A TEST BATTERY FOR THE DETERMINATION OF POSITIONAL REQUIREMENTS IN ADOLESCENT RUGBY PLAYERS

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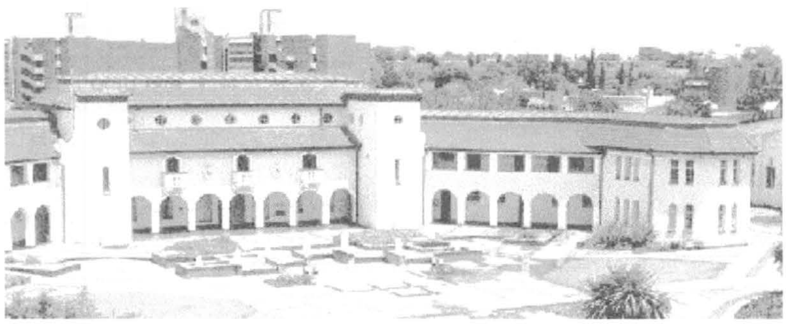

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ABSTRACT

A TEST BATTERY FOR DETERMINATION OF POSITIONAL REQUIREMENTS IN ADOLESCENT RUGBY PLAYERS

Motivation

Rugby is a very popular sport and is played from primary school to senior level in more than a hundred countries world-wide (Pretorius, 1997:2). South Africa is no exception; it has been known to be the breeding ground for some of the world's greatest players (Granger, 2002:56). According to Pienaar and Spamer (1998:14) certain anthropometric, physical, motor abilities and game-specific variables can distinguish between talented and less talented rugby players. However, a void still exists in the knowledge of how these abilities change in growing and developing rugby players (De Ridder 1993; Hare 1997; Nicholas 199; Pienaar & Spamer 1998).

Rugby consists of various activities that require certain anthropometric, physical, motor and rugby-specific components. These components are specific to the positional requirements in rugby (Craven, 1974 & 1977; Rutherford, 1983, Greenwood, 1985; Van der Merwe, 1989). However, little research has been done in sport regarding positional requirements and a need exists to develop a test battery for this purpose. Some researchers like Van der Merwe (1989) have made a movement analysis on senior players and have established that certain positions in rugby require specific skills. Pretorius (1997) established that talented youth rugby players could be identified according to their playing position. However, it is important to remember that anthropometric, physical, motor and sport-specific components required by specific

positions will change as the player grows older, attains physical maturity and gains more experience (Pienaar et al., 2000:32).

At present the positional selection of players is left to the coaches and teachers, who do not necessarily possess the experience or knowledge for proper positional selections. The possibility of identifying positional requirements by using a scientifically compiled test battery for rugby players will assist coaches and teachers in the correct positional selection of players at specific ages. Rugby will benefit from a much more competent player and the quality of the game will also improve. Elite players would also experience more satisfaction from their sport participation.

Research aims

The aim of this study was to establish positional requirements for U/13, U/16, U/18 and U/19 rugby players.

Methodology

This thesis consists of seven chapters. Chapter 2 presents literature reviews on the value of sports education in schools, while chapter 3 discusses the growth and motor development of adolescents. Chapter 4 sets out the positional requirements for rugby players according to previous studies and the literature. Chapter 5 explains the different measurements and tests that were done on the U/13, U/16, U/18 and U/19 Northwest provincial teams. Chapter 6 presents the results of this study, while chapter 7 consists of the summary, conclusion and recommendations for further studies.

Results and conclusion of study

- *Practically significant differences were found between different playing groups in every age group in terms of anthropometric, rugby-specific skill, physical and motor components. This implies that it is necessary to include the differences that do exist between playing groups in terms of anthropometric, rugby-specific skill, physical and motor components in a positional group test battery.*

- *The players were also classified into positional groups according to components that best distinguished between them. The lowest percentage of correctness was 85,71%. This proves that according to certain components positional group test batteries can be established*
- *Practically significant differences were found between different playing positions in every age group in terms of anthropometric, rugby-specific skill, physical and motor components. This implies that the differences that do exist between playing positions in terms of anthropometric, rugby-specific skill, physical and motor components are necessary to include in a positional group test battery. The standardised data values that were presented for all playing positions and ages also indicated which components distinguish most between playing positions.*

The results of this study prove that it is possible to establish a test battery for positional selection among adolescent rugby players. This test battery can therefore be used in positional talent identification and development models for adolescent rugby players. Coaches can also use this test battery for positional selection of players in teams and monitor their development with increasing age.

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CHAPTER 1

PROBLEM AND AIM OF THE STUDY

1.1 Introduction

Rugby is a very popular sport and is played from primary school to senior level in more than a hundred countries world-wide (Pretorius, 1997:2). South Africa is no exception, it has been known to be the breeding ground for some of the world's greatest players (Granger, 2002:56). The national team's victory in the World Cup in 1995, combined with the introduction of professionalism, resulted in a need to produce and maintain elite players (Gibson *et al.,* 1999:5). This can only be done if talented players are identified and developed. According to Pienaar and Spamer (1998:48) certain anthropometric, physical and motor abilities and game-specific variables can distinguish between talented and less talented rugby players. However, a void still exists as to how these abilities change in the growing and developing rugby player (De Ridder 1993; Hare 1997; Nicholas 1997 and Pienaar & Spamer 1998).

The age period between 12 and 22 years is known as the adolescent period (Hare, 1997:8). According to Louw and Broekman (1982:213) this is a period between the start of puberty (growth spurt and secondary sexual maturation) and reaching physical and, among others, social and emotional maturity. The most obvious change appears in physique. The boy grows faster than before, hormone composition changes, primary and secondary sexual components develop and sexual maturity is reached (Louw & Broekman, 1982:345). Because of these changes and the development of strength, motor abilities are effected, which in turn have an influence on the athletic ability of the boy (Hare, 1997:13).

Boys experience a temporary lack of co-ordination, which results in clumsiness (Sassoon (2001:56). As a result of the clumsiness the boy also experiences a lack of competence (Siedentop 2002:417). This is one of the reasons why many sports lose between 22% and 37% of participants aged 13 to 15 years annually (St-Aubin & Sidney, 1996:9). Sassoon (2001:56) suggests that by helping the boy with dyspraxia (term for clumsiness), motor skills will improve as well as competence in games and sport. Siedentop (2002:417) also stated that "fun" in sport is directly congruent with competence. Thus, competent participants will develop high self-esteem and experience total enjoyment of sports participation (Sassoon, 2001:56).

Another reason for the high drop-out rate could be that teachers and coaches are not knowledgeable enough about adolescents. According to a report by the American Sport Education Program (ASEP) (Anon., 1996:1), more than two thirds of high school coaches have received little or no formal coaching education. This raises concerns, seeing that coaches and teachers cannot help improve motor skills or assist boys in selecting the sport that they might be anthropometrically and physiologically best suited for (Hahn & Gross, 1990:1). Many try their best in certain sports which they are not suited for, resulting in little progress. This may cause feelings of frustration, disappointment and incompetence in the athlete and result in less sport participation and a lack of proper character building in young boys (Frey & Massengale, 1988:40). A solution to this problem might be talent identification and development. If these boys are identified at an early age and are developed in areas such as motor skill improvements, they might feel more competent and participate more and longer in sport.

Talent identification (i.e. the search for potential champions) at an early age has become a significant aspect of high-performance sport in recent years and is generally considered necessary if youths are to succeed in a given sport (Pienaar *et al.*, 2000:23). Talent identification and development assist in identifying the talented (competent) participant and direct that participant to the sports he/she may be best suited for, resulting in greater gratification and enjoyment (Gibson *et al.*, 1999:5). The benefits of talent identification include a reduction in the time required to reach high standards, with an increase in competitiveness and the number of athletes aiming at reaching high performance levels (Malina, 1997:3).

1.2 Problem statement

Rugby consists of various activities that require certain anthropometric, physical, motor and rugby-specific components. These components are specific to the positional requirements in rugby (Craven, 1974 & 1977; Joynson, 1978; Rutherford, 1983, Greenwood, 1985; Van der Merwe, 1989). Studies by Hare (1997) and Pienaar and Spamer (1998) have all made a contribution to talent identification among rugby playing youths, although it was not according to positional requirements. Du Randt and Headley (1993:320) suggest that every talent identification and development programme should be specific to the positional requirements that exist in team sports. However, little research has been conducted in sport regarding positional requirements and a need exists to develop a test battery for this purpose. Some researchers like Van der Merwe (1989) did a movement analysis of senior players and established that certain positions in rugby require certain skills. Pretorius (1997) established that talented youth rugby players could be identified according to their playing position. However, it is important to remember that anthropometric, physical, motor and sport-specific components required by specific positions will change because, as the player grows older, he attains physical maturity and gains more experience (Pienaar *et al.,* 2000:32).

At present the positional selection of players are left to the coaches and teachers, who do not necessarily possess the experience or knowledge for proper positional selections. The possibility to identify positional requirements by using a scientifically compiled test battery for rugby players will assist coaches and teachers in the correct positional selection of players at specific ages. Rugby will benefit from more competent players, and the quality of the game will also improve. Elite players would also experience more satisfaction from their sports participation.

The question to be addressed in this study is what physical, motor and sports-specific tests should be included in a scientific test battery to assist in the positional selections among U/13, U/16, U/18 and U/19 rugby players.

1.3 Research aim

The only aim for this study is to establish positional requirements for U/13. U/16, U/18 and U/19 rugby players, in terms of anthropometric-, rugby specific skill-, physical- and motor components.

1.4 Research method

1.4.1 Review of literature sources

The following databases were used:

- Sport discuss
- Medline
- Internet e.g. EBSCOhost
- Relevant books

1.5 Empirical investigation

1.5.1 Study population

The study population consisted of U/13 (n=22), U/16 (n=21), U/18 (n=18) and U/19 (n=19) rugby players of the North West province competing in the national tournament.

1.5.2 Test battery

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

The anthropometric measurements included the following:

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

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

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

- Passing for accuracy over 7 m ability (AAHPER, 1966)
- Kicking ability (AAHPER, 1966)
- Kick-off ability (AAHPER, 1966)
- Catching ability (AAHPER, 1966)

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

- Flexibility (adapted sit-and-reach) (Thomas & Nelson, 1985)
- Power (vertical jump) (Thomas & Nelson, 1985)
- Speed endurance (speed endurance test) (Hazeldine & McNab, 1991)
- Agility (Illinois and T-test) (Badenhorst, 1998; SISA, 1998)
- Speed (10 m and 30 m) (Hazeldine & McNab, 1991)
- Strength (flexed arm hang, seven stage abdominal strength test and pull-ups) (Norton & Atherton, 1997; Ellis et al., 1998).

1.5.3 Procedures and research methods

Once approval had been granted by the North West Rugby Union the evaluation took place. Qualified sports scientists and human movement students, trained in the correct methods for each test did the measurements and evaluations.

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.

1.5.4 Statistical data processing

The data will be statistically analysed by means of Windows 1999 Statistica. Firstly a descriptive statistics ($\bar{x}$= mean, sd= standard deviation, min. and max) will be done for each age group. Secondly, one-way analyses of variance (ANOVA) will be done to establish practical significant differences between positional group for each age group Thirdly, a stepwise discriminant analyses will be done to determine the components that discriminated the most between playing groups of each age group. A classification matrix will be performed to classify the players in to the right positional groups according to the descriminant components. Lastly, a one-way of variance (ANOVA) will be done to establish practical significant differences between each position for each age group. Together with this the data will be standardised, meaning all positions will have a mean of 0. This data will then be presented in a line plot graph for each age group and all relevant components (z=>1/-1) will be discussed.

CHAPTER 2

THE VALUE OF SPORTS EDUCATION IN SCHOOL

2.1 Introduction

2.2 The value of sport for participants

2.3 The value of physical and sports education in school

2.4 The value of the physical and sports educator

2.5 Factors influencing adolescents' participation in sport and physical activity

2.6 Conclusion

2.1 Introduction

The word "sport" was derived from the word "disport" (sometimes spelled dysport). It first appeared in the literature in 1303 and meant sport, pastime, recreation and pleasure (Zakrajsek, 1991:10). Several meanings of sport have evolved over time; however, most are associated with three constituent elements: play, physical education/exercise and competition (Zakrajsek, 1991:10).

For some, sport is synonymous with athletics and elite competition, while for others, especially for those in sport education, sport means physical activity that includes formal and informal competition, recreation, play and dance (Zakrajsek, 1991:10). This study focuses on adolescents who participate in provincial rugby teams, which means they are competing in formal competition. During school adolescents are exposed to all the fundamental skills necessary for participation in any kind of sport. This exposure during school might also have an influence on the quality of adult rugby players on provincial and national levels. The aim of this chapter is then to emphasise the importance of school sport and its educational value, as well as the factors influencing participation among adolescence.

2.2 The value of sport for participants

Sport is practised for a variety of reasons, all of which give meaning to the participant. Striving for excellence, achievement, humility, loyalty, self-control, respect for authority, self-discipline, hard work and deferred gratification are values that the adolescent acquires from participation in school sports (Frey & Massengale, 1988:40). Such values and benefits find their source in amusement, education, recreation, health, social relationships, biological development and freedom of expression (Zakrajsek, 1991:11).

Sport is also practised on different levels. On the individual level, sport provides the individual the opportunity to test and develop him-/herself physically and personally – and to pursue and achieve excellence (Dyck, 2000:140). At the community level, sport is a basis for social interaction, community building and developing intercultural relationships. At the national level, sport plays an important role in developing feelings of national unity and pride (Dyck, 2000:140).

Sport also improves the physical and psychological well-being of children and adolescents, easing the effects of life-threatening diseases, relieving stress and improving academic performance (LeBlanc & Dickson, 1997:2). Sport can affect a child's development of self-esteem and self-worth, and it is also within a sport that peer status and peer acceptance are established and developed (LeBlanc & Dickson, 1997:4). Adolescents find in sport an opportunity to enjoy life, to develop their bodies and strengthen their minds (Anon, 2002b:1). The dynamics of sport and play involves a process of learning creativity and imagination, language and expression, challenge and risk-taking, problem-solving and decision-making (Zakrajsek, 1991:12).

As in the world of the Ancient Greeks, sport plays an important role in the educational institutions of the 20th century. The reasoning for this in ancient times, as now, is a belief that sport helps make better people – that it promotes excellence (what the Greeks called *aretḗ)* in individuals, excellence which can be applied to almost any endeavour in life (Reid, 2001:1). Sport is part of the development of human beings. Sport in school educates while amusing, and it counteracts boredom and mental strain (Zakrajsek, 1991:11). The real goal of sport and education is the cultivation of human excellence (Reid, 2001:5).

2.3 The value of physical and sports education in schools

Physical and sports education are interrelated, yet also differ in some aspects. The definition and a brief discussion of each will follow in this section. There will also be a brief discussion of the present situation in South Africa regarding physical and sports education.

- ***Physical education***

Physical education is defined as follows: "Physical education is planned, sequential instruction that promotes lifelong physical activity. It develops basic movement skill and physical fitness as well as to enhance mental and social abilities." (Anon, 2000a:1). Physical education aims to promote healthy lifestyles through regular physical activity and through improving motor ability.

The function of physical education is to produce students who can demonstrate competency in many movement forms and proficiency in a few movements, exhibit a physically active lifestyle, demonstrate responsible personal and social behaviour in physical activity settings and understand that physical activity provides opportunity for enjoyment and social interaction (Anon, 1998a:1). Shaw (1994a:1) suggests that the desired outcomes of physical education include skill development and increased fitness levels.

