, game-specific skill tests and physical and motor tests.

The anthropometric measurements included the following:

- Body mass (Norton *et al*., 1996)
- Body Length (Norton *et al*., 1996)
- Skin-folds (Norton *et al*., 1996):
  - Tricep Skin-fold
  - Subscapular Skin-fold
  - Midaxcilliary Skin-fold
  - Pectoral Skin-fold
  - Supra Spinal Skin-fold
  - Abdominal Skin-fold
  - Thigh Skin-fold
  - Calf Skin-fold
- Girths (Norton *et al*., 1996):
  - Flexed Upper arm Girth
  - Forearm Girth
  - Thigh Girth
  - Calf Girth
  - Ankle Girth

The game-specific skill tests were used to determine the following components:

- Passing for accuracy over 7 m ability (AAHPER, 1966)
- Passing for accuracy over 4 m ability (Pienaar & Spamer, 1998a)
- Passing for distance ability (AAHPER, 1966)
- Kicking for distance ability (AAHPER, 1966)
- Kick-off for distance ability (AAHPER, 1966)
- Air and ground kicking ability (Australian Rugby Football Union, 1990)
- Ground skills ability (Australian Rugby Football Union, 1990)
- Side-step ability (Cooke, 1984)

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

- Sprinting Speed (45.7m) (AAHPER, 1966)
- Power/explosive strength (vertical jump) (Thomas & Nelson, 1985)
- Flexibility (adapted sit and reach) (Thomas & Nelson, 1985)
- Agility (zig-zag run) (AAHPER, 1966)
- Speed endurance (speed endurance test) (Hazaldine & McNab, 1991)
- Strength (flexed arm hang) (Thomas & Nelson, 1985)

All these measurements and tests will be fully discussed and explained in this chapter.

3.3.1 Anthropometrical measurements

All the anthropometric measurements were taken according to the methods and standards of Norton *et al.* (1996). All the measurements require the subject to be standing in the anatomical position. The subjects' head must be in the Frankfort plane while stature is measured. These positions will be discussed first, and then an explanation of all the other anthropometric measurements will follow:

- **Anatomical position**

This position is where the subject is standing in an upright position, arms at the sides, palms and feet facing forward (Norton *et al*., 1996).

- **Frankfort plane**

The Frankfort plane is achieved when the orbital (lower edge of the eye socket) is in the same horizontal plane as the tragion (the notch superior to the tragus of the ear). When aligned, the vertex is the highest point on the skull (Norton *et al*., 1996).

- **Body mass**

Aim: To measure body mass

Equipment: An Electronic balance scale

Technique: The subject is dressed down to only underwear. The subject stands on the centre of the scale without support and with the weight distributed evenly on both feet. The head is up, arms at the sides and the eyes look directly ahead. The accuracy of measurement required is 0.1kg (Norton *et al*., 1996).

- **Body Length**

Aim: To measure stature

Equipment: Stadiometer

Technique: The subject stands with the feet together and the heels, buttocks and upper part of the back touching the meter. The head, when in the Frankfort plane, need not to touch the scale. The measurer places the hands along the jaw of the subject with the fingers reaching to the mastoid process. The subject is instructed to take a deep breath and while keeping the head in the Frankfort plane the measurer applies gentle upward lift through the mastoid process. The recorder places the head board firmly down on the vertex, pressing down the hair as much as possible. The recorder further assists by watching that the feet do not come off the floor and that the position of the head is maintained in the Frankfort plane. Measurement is taken at the end of a deep inhalation. The accuracy of measurement required is 0.1cm (Norton *et al*., 1996).

- **Skin-folds**

Aim: To measure all the skin-folds

Equipment: Skin-fold calliper

Technique: The site where the measurements had to be taken were clearly identified and marked. For the measurement, a double layer of skin with its underlying adipose tissue was firmly gripped on the marked area between the index finger and thumb. The skin-fold was then pulled away from the underlying musculature and the mouth of the measuring apparatus was applied approximately 1 cm below the fingers of the gripping hand and 1 cm deep into the fold. The apparatus was placed at the prescribed angle and the trigger was completely released. A firm grip was kept on the skin-fold throughout the measurement (Norton *et al.,* 1996).

Enough time was allowed (2-3 seconds) throughout the procedure for full pressure measurement to take place. Two measurements of each skin-fold were taken and when a discrepancy of more than 1mm occurred, a third measurement was taken. The different skin-fold measurements were taken in a specific pre-planned rotational manner. All measurements were rounded digitally to the nearest 0.2 mm (Norton *et al.,* 1996). The eight skin-folds measured were as follow:

- ***Tricep Skin-fold***

The fold is vertical and parallel to the line of the upper arm. The skin-fold is taken on the most posterior surface of the arms over the triceps muscle when viewed from the side. For measurement the arm should be relaxed with the shoulder joint slightly externally rotated and elbow extended by the side of the body (Norton *et al*., 1996).

Figure 3.1 : Tricep Skin-fold

- ***Subscapular Skin-fold***

The subject should be standing erect with the arms by the sides. The thumb palpates the inferior angle of the scapula to determine the lowermost tip. The skin-fold is raised with the left thumb and index finger at the marked site 2 cm along a line running laterally and obliquely downward from the subscapular landmark at an angle (approximately 45º) as determined by the natural fold lines of the skin (Norton *et al*., 1996)

Figure 3.2 : Subscapular Skin-fold

- ***Midaxcilliary Skin-fold***

It is a vertical fold on the midaxillary line at the level of the xiphoid process of the sternum (Baechle & Earle, 2000).

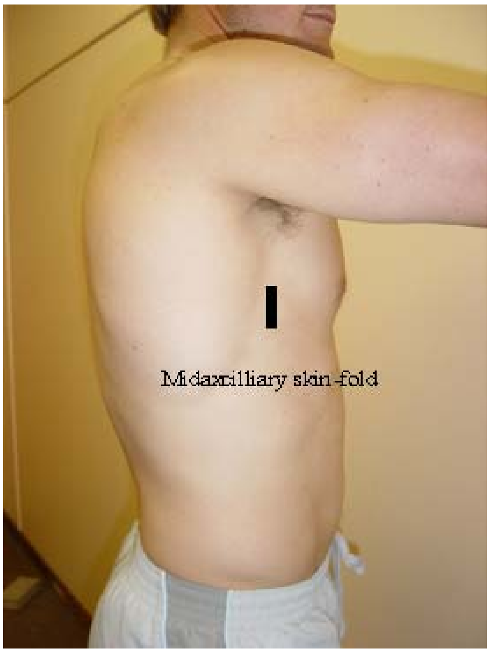

Figure 3.3 : Midaxcilliary Skin-fold

- ***Pectoral Skin-fold***

It is a diagonal fold one half the distance between the anterior axillary line and the nipple (Baechle & Earle, 2000).

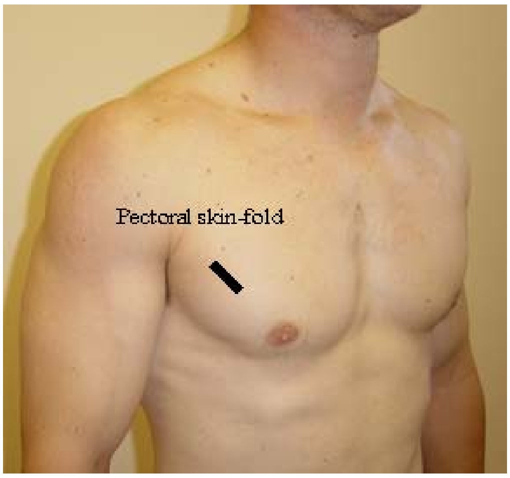

Figure 3.4 : Pectoral Skin-fold

- ***Supra Spinal Skin-fold***

This fold is raised at the point where the line from the iliospinal mark to the anterior axillary border intersects wit the horizontal line of the superior order of the ilium at the level of the iliocristal. This is about 5-7 cm above the iliospinal, depending on the size of the subject. The fold runs medially downwards at about a 45º angle (Norton *et al*., 1996).

Figure 3.5 : Supra Spinal Skin-fold

- ***Abdominal Skin-fold***

This is a vertical fold raised 5 cm (approximately in the middle of the belly of the rectus abdominis) from the right hand side of the omphalio (midpoint of the navel) (Norton *et al*., 1996).

Figure 3.6 : Abdominal Skin-fold

- ***Thigh Skin-fold***

This is a vertical fold taken halfway between the superior aspect of the patella and the inguinal fold on the anterior aspect of the thigh. The subject was measured standing with the knee at 90º and the forefoot supported on a stool. The skinfold measurement can be taken while the knee is bent or with the leg straight and resting on a box (Norton *et al*., 1996).

Figure 3.7 : Thigh Skin-fold

- ***Calf Skin-fold***

This is a vertical fold measured on the medial aspect at the point of largest circumference of the calf muscle. The subject was measured standing with the knee at 90º and the foot supported on a stool.

Figure 3.8 : Calf Skin-fold

- **Girths**

Aim: To measure all the girths

Equipment: Lufkin measuring tape

Technique: 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 than 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. To position the tape, hold the case in the right hand and the stub in the left. Facing the body part to be measured, pass the stub end around the back of the limb and take hold of the stub with the right hand which then holds both the stub and casing. At this point the left hand is free to manipulate the tape to the correct level. Apply sufficient tension on the tape with the right hand to hold it at that position, while the left hand reaches underneath the casing to take hold of the stub again. The tape is now around the part to be measured. The middle finger of both hands is free to locate the tape exactly at the landmark for measurement and to orientate the tape so that the zero is easily read. When reading the tape, the measurer's eye must be at the same level as the tape to avoid any error of parallax. The accuracy of measurement required is 0.1 cm (Norton *et al*., 1996).

- ***Flexed Upper arm Girth***

This is the maximum circumference of the right upper arm, which is raised anterior to the horizontal, with the forearm at about 45º to the upper arm. The measurer stands to the side of the subject and with the tape loosely in position asks the subject to flex the biceps partially in order to identify the point where the girth will be maximal. Loosen the tension on the casing end, and then ask the subject to "make a fist, bring your hand toward your shoulder so your elbow is at about 45º, finally tense the biceps and hold it" while the measurement is made (Norton *et al*., 1996).