Physical education is an opportunity for adolescents to develop themselves physically, psychologically and mentally. According to Siedentop (1976:114), physical and mental development are strongly interrelated. The quick, alert potential athlete is most often a child capable of high academic achievement. Physical education is also used as an intervention treatment for behavioural and emotional problems, mental rehabilitation, social interaction, relaxation, stress and anxiety reduction as well as daily routine diversions (Zakrajsek, 1991:12). The Health Education Authority (1997:12) reported that students in schools where physical education programmes were implemented reported fewer discipline problems, more voluntary participation in school sports activities and fewer playground problems. Moreover, the schools claimed that academic results were not adversely effected by the amount of time devoted each day to physical activity.

According to the Health Education Authority (1997:15), young people are interested in a wide range of physical activities and want to try out and take up new ones. LeBlanc and Dickson (1997:3) emphasize the fact that the adolescent should be encouraged to participate in as many activities as possible so as to develop as many skills as possible. Especially in South Africa, with its large rural populations, this is only possible in schools, where children and adolescents spend most of their time and can then be exposed to a variety of physical activities.

To conclude then with physical education, it must produce physically educated adolescents. A physically educated adolescent is: "one who has learned the skills necessary to perform a variety of physical activities, is physically fit, participates regularly in physical activity, knows the benefits of involvement in physical activity and values physical activity and its contribution to health" (Anon 2001a:2).

- ***Sports education***

Sports education is defined as follows: " sport education seeks to educate students to be learners of sport in the fullest sense... competent, literate and enthusiastic " (Anon., 1998:1). The purpose of sports education is to promote participation in any kind of organised school sport.

Sports education aims to educate students about all the different aspects of sport, not just performance (Shaw, 1994a:2). Essential elements of sports education include that all players participate all the time in different activities, for example as players, referees, coaches, selectors, statisticians, linespeople, managers, score-keepers etc. (Anon., 1998:1).

The important aspects of the definition of sports education are competence, literacy and enthusiasm. By competence is meant that students must know all skills involved, including the strategies and rules of the specific sport. By literacy is meant that students must understand and value the rules, traditions and rituals of the specific sport. They must also distinguish between good and bad sports participation. By enthusiasm is meant that students must be fully engaged in all the previously mentioned aspects (Anon., 1998:1). It is only in schools that adolescents can practise sport without fear, and it is there that the teacher can take advantage of its educational and socialising values and help the adolescent experience sport and life positively (Anon., 2002a:1).

Anon (2002b:1) indicated that sports education allowed students frequent interaction with their classmates and provided the opportunity to learn co-operation, team work and trust.

These opportunities helped develop leadership skills, practical knowledge on rule application and game management strategies. The researchers also categorised the major benefits of sports education into social, psychological, psychomotor and cognitive domains.

In the social and psychological domains responsibility, supportive climates between students and positive attitudes towards fair play were all noticed. In the psychomotor domain, the development of game-related skills was very dominant. Students improved their skill through continued participation in games. Benefits in the cognitive domain included better knowledge of rules and better understanding of sports activity (Anon, 2002b:3). The students who participated in this study reported that the most useful aspect of sports education was the opportunity to participate in formal competition. The students also expressed the feeling that sports education was more enjoyable than regular physical education lessons.

Anon (2002b:3) reported that sports education allowed the value of competition to be taught and learned in a controlled environment. The students participating in this study were eager to find ways of making competition fair so that every one could experience success and enjoyment, and they rated being a valued participant more highly than success in competition.

In conclusion, sports education and physical education reinforce one another by providing similar learning experiences in different context. Physical education is needed in schools to promote health and basic movement patterns, and sports education is needed to afford everyone an opportunity to be part of the joy of sport and the cultivation of *aretê* (human excellence).

- ***Physical and sports education in South Africa***

In South Africa in 1998, no physical education or sports education programmes existed in public schools (Van Deventer, 1998: 89). Children and adolescents in South Africa are becoming more obese and less active. Obesity among children and adolescents have increased to 50% in the past two decades. This tendency is threatening the total well-being of all the children and adolescents in South Africa. From a sports context, children are not exposed to the fundamental physical and motor abilities that are needed to participate in sports. Without the proper fundamental abilities, the child might find it difficult to master any specialised movement patterns that are associated with all kinds of sport (Pienaar, 2001:113).

The absence of physical education and sports education programmes might also effect talent identification. Many studies (Howe, *et al.*, 1997; Heller, *et al.*, 1993; Detterman 1993) presented in Hare (1997:23) suggest that talent is inherited, and is a contributor to success in sport. Other studies suggest that exercise and environmental attributes are just as necessary as talent, and also contribute to success in sport (Ericsson & Charness, 1995). Either way, with no physical and sport education programmes in schools, both the talented and the not so talented child will have less of an opportunity to develop physical and motor abilities. This will also have an effect on the quality of South Africa's participation in international sport.

2.4 The value of the physical and sports educator

Physical and sports education reinforces one another by providing similar learning experiences in different contexts (Anon, 2001:2). With this in mind, the value of the physical and sports educator is the same, although the physical educator educates through physical activity, and the sports educator educates through sport.

The physical and sports educator stands in a person-to-person relationship with children and adolescents (Zakrajsek, 1991:11). Humans are biosocial in nature and the physical and sports educator, more than anyone else, teaches to and through the whole person (Zakrajsek, 1991:11).

It is every physical and sports educator's responsibility to ensure that every child practises some element of sport because according to Zakrajsek (1991:11) doing sport is the total body in interaction with the sensory and extrasensory self, involving the physical, emotional, social and spiritual aspect, ensuring total well-being. The purpose of physical and sports educators is to advocate a "doing" and "being" sports mentality – one that brings all people into the arena of sports expression; and to lead this movement into all schools (Zakrajsek, 1991:11).

Zakrajsek (1991:14) concluded that the mission of physical and sports educators is to help adolescents become whole persons, persons prepared to live, to enjoy and to contribute to society. According to Siedentop (1976:114), physical and sports educators' should attempt to achieve the general goals of teaching through the medium of motor and sports activity. According to Charles Bucher in Siedentop (1976:114), the objectives of any physical and sports educator are as follows:

- Physical developmental: The objective of physical development deals with the programme of activities/sport that builds physical power in an individual through the development of the various organic systems of the body.
- Motor development: The motor development objective is concerned with making physical/sports movement useful, with as little expenditure of energy as possible, and being proficient, graceful and aesthetic in the movement/sport.
- Mental development: The mental development objective deals with the accumulation of a body of knowledge and the ability to think and to interpret this knowledge, for example the rules of a certain sport.
- Social development: The social development objective is concerned with helping an individual make personal adjustments, group adjustments and adjustments as a member of society

Physical and sports educators have the potential to influence young people's attitude towards, and consequent participation in, physical activity and sport (Health Education Authority, 1997:43; Anon., 2001a:1). Physical and sports educators believe that developing sports and movement skills will influence engagement in leisure-time pursuits now and for a lifetime, contributing to satisfaction, enjoyment and total well-being (Zakrajsek, 1991:12). Experiences of physical activity and sports during adolescence have been found to influence later participation in physical activities and sport (Health education Authority, 1997:43, Anon., 2001:2), so positive experiences at school are essential.

The responsibility of physical and sports educators has grown over the past few years. Traditionally, values and ethics have been installed in children through parenting, the church and formal education. Today, however, with the realities of single-parent families, working parents and difficult economic times, the stresses placed on family life leave less time for the development of values and ethics. The church's position as a teacher of ethics and morals has diminished. In schools, less time is devoted to sports and physical education, to building discipline, learning fair play and following rules; education budgets have decreased; class size and composition cause stress in teachers, leaving them with less energy for extracurricular sports activities. All these factors have combined to erode the moral development of youth all over the world (Dyck, 2000:140). Physical and sports educators provide the youth with experiences that contribute to their growth and development (Van Dalen & Van Dalen, 1956:13). Aside from parents, no one in any society has a greater responsibility for the development of good citizens than the physical and sports education teacher (Van Dalen & Van Dalen, 1956:5).

It is thus clear that physical and sports educators form an integral part of the child's development of self-concept, self-esteem and self-realisation (Whitehead & Corbin, 1997:175). Van Dalen and Van Dalen (1956:5) summarised this exceptionally well: "superior educators are one of the most, if not the most important, riches resources any nation can possess."

2.5 Factors influencing adolescents' participation in sport and physical activity

This section of the chapter focuses on factors influencing adolescents' participation in physical activity. Physical activity forms the basis of sports participation, therefore the reasons mentioned might also have an influence on the participation of adolescents in sport. According to Sallis et. al (1992:252) there are several factors that influence the participation of adolescents in sport and physical activity. He suggests that these factors can be divided into two main categories of variables, namely: Personal (biological and psychological) and environmental (social and physical). Knowledge about these variables will assist the physical and sports educator in improving adolescent participation in sport and physical activities. All these variables will be discussed briefly.

2.5.1 Personal variables

- ***Biological variables***

Evidence suggests that physical fitness, age, gender and levels of body fat are the primary biological variables influencing young people's participation in physical activities and sport (Doyle, 2001:2; Fein, 2001:2; Rocco, 2001:2). Participation in physical activities and sport declines with age (Health education authority, 1997: 30). The Health Education Authority (1997:32) suggests a 50-75% reduction in physical activity levels between the age of 6 and 18 years, with the decline continuing through to adulthood. In comparisons with boys, girls are less active from puberty through to adulthood, and prefer less contact sport (Doyle, 2001:2; Fein, 2001:2). A study by Welk (1999:2) suggests that the increasing levels of obesity are due to the decline in physical activity levels. A decline in participation in physical activity will certainly have an influence on the amount of adolescents participating in sport.

- ***Psychological variables***

Psychological variables influencing participation in physical activity and sport are fun and enjoyment, mental/emotional wellbeing, perceived barriers, and perceived competence. These variables and their influence on adolescents' participation in physical activity and sport will be discussed briefly.

Many studies have highlighted fun and enjoyment as being important motives for young people to participate in physical activity and sport (Health Education Authority, 1997:31; Whitehead & Corbin, 1997:177). These variables seem more important than the motivation to compete or to win. Lack of fun has also been identified as a factor leading to discontinuing participation (LeBlanc & Dickson, 1997:4). Other studies have examined the variables influencing the level of fun and enjoyment. These variables include improving skills, the excitement of the game and the perception of how well one played the game (LeBlanc & Dickson, 1997:4; Anon., 2001:1). Other variables that also influence sports participation or physical activity include keeping fit and losing weight, excitement and challenge, being successful and increasing confidence, developing athletic skills and relaxation (Health Education Authority, 1997:33; LeBlanc & Dickson, 1997:2; Fein, 2001:2; Paolini, 2001:2; Anon., 2002a:5).

Doyle (2001:2) highlights the importance of physical activity in promoting mental wellbeing. Many studies (Anon, 2001a:1; Paolini, 2001:2; Rocco, 2001:2; Weiss, 2000:1) revealed that adolescents' participation in physical activity and sport has improved self-esteem and self-concept. Social contact has been found to be an important correlate of wellbeing, and participation in physical activity and sport provides the adolescent with the opportunity to meet with peers and develop friendships (Anon., 2001:1; Welk, 1999:; Weiss, 2000:1; Rocco, 2001:2). According to LeBlanc and Dickson (1997:3), a higher level of physical fitness helps young people to participate comfortably in a wide variety of physical activities and different sports, and enables them to cope more easily with everyday activities.

Perceived barriers are factors that are seen to limit adolescents' participation in physical activity and sport, and include: lack of money, lack of time, lack of success, loss of interest, problems with facilities and support, and limited awareness of available opportunities (Health Education Authority, 1997:42; Boob, 2001:2). Boob (2001:1) suggests that the time spent watching television and playing video games appears to be the most important index of sedentariness.

Perceived competence is another psychological variable that influences adolescents' participation in physical activity and sport. The Health Education Authority (1997:35), Weiss (2000:2) and Anon (2001a:1) suggest that those with above-average ability at games/sport during childhood are more active in later life, which is probably due to their positive sports experiences as compared to their less able peers. Likewise, perceived competence has been identified as an important factor determining participation in physical activities/sports, with young people seeking to participate in those activities/sports which provide a sense of competence, and avoiding activities/sports they associate with failure (Health Education Authority, 1997:35; Paolini, 2001:3; Rocco, 2001:2). Many studies suggest that one of the strongest predictors of future levels of physical activity is an individual's perception of self-efficiency or confidence in their ability to be active on a regular basis (Sallis *et al.*, 1992: 248; Health Education Authority, 1997:36; Welk, 1999:3).

2.5.2 Environmental variables

- ***Social variables***

The combined influence of parents and all "significant others", is important in determining young people's attitudes towards, and participation in, physical activities (LeBlanc & Dickson, 1997:3; Welk, 1999:1; Weiss, 2000:1; Anon, 2001a:1; Fein, 2001:1). Many studies report that parents are thought to be the most influential in the case of young children, and peers in the case of adolescents (LeBlanc & Dickson, 1997:3; Welk, 1999:1; Weiss, 2000:1; Anon, 2001a:1; Fein, 2001:1). Primary socialization in the family unit appears to be one of the major influences on the health-related behaviour patterns formed in early childhood (Welk, 1999:3; Anon, 2001a:4). The family and social environment are important in the development of physical fitness habits and participation in sport, in the adolescent (Health Education Authority, 1997:36). The Health Education Authority (1997:38) suggests that parents act as gatekeepers to opportunities. They assist by participating with the adolescents, organising activities/sport, transporting them to activities/sport and helping with finance (Sallis *et al.*, 1992:251; Health Education Authority, 1997:39; Welk, 1999:2; Fein, 2001:1; Anon, 2001a:1).

Parents can also serve as role models, either positively or negatively. The lack of parental physical activity may influence children, as early as from pre-school age, to be less active, while the effect of parental role models may be weaker during adolescence (Health Education Authority, 1997:36). Studies have also suggested that parental belief in a child's ability or competence contributes to an increase in participation in physical activity and sport among young people (Sallis *et al.*, 1992: 255; Anon., 2001:1; Welk, 1999:3; Anon 2002a:1). There is also a correspondence between children's personal sports goals and their perceptions of the goal orientation of their parents (Health Education Authority, 1997:36; Zwick, 2001:1).

As the child grows older the influence of peer support plays a more important role in young peoples' participation in physical activity and sport (Health Education Authority, 1997:38; Welk, 1999:2; Anon, 2001a:1; Weiss, 2000:1). This is particularly true when the child approaches adolescence, when the influence of adults (parents, teachers, coaches or doctors) decreases and peer-group pressure and the sense of belonging to a group becomes increasingly important (Health Education Authority, 1997:38; Weiss, 2000:2). However, while peer influences are important, it is the combined support of family and friends that encourages young people to be active, even during adolescence (Health Education Authority, 1997:38, Anon, 2001a:2; Zwick, 2001:1).

The media has always been a major influence on adolescents. However, it is suggested that instead of providing encouragement for adolescents to be active, the mass media encourage them to be inactive consumers of entertainment (Sallis *et al.*, 1992:249; Health Education Authority, 1997:39; Lowe, 2001:2). When physical activity is portrayed in the media, it is usually at a competitive level and not much is done to encourage total participation in physical activity or sport. Because of the major influence that the media have on adolescents, television, radio, magazines and newspapers should be used to highlight the importance and benefits of physical activity and sports participation (Health Education Authority, 1997:39).

- ***Physical variables***

Sallis *et al.* (1992:251) have identified factors such as weather, time of the week and television viewing as variables within the environment that influence the participation of adolescents in physical activity and sport. Physical activity levels among adolescents were higher in summer than in winter, and adolescents were more active during weekends (Health Education Authority, 1997:42). The increases in television watching among adolescent have also been a reason for low activity levels and sports participation (Simon, 2001:1).

The Halth Education Authority (1997:43) has also suggested several physical environmental variables that influence physical activity/sport, including accessibility, safety and convenience of location and facilities in the community. Of all these environmental variables, safety and convenience of location of facilities were found to be the most important for adolescents and their parents (Anon, 2001a:2). A study by Fein (2001:2) suggests that the school's physical environment is significantly related to physical activity. Sallis *et al.* (1992:255) have also found that the more places adolescents can play that are available within walking distance from home, the more active the child is.

2.6 Conclusion

Physical and sports education in schools are the best, and for some adolescents the only, accessible facilities through which they can learn fundamental motor skills and develop to total human excellence (Reid, 2001:5). Adolescents from previously disadvantaged communities in South Africa, and in many parts of the world, have no or few sport facilities and very little expertise to assist adolescents in developing motor and physical abilities. There is also very little assistance in teaching these adolescents about the importance of physical activity for healthy lifestyles, not even mentioning sports participation.

With no physical and sports education in schools, these adolescents will never have the opportunity to develop to their full potential. Many of these adolescents, talented or not, will never have the opportunity to participate in sport.

The Ancient Greeks believed that sport helped make better people, and 2 500 years later this belief is still maintained (Reid, 2001:5). It is therefore the government's and physical and sports educators' responsibility to cultivate areté (human excellence). According to Reid (2001:4), schools are in the business of making better people, and sport is an excellent instrument for achieving this goal. If we can make better people through sport, we can make a better nation.

CHAPTER 3

THE GROWTH AND MOTOR DEVELOPMENT OF ADOLESCENTS

3.1 Introduction

The aim of this study is to develop a test battery for positional selection in adolescent rugby players. To do so, it is necessary to understand fully the adolescent's growth and motor development, and the influence that these variables have on his rugby performance. These influences on rugby performance will also vary for different age groups. Thus the aim of this chapter is to give a brief discussion of the changes that adolescents experience, as well as of how these changes influence rugby-specific physical and motor components.

3.2 Adolescence

There are many different definitions of adolescence. Anon (1992:1) defines adolescence as "the transition from childhood to adulthood". Perkins (2001:1) defines adolescence as beginning: "with biological maturation, when young people must accomplish development tasks and develop a sense of personal identity. It ends when young people achieve self-sufficient adulthood as defined by society". The World Health Organization (WHO) defines adolescence as the period between 10 and 19 years of age (Latu, 2002:1). Louw and Broekman (1982:213) define adolescence as the beginning of puberty to the total physical, psychological and emotional maturity of the child. Adolescence is defined as the period of development from age 11 to 22 and derives from the Latin verb *adolescere*, meaning to grow up, to grow into maturity (Anon, 1990:2).

All these definitions have some commonalties; all address the issue of change and transition. The lines between childhood, adolescence and adulthood differ by culture, physiological maturation, social responsibilities and roles and economic independence (Latu, 2002:1). In some cultures, for example, by getting married, leaving school or having a baby, a young person moves into adulthood, even though he or she may still fall in the age group of between 10 and 19 years (Latu, 2002:1). Researchers also differ on the exact age that certain stages occur, therefore it is very important to acknowledge the fact that individual differences do occur and that age is not a definite indicator of where a particular child is along this developmental continuum.

The period of time that makes up what we know as "adolescence" is affected by both biology and culture. It is affected by biology in the sense that sexual maturation is reached at the beginning of adolescence. It is effected by culture in that the end of adolescence and the beginning of adulthood are marked by financial and emotional independence from one's family (Gallahue & Ozmun, 1995:103). The earlier onset of puberty combined with a longer period of dependence on families has caused researchers to view adolescence in a much broader perspective than 50 years ago (Gallahue & Ozmun, 1995:103). Whereas adolescence used to span from 13 to 18 years, it now begins as early as 10 and does not end until about 20 years and beyond (Gallahue & Ozmun, 1995:103).

The adolescent period has three substages: early adolescence (10 to 14 years), middle adolescence (15 to 17 years) and late adolescence (18 to early twenties) (Perkins, 2001:1). In these substages there are a number of significant physical, biological and emotional events which contribute markedly to the growth and motor development of the adolescent (Gallahue & Ozmun, 1995:103).

Some researchers like Malina and Bouchard (1991:3) classify the changes that adolescents experience into growth, maturation and development. Other researchers, like Gallahue and Ozmun (1995:103) and Ozretich and Bowman (2001:2), classify these changes as physical, biological and emotional. To avoid confusion, Malina and Bouchard's (1991:3) classification will be used in this chapter, namely growth, maturation and development.

The maturation of the adolescent begins at the start of puberty; therefore puberty will incorporate all the changes regarding maturation. Adolescence will therefore be discussed according to growth (physical) and development (emotional). The influence that growth and maturation have on physical and motor development will also be discussed. There will also be a brief discussion about early and late maturers.

3.3 Puberty

The word *pubertas* is derived from Latin and evolved to puberty over the years, meaning the age of manhood (Anon., 1990:2). Anon (1992:5) defines puberty as the beginning of the transition from childhood to adulthood. Puberty is also defined as the period during which an individual becomes capable of reproduction and presents all the physical changes of adulthood (Anon, 2002a:1). Puberty is an early stage of adolescence (Anon, 1992:5). The onset of puberty is generally termed pubescence or the prepubertal period (Schor, 1995:1). Pubescence/the pre-pubertal period is the earliest phase of adolescence, occurring generally two years in advance of sexual maturity (Gallahue & Ozmun, 1995:110). Males enter puberty around the age of 10 or 11 years (Schor 1995:1).

Puberty is considered a major developmental milestone both for the physical and social transitions into adolescence and adulthood; it is a key challenge for the developing individual (Weichold *et al.,* 2002:29). The onset of puberty is regulated by heredity and may be influenced by nutrition, illness, climate and emotional stress (Gallahue & Ozmun, 1995:112).

According to Schor (1995:1) and Malta (2002:2) children proceed through the following stages of puberty:

- Stage 1: Prepubertal. The normal age range is 9 to 12 years and the average age is 10 years. Hormones are becoming active, but there are hardly any signs of sexual development.
- Stage 2: The normal age range is 9 to 15 years and the average age is between 12 and 13 years. Testicles and scrotum begin to enlarge, but penis size does not. Very little, if any, pubic hair at the base of the penis. Increase in body odor.
- Stage 3: The normal age range is 11 to 16 years and the average age is between 13 and 14 years. Penis starts to grow in length. Pubic hair starts to get darker and coarser. Ejaculation (wet dreams).
- Stage 4: The normal age range is 11 to 17 years and the average age is between 14 and 15 years. Penis width increases, as well as length. Penis and scrotal sac deepen

in colour. Pubic hair begins to take on adult texture. Boys have first ejaculation while awake. Underarm hair develops. Voice deepens.

- Stage 5: The normal age range is 14 to 18 years and the average age is around 16 years. Fully mature adult. Facial hair grows more completely and shaving starts soon. Pubic hair extends to inner thighs. During late teens and early twenties, some develop more bodily hair, especially chest hair

The changes that the adolescents experience during puberty are directly related to their maturation. Maturation is difficult to define. It is often described as the process of becoming mature, or of progress towards mature status (Malina & Bouchard, 1991:232). Measurements of maturity vary to some extent, according to the biological system used. The most commonly used in growth studies include: maturation of the skeleton, somatic maturation and sexual maturation (Malina & Bouchard, 1991:232).

Skeletal maturation is perhaps the best method for the assessment of biological age or maturity status (Malina & Bouchard, 1991:232). It is the best method because its development spans the entire period of growth. All children start with a skeleton of cartilage prenatally and have a fully develop skeleton of bone in early childhood. In other words, both the beginning and the end points of the maturation process are known, because the skeletal structure of all individuals progresses from cartilage to bone (Malina & Bouchard, 1991:232). However, the method of skeletal maturation assessment is very expensive.

Somatic maturity is the use of body measurements as indicators of maturity. If the data span the adolescent years, the timing of adolescent growth spurts in specific body dimensions can be used as indicators of somatic maturity. Stature is the most commonly used measurement in the assessment of somatic maturity (Malina & Bouchard, 1991:241). However, this assessment requires longitudinal data.

The assessment of sexual maturation is based upon the development of the secondary sex components, like breast development and menarche in girls, penis and testes (genital) development in boys, and pubic heir in both sexes. The use of secondary sex components as indicators of maturity status and progress is obviously limited to the pubertal or adolescent phase of growth and maturation. These indicators thus have limited applicability over the growth span, in contrast to skeletal maturation, which can be monitored from infancy into young adulthood (Malina & Bouchard, 1991:236).

The measurement of maturity that will be discussed in this study is sexual maturation; of all the methods it is the less expensive. Sexual maturity means a fully functional reproductive capability (Malina & Bouchard, 1991:4). The assessment of sexual maturation is based upon the development of secondary sex components (Malina & Bouchard, 1991:236).

This assessment is limited to the pubertal or adolescent phase of growth and maturation. During this time, hormones are released by the anterior pituitary gland. This has a stimulating effect on endocrine glands, resulting in the release of growth and sex hormones (Gallahue & Ozmun, 1995:112). These hormones have a direct influence on all the changes that the adolescent experiences during puberty. This process is highly variable in onset and may begin as early as age 9, or as late as age 15 (Gallahue & Ozmun, 1995:111).

As previously said, the first sign of puberty in boys is usually the enlargements of the testes, accompanied by changes in the texture and colour of the scrotal skin. At this time there is an increase in luteinizing hormone (LH) secretion during sleep, which gradually extends into the waking part of the day as puberty progresses. LH stimulates the production and secretion of testosterone by the testes and the gonadotrophic hormone called the follicles-stimulating hormone (FSH) stimulates sperm production. Testosterone and dihydrotestosterone, and androgen which is derived from testosterone, are responsible for the enlargement of the testes, penis, scrotum, semi-vesicles and prostate, voice changes, and the growth and coarseness of pubic, axillary and facial hair during male sexual maturation (Armstrong & Welsman, 1997:12). The development of both pubic hair and genitalia is normally complete before hair grows on the chin (Armstrong

& Welsman, 1997: 13). Growth of the testes and penis continues until somewhere between the ages 14 and 18 (Gallahue & Ozmun, 1995:142).

The most important event of puberty in males is marked by the first ejaculation (the sudden discharge or ejection of semen). However, this does not truly mark reproductive maturity. Ejaculation is a psychological as well as physiological event and occurs most frequently in the young male through nocturnal seminal emissions (Gallahue & Ozmun, 1995). Clearly this increase in sexual behaviour is associated with rising levels of testosterone. Only when live sperm are produced is reproductive maturity attained. Live sperm generally appear in boys of 13-16 years of age (Gallahue & Ozmun, 1995:110). The first ejaculation of semen during wakefulness has been reported to occur between the ages of 12,5 and 16,5 years.

The peak growth period occurs about two years after the beginning of puberty (Schor, 1995:1). The growth spurt in stature, which forms part of the peak growth period, is also the first visual indicator of the onset of puberty (Gallahue & Ozmun, 1995:105). This peak growth period will be discussed later when adolescent growth is dealt with.

Along with all these physical changes, there are psychological changes that adolescents go through as well. The appearance of secondary sex components is frequently a cause for heightened interest in one's body and a dramatically increased level of self-consciousness (Gallahue & Ozmun, 1995:113). Psychological development includes an intense self-focus (Ozretich & Bowman, 2001:2). The adolescent is worried about what others might think about him; he has an intense desire for privacy and a sensitivity about his body (Ozretich & Bowman, 2001:2). Adolescents experience anxiety about changes that the body undergoes, and it is important for teachers, parents and other adults to be responsive to the concerns of teens and to reassure them that in the end everything will be all right (Preissers, 2000:5).

Many of the events of puberty and early adolescence overlap and should not be expected to occur in specific time frames (Gallahue & Ozmun, 1995:111).

3.4 Adolescent growth

Growth refers to the increase in the size of the body as a whole, or the size attained by specific parts of the body (Malina & Bouchard, 1991:3). Changes in size are outcomes of three underlying cellular processes: (a) an increase in cell number, or hyperplasia; (b) an increase in cell size, or hypertrophy; and (c) an increase in intercellular substances, or accretion. Hyperplasia, hypertrophy and accretion all occur during growth, but the predominance of one or another of these processes varies with age and the tissue involved (Malina & Bouchard, 1991:4). Adolescent growth, according to Gallahue and Ozmun (1995:367), is marked by a period of accelerated increases in both height and weight, which are due to cellular processes, as mentioned above.

From birth to early adulthood, both stature and weight follow a four-phase growth pattern: rapid gain in infancy and early childhood, rather steady gain during middle childhood, rapid gain during the adolescent spurt (which will be discussed later), and slow increase until growth ceases with the attainment of adult stature (Malina & Bouchard, 1991:147). Body weight usually continues to increase into adult life.

The most obvious change from birth to adulthood occurs in stature, and because of the relative ease of its measurement, stature is the most widely used indicator of growth (Armstrong & Welsman, 1997:7). During infancy body length increases by about 25 cm and in the second year another 12-13 cm or so are added so that by the age of two years the child has attained about 50% of adult stature. Thereafter there is a steady deceleration of growth down to a rate of about 5-6 cm per annum before the start of the adolescent growth spurt in stature.

The adolescent experiences growth spurts in stature, body mass and in other body dimensions. All of these will be discussed.

3.3.1 Growth spurt in stature

Adolescence begins with an acceleration in the rate of growth in stature, which marks the onset of the adolescent growth spurt (Malina & Bouchard, 1991:6). Thus the growth spurt in stature involves rapid gains in height (Huebner, 2000:1). The rate of stature growth reaches a peak during adolescence, then begins a slower or decelerative phase, and finally terminates with the attainment of adult stature (Malina & Bouchard, 1991:6).

All young people follow the same pattern of growth from infancy through adolescence but there are significant individual differences in both timing and magnitude of the changes in stature (Armstrong & Welsman, 1997:7). Both the timing and magnitude of the changes in stature lead to the phenomena of early and late maturers (Ozretich & Bowman, 2001:1).

The age of onset, duration and intensity of this growth spurt is controlled by one's genotype (growth potential), which in turn is influenced by one's phenotype (environmental conditions), which varies considerably from individual to individual (Gallahue & Ozmun, 1995:103). The adolescent's genotype plays the determining role in linear body measures, skeletal maturation, sexual maturation and body type. Similarly, bone ossification, onset of puberty, final standing height, trunk, arm and leg length, and the manner in which body fat is distributed around the body are all products of genotype (Gallahue & Ozmun, 1995:105). Each of these may be modified to a certain extent, though an individual cannot go beyond his inherit potential; however, the environment will influence how close one comes to fulfilling one's genetic potential, for example lean body mass and skinfolds can be influenced by one's environment (Gallahue & Ozmun, 1995:105). The interaction between genotype and the environment results in considerable variability among individuals' growth patterns during the adolescent period.

Males on average begin their growth spurt in stature around the age of 11 (Gallahue & Ozmun, 1995:105). The adolescent growth spurt in stature lasts about 4,5 years in males (Gallahue & Ozmun, 1995:105).

The maximum rate of growth in stature during the spurt is called peak height velocity (PHV) (Malina & Bouchard, 1991:188). The mean age for PHV in males is around 14 years of age. The magnitude of the spurt for males is about 9 cm. It is not uncommon to show a one-year incremental gain in height during the period of peak velocity of 6-8 inches or more. Males appear to reach their mature adult heights at approximately age 18 (Armstrong & Welsman, 1997:7). In longitudinal studies PHV (peak height velocity) has often been used as a marker of somatic maturity (Gallahue & Ozmun, 1995:105). By the age of 10, males have attained approximately 55 percent of their final adult weight (Armstrong & Welsman, 1997:7).

The appearance of secondary sex components such as axillary and pubic hair coincides with the rapid growth in stature (Gallahue & Ozmun, 1995:105). The overall genetic effects on stature are not fully understood but it has been estimated that the contribution of the genotype to adult stature is about 60% (Armstrong & Welsman, 1997:7).