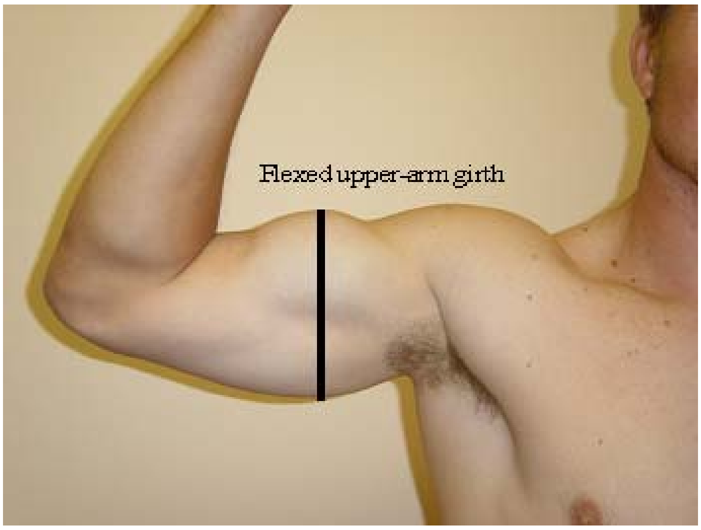

Figure 3.9 : Flexed upper-arm Girth

- ***Forearm Girth***

The measurement is taken at the maximum girth of the forearm, with the subject holding the palm up while relaxing the muscle of the arm. Using the cross-hand technique, it is necessary to slide the tape measure up and down the forearm and make sure it occurs just distal to the elbow (Norton *et al*., 1996).

Figure 3.10 : Forearm Girth

- ***Thigh Girth***

This measurement is taken at the point of maximal circumference, usually just below the buttocks (Baechle & Earle, 2000).

Figure 3.11 : Thigh Girth

- ***Calf Girth***

This is the maximum girth of the calf. The subject stands facing away from the measurer in an elevated position, with weight distributed on both feet. The measurements are taken from the lateral aspect of the leg. The maximal girth is found by using the middle finger to manipulate the position of the tape in a series of up or down measurements to identify the maximal girth (Norton *et al*., 1996).

Figure 3.12 : Calf Girth

▪ ***Ankle Girth***

The minimum girth of the ankle is taken at the narrowest point superior to the sphyrion tibiale. The tape needs to be manipulated up and down this region to ensure that the minimal girth is obtained (Norton *et al*., 1996).

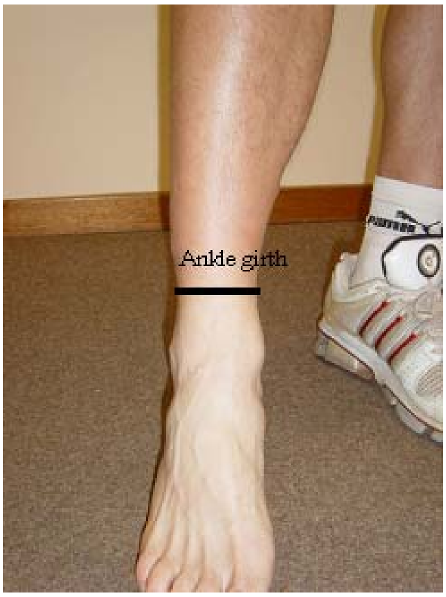

Figure 3.13 : Ankle Girth

3.3.2 Game-specific skills

The following tests were performed to assess the players' game-specific skills. The standard number 5 rugby ball was used during all these tests.

▪ ***Passing for accuracy over 7 m ability***

Aim: To assess passing accuracy ability over 7 m

Equipment: A circle with a diameter of 180 cm with two smaller circles inside, 120 cm and 60 cm in diameter drawn against a vertical wall, a measuring tape and a senior rugby ball.

Description: The subject stands 7 m away and passes a normal or a scrumhalf pass from the preferred side to the circle. The different circles represent different points:

Inside circle	(60 cm)	-	3 points
Middle circle	(120 cm)	-	2 points
Outside circle	(180 cm)	-	1 point

A pass that touches the circle on the line receives the higher point. Ten attempts are allowed and the total is recorded. The maximum score that can be achieved is 30 points (AAHPER, 1966).

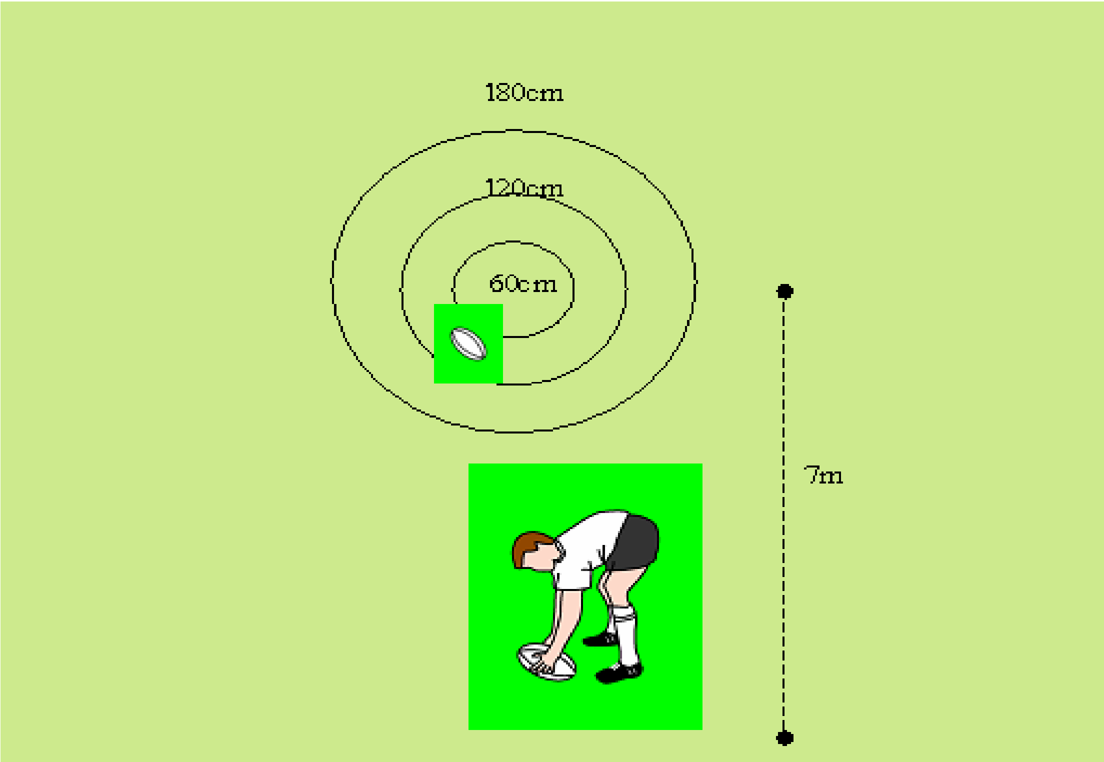

Figure 3.14 : Passing for accuracy over 7 m

- ***Passing for accuracy over 4 m ability***

Aim: To assess passing accuracy ability over 4 m

Equipment: Metal circle of 50 cm in diameter, standing on a pedestal 50 cm from the ground, and a senior rugby ball.

Description: while the subject is jogging parallel with the circle he must attempt to pass the ball through the circle. The circle is placed 4m from where the player is running. The player has five attempts to the left and five attempts to the right. The total of successful passes (out of ten) is recorded (Pienaar & Spamer, 1998a).

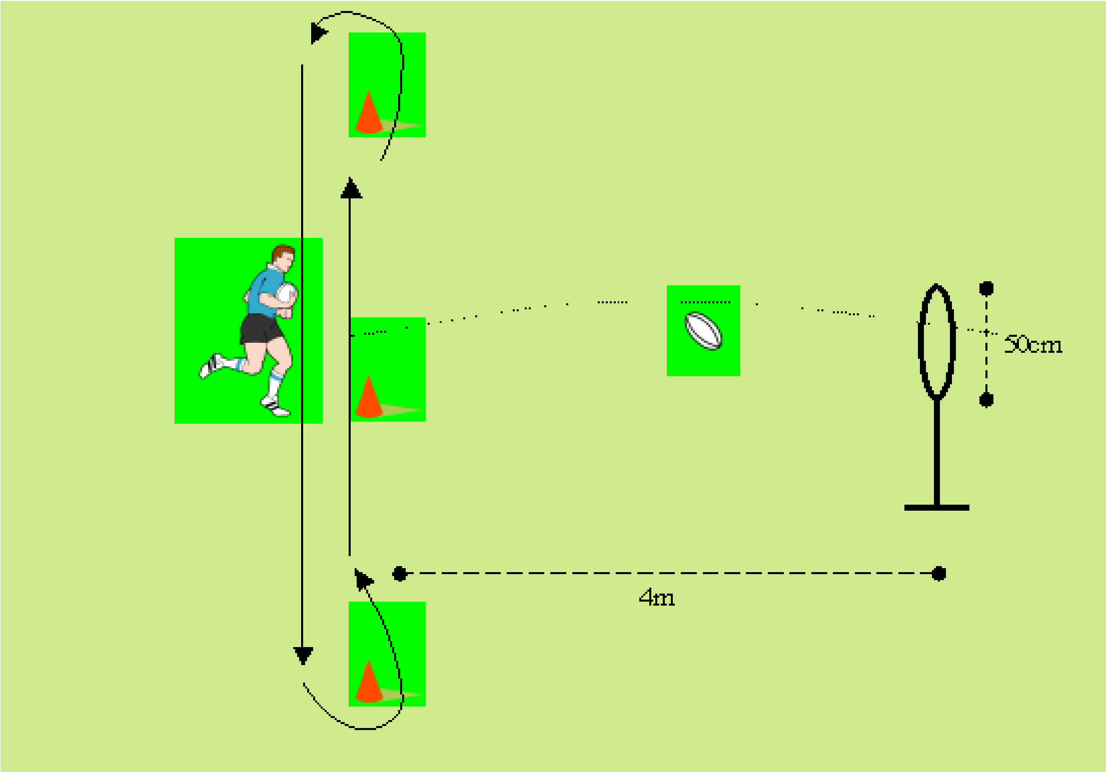

Figure 3.15 : Passing for accuracy over 4 m

- ***Passing for distance ability***

Aim: To assess passing ability

Equipment: 50 m measuring tape and a senior rugby ball

Description: The subject is allowed three attempts to pass the ball as far as possible. The technique used is the torpedo pass, used by scrumhalves. The preferred side of passing is used. The distance from the line of passing to where the ball touches ground is recorded (AAHPER, 1966).