3.3.2 Growth spurt in body weight

The growth spurt in body weight takes place when rapid gains in body weight occur during adolescence (Malina & Bouchard, 1991:189). The growth spurt in body weight is similar to that in stature but normally occurs from 0,2-0,4 years later than the spurt in height in males (Armstrong & Welsman, 1997:7). The growth spurt in males' body weight is primarily due to gains in skeletal tissue and muscle mass, with body fat mass remaining relatively stable. Boys gain on average 43,8 kg between the ages of 7 and 18 years. Muscle mass increases from 42-54% of body mass in boys between 5 and 17 years (Armstrong & Welsman, 1997:7). Body weight changes during adolescence are great. Increases in body weight tend to follow the same general curves as increases in height, but weight is affected much more by environmental factors (Gallahue & Ozmun, 1995:110).

Peak weight velocity is the period during the adolescent growth spurt in body mass when weight gains are the greatest. It appears as if peak weight velocity occurs close to peak height velocity (Malina & Bouchard, 1991:199).

Males continue to make significant gains in weight until about age 22. Care must be taken to help the adolescent understand the changing nature of his body and not to overstep the fine line between a healthy regard for weight control and an obsessive preoccupation with weight gain (Gallahue & Ozmun, 1995:107).

Thus the peak weight velocity forms part of the growth spurt in body weight, and the weight gained during this spurt compromises lean body mass, fat mass and skeletal tissue.

3.3.3 Growth spurt in other body dimensions

The growth spurt in other body dimensions are exactly the same as in stature and in body weight, namely a rapid growth rate. Most body dimensions, with the exception of body fat and dimensions of the head and face, follow a growth curve similar to that of stature and weight (Malina & Bouchard, 1991:255).

Growth is rather rapid during infancy and early childhood, slows down to a more steady pace during middle childhood, increases sharply during the adolescent spurt, and slows down and eventually terminates as adult dimensions are attained (Malina & Bouchard, 1991:55). The body dimensions differ in magnitude and timing of their respective adolescent growth spurts. Gradients in the growth of different body segments contribute to variation in body proportions and are especially apparent during adolescence (Malina & Bouchard, 1991:258).

During infancy, trunk length is the fastest-growing component of stature but from then until puberty the legs account for 66% of total increase in stature. Growth in leg length ceases earlier than growth in trunk length. Therefore, trunk length makes a greater contribution to increase in stature during the adolescent growth spurt than growth in leg length. Peak velocity for leg length occurs earlier than that for stature, and peak velocity for sitting height or trunk length occurs after that for stature. Rapid growth of the lower extremities is thus characteristic in the early part of the adolescent spurt (Malina & Bouchard, 1991:259). This suggests that the adolescent spurt in sitting height or trunk length occurs over a longer period of time than the spurt in leg length. As a result, growth in sitting height contributes more to the adolescent gain in stature than does growth in leg length (Malina & Bouchard. 1991:260)

With regard to the bones of the lower extremity, maximum growth is attained first by the tibia and then the femur, followed by the fibula and then the bones of the upper extremity. Peak velocities of growth in humerus and tibia widths occur near those for stature and leg length, (Malina & Bouchard, 1991:259). Analysis of the growth of the major long bones of the upper and lower extremities illustrates the variation in the timing of growth of different body parts as well as gradients in growth. Maximum growth in stature occurs, on average, more or less at the same time as maximum growth of the humerus and radius.

Thus, in early adolescence a youngster has relatively long legs, because the bones of the lower extremity experience their growth spurts earlier than those of the upper extremity. With later growth in sitting height, the appearance of long-leggedness disappears (Malina & Bouchard, 1991:259). The longer period of preadolescent growth in boys is largely responsible for the fact that men's legs are longer than women's in relation to trunk length (Armstrong & Welsman, 1997:10).

The growth of the hands and feet accelerate first, then that of the calf and forearm, followed by the hips and chest, and then the shoulders. The forearm is closer to its adult length than is the upper arm (Malina & Bouchard, 1991:260). In boys, hand length is advanced relative to forearm length. The forearm attains maximal growth velocity earlier and is thus closer to adult size; the upper arm attains maximal growth velocity later and is thus farther from adult size (Malina & Bouchard, 1991:260). There is therefore a transient stage where some youngsters have relative large hands and feet, but by the time the adolescent spurt has ended, hand and feet are relatively smaller in proportion to arms, legs and stature. The timing and speed of these changes may have dramatic effects on several aspects of physical performance (Armstrong & Welsman, 1997:11).

3.5 Adolescent development

Development is often referred to in conjunction with growth and maturation. Development, though, denotes a much broader concept, often used in two distinct contexts. The first is biological, where development is the differentiation of cells along specialized functions. The second context is behavioural and relates to the development of competence in a variety of interrelated domains as the child adjusts to his or her cultural milieu. Thus one can speak of the development of social competence, intellectual or cognitive competence, emotional competence, or well-being, as the child's individual personality emerges within the context of the particular culture in which the child was born and reared (Malina & Bouchard, 1991:5).

The development and refinement of skilful performance in a variety of physical activities is a major developmental task of childhood (Malina & Bouchard, 1991:5). A child's physical performance components are related in part to his growth, maturation and development (Malina & Bouchard, 1991:5). For the purpose of this study, only the major development task will be discussed, in other words, specialised movement skills as well as physical and motor components of adolescents and how these components develop and change.

3.5.1 Specialised movement skills

Specialised movement skills are mature fundamental movement patterns that have been refined and combined to form sports skills and other specific and complex skills. Specialised movement skills are task-specific, but fundamental movements are not (Gallahue & Ozmun, 1995:386). Most children have the potential by about age six to perform at the mature stage of most fundamental movement patterns and to begin the transition to the specialised movement phase. Fundamental movements are divided into locomotive, manipulative and stability. A short discussion on each fundamental movement skill follows below:

a) Locomotive
- Basic (one element)
  - Walking
  - Running
  - Leaping

- Jumping
- Hopping

- Combinations (two or more elements)
  - Galloping
  - Sliding
  - Skipping
  - Climbing

b) Manipulative

- Propulsive
  - Throwing
  - Kicking
  - Punting
  - Striking
  - Volleying
  - Bouncing
  - Rolling
- Absorptive
  - Catching
  - Trapping

c) Stability

- Axial
  - Bending
  - Stretching
  - Twisting
  - Turning
  - Swinging

- Static and dynamic posture
  - Inverted support

- Body rolling
- Starting
- Stopping
- Dodging
- Balancing

According to Pienaar (2001:120), Spamer (1997) used these fundamental movement skills and applied them to specialised movements skills that are used in rugby and presented in table 3.1

It is important for the coach and teacher to have knowledge of these skills and how they develop. If adolescents are struggling to master a certain specialised movement skill during rugby, the problem might be that they have not developed the necessary fundamental skill. According to Gallahue and Ozmun (1995:387) the reasons for not developing fundamental movement skills might be limited opportunities for regular practice, poor or absent instructions and little or no encouragement.

These specialised movement skills have certain phases of development (Gallahue & Ozmun, 1995:388). It is, however, important to keep in mind certain points. Firstly, even thought a person may be cognitively and affectively ready to advance to this phase (specialised movement skill), progression depends on successful completion of specific aspects of the previous phase (fundamental movement skill). Secondly, progress from one phase to another is not an all or none proposition. One is not required to be at the mature stage in all fundamental movements before advancing to subsequent stages (Gallahue & Ozmun, 1995:388).

Table 3.1: Examples of fundamental and specialised movement skills in rugby by Spamer (1997) in Pienaar (2001:120-121)

LOCOMOTIVE SKILLS	
Fundamental movement skills	**Specialised movement skills**
Running	• Carrying the ball • Support to ball carrier
Sliding	• "Tackle"
Jumping	• Defence during passing
MANIPULATIVE SKILLS	
Fundamental movement skills	**Specialised movement skills**
Throwing	• Passing • Throwing in at line-outs
Kicking	• Drop goal, conversion kick • Aerial and ground kicks
Catching	• Catching above the hips (over the shoulder • Catching below the hips (over the mid-line • Catching at hip height (one hand)
STABILITY SKILLS	
Fundamental movement skills	**Specialised movement skills**
Turning	• Defence and attacking
Static and dynamic balance	• Defence, holding the line and dodging the opposition • Rolling and pushing

Within the specialised phase there are three separate but often overlapping stages. The onset of stages during this phase of development depends on neuromuscular, cognitive and affective factors within the individual. These stages will be discussed briefly.

- ***Transition stage***

This stage is characterised by the individual's first attempts to refine and combine mature movement patterns (Gallahue & Ozmun, 1995:389). Children have a heightened interest in sport and standards of performance. During this stage children are attracted to several different types of sport and do not feel limited by physiological, anatomical or environmental factors (Gallahue & Ozmun, 1995:389). This stage begins at around 7-8 years of age (Gallahue & Ozmun, 1995:390).

- ***Application stage***

During this stage the individual becomes more aware of personal physical assets and limitations and, accordingly, focuses on certain types of sports. Emphasis is on improving proficiency (Gallahue & Ozmun, 1995:389). During this stage practice is the key to developing higher degrees of skill.

- ***Lifelong utilisation stage***

During this stage the individual reduces the scope of his athletic pursuits by choosing a few activities to engage in regularly in competitive, recreational or daily living settings (Gallahue & Ozmun, 1995:389). Lifetime activities are chosen on the basis of personal interest, abilities, ambitions, availability and past experiences.

Many individuals do not go through the development and refinement of specialised movement skills in the sequence presented above. Many children are often encouraged to refine their skills in a particular sport at an early age. Early participation in certain sports is not detrimental, but premature specialisation may have a high cost (Gallahue & Ozmun, 1995:389). According to Gallahue (1984:5) in Pienaar (2001:114) the sport-specific skills start at 7 years and specialisation in certain sports starts at 14 years of age.

From this discussion it is clear that all children have the potential to develop and learn a variety of fundamental and special movement patterns and skills. These skills have an influence on the physical and motor performance of adolescents. A discussion on the physical and motor performance of adolescents will focus on how these performance variables improve, and when spurts in performance are evident during the adolescent period.

3.5.2 Physical and motor performance

Children are growing and maturing, and their physical and motor needs and capabilities change as they progress through life (Armstrong & McManus, 1996:19). During the last few years knowledge about the physical and motor capabilities of children have increased considerably, and researchers have found that children are capable of much more than previously thought (Gallahue & Ozmun, 1995:391).

As previously discussed, the fundamental movement skills are in most individuals fully developed by the age of 6 years (Gallahue & Ozmun, 1995:386). Malina and Bouchard (1991:267) suggest that age-related trends in strength, motor performance and aerobic power suggest an acceleration in growth during adolescence in males. It is thus of interest to inquire whether physical performance tasks show a well-defined growth spurt during adolescence. Most performance tasks show a clear adolescent spurt in boys (Malina & Bouchard, 1991:267). These growth spurts in performance will be discussed, together with each physical and motor component that is relevant to this study.

- ***Speed***

According to Malina and Bouchard (1991:193) and Haywood (1986:176), 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. 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 PHV (Malina & Bouchard, 1991:269).

- ***Anaerobic endurance***

Anaerobic energy is used to perform high-intensity activities of short duration (Armstrong & McManus, 1996:25). Anaerobic fitness is difficult to assess and data on children and adolescents are very limited. Adolescents' anaerobic power is lower than that of adults because adolescents have less muscle mass (Haywood, 1986:2424). Boys' anaerobic performance increases with age from childhood through to adulthood (Armstrong & McManus, 1996:25). Even when analysed in relation to body mass, the anaerobic performance of 8-year-old boys is only about 70% of that of 11-year-old boys. Pre-pubertal children are sometime regarded as "metabolic non-specialist" since those who score high on anaerobic tests tend to have a high peak VO_2.

As youths progress through adolescence, it becomes apparent that those who are capable of high anaerobic performance may not have similar aerobic potential (Armstrong & McManus, 1996:25). Although pre-pubertal children are adequately equipped to handle activities which require very short but intensive exertions, they are more "aerobic" than adolescents and well-suited to relatively long periods of moderate to vigorous physical activity (Armstrong & McManus, 1996:25). Most cross-sectional and longitudinal studies have consistently confirm in boys an increase in peak and/or mean power of at least 150% at the ages of 8-16 years. Armstrong and Welsman (1997:81) reported studies where annual changes in anaerobic performance report a maximal increase in peak and mean power of 30-40%. The age at which this is reported to occur varies from 11-12 years to 12-13 years. This, however, supports an adolescent spurt in anaerobic performance (Armstrong & Welsman, 1997:81).

Regarding maturation and anaerobic power, Armstrong and Welsman (1997:82) reported a study that noted peak and mean anaerobic power, expressed in ratio with body mass, increased by 52% and 58%, respectively, between the ages of 10 and 15 years, in association with an almost twofold increase in testosterone levels over the same period. This, according to Armstrong and Welsman (1997:82), represents the transition between early puberty and late puberty, a period which is characterized by significant developmental events, such as the attainment of PHV and subsequent growth of muscle mass.

- ***Strength***

Muscle strength is the ability of a muscle group to exert force against a resistance in one maximal effort (Armstrong & McManus, 1996:25). Most studies have concentrated on measuring grip strength, which might not represent total strength development (Armstrong & McManus, 1996:25). However, 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, 1996:26; Armstrong & Welsman, 1997:139). Composite strength increases only slightly faster than body mass during the pre-pubertal period (Armstrong & McManus, 1996:26).

According to Malina and Bouchard (1991:189), strength increases linearly with age until 13 to 14 years of age in boys, when there is an adolescent strength spurt. 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, 1997:140). From 10-16 years of age, an average of 10,1% yearly increase in composite mass-related strength has been observed, compared to a value of 18,3% when expressed relative to stature (Armstrong & Welsman, 1997:140) . On average, peak gains in the arm pull (static strength) occur after PHV. The adolescent spurts in strength appear to begin about 1,5 years prior to PHV and reach a peak about 0,5 to 1,0 year after PHV (Malina & Bouchard, 1991:267). Scores for chin-ups, a measure of upper body trunk strength, provide additional support for the contention that strength increases at a near linear rate for boys from about age 12 through approximately age 18 (Gallahue & Ozmun, 1995:413).

It has been suggested by Armstrong and Welsman (1997:141) that neural maturation enables a more co-ordinated recruitment of muscle fibre. Although growth studies generally stop at age 18, strength continues to increase into the third decade of life, especially in males (Malina & Bouchard, 1991:190).

- ***Muscle endurance***

Muscle endurance is the ability to apply force repeatedly over a period of time (Malina & Bouchard, 1991:191). Muscle endurance improves linearly with age from 5 to 13 or 14 years of age in boys, followed by a spurt. In the bent-arm hang (muscular endurance), a spurt in performance appears to begin about 1,5 year prior to PHV and reaches a peak at about 0,5-1,0 year after PHV (Malina & Bouchard, 1991:267)). Males tend to improve slightly in terms of bent-harm hang from age five onward, with a preadolescent lull followed by rapid improvement through to age 18 (Gallahue & Ozmun, 1995:416)

- ***Power (explosive strength)***

Power is the ability to exert maximum force as fast as possible (Malina & Bouchard, 1991:191). On average, power improves linearly with age until 13 years of age, and then increases more sharply, indicating a spurt (Malina & Bouchard, 1991:192). The spurt in performance of the vertical jump occurs after PHV (Malina & Bouchard, 1991:267).

- ***Flexibility***

Flexibility has been defined as the range of possible movement available in a joint or groups of joints and is an important, though frequently neglected, aspect of performance (Armstrong & McManus, 1996:26). There are few available data about the flexibility of adolescents, and inadequate methods of testing flexibility have resulted in difficulties when comparing data. 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, 1996:27).