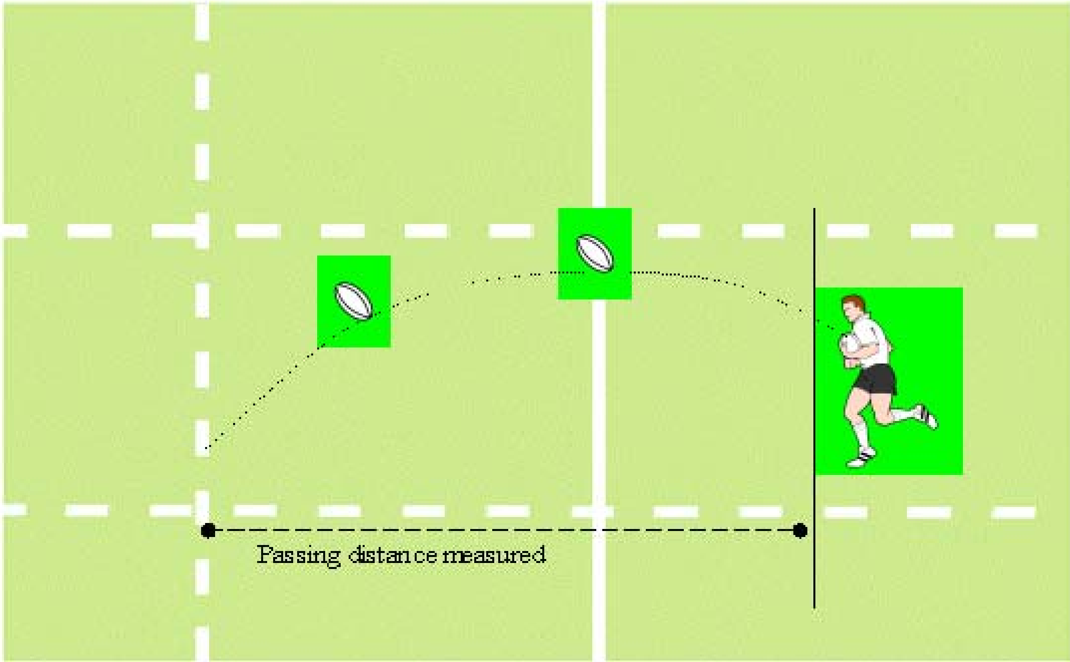

Figure 3.16 : Passing for distance

- ***Kicking for distance ability***

Aim: To assess kicking ability

Equipment: Measuring tape and a senior rugby ball

Description: The subject takes the ball in both hands and kicks the ball as far as possible with the preferred foot. The subject may take a few steps before the kick. Three attempts are allowed and the best is recorded (AAHPER, 1966).

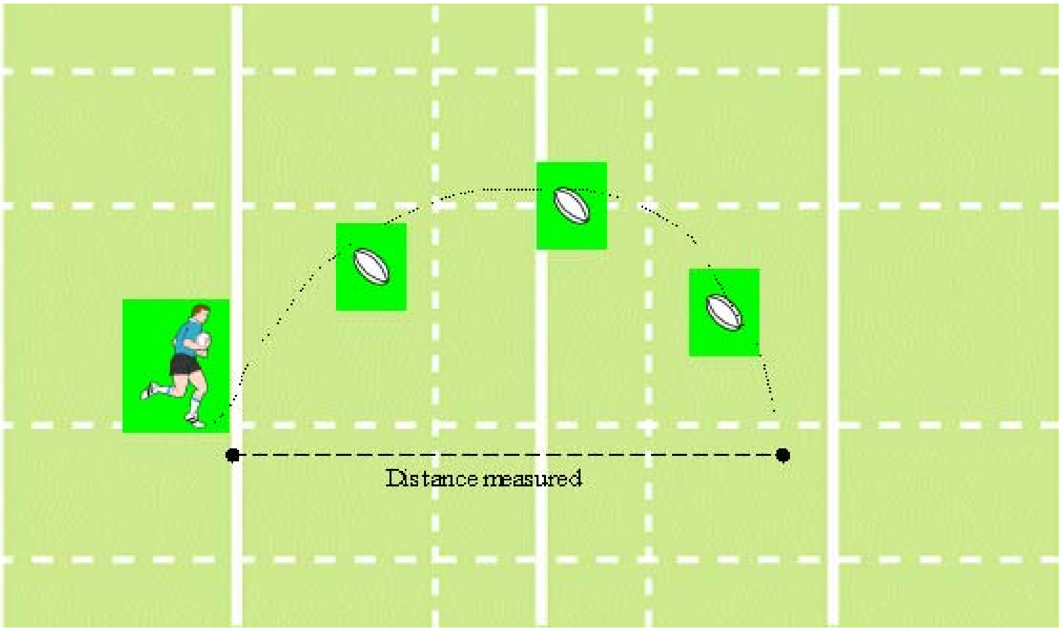

Figure 3.17 : Kicking for distance

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

Aim: To assess kick-off ability

Equipment: Measuring tape, kicking tee and senior rugby ball

Description: The subject places the ball on the kicking tee and with an unlimited approach, with his preferred foot, kicks the ball as far as possible. Three attempts are allowed and the best is recorded (AAHPER, 1966).

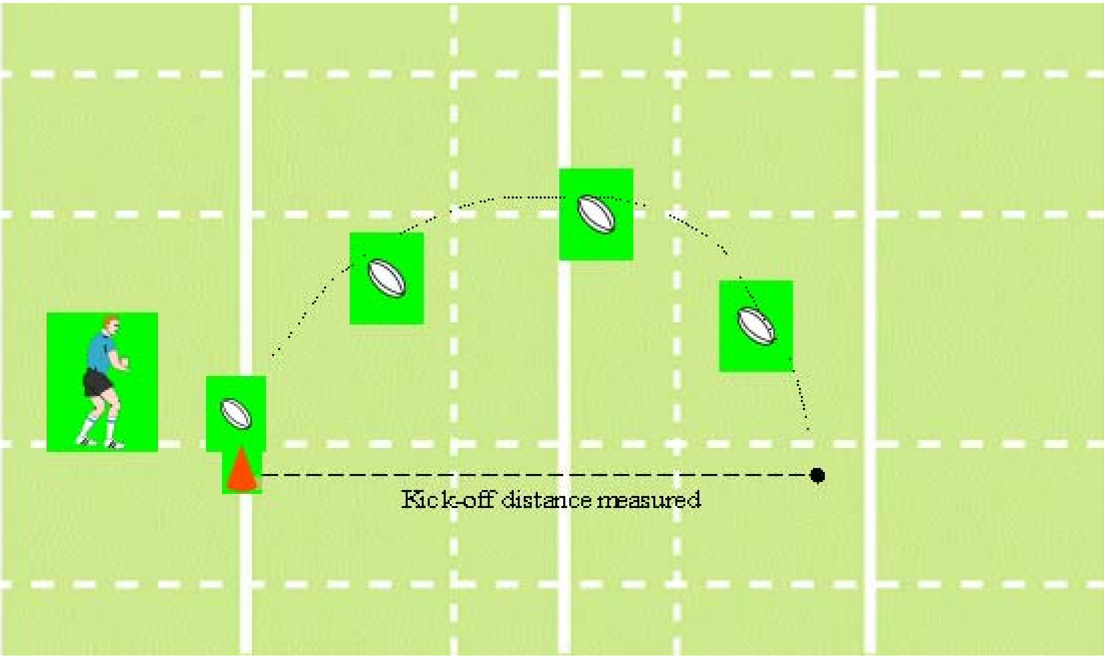

Figure 3.18 : Kick-off for distance over 4 m

- ***Air and ground kick ability***

Aim: To assess air and ground kicking ability

Equipment: Five markers and a senior rugby ball

Description: The five markers are placed 15 m apart. The subject is then to perform a chip followed by a grubber, and again a chip followed by a grubber. The subject then turns and does the same routine, but with the other foot. The player gets three attempts, with the best trial (a mark out of ten) counting. The subject must execute the test without any handling errors. The execution of the test must take place between the markers. The minimum mark is two and the maximum mark ten (Australian Rugby Football Union, 1990). A mark is deducted for each of the following mistakes

  - Slow, rigid execution of kicks

- Air kick not being high or far enough
- Kicking with the wrong foot
- If the ball is knocked on while kicking or catching

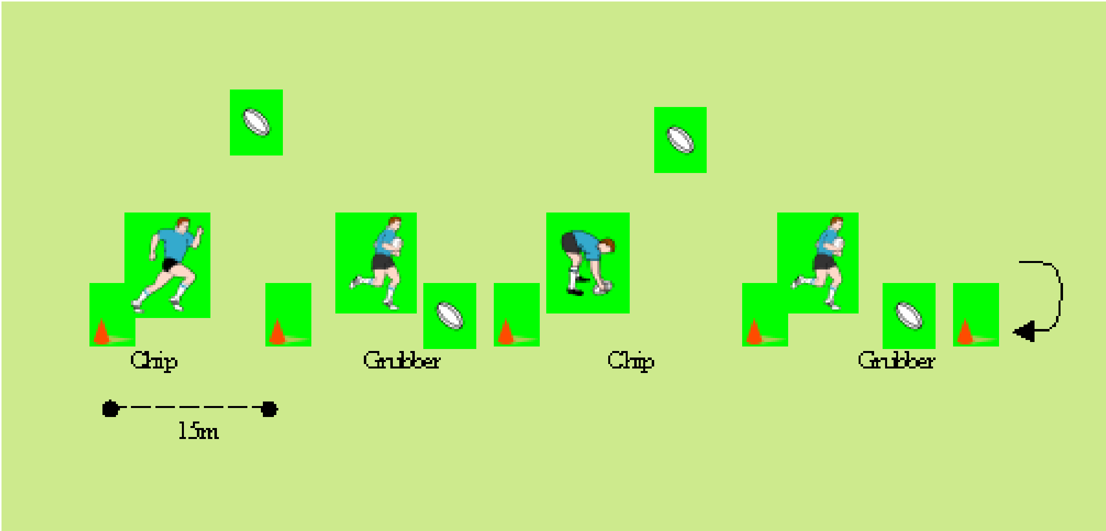

Figure 3.19 : Air and ground kick

- ***Ground skills ability***

Aim: To assess ground skill ability

Equipment: Stopwatch, markers and a senior rugby ball

Description: The rugby ball is placed halfway between the starting line and a marker 5 m from the starting line. The subject sprints on command, picks up the ball, runs around the marker, places the ball back where it was picked up, and runs across the starting line. Three trials are given to the subject and the best time (0.1 sec) is recorded (Australian Rugby Football Union, 1990).