In general, flexibility has been found to increase between the ages 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, 1996:22). It is interesting to note the slight drop-off in sit-and-reach scores for males around age 12. This may be associated with the prepubescent growth spurt during which time the long bones are growing faster than the muscles and tendons. As a result, performance on the sit-and-reach regresses until the muscles and tendons catch up (Gallahue & Ozmun, 1995:416). The spurt in performance of flexibility usually occurs before PHV (Malina & Bouchard, 1991:267).

Flexibility exercises should be conducted cautiously with children and during periods of rapid growth, when joints become progressively taut; as a consequence, a loss of flexibility may occur and the risk of injury is increased (Armstrong & McManus, 1996:27). Training for increased joint mobility should start before puberty, as long as it is carried out with a concern to avoiding damage to the joints and vertebral column (Armstrong & McManus, 1997:28). However, older children and adolescents can enhance their flexibility with a regular programme of static stretching exercises.

- *Agility*

Agility 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 from 5 to 8 years, and it then improves at a lesser rate in boys up to 18 years (Malina & Bouchard, 1991:194; Armstrong & McManus, 1997:29). There is no indication of a spurt in boys.

3.6 Early and late maturers

Not all adolescents enter puberty at the same time. In fact, there is a great deal of variation. Some children may begin and complete their pubertal changes before others even begin experiencing any physical changes. This is sometimes a concern to the child and the parent, though it is all very normal (Preissers, 2000:2).

Body build varies according to age and maturity. Late-maturing boys have been found to have a slender build, longer legs and to be relatively weaker at these ages, when they are lagging behind their classmates in size. Early-maturing boys have more of an athletic build, are usually large and strong, and possess broad hips (Preissers, 2000:2; Salili, 2001:19).

According to Salili (2001:18) the consequence of early or late maturation are generally more marked for boys than girls. Early maturation tends to have more advantages, and late maturation more disadvantages, for boys than girls. Early maturing usually occurs in boys at the age of 9,5 years (Weichold *et al.*, 2002:1). Early maturers have several potential advantages. They have a competitive edge in most sports (generally a valued characteristic of accomplishment for an adolescent boy), they are viewed as leaders, adults expect more mature behaviour from early maturers, they are more attractive to girls and they are associated with more positive personality traits (poise, self-confidence, etc.).. The pubertal peak is a little longer for early-maturing than for late-maturing boys. However, there are potential disadvantages too. The period of adolescent experimentation may be curtailed for early maturers because adults expect more mature, "settled" behaviour from them, thus there is less time to adjust to physical maturity, which may result in social immaturity.

According to Weichold *et al.* (2002:1), boys who mature early show greater social success yet may experience academic difficulty because social success leave these boys with less need to develop creativity and multiple social solutions, and to experiment with different roles. This may have a negative impact on their academic standing, as more of their attention is directed at older social groups and at risk behaviour.

According to Weichold *et al.* (2002:2), late maturing in boys usually starts around 13,5 years of age. Salili (2001:21) suggest that the late maturer has some advantages to. He has a longer period of pubertal adjustment, which may permit development of a wider range of cognitive abilities and coping skills. The disadvantages include that he may struggle with sport and boy-girl relationships. Late maturers are less popular with peers and are less frequently chosen as leaders. These adolescents may react by developing a negative self-concept, feelings of inadequacy, dependency and rejection.

Physically mature children are more likely to succeed in sports (Anon, 1998:1). Athletes who are early maturers might also experience physical dissatisfaction when the late maturing athletes catch up, when the early maturer might not be seen as the "star" anymore. A 12-year study indicated that only one out of four star athletes in elementary school maintained the rating as "star athlete" in junior high school (Anon, 1998:1). Every young athlete and every young athlete's coach should take note of this fact. The coach should use this information to encourage the late maturer, and remind the early maturer that success may not be achieved so easily in future.

Research shows that at age 12 there can be a four-year difference in the physical maturity of children (Anon, 1998:2). An early maturer may be 30 cm taller and weigh 15 or 20 kg more than a late maturer. In sports such as hockey or basketball, which require strength, power and speed (and size, such as rugby), the more mature child will usually perform better and his fitness levels will be greater than those of his less-developed peers. This uneven spread of early and late maturers is a great challenge to any physical educator or sports coach. Early maturers are chosen most for first teams, and late bloomers might develop a low self-esteem and may drop out of sport because of the exclusion from teams (Anon, 1998:2).

Parents, physical educators and sports coaches must encourage and nurture late developers to keep them in sport long enough to benefit from their eventual maturity. Towards the end of adolescence, late developers often surpass and become better athletes than early developers (Anon., 1998:2).

3.7 Conclusion

It is often assumed that regular participation in physical activity is necessary for optimal growth, maturation and development. Therefore it is important to understand the normal process of growth and maturation in order systematically to evaluate and understand the effects of regular physical activity on the processes and outcomes (Malina & Bouchard, 1991:7).

The adolescents' growth, maturation and development will therefore have an effect on his physical and motor performance. This information enables the physical educator and coach to recognize individual differences in rate of growth, maturation and development, and to produce good quality physical education programmes or exercise programmes specific to adolescents' growth, maturation and development needs (Armstrong & McManus, 1996:19).

CHAPTER 4

POSITIONAL REQUIREMENTS FOR RUGBY PLAYERS

4.1 Introduction

The aim of this study is to compile a test battery that may assist coaches with positional selections in rugby. All playing positions according to anthropometric, rugby-specific- and physical and motor components will be discussed in this chapter.

A rugby team is often divided into positional categories, namely forwards and back-line players (Rigg & Reilly, 1988:194; De Ridder, 1993:34). In the past forwards' primary responsibility during the game were to gain ball possession. Their game mostly consisted of scrums, line-outs, driving movements, rucks and mauls, defence and attack, and little ball handling. The back-line players played more with the ball gained by the forwards, and had to possess components like agility and speed, as well as skills like kicking, ball handling and good defence (Rigg & Reilly, 1988:194; De Ridder, 1993:34). However, these responsibilities have changed over the last few years, with forwards being found more and more in the back-line, and back-line players being required to "clean" in the rucks and mauls.

The anthropometric, rugby-specific skill, physical and motor components in rugby will first be discussed, after which the positional requirements in rugby will be discussed.

4.2 Anthropometric, physical and motor requirements in rugby

Before the components of different playing positions can be addressed, it is important to discuss the requirements that the game of rugby makes of the players. Firstly, it is important to know what skills the game requires. According to Craven (1977:6-7) and Joynson, (1978:7) the early years of the game consisted of the following skills; pickup of 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. According to the SARFU coaches manuals (Joubert & Groenewald, 1998; Groenewald, 2001) the modern game of rugby consists of scrums, line-outs, loose play, contact, handling skills, defensive skills, specialised play (kick-off, penalty kicks, free kicks) and counter-attacks. It is clear that modern-day rugby players still need the same basic skills that were required in the past.

Secondly, according to Shields *et al.* (1984:455) the performance of players in specific positions in rugby is directly linked to certain anthropometric, physical and motor components required for the particular position. The increase in the level of competition has caused players to become bigger, stronger and faster and to develop better motor ability (Babić *et al.*, 2001:250). Studies by Bell (1980:447), Maud and Shultz (1984:86), Quarrie *et al.* (1995:263) and Nicholas (1997:375) suggest that the following components contribute to success in rugby:

- ***Speed***

Speed is one of the most important components in most sports (Badenhorst, 1998:20). Speed is inherited, but can improve dramatically with good training (Clarke, 1996:62). The game of rugby is getting faster every year and therefore speed plays a very important part in the success of the modern-day rugby player (Noakes & Du Plessis, 1996:10).

Speed in rugby consists of different phases such as the start, acceleration phase, "planing out" phase and the finish. It also includes effective deceleration (Pearson, 2001:vii). Nicholas (1997:388) found that to accelerate and to reach maximum speed as quickly as possible from a stationary start are very important in rugby. Rugby consists of defensive and attacking situations. Speed plays a very important role during attack to get past the defence, and during defence to stop the opposition before they cross the advantage line (Meir, 1993:11).

According to Nicholas (1997:388) the study done by Rigg and Reilly (1988) on first- and second-class rugby union players found significant differences in speed ability between different playing positions and levels. They found the halves and the back-line players to be the fastest. Although today some of the loose forwards in international rugby have almost the same speed ability as back-line players.

- ***Agility***

Agility is the ability to change direction as fast as possible with the least loss of speed (Meir, 1993:14). Dynamic strength, power and speed have an influence on agility

(Hanekom, 2000:14). Meir (1993:14) suggests that every player needs agility, especially during defensive and attacking situations in rugby. Research has also found that players who performed well in speed, strength and power also performed well in agility (Quarrie *et al.*, 1996:54). The different ways of evaluating agility as well as the fact that agility is very sport-specific makes it hard to compare results from different studies.

The study by Quarrie *et al.*, (1996:53) on New Zealand club A rugby union players found no significant differences between positions in terms of agility.

- ***Strength***

Many researchers found strength to be one of the most important components of successful rugby players (Hage 1981:115; Blair, 1990:3). According to Hage (1981:115) there is a direct link between a player's strength and his performance. In his study on American rugby players, he found that the stronger the player the better he plays.

There are different types of strength required in rugby. According to Nicholas (1997:390) basic strength, power (dynamic strength) and static (isometric) strength are the most important. The forwards need more basic strength, static strength and power due to their responsibilities (Nicolas, 1997:391). It was also found that there are differences in strength between forwards and backs, with forwards being much stronger in the upper body than backs (Shields *et al.*, 1984:456). Meir (1993:13) and Nicholas (1997:390) also found that senior players show greater strength than junior players, therefore the assumption can be made that strength will develop with progressing age.

- ***Flexibility***

Flexibility is one component in rugby that receives very little attention (Nicholas, 1997:391). The lack of flexibility in players can result in a higher risk of injury and may have an adverse effect on speed and endurance performance (Nicholas, 1997:391). Flexibility may also attribute to strength and power, seeing that more strength can be produced in a greater range of motion (Hanekom, 2000:24) and that flexible muscles can produce more power for longer periods of time (Nicholas, 1997:391).

Flexibility is very specific to joints, and therefore it is important to have a flexibility programme that addresses all joints (Opliger *et al.*, 1986:14). Shields *et al.* (1984) are of the opinion that the over-development of the quadriceps muscle and the poorer hamstring muscle development among rugby players are the main contributors to hamstring injuries. A flexibility programme can address and minimise this problem.

The evaluation of flexibility is mostly done with the sit and reach test. This test evaluates the flexibility of the lower back and hamstrings (Shields *et al.,* 1984). According to Hanekom (2000:25) flexibility of the lower back and hamstring is of specific importance for rugby players. Studies by Nicholas (1997:391) and Williford *et al.* (1994:860) found differences among playing positions as well as playing levels in terms of flexibility.

Table 4.1 reflects values for the sit and reach test from different studies. The studies also present the different values for forwards and back-line players.

- ***Endurance***

A rugby player needs aerobic and anaerobic endurance (Hanekom, 2000:16). Aerobic endurance is important for a rugby player during sub-maximal exertions, for instance when jogging during support play (Meir, 1993:15).

The best method for testing aerobic endurance is the VO2 maximum test (Nicholas, 1997:385). The VO2 maximum test determines the maximum aerobic capacity of the player during exercise (Seiler, 1996:1). Shields *et al.* (1984) found that junior and senior players differ in terms of VO2 maximum. According to Bell (1980:448) there are also differences between forwards and backs in terms of VO2 maximum.

Table 4.1 Mean values for body mass, stature and flexibility among rugby players (Hanekom, 2000:25)

Researchers	Team and position	Age	Body mass (kg)	Stature (cm)	Sit and reach (cm)
Nicholas 1997	USA national team				
	Forwards	28.1	92	186	42.2
	Back-line players	28.1	78	176	46.4
Shields *et al.* 1984	Forwards	25	90	188	45
	Back-line players	24	80	178	49.5
Williford *et al.* 1994	Forwards	16.5	98	185	28
	Back-line players	16.5	78	180	38
Spamer & Winsley 2002	Sport College in Southwest England	18	87.8	181.9	-6.6
	Northern Bulls Craven week team, South Africa	18	87.4	185.6	2.9

Table 4.2 presents VO2- maximum values for rugby players from different studies. Some values are also presented positional.

Nicholas (1997:385) suggests that the heart rate of a rugby player during a game is between 135 and 180 heart beats per minute. It is important to keep in mind that a rugby game consists not only of sub-maximal (aerobic) exertions but also of repeated maximal (anaerobic) exertions. Therefore it is difficult to plot a specific heart rate for the maximum oxygen consumption of a player (Nicholas, 1997:385).

Table 4.2 Mean values of VO2-maximum for rugby players (Hanekom, 2000:18)

Researchers	Team and position	Age	VO2-max values (Ml/KG/ MIN^{-1})
Shields *et al.* 1984	Beginners	-	44.4
	Social players	-	46.8
	Advanced players	-	47.2
Maud & Shultz 1984	USA national team	28.1	45.9 – 49.5
Bell 1980	Senior first and second division Wales rugby players	20.8	
	-Prop		43.97
	-Hooker		43.20
	-Lock		44.92
	-Eighth man		55.80
	-Flank		50.90
	-All positions		46.26
Nicholas 1997	-UK national team	18 – 24	51.0
	-USA national team	-	
	-Forwards	30.7	54.1
	-Back-line players	26.0	59.5
	-South African national team	22.8	53.9
	-Forwards	23.1	52.0
	-Back-line players	22.4	55.8
	-Japan national team	-	54.8
	-Forwards	-	54.7
	-Back-line players	-	55.8

Rugby is also an interval-type sport, which means players must be capable of repeating a large number of intensive efforts (Morton, 1992:4). This means that a rugby player has to have a good anaerobic endurance base, which includes speed endurance and muscle endurance. Muscle endurance, which is the ability to contract muscles repeatedly over a period of time, is an important component for all rugby players, because all players get involved in rucks and mauls (Hanekom 2000:18). According to Hazeldine and McNab (1991:31) muscle endurance and aerobic endurance are related to each other.

Meir (1993:15) and Nicholas (1997:391) found that there were differences between forwards and back-line players in terms of muscle endurance, with the back-line players performing best. Nicholas (1997:392) also found differences between first- and second-league teams in terms of muscle endurance, with the first league outperforming the second league.

- ***Anthropometric components***

The game of rugby, as previously discussed, makes certain demands of players, which differ in terms of positions (Hanekom, 2000:21). The players in these different positions also differ in terms of their body composition (Bell, 1995:49).

According to De Ridder (1993:287) there are definite differences in terms of body composition between forwards and back-line players of primary and high school Craven week teams. De Ridder (1993:287) found that there were almost 4% differences in body fat between forwards and back-line players among the primary school Craven week players, with the forwards presenting a higher fat percentage. This was also the case for the Craven week high school teams. Fat percentages also differed among national teams as well as between forwards and back line-players (Maud & Shultz, 1984; Carlson *et al.*, 1994). It is important that the same models be used to determine these anthropometric components, otherwise comparisons are hard to make.

Nicholas (1997:389) emphasises the importance of measuring body composition of rugby players because of the importance of their positional responsibilities. A study by Quarrie *et al.* (1995:263) found that a national team's forwards were much more endo-mesomorphic than its back-line players.

Table 4.3 Mean values for body mass, stature and fat percentage of rugby players (Hanekom, 2000:25).

Researchers	Team and Position	Age	Body mass (kg)	Stature (cm)	Fat %
Pienaar & Spamer 1998	Junior Craven week players Forwards and back-line players	Mean age of 10 years	44.2	152.2	-
De Ridder 1993	Junior Craven week players				
	-Forwards	13.1	60.2	167.3	16.7
	-Back-line players	13.1	49.0	160.3	12.9
	Senior Craven week players				
	-Forwards	18.1	87.3	183.3	18.4
	-Back-line players	18.1	72.9	176.2	14.1
Nicholas 1997	First division rugby players				
	-Forwards	23.1	92.2	186.1	13.1
	-Backs	23.1	78.6	176.6	11.3
	Second division rugby players				
	-Forwards	22.4	82.2	177.2	12.7
	-Back-line players	22.4	74.7	175.8	11.4

Researchers	Team and Position	Age	Body mass (kg)	Stature (cm)	Fat %
Carlson et al 1994	USA national rugby team				
	-Forwards	26.8	99.1	186.8	10.9
	-Back-line players	25.8	80.8	178.9	8.4
	-All players	26.3	90.6	183.2	9.7
Maud & Shultz 1984	USA National rugby team				
	-Forwards	-	94.4	187.3	10.5
	-Back-line players	-	78.2	175.9	7.8
	-All players	-	86.3	181.6	8.2
Spamer & Winsley 2002	Sport College in Southwest England	18	87.8	181.9	22.1
	Northern Bulls Craven week team, South Africa	18	87.4	185.6	15.8

4.3 Positional requirements in rugby

The importance of possessing a certain type of physique and a typical set of physical performance components to best meet the demands imposed by each of the positions in rugby is widely accepted by selectors, coaches, and players of the game (Quarrie *et al.*, 1996:55). The type of physique and the typical set of physical performance components of rugby players depend on the specific positional requirement. Studies by Daniel (1984) and Shields *et al.* (1984) among football players found that certain morphologic and performance variables characterise player positional groups. If this was found among football players, it might also be the case for rugby players.

Craven (1974:103), Greenwood (1985:276), Van der Merwe (1989), Quarrie et al (1996:55), Hare (1997) and Pretorius (1997) emphasise that all playing positions in rugby require certain anthropometric, rugby-specific and physical and motor components.

Studies by Rigg and Reilly (1988) and Babić *et al.* (2001:254) found significant differences between playing positions in terms of anthropometric, physical and motor components on all levels of competition. Assessing such variables among individual players may help determine which positions each player is best suited for. According to Shields *et al.* (1984:455) the degree to which a player is physically suited to his position will determine his value as a player for the team's success.

A study by Gibson *et al.* (1999:6) questioned Level 2 Australian rugby union coaches on the most important attributes and individual skills among rugby players. Nine of the final 15 individual skills and attributes were rugby-specific skills, while physiological and psychological make-up each accounted for three of the 15 skills. Overall these results suggest that the majority of Level 2 Australian coaches believe that proficiency in rugby-specific skills is the most important requirement for a successful rugby union player. The five most important skills selected were passing while running (93%), front on tackle (91%), catch while running at speed (87%), self-discipline (86%) and side-on tackle (82%) Gibson *et al.* (1999:8).

The physiological attributes like aerobic fitness (8th), speed (12th) and strength (13th) were among the top 15 most commonly chosen skills and attributes. Gibson *et al.* (1999:9) also makes the comment that if the player has the necessary psychological and physiological attributes to be elite, they will have the ability to learn the skills that are required for that sport.

Du Randt and Headley (1993:320) stated that for talent identification in team sports to be successful, talent identification should be done according to position. With specific positional selection and identification at an early stage it is possible to determine which position the player is best suited for in terms of anthropometric, rugby-specific skills and physical and motor components (Bloomfield *et al.,* 1994:268). If this could be done, no time would be wasted on teaching the player skills that are not necessary for his position. It is also important that this selection be specific to age because according to Pienaar *et* *al.* (2000:32) the physical and rugby-specific profile of adult (senior) players is not necessarily the same as for youth players.

At primary school level players are more part of all aspects of the game, but the further they progress to senior level, the more specialised the skills according to position become (Hare, 1997:24). There are not many positional differences among 10-year-old players according to these researchers (Pienaar et al, 2000:33), the reason being that they are young and that they are beginners in the game. It still remains important to know when positional differences do occur among youths, in order to have a better understanding of when talent identification according to position should take place.

It is clear that gathering information in regard to positional requirements for different age groups in terms of anthropometric, physical and motor and rugby-specific components is very important. Research on positional requirements in rugby is limited, especially on adolescents. The few studies that do exist will be discussed according to relevance.

4.3.1 Positional requirements of the forwards

Pool (1997:23) stated that first-rate rugby starts with first-class forward play. The forwards' play mostly consists of scrums, line-outs, rucks, mauls, defence and attacks (Craven, 1974:96 & De Ridder, 1993:35). Due to the responsibilities in set phases it is clear that forwards should obtain and retain ball possession (Hare, 1997:36). The two props are responsible, with the hooker, for obtaining ball possession during scrums and during rucks and mauls (Craven 1974:103). This ability not only depends on the size of the player but also on experience. Older players with more experience are usually more capable of producing and transferring the required force, as well as to maintain the stability of the scrum (Babić *et al.*, 2001:254).

The most important components for a forward should be the right build with strength, tallness and speed (Craven 1974:99-100; Hazeldine & McNab, 1991:105). According to Craven (1974:137) forwards are expected to be strong and have a high degree of endurance. Maud and Shultz (1984:90) conducted a study on the US national rugby team and found stature and power to be the most important components of forwards.

Quarrie *et al.* (1996:54) conducted a study among New Zealand A club rugby union players and found that significant differences exist between the different positions in the grouping of forwards, in terms of anthropometric measurements. According to another study by Quarrie *et al.*, (1995:268) also on New Zealand A club rugby union players, it was found that forwards were taller, possessed greater body mass and had a larger neck circumference than backs. A study by Carlson *et al.* (1994:403) on the most outstanding rugby players in the USA (according to coaching staff) found the forwards to taller and heavier than the backs, and to be more endo-mesomorphic. Bell (1980:449) and Carlson *et al.* (1994:404) suggested that an increased lean mass in forwards increased the impacting mass, but that an increase in lean mass may be accompanied by greater total body fat, which could act as a buffer against contact forces.

Carlson *et al.*, (1994:406) found that body mass, femur breadth and arm girth were the three body size variables that were most important for distinguishing between backs and forwards. Body mass is important to forwards in set scrums, the mauls and the rucks. The heavier the pack of forwards, the greater the stability of the scrum, mauls or rucks will be, and the greater the momentum, provided that speed is not negatively affected (Carlson *et al.*, 1994:410).

Significant differences were also found between forwards in term of the aerobic shuttle test and the 30 m sprint from a running start (Quarrie *et al.*, 1996:54). Carlson *et al.* (1994:410) found that the motor performance variables that best distinguished between backs and forwards were repeated jumping in place, push-ups and standing vertical jump. Maud and Shultz (1984:90) found vertical jumping ability to be important for forwards, who must obtain possession of the ball from line-out play. Maud and Shultz (1984:91), however, found a significant difference in anaerobic power between forwards and backs, with the forwards being superior. However, when the work completed was calculated per body mass, no significant differences were found. Forwards are capable of producing greater power momentum than backs. As momentum is a vector quantity, if two players moving in opposite directions at velocities of equal magnitude collide, the change in their respective velocities will be inversely proportional to their masses (Quarrie et al, 1995:269). Thus forwards, being heavier, will produce greater power.

The tight forward positions that will be discussed in terms of anthropometric, rugby-specific and physical and motor components are those of props, hookers and locks.

- **Props**

Anthropometric components

De Ridder (1993) conducted a study to determine the morphological profile of primary and high school Craven Week rugby players. He found the props to be the heaviest of all the players, both in primary (29,0 kg) and in high school (50 kg) (De Ridder, 1993:131-163).

This seems to be the case with adult props as well. Quarrie *et al.* (1996) attempted to describe the anthropometric and physical performance components of senior level A club players in New Zealand. They also found that senior level props were on average (102,8 kg) the heaviest in the team. Bell (1980) conducted a study of body composition and maximum aerobic power among rugby forwards playing second-class rugby in Wales. He found the props (90,9 kg) to have the highest mean body mass of all the players in the team (Bell, 1980:449).

The primary school Craven week props were on average the tallest (167,2 cm) of all playing positions, with exception of the locks and eighth men (De Ridder, 1993:131). The high school Craven week props were the third tallest players (180,60 cm) in the team. The study by Bell (1980:449) found adult prop club players to be the tallest (180,9 cm) of all the forwards, with exception of the locks. The mean stature value of the props who participated in the study of Quarrie *et al.* (1996:54) was 182,2 cm. The props presented the highest stature value among the forwards, with the exception of the locks and loose forwards.

The primary school Craven week props presented the second highest value in terms of humerus (6,6 cm) and femur breadths (9,3 cm) of all the forward players, with the exception of the locks (De Ridder, 1993:141). The high school Craven week props presented the highest value of all players in femur breadth (9,8 cm) and the second highest value of all players in humerus breadth (7,1 cm) (De Ridder, 1993:178). Bell (1980) did not report the breadth of the players.

The primary school Craven week props presented the highest mean values of all the players, in forearm (28,0 cm), flexed upper arm (31,6 cm), thigh (57,9 cm), calf girth (37,7 cm) and ankle (25,1 cm) (De Ridder, 1993: 150). The high school Craven week props showed the same tendency as the primary school props in terms of mean girths (De Ridder, 1993:184).

The primary and high school Craven week props also had the highest mean sum of skinfolds of all playing positions (102,2 mm and117,9 mm respectively) (De Ridder, 1993:158). They also presented the highest fat percentage (21,4% and 24,1% respectively) of all the players.

Rugby-specific components

Props form the base of all set-piece play in rugby, whether it be the scrum or line-out (Groenewald, 2001:210). The primary requirements for a prop are that he must be a good and aggressive scrummager and must support his jumpers very well in line-outs. (Joubert & Groenewald, 1998:27). The prop must be able to retain ball possession and to put pressure on the oppositions' ball in the scrum (Rutherford, 1983:28, Joubert & Groenewald, 1998:27).

During loose play situations the prop must firstly excel after set pieces in giving support to team mates (Whineray, 1982:82). Secondly, they must drive hard over the ball in loose play to obtain possession and provide good ball to the backs. Thirdly, during rucks props should be able to drive together with other forwards over the advantage line with the ball and then provide a good ball to the backs (Rutherford, 1983:28).

Props are involved in gaining possession of the ball, which involves close contact with the opposition, and limited opportunity to run with the ball (Nicholas, 1997:377). Van der Merwe (1989) conducted a time analysis on club games during the Toyota Club Championship and found that props do not use any kicking skill, but do use approximately 14 different handling skills (Van der Merwe, 1989: 83). The assumption can thus be made that props need good handling skills.

Physical- and motor components

As previously discussed, the props are the cornerstones of set pieces such as scrummaging and line-out, and thus require strength and power to compete successfully in scrums, rucks and mauls (Hare, 1997:50).

Craven (1974:103) stated that the prop should have a short strong neck, strong back and strong legs so as to withstand the pressure in a scrum from both the opposition and his own players. Static strength in the legs, back, arms and neck is also very important for props (Hare, 1997:50). The physique of props reflects their responsibilities during the game.

The game rugby, due to rule changes, has become faster (Hanekom, 2000:13). The prop must therefore also be mobile and have a high working rate (Joubert & Gronewalt, 1998:27). A time study conducted by Van der Merwe (1989:83) among club teams competing in the Toyota Club championship found that props approximately sprinted 248 m, jogged 1 936 m and walked 703 m per club game (Van der Merwe, 1989:83). The assumption can be made that props should have a good endurance base for all their supportive roles during rucks and mauls.

It is also important to note that that the study of Van der Merwe (1989) is old and with the game becoming faster, props (and all the other positions) might need to be even faster and fitter than this study might suggest.

- **Hookers**

Anthropometric components

Hookers are on average generally smaller and lighter compared with other forwards (Pool, 1997:24). Primary school Craven week hookers had the smallest mean body mass (51,2 kg) as well as the smallest mean stature (156,5 cm) of all the forwards (De Ridder, 1993:145). The high school Craven week hookers presented the same tendency in terms of mean body mass (79,0 kg) and stature (174,9 cm).

The study of Bell (1980:449) en Maud and Shultz (1984:97) on senior hookers found that they presented the lowest mean mass (77,6 kg en 69,99 kg) and the shortest mean stature (173 cm en 160 cm) of all forwards.

The primary school Craven week hookers presented the smallest mean values of all the forwards in respect of humerus breadth (6,3 cm) and femur breadth (8,6 cm) (De Ridder, 1993:147). The high school Craven week hookers presented the same tendency as the primary school Craven week hookers.

The primary school Craven week hookers presented the smallest mean girths of all the forwards in terms of forearm (25,2 cm), flexed upper arm (27,7 cm), calf (34,2 cm) and ankle girth (23,3 cm) (De Ridder, 1993:150). The high school Craven week hookers presented the lowest mean values of all the forwards in terms of girths, with the exception of flexed upper arm (34,8 cm) and ankle girth (25,1 cm) (De Ridder, 1993:182-184).

The primary school Craven week hookers presented the second highest mean value of all the forwards for the sum of skinfolds (74,4 mm), with exception of the props (De Ridder, 1993:190). The high school Craven week hookers presented the third highest mean value of all the forwards for the sum of six skinfold (71,5 mm). The primary school Craven week hookers, together with the locks, presented the second highest mean fat percentage (17,6%) of all the players. The high school Craven week players presented the third highest mean value of fat percentage (17,2 %) of all the forwards.

According to Bell (1980:449) the senior hookers presented the highest mean fat percentage of all the forwards (17,18%), but research by Maud and Shultz (1984;97) showed that hookers had the lowest mean fat percentage (6,5%) of all the playing positions. It must be kept in mind that different researchers used different methods for calculating fat percentage, and therefore comparisons are difficult.

Rugby-skill components

Many see the hooker as a specialist position because of his responsibilities in the scrum (hooking the ball) and during a line-out (throwing in the ball) (Hare, 1997; Pool, 1997). The hooker is someone who consistently throws in accurately in the line-out and is the most crucial line-out player (Pool, 1997:24).

Firstly, the hooker should possess very good ball handling skills, for throwing in during line-outs. According to Bell (1980:450) the props are responsible for the support work of the hooker, specialising in winning the ball during set scrummaging. The hooker on average completes six tackles and six ball handling skills during a club game, while they do not use any kicking skills (Van der Merwe, 1989:84).

Physical and motor components

A strong hooker is a great asset (Pool, 1997:24). Just like the props, he must possess neck, back and leg strength because he is part of the front row in the scrum (Craven, 1974:100). Leg power for driving forward in the scrum, rucks and mauls, a fast reaction speed and leg speed in open play are essential requirements for success in this position (Nicholas, 1997:377).

Norton (1982:64) suggests that the hooker must possess good co-ordination skills that are needed when throwing to the locks during a line-out. His reactions must also be good so that he can hook the ball during scrums. Hookers rely on agility and suppleness during the game (Norton, 1982:65; Pool, 1997:24). According to Norton (1982:65) the hooker must have good reactions and good physical strength. Static strength is important in the legs, back, neck and arms, as well as power and muscle endurance (Hare, 1997). The hooker is also seen as the fourth loose forward, therefore it is important for the hooker to be fast, agile and to have good ball-handling abilities (Hare, 1997).

The hooker covers a total distance of approximately 4 996 m during a club game. This distance comprises 1 508 m of walking, 3 165 m of jogging and 323 m of running (Van der Merwe, 1989:84). It is therefore essential that the hooker has high levels of endurance.

- **Locks**

Anthropometric components

The primary school Craven week school locks were found to have the second highest mean body mass (65.0 kg) in the team (De Ridder, 1993:131). The high school Craven week locks presented the same tendency in terms of mean body mass (90.0 kg) (De Ridder, 1993:163). The tendency was not found in adult players, as adult locks (98,9 kg) were on average the heaviest of all the players (Bell, 1980:449)

According to Bell (1980:450) locks need to be tall to win possession in the line-outs. The primary school Craven week locks were on average the tallest (174,9 cm) players in the team (De Ridder, 1993:131). This tendency was also found in high school Craven week locks (191,6 cm), as well as adult locks (187,9 cm) (Bell, 1980:450; De Ridder, 1993:131).