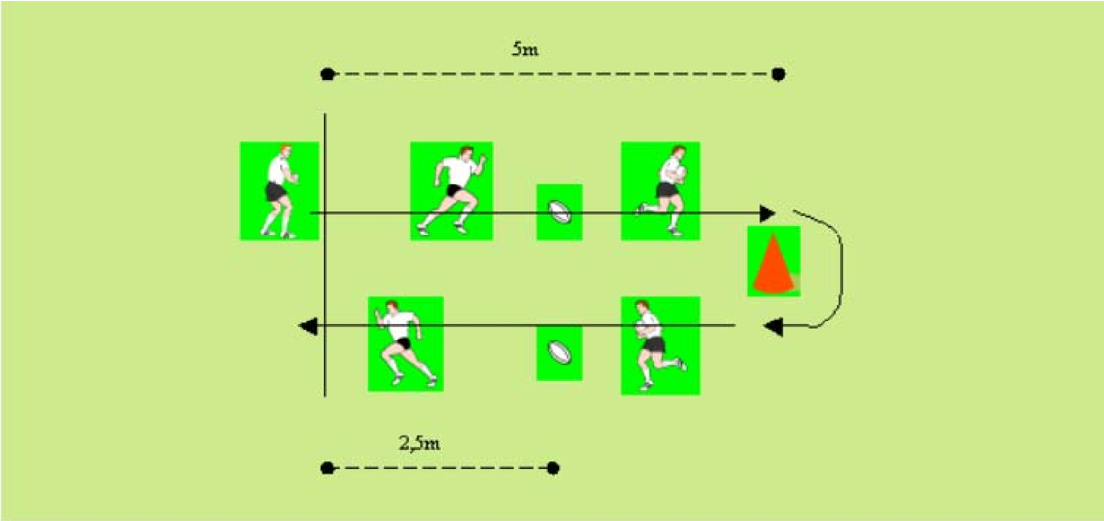

Figure 3.20 : Ground Skills

- ***Side-step ability***

Aim: To assess side step ability

Equipment: Two tackle bags and a senior rugby ball

Description: The two tackle bags are placed 10 m apart. The subject runs towards the tackle bags, holding the ball in both hands, and side steps to the left and right. After the second tackle bag has been reached, the subject turns around and repeats the side-step (Cooke, 1984). A mark out of ten is given to the subject. Marks are deducted for each of the following mistakes:

- No shortening of the last step before side-stepping
- Body mass is not transferred to the opposite side while side-stepping
- Contact was made with the tackle bags
- No acceleration after side-step
- If subject trips over own feet

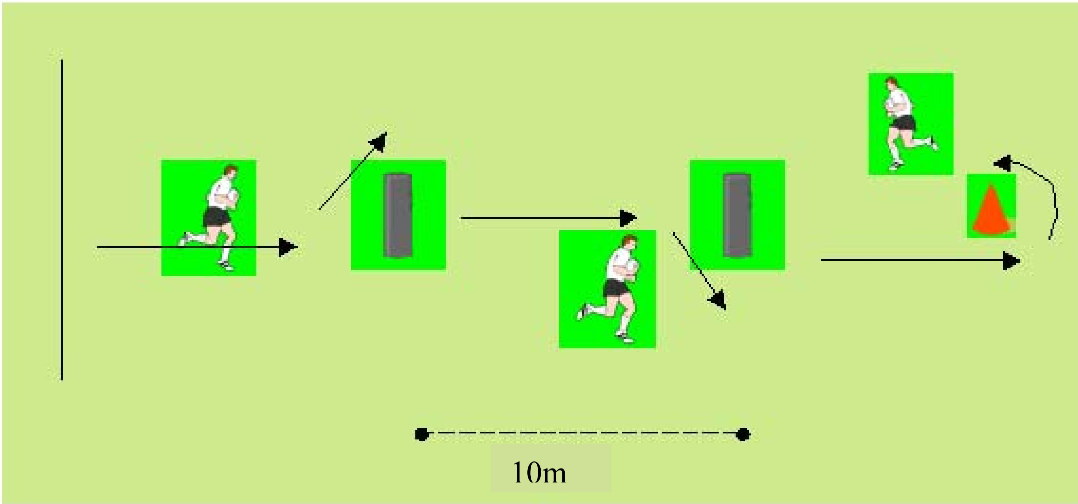

Figure 3.21 : Side-step

3.3.3 Physical and motor tests

The following tests were done to assess the physical and motor capabilities of the 16 year-old rugby players.

- ***Sprinting Speed (45.7m)***

Aim: To assess speed ability

Equipment: Stop watches, measuring tape, senior rugby ball and markers

Description: Two attempts over the distance of 45.70 m and the best time is recorded (0.1 second). The subject runs with the ball under his arm (AAHPER, 1966).

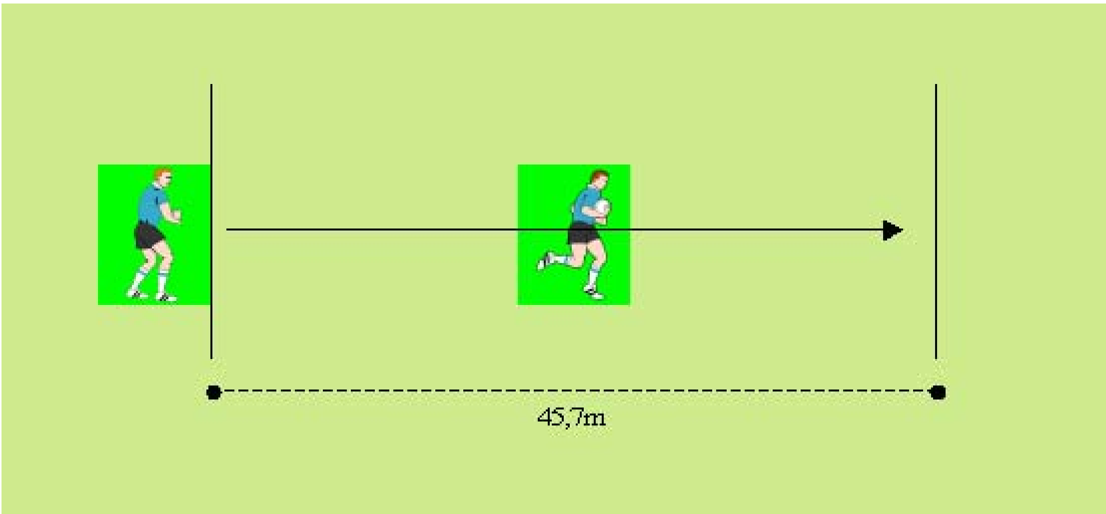

Figure 3.22 : Sprinting speed test

- ***Power/explosive strength (vertical jump)***

Aim: To assess power (explosive strength) in the legs

Equipment: Measuring tape and white powder

Description: The subject stands side-on next to a wall. The subject is then asked, with the hand closest to the wall, to reach up as high as possible and with the powder make a mark against the wall (the feet have to remain flat on the ground). The subject must now jump and again make a mark against the wall. The subject is allowed to use his arms but may not take a "double jump". The distance between the first and second mark is recorded. The subject is allowed three attempts and the best is recorded (Thomas & Nelson, 1985).

- ***Flexibility (adapted sit and reach)***

Aim: To assess flexibility in the lower back and hamstrings.

Equipment: Two rulers of 30 cm each.

Description: The aim of this test is to measure hip and lower back flexibility. The subject sits flat on the ground with the legs stretched out forward and flat. The ruler is placed between the feet of the subject, with the zero mark at the heel of the feet. The subject is then asked to put his hands on top of one another and slowly bent forward, trying to reach as far as possible without bending the knees. The maximum reach is where the subject's middle fingers reach on the ruler. The maximum reach must be held for two seconds. The measurer must keep the knees from bending and ensure that the subject's feet do not move forward. If the subject cannot reach past his feet, a negative value is recorded (Thomas & Nelson, 1985).

- ***Agility (zig-zag run)***

Aim: To assess agility ability

Equipment: Measuring tape, stop watch, markers and senior rugby ball.

Description: The subject stands on the line on the right hand side of the first marker with the rugby ball in his hands. Five markers are placed 3 m apart on a straight line. The subject runs with a zig-zag movement through the markers. The subject runs like this through the markers and back. The ball must be carried on the outside of the marker. Two attempts and the best time is recorded (0.1 second) (AAHPER, 1966).

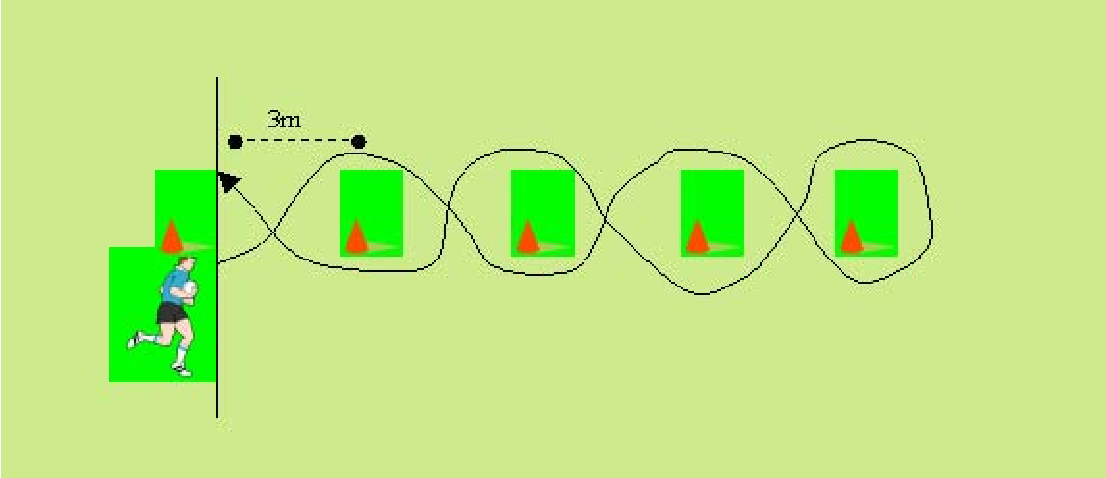

Figure 3.23 : Zig-zag run test

- ***Speed endurance (speed endurance test)***

Aim: To assess speed endurance ability

Equipment: Measuring tape, two stopwatches and three markers

Description: The three markers (B, A, C) are placed 10 m apart in a straight line. The subject stands at the middle marker (A), sprints to the second marker (B), turns and sprints to the third marker (C), turns again and sprints back to the start (A). The time it took the subject to complete this sprint is then recorded (Hazeldine & McNab, 1991). The subject performs this sprint six times with a 20 second rest between each sprint. All six times are recorded and the speed endurance is calculated as follows:

1) $$\frac{(X1 + X2)}{2} - \frac{(Y1 + Y2)}{2} = Z$$

2) $$Z \div \frac{(Y1 + Y2)}{2} \times 100 = X\%$$ where

- X1 + X2 ÷ 2 = average X (where X1 and X2 represent the two slowest times)
- Y1 + Y2 ÷ 2 = average Y (where Y1 and Y2 represent the two fastest times)
- Average Y – average X = Z
- Z ÷ average Y x 100 = % decrease in speed endurance

This percentage indicates the percentage decrease in speed endurance. The lesser this percentage, the better speed endurance.

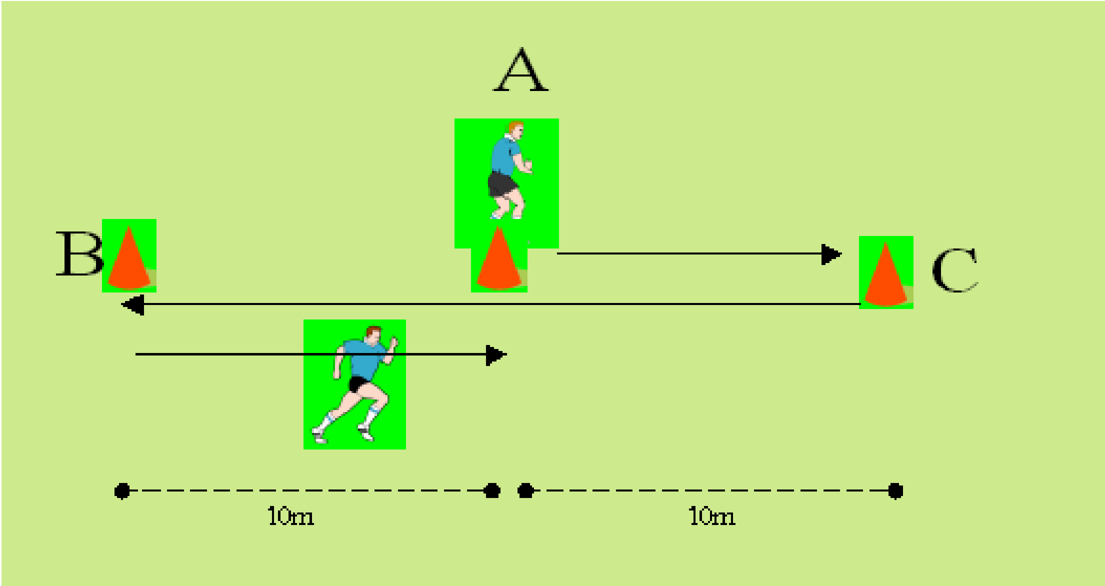

Figure 3.24 : Illustration of speed endurance

- ***Flexed arm hang***

Aim: To assess isometric strength ability

Apparatus: A cross-bar high enough off the ground so that the respondent's feet do not touch the ground during the test, stopwatch to determine respondent's "hanging" time

Description: Two helpers lift the athlete so that he can take hold of the bar with the palms of his hands outwards. His chin must appear above the crossbar. The athlete must try to maintain this position for as long as possible. Only one attempt is allowed for the athlete.

The time is taken from the time he begins to hang until one of the following happens:

- His chin touches the crossbar
- His head is thrown back to keep the chin from touching the cross-bar
- Until his chin sinks below the level of the cross-bar
- Time respondent can hang is measured in minutes and seconds

CHAPTER 4
RESULTS AND DISCUSSION

4.1 INTRODUCTION

In this chapter the results will be presented according to the aim of this study. For the discussion on the first aim of this study, the results will be presented on the specific characteristics of New Zealand elite under 16 rugby players, in terms of anthropometric-, game specific skills, physical and motor components. For the discussion on the second aim of this study, a comparison will be drawn between elite under16 New Zealand and South African rugby players. (SA group 1: Hare, 1997; SA group 2: Van Gent, 2003)

The New Zealand group's data was statistically analysed with descriptive statistics (means and standard deviation).

The two South African group's data was processed with the SAS-computer programme of the North West University, Potchefstroom campus (SAS Institute Inc., 1991). Practical signifficants were determined by d-values (Cohen, 1988) to compare the New Zealand and South African teams.

4.2 CHARACTERISTICS OF ELITE NEW ZEALAND UNDER 16 RUGBY PLAYERS

The elite New Zealand under 16 rugby group consisted out of the U/16 Taranaki provincial rugby side (n = 24) and was tested at the end of the 2004 rugby season. The Taranaki players were tested in accordance to the protocols outlined by Hare (1999).

TABLE 4.1: DESCRIPTIVE STATISTICS OF GAME SPECIFIC SKILLS FOR ELITE UNDER 16 NEW ZEALAND RUGBY PLAYERS

Tests	$\overline{X}$	Sd	Min value	Max value
Ground skills (sec)	3.27	0.22	3.00	3.82
Side steps (/10)	5.96	2.46	0.00	10.00
Air and ground kicks (/10)	7.13	1.92	4.00	10.00
Passing distance (m)	21.96	2.71	17.40	26.90
Passing accuracy over 4m (/10)	3.83	1.88	1.00	7.00
Passing accuracy over 7m (/30)	24.42	3.12	15.00	29.00
Kicking distance (m)	40.90	4.60	31.20	50.00
Kick-off distance (m)	37.59	4.37	31.10	50.00

4.2.1 Game Specific Skills

In the side step test (table 4.1) great differences in scores were found, from a minimum of 0 to a maximum of 10 in the correctness completion of the side step test, the average score of the group ($\overline{X}$ = 5.96) also appears low for elite rugby players. The passing for accuracy also tested low, for the shorter pass (passing for accuracy over 4m) the average of the group was very low with a score of 3.83 out of 10, thus 38% success, whereas the passing over the longer distance (passing for accuracy over

7m) the success rate was an average of 24.42 out of 30, thus a percentage success of 80%.

4.2.2 Physical and Motor Abilities

One of the concerns with the results in table 4.2 is the flexibility of the elite players. A negative average of –2.21 was scored with a maximum value of –17.00. The power and speed tests of this group compared good to other elite groups, but will be thoroughly discussed later in this chapter.

4.2.3 Anthropometrical Components

Looking at table 4.3 there are large differences between the minimum and maximum scores of most of the anthropometrical tests. A tests result that can be of concern is the test for the percentage body fat with an average value of 13,66%, a minimum of 7,96%, a maximum score of 24,40% and standard deviation of 4.77% was found, which indicates that the groups fat percentage fluctuated between players but this can be due of the fact of different playing positions. This issue will be further discussed in the next chapter (Chapter 5: Empirical Investigation). The same was found with the mass and the body length tests with standard deviations of 8.31 for mass and 5.83 for body length tests.

TABLE 4.2: PHYSICAL AND MOTOR ABILITY TEST RESULTS FOR ELITE UNDER 16 NEW ZEALAND RUGBY PLAYERS

Tests	$\overline{X}$	Sd	Min	Max
Sit and reach (cm)	-2.21	8.75	-17.00	16.00
Vertical jump (cm)	50.07	7.00	36.80	63.00
Speed endurance (%)	5.38	1.48	2.59	8.50
Zig-zag run (sec)	6.65	0.44	5.69	7.22
Speed 10m (sec)	1.79	0.09	1.66	1.99
Speed 40m (sec)	5.52	0.33	5.16	6.47
Speed 45,7m (sec)	6.21	0.38	5.77	7.30
Flexed arm hang (sec)	38.63	16.17	9.00	77.00

TABLE 4.3: ANTHROPOMETRICAL COMPONENT TEST RESULTS FOR ELITE UNDER 16 NEW ZEALAND RUGBY PLAYERS

Tests	$\overline{X}$	Sd	Min	Max
Mass (kg)	81.26	8.31	64.90	102.80
Length (cm)	179.71	5.83	166.00	190.00
Tricep (mm)	12.96	4.48	7.50	23.50
Sub-scapular (mm)	14.46	7.06	8.50	37.00
Midaxilla (mm)	13.25	7.57	6.50	40.00
Supra-spinal (mm)	20.69	9.29	7.50	43.00
Pectoral (mm)	9.73	3.44	5.00	21.00
Abdominal (mm)	20.73	9.89	9.00	46.00
Thigh (mm)	17.15	5.22	10.00	34.00
Calf (mm)	11.75	4.64	6.50	24.50
Percent body fat (%)	13.66	4.77	7.96	24.40
Flexed upper arm (cm)	33.73	2.88	23.00	37.00
Forearm (cm)	28.41	1.58	24.00	31.50
Ankle (cm)	24.80	1.22	22.50	27.00
Calf (cm)	38.14	2.70	34.00	42.90
Upper leg (cm)	57.00	3.46	50.00	65.20

4.3 DESCRIPTIVE STATISTICS AND SIGNIFICANT DIFFERENCES BETWEEN ELITE NEW ZEALAND AND SOUTH AFRICAN RUGBY PLAYERS WITH REFERENCE TO SPORT SPECIFIC SKILLS, PHYSICAL AND MOTOR ABILITIES AND ANTHROPOMETRICAL COMPONENTS

The elite New Zealand group is compared with reference to sport specific skills, physical and motor abilities and anthropometrical components to the South African group 1 (Hare, 1997), and to the South African group 2 (Van Gent, 2003) to determine significant differences between these groups.