The primary school Craven week locks presented the highest mean value of all the forwards for the sum of skinfolds (70,9), with the exception of the props and hookers (De Ridder, 1993:190). The high school Craven week locks presented the highest mean value of all the players for the sum of skinfolds (71,7 mm), with the exception of the props (De Ridder, 1993:190).

The primary school Craven week locks (16,6 %) had the third highest mean fat percentage of all the players, while the high school Craven week locks (17,4%) presented the second highest mean value of all the players. Bell (1980:449) found the same tendency in adult locks (15,59%)

The primary school Craven week locks had the largest mean humerus breadth (6,7 cm) and the second largest mean femur breadth (9,2 cm) of all the players (De Ridder, 1993:146). The high school Craven week locks presented the same tendency (De Ridder, 1993:178)

These primary school Craven week locks also had the highest mean measurement of the whole team in respect of forearm (26,9 cm), flexed upper arm (29,8 cm), thigh (54,4 cm), calf (36,9 cm) and ankle girth (24,8 cm) (De Ridder, 1993:150). The high school Craven week locks presented the same tendency, except for ankle girth (25,1 cm) and flexed upper arm girth (34,8 cm) (De Ridder, 1993:182).

Rugby-specific components

Pool (1997:24) stated that locks are usually selected because they can take balls in the line-out, and stated that if locks cannot scrum, one does not have a scrum. Quarrie *et al.* (1996:56) also stated that locks play a major role in contesting possession in the line-out. According to Van der Merwe (1989:84) locks on average used eight tackling skills and eleven handling skills during a game.

Physical and motor components

Locks should be strong and agile Quarrie *et al.* (1996:56). Strength is however more important than size for a lock, but that stature is important on the international level participation (Bell, 1980:450). Locks should also possess good hand-eye co-ordination and balance, which enable them to catch the ball in mid-air during line-outs and kick-off. They should also possess great power inn order to jump high during line-outs and kick-offs. In the set scrummaging and in the loose play locks need weight and power for successful participation (Bell, 1980:450). Quarrie *et al.* (1996:56) also stated that locks play a major role in contesting possession in the line-out, and jumping ability is considered an asset.

Quarrie *et al.* (1996:56) suggest that the lock should possess neck, back, arm and leg strength. In the set scrummages and in loose play both weight and power are an additional advantage for successful participation (Nicholas, 1997:377; Hare, 1997:50). Craven (1974:104) suggests that if locks are fast, it should be regarded as an asset. The study by Van der Merwe (1989:84) found that locks walk approximately 616 m, jog 1 699 m and run 452 m during a game. It is essential for locks to have good speed endurance.

4.3.2 Positional requirements of the loose forward players

Pool (1997:24) stated that the loose forwards form a combination. The loose forwards are those players who keep the ball alive and regain possession from the opponents. The emphasis in the case of loose forwards is on strength, speed and skill (Pool, 1997:24).

Loose forwards are expected to be aggressive tacklers and to be fast over short distances (Quarrie et al, 1996:56). In the study of Quarrie *et al.* (1996:56) the loose forwards were taller than the front row forwards but shorter than the locks. Loose forwards require a great deal power and mobility in open play (Quarrie et al, 1996:56). Speed acceleration and endurance are necessary in this role of gaining and retaining possession of the ball in loose play (Quarrie et al, 1996:56). Strength and power for aggressive tackling and driving forward in the scrum, rucks and mauls are also essential (Nicholas, 1997:378).

Loose forward positions that will be discussed in terms of anthropometrical, rugby-specific, physical and motor components are flankers and the eighth man.

- **Flankers**

Anthropometric components

Primary school Craven week flankers' mean body mass (56,3 kg) and stature (167,0 cm) were the lowest of all the forwards, with exception of the hookers (De Ridder 1993:131). The high school Craven week flankers presented the second lowest mean value in body mass (82,1 kg) and the third lowest mean value in stature (182,9 cm), of the all the forwards. The same tendency was found in adult flankers' mean body mass and stature than in high school Craven week flankers (Bell, 1980:449 & Maud an Shultz, 1984:97).

The mean humerus breadth (6,5 cm) of the primary school Craven week flankers were the smallest of all the forward players, with the exception of the hooker. The mean femur breadths (8,9 cm) were also smaller than those of the props and locks but bigger than those of the eighth men and hookers (De Ridder, 1993:147). The high school Craven week flankers presented the lowest mean value of all the forwards in terms of humerus breadth (6,8 cm) and the second lowest mean value for femur breadth (9,3 cm) (De Ridder, 1993:178).

The primary school Craven week flankers presented the second lowest mean value of all the forward players, with the exception of ankle girth (23. cm) (De Ridder, 1993:152). The high school Craven week flankers presented the third highest mean values of all the forwards in terms of all the girths, with the exception of ankle girth (25,0 cm), which was the lowest value for all the forward players in terms of girths.

The primary and high school Craven week flankers presented the smallest mean value of all the forwards for the sum of skinfolds (54,8 mm and 61,1 mm respectively) as well as the smallest mean value for fat percentage (13,6% and 15,6% respectively) (De Ridder, 1993:190-194).

Rugby-specific components

Flankers are players who like to play forward (Pool, 1997:24). Flankers must be aggressive defenders and be able to stop the opposition in its tracks (Hanekom, 2000:10). Good handling skills and good defence are seen as the most important skills for flankers. Flankers are very important in broken play such as rucks and mauls (Hanekom, 2000:10)

The flanker uses approximately four tackling skills, two running skills, 26 handling skills and three ground skills during a club game (Van der Merwe, 1989:84).

Physical and motor components

Many researchers found that speed is important too flankers (Craven, 1974:104). Good speed assures that flankers get to a back-line player for support when he is tackled (Craven, 1974:104). Agility is very important because the flankers form the link between forwards and backs during broken play. They change direction frequently, and speed ensures that they reach the rucks and mauls first (Hanekom, 2000:24).

During a club game the flankers ran the highest distance of all the loose forwards, namely 466 m. Therefore the flanker should possess good speed endurance (Van der Merwe, 1989:84).

- **Eighth men**

Anthropometric components

The primary school Craven week eighth men's mean body mass (58,0 kg) was less than that of the props and locks but higher than that of the flankers and hookers (De Ridder 1993:131). The primary school Craven week eighth men presented the second highest mean value for stature (168,6 cm) of all the forwards, with the exception of the locks (De Ridder, 1993:131).

The high school Craven week eighth men presented the highest mean body mass (85,1 kg) of all the forwards, with the exception of the props and locks. They also presented the highest mean value for stature (186,7 cm) of all the forwards, with the exception of the locks.

The same tendency was observed in adult eighth men (Bell, 1980:449). However, the study by Maud and Shultz (1984:97) found the eighth men's mean body mass to be the highest (91 kg) of all the forwards, with the exception of the props. He also found the eighth men (185 cm) to be the second tallest players in the team. Although Bell (1980:449) found the eighth men to be on average the tallest of all the players in the team

The primary school Craven week eighth men had the highest mean value of all the forwards for humerus breadth (6,6cm), with the exception of the locks. The mean femur breadth (8,3 cm) was the smallest of the whole team, with exception of the scrum-halve (De Ridder, 1993:146). The high school Craven week eighth men presented the lowest value of all the forwards, with the exception of the flankers and hookers, in terms of humerus breadth (7,0 cm). They also presented the lowest mean value of all the forwards in terms of femur breadth (9,3 cm), with the exception of the hookers (De Ridder, 1993:178).

The primary school Craven week eighth men presented the third highest mean girths in the flexed upper arm (28,5 cm) and forearm girth (26,2 cm), of all the forwards. They presented the second lowest mean calf girth (34,6 cm) and the lowest mean ankle girth (23,2 cm) of all the forwards (De Ridder, 1993:150). The high school Craven week eighth men presented the lowest mean flexed upper arm girth (34,7 cm), second lowest mean forearm girth (30,6 cm) and mean ankle girth (25,6 cm), as well as the third lowest mean calf girth (40,0 cm) of all the forwards (De Ridder, 1993:184).

The primary Craven week eighth men presented the second smallest mean value of the forward players for the sum of skinfolds (57,5 mm) (De Ridder, 1993:158). The high school Craven week eighth men presented the second lowest mean value of all the forwards for the sum of skinfolds (61,8 mm).

The primary school Craven week eighth men presented the second lowest mean fat percentage (14,3 %) of all forwards (De Ridder, 1993:194). The same tendency was found for the high school Craven week eighth men in terms of mean fat percentage (15,7 %) (De Ridder, 1993:194).

Rugby-specific components

The eighth man is a specialist position. He must show good judgement in whether to hold the ball in the scrum or to play it (Pool, 1997:24). According to Bell (1980:449) the eighth man is best used during attacks, especially from the scrum. The eighth man also plays an important part in the defence around the blind side of the scrum. He must jump well at the back of the line-out (Bell, 1980:449). Eighth men must be able to handle the ball well, because they initiate driving play rather that rucks and mauls (Pool, 1997:24).

According to Graham (1982:62-63) one of the responsibilities of the eighth man is to help protect the scrumhalf behind the scrum. The eighth man together with the scrumhalf is responsible for attacking play around the scrum as well provide the support during cross-defence (Joubert & Groenewald, 1998:86).

The eighth man uses approximately four tackle skills, two running skills, 26 handling skills and three ground skills during a club game (Van der Merwe, 1989:84).

Physical and motor components

The eighth man must be faster than the average forward. The eighth man should be strong, fast and agile. Power is very important to the eighth man, as is muscle endurance (Hare, 1997:50).

During a club game the eighth man, together with the flanker, runs the highest distance of all the loose forwards, namely 466 m. Therefore the eighth man should possess good speed endurance (Van der Merwe, 1989:84).

4.3.3 Positional requirements of the inside backs (scrumhalves and flyhalves)

The inside backs control the possession obtained by the forwards, and decide whether to launch attacking or defensive plays. In the study by Quarrie *et al.* (1996:56) the inside backs were the shortest and the lightest players in the team.

Endurance is important for the halves, in order to be in the correct position, to support the ball carrier and to cover in defence (Nicholas 1997:378). Speed is also vital for acceleration away from the scrums, line-outs, rucks and mauls (Nicholas 1997:378).

The halves that will be discussed in terms of anthropometric, rugby-specific, physical and motor components are the scrum-half and fly-half.

- **Scrum-halves**

Anthropometric components

Primary school Craven week scrum-halves were on average the shortest (152,5 cm) and the lightest (43,2 kg) of the all the players (De Ridder, 1993:131). The high school Craven week scrum-halves presented the same tendency as the primary school Craven week scrum-halves in terms of mean body mass (67,8 kg) and mean stature (171,0 cm) (De Ridder, 1993:163). The study by Maud and Shultz (1984:98) also found that adult scrumhalves were also on average the smallest and the lightest of all the other playing positions. Rigg and Reilly (1988:198) found the halves to be on average the smallest (172,8 cm) and the lightest (77 kg) of all the players.

The primary school Craven week scrum-halves were also the group with smallest mean value for humerus (5,9 cm) and femur breadth (8,2 cm) (De Ridder, 1993:147). The high school Craven week scrum-halves presented the same tendency in terms of mean humerus breadth (6,5 cm), but femur breadth (8,9 cm) was the second lowest value among the back-line players (De Ridder, 1993:178). The primary school Craven week scrum-halves also had on average the smallest forearm (23,8 cm), thigh (47,7 cm), calf (31,6 cm) and ankle girth (21,3 cm) of all the players (De Ridder, 1993:150-152). The high school Craven week scrum-halves presented the lowest mean values of all the players in terms of flexed upper arm girth (32,5 cm), forearm girth (28,4 cm), ankle girth (23,6 cm) and the second lowest value in terms of calf girth (37,2 cm) (De Ridder, 1993:184).

The primary school Craven week scrum-halves presented the third highest mean value for the sum of skinfolds (52,3 mm) of the back-line players (De Ridder, 1993:158). The high school Craven week scrum-halves presented the second highest mean value in terms of sum of skinfolds (58,4 mm) of all the back-line players (De Ridder, 1993:190).

The primary school Craven week scrum-halves presented the highest mean value in terms of fat percentage (14,1 %) of all the back-line players (De Ridder, 1993:194). The high school Craven week scrum-halves presented the second highest mean value in terms of fat percentage (14.3 %) of all the back-line players (De Ridder, 1993:198). Adult scrumhalves had the highest mean fat percentage (16.6%) of all playing positions. (Maud and Shultz, 1984:87). Rigg and Reilly (1988:198) found adult scrum-halves to have the highest mean fat percentage (12.1%) in the team, with the exception of the forwards.

Rugby-specific components

Just as the name suggests, the scrumhalf is the link between the forwards and back-line players. The scrumhalf should possess good handling skills, in other words, be able to pass quickly to both sides (Pool, 1997:24). The scrumhalf should possess good kicking abilities (De Ridder, 1993:36), and should also know when to pass, when to break, when to play with the forwards and when to kick (Pool, 1997:24).

Rutherford (1983:28) states that good decision-making is very important for the scrum-half. Often in games the scrumhalf must make split-second decisions about what to do with the ball, which he often receives under pressure. Ball handling is also very important for the c because the scrumhalf often handles the ball and poor handling will often have negative effects on the attacking play of the team (Rutherford, 1983:28).) The scrum-half must also be good in defence, seeing that he often has to tackle a much bigger and stronger player around the scrum (Rutherford, 1983:29).

During a game the scrumhalf uses approximately four tackling skills and four running skills. On average he uses 65 different types of handling skills. He also uses approximately five aerial kicks and one ground kick during the game (Van der Merwe, 1989:83).

Physical and motor components

Rutherford (1983) is of the opinion that speed and agility are very important. The scrumhalf should also have good left and right foot co-ordination for kicking with either as well as for acceleration away from the scrum (Hare 1997:50). Good dynamic strength in the arms ensures that the scrum-half can pass effectively and accurately (Hare 1997:50)

The study by Van der Merwe (1989:83) found that the scrum-half jogs approximately 2 917 m, walks 867 m and runs 289 m during a game. Therefore endurance and speed endurance are essential for the scrum-half.

- **Fly-halves**

Anthropometric components

De Ridder (1993:131) found that the primary Craven week school fly-half had higher mean body mass (43.2 kg) and stature (159.2 cm) than the scrum-half but was lighter and smaller than all the other back-line players. The senior Craven week fly-halves had the lowest mean body mass (72.9 kg) of all the back-line players, with exception of the scrum-halves (De Ridder, 1993:163). They also presented the highest mean value for stature (177.9 cm) of all the back-line players, with exception of the full-backs (De Ridder, 1993:163). Maud and Shultz (1984:95) found that the adult fly-half to have the smallest mean body mass among all players (73,6 kg).

The primary school Craven week fly-half had the smallest mean humerus (6,1 cm) and femur breadth (8,5 cm) of all the positions, with the exception of the scrum-halves (De Ridder 1993:146-148). The high school Craven week fly-halves presented the same values as the wings, centres and full-backs in terms of mean humerus breadth (6,7 cm), which is higher than in the case of the scrum-halves (De Ridder, 1993:178). They also presented, together with the scrum-halves, the lowest mean value of all the back-line players in terms of femur breadth (8,9 cm), with the exception of the wings.

The primary school Craven week fly-halves also had the smallest mean flexed upper arm (25,7 cm), thigh (47,1 cm), calf (32,1 cm) and ankle girth (22,0 cm) of all the players, with the exception of the scrum-halves (De Ridder, 1993:150-153). The high school Craven week fly-halves presented the second lowest mean value in terms of flexed upper arm girth (32,8 cm) , forearm girth (29,2 cm) and ankle girth (23,9 cm), and the lowest value in terms of calf girth (37,1 cm).