4.3.1 Game Specific Skills

According to Table 4.4, the New Zealand players performed the best in the ground skills test ($\overline{X}$ = 3.27sec), followed by the South Africa group 2 ($\overline{X}$ = 3.62sec), with the South Africa group 1 with the slowest ground skill test time ($\overline{X}$ = 5.68sec). In the side step test the SA group's 1 ($\overline{X}$ = 4.46) score was lower than the NZ's group ($\overline{X}$ = 5.96) and the SA group 2 ($\overline{X}$ = 5.5). In the air and ground kicks the NZ group had better average scores ($\overline{X}$ = 7.13) than SA group 1 ($\overline{X}$ = 4.46) and the SA group 2 ($\overline{X}$ = 5.19). Noticeable is that the NZ group scored the best in all three tests where distance was the determinant factor namely, passing distance ($\overline{X}$ = 21.96m), kicking distance ($\overline{X}$ = 40.9m) and kick-off for distance ($\overline{X}$ = 37.59m), but where accuracy was the determinant factor in passing for accuracy over 4m, SA group 2 ($\overline{X}$ = 4.5) and over 7m, the SA group 1 ($\overline{X}$ = 25.69) had better scores than the NZ group (over 4m, $\overline{X}$ = 3.83; over 7m $\overline{X}$ = 24.42).

The results in Table 4.5 shows that there is in only 2 of the 8 game specific skill tests, namely ground skills (NZ vs SA_1: d = 6.7 and NZ vs SA_2: d = 1.4) and air and ground kicks (NZ vs SA_1: d = 1.3 and NZ vs SA_2: d = 1.0), significant differences between the NZ and SA groups. As was earlier stated in this chapter, there is a significant difference (d = 6.7) in the ground skill test between NZ vs SA_1, but a similar result was found between SA_1 vs SA_2 with a high significant difference of 5.7. In al the other game specific skill tests the significant difference values between SA_1 and SA_2 were low except in the side step test where the significant difference value was 0.7.

Comparing the averages of game-specific skills in table 2.9 (Chapter 2), a study done by De la Port (2005), with the two South African (Hare 1997; Van Gent 2003) and New Zealand groups that are used in this study, it clearly showed that the group in De la Port's (2005) study performed better in the ground skills test ($\overline{X}$ = 3.18sec), passing distance ($\overline{X}$ = 27.95m), passing accuracy over 4m ($\overline{X}$ = 5.30) and kicking for distance ($\overline{X}$ = 45.13m). This results can be due to a number of factors namely; *players conditioning* – through research and scientific development players get better conditioned thus will be able to kick and pass a rugby ball further due to the fact that they are stronger and more flexible, *improved equipment* – every year equipment is improved for better performance, and *technique* - as in equipment, technique also improves to better complete a certain skill for improved performance.

In conclusion, the South African groups performed better in accuracy tests than the New Zealand group, and the New Zealand group performed better in tests where distance is important. Similar results was found in a study done by Van der Westhuizen *et al.* (2004) between 12-year old New Zealand and South African rugby players.

In rugby the above can play an important role in selecting players for a team, talent identification, or developing players for a certain position. In rugby accuracy is more important than distance, for example, you would rather want a fly half to kick the ball 35m out, than 45m and not out.

TABLE 4.4: DESCRIPTIVE STATISTICS OF ELITE UNDER 16 NEW ZEALAND AND SOUTH AFRICAN PLAYERS WITH REFERENCE TO GAME SPECIFIC SKILLS

Tests	New Zealand n = 24				South Africa; Group 1 n = 43				South Africa; Group 2 n = 22			
	$\overline{X}$	Sd	Min	Max	$\overline{X}$	Sd	Min	Max	$\overline{X}$	Sd	Min	Max
Ground skills (sec)	3.27	0.22	3.00	3.82	5.68	0.36	4.80	6.30	3.62	0.25	3.20	4.08
Side steps (/10)	5.96	2.46	0.00	10.00	4.46	1.35	2.00	8.00	5.50	1.40	2.00	8.00
Air and ground kicks (/10)	7.13	1.92	4.00	10.00	4.60	1.90	1.00	8.00	5.19	0.93	4.00	7.00
Passing distance (m)	21.96	2.71	17.40	26.90	19.95	3.27	12.10	25.20	21.14	4.34	10.20	28.90
Passing accuracy over 4m (/10)	3.83	1.88	1.00	7.00	4.23	2.36	0.00	9.00	4.50	2.28	0.00	10.00
Passing accuracy over 7m (/30)	24.42	3.12	15.00	29.00	25.69	2.57	16.00	30.00	23.55	5.76	1.00	30.00
Kicking distance (m)	40.90	4.60	31.20	50.00	38.02	6.56	21.90	51.00	41.41	11.13	23.30	69.00
Kick-off distance (m)	37.59	4.37	31.10	50.00	36.07	7.80	21.90	56.40	33.60	9.18	10.00	51.00

$\overline{X}$ = Mean Sd = Standard Deviation Min = Minimum score Max = Maximum score

TABLE 4.5: SIGNIFICANT DIFFERENCES (D-VALUES) BETWEEN ELITE UNDER 16 NEW ZEALAND AND SOUTH AFRICAN PLAYERS WITH REFERENCE TO SPORT SPECIFIC SKILLS

Tests	New Zealand n = 24		South Africa; Group 1 n = 43		South Africa; Group 2 n = 22		New Zealand vs South Africa Group 1	New Zealand vs South Africa Group 2	South Africa Group 1 vs South Africa Group 2
	$\overline{X}$	Sd	$\overline{X}$	Sd	$\overline{X}$	Sd	d - value	d - value	d - value
Ground skills (sec)	3.27	0.22	5.68	0.36	3.62	0.25	***6.7**	***1.4**	***5.7**
Side steps (/10)	5.96	2.46	4.46	1.35	5.50	1.40	**0.6**	**0.2**	**0.7**
Air and ground kicks (/10)	7.13	1.92	4.60	1.90	5.19	0.93	***1.3**	***1.0**	**0.3**
Passing distance (m)	21.96	2.71	19.95	3.27	21.14	4.34	**0.6**	**0.2**	**0.3**
Passing accuracy over 4m (/10)	3.83	1.88	4.23	2.36	4.50	2.28	**0.1**	**0.3**	**0.1**
Passing accuracy over 7m (/30)	24.42	3.12	25.69	2.57	23.55	5.76	**0.4**	**0.2**	**0.4**
Kicking distance (m)	40.90	4.60	38.02	6.56	41.41	11.13	**0.4**	**0.04**	**0.3**
Kick-off distance (m)	37.59	4.37	36.07	7.80	33.60	9.18	**0.2**	**0.4**	**0.3**

$\overline{X}$ = Mean Sd = Standard Deviation *High significant difference: $d \geq 0.8$

Medium significant difference: $d \leq 0,5$ Low significant difference: $d \leq 0,2$

4.3.2 Physical and Motor Abilities

The test protocol for the 2 South African groups were not the same as for the New Zealand group in the physical and motor ability tests. SA_1 did not test the speed over 10m and the flexed arm hang, and SA_2 did not test the zig-zag run and speed over 45.7m.

The results in Table 4.6 shows that SA_2 could only score in 1 of the 8 tests (adaptive sit and reach, $\overline{x}$ = 5.91) better than SA_1 and NZ group. SA_1 couldn't perform the best in any of the 8 tests, leaving the NZ group to score on average best in the vertical jump ($\overline{x}$ = 50.07cm), speed endurance ($\overline{x}$ = 5.38%), zig-zag run ($\overline{x}$ = 6.65sec), speed over 10m ($\overline{x}$ = 1.79sec), speed over 45,7m ($\overline{x}$ = 6.21sec) and the flexed arm hang ($\overline{x}$ = 38.63sec). The New Zealand group could hang on an average of 12 seconds longer in the flexed arm hang test. This shows that the New Zealand's group arm strength is better than SA_2, which can be a reason why the NZ group achieved further distances in the passing for distance test (game specific tests) where arm strength play an important role. Hare (1997) stated that strength is one of the single most important factors that play a role in rugby and that it separates talented from less talented rugby players.

There is a significant difference (as in table 4.7) between the NZ group and SA_1 in the zig-zag run (d = 1.0) and in the 45,7m speed (d = 1.0) test, where the NZ groups' times, as we can see in table 4.6, are faster in both tests.

In the sit and reach (d = 0.9), vertical jump (d = 0.9), and flexed arm hang (d = 0.8) tests there is a high practical significant differences between the NZ group and the SA_2, with low significant differences in the speed endurance (SA_1: d = 0.3; SA_2: d = 0.4) and medium significant difference in the speed over 10m (SA_2: d = 0.5) test.

In conclusion, with the physical and motor components results, the NZ group scored on average the best of the three groups in the 8 tests, there is not a significant difference in all of the components but the tendency and higher scores is with the New Zealand group. Pienaar and Spamer (1998b) found that younger rugby players' strength isn't developed, as it should be, which can be the reason with the poor performance of the two South African groups in this specific test component. Race can be a factor in the strength test where Maori, Tongans and Samoan rugby players develop earlier than their South African counterparts, but this issue will be thoroughly discussed in the next chapter.

TABLE 4.6: DESCRIPTIVE STATISTICS OF ELITE UNDER 16 NEW ZEALAND AND SOUTH AFRICAN PLAYERS WITH REFERENCE TO PHYSICAL AND MOTOR COMPONENTS

Tests	**New Zealand n = 24**				**South Africa; Group 1 n = 43**				**South Africa; Group 2 n = 22**			
	$\overline{X}$	**Sd**	**Min**	**Max**	$\overline{X}$	**Sd**	**Min**	**Max**	$\overline{X}$	**Sd**	**Min**	**Max**
Sit and reach (cm)	-2.21	8.75	-17.00	16.00	2.36	2.30	-4.00	9.50	5.91	6.80	0.00	20.00
Vertical jump (cm)	50.07	7.00	36.80	63.00	47.16	6.11	35.10	59.50	40.55	10.67	21.00	61.00
Speed endurance (%)	5.38	1.48	2.59	8.50	6.37	3.15	1.04	14.03	6.58	3.21	3.14	13.05
Zig-zag run (sec)	6.65	0.44	5.69	7.22	7.16	0.48	6.30	8.40				
Speed 10m (sec)	1.79	0.09	1.66	1.99					1.89	0.20	1.47	2.25
Speed 45,7m (sec)	6.21	0.38	5.77	7.30	6.61	0.34	6.00	7.80				
Flexed arm hang (sec)	38.63	16.17	9.00	77.00					26.03	12.04	5.22	42.75

$\overline{X}$ = Mean Sd = Standard Deviation Min = Minimum score Max = Maximum score

TABLE 4.7: SIGNIFICANT DIFFERENCES (D-VALUES) BETWEEN ELITE UNDER 16 NEW ZEALAND AND SOUTH AFRICAN PLAYERS WITH REFERENCE TO PHYSICAL AND MOTOR ABILITIES

Tests	**New Zealand N = 24**		**South Africa; Group 1 n = 43**		**South Africa; Group 2 n = 22**		**New Zealand vs South Africa Group 1**	**New Zealand vs South Africa Group 2**
	$\overline{X}$	**Sd**	$\overline{X}$	**Sd**	$\overline{X}$	**Sd**	**d - value**	**d - value**
Sit and reach (cm)	-2.21	8.75	2.36	2.30	5.91	6.80	**0.5**	***0.9**
Vertical jump (cm)	50.07	7.00	47.16	6.11	40.55	10.67	**0.4**	***0.9**
Speed endurance (%)	5.38	1.48	6.37	3.15	6.58	3.21	**0.3**	**0.4**
Zig-zag run (sec)	6.65	0.44	7.16	0.48			***1.0**	
Speed 10m (sec)	1.79	0.09			1.89	0.20		**0.5**
Speed 45,7m (sec)	6.21	0.38	6.61	0.34			***1.0**	
Flexed arm hang (sec)	38.63	16.17			26.03	12.04		***0.8**

$\overline{X}$ = Mean Sd = Standard Deviation *High significant difference: $d \geq 0.8$ Medium significant difference: $d \leq 0,5$

Low significant difference: $d \leq 0,2$

4.3.3 Anthropometrical Components

Table 4.8 presents the average body mass of the New Zealand group ($\overline{X}$ = 81.26 kg) in this study to be heavier than that of SA_1 ($\overline{X}$ = 72.82 kg) and SA_2 ($\overline{X}$ = 76.64 kg), and that the average length of the players in SA_2 ($\overline{X}$ = 180.86 cm) is taller than the average of the NZ group ($\overline{X}$ = 179.71 cm) and SA_1 ($\overline{X}$ = 177.63 cm) players. There is a significant difference in the body mass between the NZ and SA_1 with a d-value of 0.9, but no significant differences between the NZ and SA_2 (d = 0.4).

On average, all the 8 skin-folds obtained in this study of the NZ group namely: tricep (12.96mm), sub-scapular (14.46mm), midaxilla (13.25mm), supra-spinal (20.69mm), pectoral (9.73mm), abdominal (20.73mm), thigh (17.15mm), and calf (11.75mm) was higher than both the SA groups' skinfolds. One of the concerns is the high average value that was achieved by the New Zealand group's abdominal skinfold (20.73mm). There is a significant difference between the NZ group and SA_1 with the supra-spinal (d = 0.9) and pectoral (d = 0.9) skinfolds; and between the NZ group and SA_2 with the tricep (d = 1.1), pectoral (d = 1.2), abdominal (d = 0.8), thigh (d = 1.2), and calf (d = 1.0) skinfolds.

With the percent body fat calculation the South African groups used different calculation methods to the New Zealand group. This is the reason why the New Zealand group's skinfolds are all larger than that of the South Africans but had a lower percentage body fat than the South Africans.If only the skinfolds are taken into consideration the NZ group carried the most percentage body fat, which isn't good for rugby.

Table 4.8 shows that the girth measurement results is similar than the skinfold results where the NZ group scored higher in all of the girth measurements, flexed upper arm ($\overline{X}$ = 33.73 cm), forearm ($\overline{X}$ = 28.41 cm), ankle ($\overline{X}$ = 24.8 cm), calf (38.14 cm) and upper leg ($\overline{X}$ = 57.0 cm). There are medium significant difference values between the NZ group and SA_1 in the flexed upper arm (d = 0.6), forearm (d = 0.6) and ankle (d = 0.5) girth measurements. The larger girth measurements of the New Zealand group is an indication of strength (NZ group's flexed arm hang's score was longer than the SA group, which is an indication of arm strength) and higher subcutaneous fat levels.

In conclusion, the New Zealand's group players are heavier than the SA groups but slightly shorter than SA_2 with larger skinfolds and bigger girth measurements than both the SA groups. Similar results were found in a comparative study between elite English and South African 18-year old rugby players done by Spamer and Winsley (2003b). The SA group had a body fat percentage of 15.8% and the English group had an average of 22.1%, the South Africans were also on average taller than their English counterparts (SA: $\overline{x}$ = 185.6cm, English: $\overline{x}$ =181.9cm).

TABLE 4.8: DESCRIPTIVE STATISTICS OF ELITE UNDER 16 NEW ZEALAND AND SOUTH AFRICAN PLAYERS WITH REFERENCE TO ANTHROPOMETRICAL COMPONENTS

Tests	New Zealand n = 24				South Africa; Group 1 n = 43				South Africa; Group 2 n = 22			
	$\overline{X}$	Sd	Min	Max	$\overline{X}$	Sd	Min	Max	$\overline{X}$	Sd	Min	Max
Mass (kg)	81.26	8.31	64.90	102.80	72.82	9.63	55.50	97.00	76.64	11.41	60.00	104.00
Length (cm)	179.71	5.83	166.00	190.00	177.63	5.64	166.00	190.50	180.86	8.22	167.00	201.00
Tricep (mm)	12.96	4.48	7.50	23.50	12.68	5.56	6.00	30.00	8.02	2.81	4.00	15.00
Sub-scapular (mm)	14.46	7.06	8.50	37.00	10.99	4.41	5.00	24.00	10.32	2.77	6.00	17.00
Midaxilla (mm)	13.25	7.57	6.50	40.00	9.63	4.49	4.00	22.00				
Supra-spinal (mm)	20.69	9.29	7.50	43.00	11.91	5.54	5.00	28.00				
Pectoral (mm)	9.73	3.44	5.00	21.00	6.80	2.75	3.00	10.50	5.73	2.30	2.00	10.00
Abdominal (mm)	20.73	9.89	9.00	46.00	15.60	8.92	6.00	42.00	12.64	6.52	5.00	28.00
Thigh (mm)	17.15	5.22	10.00	34.00	15.45	5.18	8.00	35.00	10.77	4.01	5.50	23.00
Calf (mm)	11.75	4.64	6.50	24.50	10.95	4.44	5.00	26.00	7.11	2.84	3.00	15.00
Percent body fat (%)	13.66	4.77	7.96	24.40	18.77	6.44	9.07	32.23	15.96	3.96	9.43	24.31

$\overline{X}$ = Mean Sd = Standard Deviation Min = Minimum score Max = Maximum score

TABLE 4.8: DESCRIPTIVE STATISTICS OF ELITE UNDER 16 NEW ZEALAND AND SOUTH AFRICAN PLAYERS WITH REFERENCE TO ANTHROPOMETRICAL COMPONENTS (cont.)

Tests	**New Zealand n = 24**				**South Africa; Group 1 n = 43**				**South Africa; Group 2 n = 22**			
	$\overline{X}$	**Sd**	**Min**	**Max**	$\overline{X}$	**Sd**	**Min**	**Max**	$\overline{X}$	**Sd**	**Min**	**Max**
Flexed upper arm (cm)	33.73	2.88	23.00	37.00	32.05	2.33	28.00	37.00	32.57	2.83	27.10	37.40
Forearm (cm)	28.41	1.58	24.00	31.50	27.45	1.66	24.60	31.20	27.93	1.91	23.20	30.80
Ankle (cm)	24.80	1.22	22.50	27.00	23.89	1.71	21.20	27.50	24.14	3.19	20.80	37.00
Calf (cm)	38.14	2.70	34.00	42.90	36.97	3.68	22.00	43.50	36.77	4.21	22.20	42.50
Upper leg (cm)	57.00	3.46	50.00	65.20	56.02	4.36	49.60	68.40				

$\overline{X}$ = Mean   Sd = Standard Deviation   Min = Minimum score   Max = Maximum score

TABLE 4.9: SIGNIFICANT DIFFERENCES (D-VALUES) BETWEEN ELITE UNDER 16 NEW ZEALAND AND SOUTH AFRICAN PLAYERS WITH REFERENCE TO ANTHROPOMETRICAL COMPONENTS

Tests	**New Zealand n = 24**		**South Africa; Group 1 n = 43**		**South Africa; Group 2 n = 22**		**New Zealand vs South Africa Group 1**	**New Zealand vs South Africa Group 2**
	$\overline{X}$	**Sd**	$\overline{X}$	**Sd**	$\overline{X}$	**Sd**	**d - value**	**d - value**
Mass (kg)	81.26	8.31	72.82	9.63	76.64	11.41	***0.9**	**0.4**
Length (cm)	179.71	5.83	177.63	5.64	180.86	8.22	**0.4**	**0.1**
Tricep (mm)	12.96	4.48	12.68	5.56	8.02	2.81	**0.05**	***1.1**
Sub-scapular (mm)	14.46	7.06	10.99	4.41	10.32	2.77	**0.5**	**0.6**
Midaxilla (mm)	13.25	7.57	9.63	4.49			**0.5**	
Supra-spinal (mm)	20.69	9.29	11.91	5.54			***0.9**	
Pectoral (mm)	9.73	3.44	6.80	2.75	5.73	2.30	***0.9**	***1.2**
Abdominal (mm)	20.73	9.89	15.60	8.92	12.64	6.52	**0.5**	***0.8**

$\overline{X}$ = Mean Std. Dev. = Standard Deviation *High significant difference: d ≥ 0.8 Medium significant difference: d ≤ 0,5

Low significant difference: d ≤ 0,2

TABLE 4.9: SIGNIFICANT DIFFERENCES (D-VALUES) BETWEEN ELITE UNDER 16 NEW ZEALAND AND SOUTH AFRICAN PLAYERS WITH REFERENCE TO ANTHROPOMETRICAL COMPONENTS (cont.)

Tests	New Zealand n = 24		South Africa; Group 1 n = 43		South Africa; Group 2 n = 22		New Zealand vs South Africa Group 1	New Zealand vs South Africa Group 2
	$\overline{X}$	**Sd**	$\overline{X}$	**Sd**	$\overline{X}$	**Sd**	**d - value**	**d - value**
Thigh (mm)	17.15	5.22	15.45	5.18	10.77	4.01	**0.3**	***1.2**
Calf (mm)	11.75	4.64	10.95	4.44	7.11	2.84	**0.2**	***1.0**
%BF (%)	13.66	4.77	18.77	6.44	15.96	3.96	***0.8**	**0.5**
Flexed upper arm (cm)	33.73	2.88	32.05	2.33	32.57	2.83	**0.6**	**0.4**
Forearm (cm)	28.41	1.58	27.45	1.66	27.93	1.91	**0.6**	**0.3**
Ankle (cm)	24.80	1.22	23.89	1.71	24.14	3.19	**0.5**	**0.2**
Calf (cm)	38.14	2.70	36.97	3.68	36.77	4.21	**0.3**	**0.3**
Upper leg (cm)	57.00	3.46	56.02	4.36			**0.2**	

$\overline{X}$ = Mean Sd = Standard Deviation *High significant difference: $d \geq 0.8$ Medium significant difference: $d \leq 0,5$

Low significant difference: $d \leq 0,2$

4.4 CONCLUSION

According to the aim of the study the results were discussed in two separate sections. Firstly the characteristics of elite New Zealand players with reference to sport specific skills, physical and motor abilities and anthropometrical data were discussed and secondly, a comparison were drawn between the elite New Zealand group (tested 2004) and two elite South African groups previously tested by Hare (1997) and Van Gent (2003). All of the groups were tested at the peak of their season so an accurate comparison can be made.

An important conclusion is that although in the anthropometrical components the body mass, girth measurements and skinfolds of the New Zealand group where higher than those of the South African groups they still recorded the fastest time over 10m and 45.7m and zig-zag run. Similar results were obtained in a comparative study done on 12-year old South African and New Zealand rugby players (Van der Westhuizen *et al.* (2004). This can lead to the conclusion that the New Zealand players posses more power (strength) than their South African counterparts.

Secondly, in the game specific skill tests the passing- ($\overline{X}$ = 21.96m), kicking ($\overline{X}$ = 40.9m) and kick-off ($\overline{X}$ = 37.59m) for distance tests can confirm the above statement of the New Zealand players possessing more strength than the South African players, where the New Zealand players scored the best distances in all three tests.

In the game specific skills tests where accuracy where the determinant factor, passing accuracy over 4m and 7m, the South African groups had better scores than the New Zealand group, but there was no real practical significant difference in any of the accuracy tests.

In the physical and motor abilities tests the New Zealand under-16 group scored better in the speed endurance and vertical jump tests which is important in short speed times and for certain game specific skills tests, for example the ground skill test, where the NZ players had, on average, better times than the South African groups.

The statements mentioned above can bring us to the conclusion that the New Zealand elite under-16 rugby players performed better on average in all the different tests in the game specific skills, physical- and motor abilities, and anthropometrical components, and where the South African groups had better scores than the New Zealand group the practical significant differences were low.

CHAPTER 5
SUMMARY, CONCLUSIONS AND RECOMENDATIONS

5.1 INTRODUCTION

The aim of this study was to investigate specific characteristics among New Zealand elite under 16 rugby players, in terms of anthropometric, game specific skills, physical and motor components and to compare elite South African and New Zealand under 16 rugby players with references to anthropometric, game specific skills, physical and motor variables.

This chapter will include a summary of the main results found in the characteristics of the elite u/16 New Zealand rugby players, and the comparison of the elite New Zealand with the South African players. Conclusions will be made in accordance with the aim and findings of this study, and recommendations in identifying and developing youth rugby players.

As Willford *et al.* (1994) and Hare (19970) stated that successful sport participants on all levels of sport and competition have certain unique characteristics that include anthropometrical, game-specific skills and physical and motor abilities and that all elite rugby players have certain characteristics that distinguish them from average or less talented rugby players.

Comparisons of elite rugby players in top rugby playing nations such as South Africa, New Zealand, England and Australia can help coaches and sport scientists to identify talented rugby players at a younger age and to develop these players to a higher standard to be competitive on an international basis.

Most of the game related skills, anthropometrical, and physical and motor abilities change during the development years of young sportsmen. These changes can be due to the physiological changes a young sportsman undergoes during his/her development years (years 8-18). Abilities such as speed, anaerobic endurance, strength, muscle endurance, power, flexibility, agility, aerobic fitness and maximal strength and power all increased as the sportsman's age increased. Talent identification is done at a young age, but Willford *et al.* (1994) stated that successful sport participants on all levels of sport and competition have certain unique characteristics and these characteristics include anthropometrical, game-specific skills and physical and motor abilities.

5.2 CONCLUSION

The conclusions that is made, is made according to the aims that was set for this study. The first aim of this study was:

- *To investigate specific characteristics among New Zealand elite under 16 rugby players, in terms of anthropometric, game specific skills, physical and motor components.*

One of the concerns with the results was with the flexibility of the New Zealand players. The New Zealand player's flexibility test values were lower than both the South African group's values. A similar tendency was found in a study done by Spamer and Winsley (2003b) on 12 and 18 year old English rugby players where the South African group's values were better in both the age groups. The same was found with the New Zealand group's percentage body fat, where all eight skinfolds that was obtained for this study was larger than both the South African group's skinfolds.

The second aim of this study was:

- *A comparative study of elite South African and New Zealand u/16 rugby players with references to anthropometric, game specific skills, physical and motor variables.*

In the *anthropometric* tests the New Zealand group were on average heavier than the South African group, the skinfolds and girth measurements were larger and body length where taller than the South African groups. This can explain the large weight difference between the New Zealand and South African groups.

When a comparison was made in the *physical and motor ability* tests, the New Zealand group was quicker in the sprint speed tests. This can be due to their vertical jump test, which shows that they possess more explosive power than the South African groups. According to Foran (2001) explosive power is one of the most important motor abilities for speed. An improvement of flexibility (hamstring) may improve speed by slightly increasing stride rate and decreasing energy expenditure and resistance during sprinting (Dintiman & Ward, 2003). In the zig-zag run test where speed plays an important role the New Zealand group had also quicker times than the South African group.

For the speed endurance test where the New Zealanders had the best test values, a factor that could have played a role was the fact that the New Zealand group was tested at sea level and the South African group at high altitude (North-West Province). According to McArdle *et al*. (2001) anaerobic performance times are longer (poorer performance) at higher elevations than at sea level.

In the *game-specific skills* tests the New Zealand group scored better in the kicking for distance, passing for distance, and kick-off for distance. This can be due to that the New Zealand group possesses more power (vertical jump), strength (New Zealand had better flexed arm hang values) and have longer limbs (body length). All of the previously named helped the New Zealand players to kick and pass the ball further than the South African group. But where accuracy was the determinant factor with passing for accuracy over 4m and 7m the South Africans had better test values. The difference in the ground skills test is due to the New Zealand group that is quicker (speed test) than the South African group.

There are a number of reasons why the New Zealand group scored better in the game-specific skills. One is that New Zealanders play rugby, and take part in rugby development programs, from a very young age (4 years of age), compared to South Africans that start playing rugby at a later age (8 years of age). Although morning grade ("Bulletjie") rugby started in the late nineties in South Africa, this will have no effect on the South African groups that was tested in this study (they were tested in 1997 and 2003). Thus, the New Zealand group played rugby and participated in rugby clinics for an average of 4 years longer than the South African group, which means that they had more time to develop their rugby-specific skills. Another reason is that there was a period of approximately seven years between the New Zealand and South Africa group 1 (Hare, 1997) testing dates. Practical significant differences between the two South African groups where also found in the game specific skills tests where their were also a period of 6 years between the tests (Van Gent tested in 2003). The periods that have elapsed between the test dates have affected the scores of the game-specific skills and, the equipment that was used (technology helped to improved the rugby ball to travel further distances) and the training and coaching techniques that improved over the years.

The New Zealand group scored better in the side-step and air-and-ground skill tests. A number of factors could have played a role in these two tests. One is that the New Zealand group scored better in the speed and zig-zag run tests, therefore they will be able to run themselves into better position to recollect the ball in the air-and-ground skill test, and perform better in the side-step test, and another is that interrater reliability could have played a role in the difference in the scores of the side-step test and the air-and-ground skills test. Interrater reliability is the degree to which different raters agree (Baechle & Earle, 2000). The same tester did not administer both the New Zealand and South African groups.

New Zealanders are already on an early age (16-yeard old) physical heavier and stronger than the South African players. One of the reasons that were given earlier in this chapter was that the New Zealander's skinfolds, girth measurements and body length was all greater than the South Africans which explains why the New Zealanders body mass are heavier. A reason for the strength can be the live style and culture the New Zealanders follow. From a young age the New Zealanders are active and follow physical education programmes in the schools, while in South Africa a study done by Coetzee and Coetzee (2003) on reasons for sport participation among adolescent athletes, found that South African children are less active and competitive at a young age.

Previous studies on a comparison between New Zealand and South African 12-year old rugby players showed that the New Zealand players had larger skinfold and girth measurements, and were better in the speed and zig-zag run tests, and that the South

African players scored better in the passing for accuracy over 4m and 7m (Van der Westhuizen *et a*l., 2004). This results are similar that was found in the comparison between New Zealand and South African U/16 elite rugby players, thus, it be recognized that South African players are more accurate and score higher points in accuracy tests than New Zealand players at a younger age.

5.3 RECOMMENDATIONS

Following are recommendations that can be made from the results of elite New Zealand and South African youth rugby players that were obtained in this study, as well as to effectively continue with further similar studies:

5.3.1 South African players scored better in the accuracy tests which included passing for accuracy over 4m and 7m. Both of these tests are passing for accuracy tests, another test that can be inducted into the test battery can be a kicking for accuracy test over a certain distance to establish if South Africans will have better scores in kicking for accuracy tests as well.

5.3.2 South African players, coaches and sport scientists should focus more on game specific skills in their training programmes.

5.3.3 New Zealanders should place more focus on flexibility training in their training programmes.

5.3.4 New Zealanders must focus on diet plans and exercises to reduce their percentage body fat.

5.3.5 More international research between countries can contribute to a more accurate profile between country's elite players. These norms can be used by coaches to identify potential talented players.

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