The primary school Craven week fly-halves also had the smallest mean value of all the back-line players for the sum of skinfolds (49,5 mm), with the exception of the wings (De Ridder, 1993:158). The primary school Craven week fly-halves, however, had the highest mean value for sum of skinfolds (59,2 mm) (De Ridder, 1993:190). The primary school Craven week fly-halves presented with the lowest mean value in terms of fat percentage (12,3%) of all the back-line players (De Ridder, 1993:194). High school Craven week fly-halves were the opposite of their younger counterpart, and had the highest mean fat percentage of all the back-line players (14,9%). Adult fly-halves had the smallest mean fat percentage (6,8%) of all the players (Maud and Shultz, 1984:98).

Rugby-specific skills

The fly-half must have good kicking skills and be able to kick with both feet during attacking or defensive situations, pass and receive the ball at maximal speed and be able to read the opposition's play (Pool, 1997:25). Fly-halves are responsible for ball distribution and calling plays, therefore they should possess good leadership skills and knowledge of the game. Fly-halves must also be able to use good running skills like side-stepping and acceleration (Craven, 1974:105). Fly-halves must also possess good tackling skills, because sometimes they are responsible for tackling forwards who break away from the set pieces (Rutherford, 1983:29). Fly-halves should also be specialist goal kickers. The responsibility for converting tries and penalties will mostly be on them (Rutherford, 1983:29).

The fly-half on average uses four tackling skills, and 28 running skills. The fly-half on average uses 88 different kicking skills, such as kick-offs, drop goals, ground and aerial kicks (Van der Merwe, 1989:83).

Physical and motor components

Speed, agility, alertness and quickness are components that the fly-half should possess to dictate the game (Craven, 1974:105; Rutherford, 1983:30). The fly-half should be fast, so that once he has passed the ball he can quickly return to his position and support the forwards (Rutherford, 1983:30).

Good speed, agility and strength as well as power are essential in all the muscles that are involved in the kicking action (Hare, 1997:50). According to Van der Merwe (1989:83) the fly-half completed a total distance of 4 664 m during an average game. The fly-half walks approximately 880 m, jogs 3 339 m and runs 445 m. Therefore it is important for the fly-half to have good endurance, as well as speed endurance.

4.3.4 Positional requirements of the back-line players

According to Quarrie *et al.* (1996:53) the playing positions in the back-line differed significantly in terms of anthropometric measurements and in the performance of the aerobic shuttle test. The back-line player must have good handling skills and speed, which he must use accordingly (Craven, 1974:137). A study by Quarrie *et al.* (1995:269) found that the backs performed better than forwards on most physical performance assessments. Back-line players on average have a better motor capacity (they have better aerobic capacity, and they are faster with higher muscle endurance) in comparison with the forwards (Babić *et al.*, 2001:250)

The back-line positions that are discussed in terms of anthropometric, rugby-specific, physical and motor components are the centres, wings and full-back.

- **Centres**

Anthropometric components

The primary school Craven week centres presented with the highest mean body mass (51 kg) of all the back-line players (De Ridder, 1993:131). The primary school Craven week centres' mean stature (161,3 cm) was higher than that of the halves but they were shorter than the wings and full-backs. The senior Craven week centres presented the highest mean body mass (74.8 kg) of all the back-line players, with the exception of the full-backs (De Ridder, 1993:163). They presented the lowest mean value for stature (177,0 cm) of all the back-line players, with the exception of the scrum-halves (De Ridder, 1993:163). Maud and Shultz (1984:89) found that adult centres have the highest mean body mass (86,15 kg) and mean stature (185 cm) of all the back line positions.

The primary school Craven week centres also presented with the biggest mean humerus (6,2 cm) and femur breadth (8,6 cm) of the back-line players, together with the full-back and wings, (De Ridder, 1993:147). The high school Craven week centres presented with the highest mean value of the back-line players, together with the wings, full-backs and fly-halves, in terms of humerus breadth (6,7 cm) (De Ridder, 1993:178). They also presented the highest mean value of all the back-line players, together with full-backs, for femur breadth (9,0 cm).

The primary school Craven week centres also presented the highest mean forearm (25,0 cm), flexed upper arm (26,9 cm), calf (33,4 cm) and ankle girth (22,6 cm) of all the back-line players (De Ridder, 1993:158). The high school Craven week centres presented he same tendency in terms of mean forearm girth (29,9 cm) and flexed upper arm girth (33,7 cm), but presented the second highest mean value of the back-line players in terms of calf (38 cm) and ankle girth (24,1 cm) (De Ridder, 1993:184).

The primary school Craven week centres presented the second highest mean value for the sum of skinfolds (52,5 mm) of the back-line players (De Ridder, 1993:158). The high school Craven week centres presented the third highest mean sum of skinfolds (55,4 mm) of the back-line players (De Ridder, 1993:190). The primary school Craven week centres presented the third highest mean fat percentage (12,8 %) off all back-line players (De Ridder, 1993:194). The high school Craven week players presented the same tendency in terms of mean fat percentage (14,2 %) (De Ridder, 1993:198).

Rugby-specific skills

The centres should play a supportive role to the fly-half and the wing (Quarrie *et al.*, 1996:56). This means that the centre should keep in mind that he creates space, and that he should always run straight, except during technical moves. The centres have the most contact with the opposition (Quarrie *et al.*, 1996:56). It is therefore essential for the centre to be successful in passing the ball in contact situations (Rutherford, 1983:29). Centres have both defensive and offensive roles and a considerable area of the field in which to run, and they generally have the most physical contact with the opposition (Nicholas, 1997:378)

Good handling abilities are essential for centres, they often receive the ball under pressure and must be able to pass the ball on the inside as well as the outside (Rutherford, 1983:29). Running skills like the swerve and side-step are very important for centres. Centres must also be able to use different kicking skills, like ground and aerial kicks, to break the defensive lines of the opposition (Rutherford, 1983:29 & De Ridder, 1993:37)

During a game the centres utilise approximately eight tackles, seven running skills and 26 handling skills. They kick the ball 18 times during a club game, which includes aerial and ground kicks (Van der Merwe, 1989:82)

Physical- and motor components

The most important components of centres are speed and agility (Craven, 1974:105). They have to accelerate quickly so that more space can be created for the wings. They must also be strong and good in defence (Joubert & Groenewald, 1998:88). Bursts of speed with varied intensity, strength, power for running at the opposition and absorbing physical contact in attack and defence are attributes required in this position (Nicholas, 1997:378). Dynamic strength in the upper body and power in the legs are essential for driving force (Hare 1997:50).

Centres' cover a total distance of 4 075 m during a game. They walk a distance of 1 772 m, jog a distance of 1 449 m, and run a distance of 854 m during a game. Therefore it is essential that centres have good speed endurance (Van der Merwe, 1989:82).

- **Wings**

Anthropometric components

The primary school Craven week wings presented with the highest mean measurements of all the back-line players in terms of body mass (52,2 kg) and stature (163,1 cm) (De Ridder, 1993:131). However, this was not the case with high school Craven week wings, who presented with the third highest mean value in body mass (73,7 kg), after the full-backs and centres. They also presented the third highest mean value in stature (177,3 cm) after the fly-halves and full backs (De Ridder, 1993:163). Maud and Shultz (1984:97) found that the adult wings presented the highest mean value in body mass (80,25 kg) and in stature (181 cm) of all the back-line players, with the exception of the centres.

The primary school Craven week wings also presented with the highest mean measurements, together with the wings and full-back, in humerus- (6.2 cm) and femur breadth (8,6 cm) of all the back-line players. The high school Craven week wings presented the highest mean value, together with the full-backs, fly-halves and centres, in regard to humerus breadth (6,7 cm). However, they presented with the smallest mean value of all the back-line players in terms of femur breadth (8,8 cm) (De Ridder, 1993:178).

The primary school Craven week wings presented with the highest mean forearm (25,5 cm), flexed upper arm (27,5 cm), calf (33,6 cm) and ankle girth (22,8 cm) of all the back-line players (De Ridder, 1993:150-152). The high school Craven week wings presented with the second highest mean values in terms of flexed upper arm girth (33,0 cm), calf girth (38,0 cm) and the third highest mean values in terms of forearm girth (29,3 cm) and ankle girth (24,0 cm) of all the back-line players (De Ridder, 1993:182).

The primary school Craven week wings also presented with the smallest mean value for the sum of skinfolds (48,8 mm) of all the back-line players (De Ridder, 1993:158). This was also the case with the high school Craven week wings in terms of mean sum of skinfolds (51,2 cm) (De Ridder, 1993:190). The primary school Craven week players also presented with the second lowest mean fat percentage (12,4 %) off all back-line players (De Ridder, 1993:194). The high school Craven week players presented with the lowest mean value, together with the full-backs, in terms of fat percentage (13,5 %).

Rugby-specific components

Wings are very involved in the game during situations like cross-defence, covering when the full back attacks and supporting in counter-attack (Pool, 1997:25). Wings, just like other playing positions, during the game should keep applying pressure on the opposition's wings and full back, chasing high kicks launched at the opposition and tackling the opposition before they can start attacking (Rutherford, 1983:29 & De Ridder, 1993:141).

According to Van der Merwe (1989:82) wings use approximately nine tackle skills, 11 running skills and 26 handling skills during a club game. On average they catch five high balls, and use 25 kicking skills.

Physical and motor components

Speed is the most important characteristic of wings (Craven, 1974:105). The wings are often thought of as the speedsters in the team and are required to beat opposition players with pace, agility and physical strength (Rutherford, 1983:29; Quarrie *et al.*, 1996:56). They are seen as the try-scorers in the team, therefore they have to be very fast, and they also have to be quick on the cross-defence (Joubert & Groenewald, 1998:89).

Wings cover approximately 2 851 m during a game. They walk about 1 398 m, jog 951 m and run 502 m during a game (Van der Merwe, 1989:82). This emphasises the need for speed as well as speed endurance.

- **Full-backs**

Anthropometric components

The primary school Craven week full-backs had the highest mean body mass (49,4 kg) of the back-line players, with the exception of the centres and wings, and they had the highest mean value for stature (162,2 cm), with the exception of the wings (De Ridder, 1993:131). The high school Craven week full-backs presented with the highest mean value in body mass (72,9 kg) and in stature (178,0 cm) of all the back-line players (De Ridder, 1993:163). Maud and Shultz (1984:96) found that adult full-backs had a mean body mass of 79 kg, and were the lightest of the back-line, with the exception of the halves. Maud and Shultz (1984:96) also found that the full-back, together with the scrum-half, has the shortest mean stature of the back-line players.

The mean humerus (6,2 cm) and femur breadth (8,6 cm) of the junior Craven week full-backs were the biggest, together with those of the wings and centres, of the back-line players (De Ridder, 1993:147). The high school Craven week full-backs presented with the highest mean value of the back-line players, together with the fly-halves, wings and centres, in regard to humerus breadth (6,7 cm). They and the centres presented with the highest mean value for femur breadth (9,0 cm) of all the back-line players (De Ridder, 1993:178).

The primary school Craven week full-backs presented with the third highest mean forearm (24,6 cm) and calf girth (33,3 cm) of all the back-line players. They also presented with the second lowest mean flexed upper arm (26,3 cm) and ankle girth (22,4 cm) of all the back-line players (De Ridder, 1993:150-152). The high school Craven week full-backs presented with the highest mean values in terms of calf girth (38,2 cm) and ankle girth (24,4 cm), and the second highest mean values in terms of flexed upper arm girth (33 cm) and forearm girth (29,6 cm) of all the back-line players (De Ridder, 1993:182).

The primary school Craven week full-backs presented with the highest mean value for the sum of skinfolds (54,7 mm) of all the back line players (De Ridder, 1993:158). The high school Craven week players presented with the third highest value for the sum of skinfolds (55,4 mm) of all the back-line players (De Ridder, 1993:190).

The primary school Craven week players also presented with the second highest mean fat percentage (13,2 %) off all back-line players (De Ridder, 1993:194). The high school Craven week full-backs presented with the lowest value in terms of fat percentage (13,5 %) of all the back-line players (De Ridder, 1993:198).

Rugby-specific components

Craven (1974:106) suggests that the full-back is like a second fly-half, who must possess good handling and kicking skills. He must be able to kick high balls to put the opposition under pressure, as well as technical kicks for attacking positions (Rutherford, 1983:29). He must be fast because during attacking moves the full-back has to form part of the back-line movements. The full-back must also be a good defender (De Ridder, 1993:37)

The full-back uses approximately four tackling skills, 16 different handling skills, catching high balls 19 times and applying six running skills during a club game (Van der Merwe, 1989:82). The full-back should be fearless, and the up-and-under in particular is the downfall of many a promising full-back (Pool, 1997:24). The full-back must be able to kick with both feet, must be able to read the game and must be fast enough to join the game on attack (Pool, 1997:24).

Physical and motor components

The full-back must possess good speed and agility (De Ridder, 1993:37). Full-backs are required to beat the opposition by means of speed and strength (Pool 1997:24).

The full-back covers a total distance of approximately 3 841 m during a game. Of this distance he walks 799 m, jogs 1 506 and runs 1 536 m. Therefore it is essential for the full-back to have good endurance, especially speed endurance (Van der Merwe, 1989:82).

4.4 Conclusion

From the literature it is clear that there are differences between playing positions, not just between playing groups. It is also evident that the anthropometric, rugby-specific, physical and motor components differ among players of different ages. Thus the information about anthropometric, rugby-specific, physical and motor components of different age groups might make it possible to compile a test battery for positional selections. This will assist in talent identification, and team selection, so that the selected players can be taught the necessary skills for the specific position. The players should also perform better and enjoy their participation more if this is done.

CHAPTER 5

EMPIRICAL STUDY

5.1 Introduction

5.2 Study population

5.3 Test protocol

5.1 Introduction

All elite rugby players have certain anthropometric components, rugby-specific skills and physical and motor components that distinguish them from average players (Hare, 1997). These components are also relevant to certain playing positions in rugby. The aim of this study is to determine which of these components are specific to certain positions in rugby and what tests are suitable for selecting the best potential player for every position.

The playing positions in this study will be grouped together as follows: tight forward players (props, hooker and locks), loose forward players (flankers and eighth man), halfbacks (scrum-half and fly-half) and back-line players (centres, wings and full-back).

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

5.2 Study population

The study population consisted of U/13 (n=22), U/16 (n=21), U/18 (n=18) and U/19 (n=19) North West provincial rugby players. The teams were also selected according to the SARFU development policy, which states that 50% of selected players be from previously disadvantaged communities.

5.3 Test protocol

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

The anthropometric measurements included the following:

- Body mass (Norton *et al.*, 1996)
- Stature (Norton *et al.*, 1996)
- Fat percentage (sum of triceps, supraspinal, subscapular, abdominal, thigh and calf skinfolds) (Norton *et al.*, 1996)
- Breadths (humerus, femur and wrist) (Norton *et al.*, 1996)
- Girths (flexed upper arm, forearm, ankle and wrist) (Norton *et al.*, 1996)

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

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

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

- Flexibility (adapted sit and reach) (Thomas & Nelson, 1985)
- Power/explosive strength (vertical jump) (Thomas & Nelson, 1985)
- Speed endurance (speed endurance test) (Hazeldine & McNab, 1998)
- Agility (Illinois and T-test) (Badenhorst, 1998; ERFU, 1996)
- Speed (10 m and 30 m) (Hazeldine & McNab, 1998)
- Strength (flexed upper arm hang, abdominal strength and pull-ups) (Norton & Atherton, 1997; Ellis et al., 1998).

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

5.3.1 Anthropometric 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 an the explanation of the technique of all the other anthropometric measurements will follow.

a) Anatomical position

This is a position where the subject is standing in an upright position, arms at the sides, palms and feet facing forward (Norton *et al.*, 1996:5).

b) 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.*, 1996:37).

- **Body mass**

Aim: To measure body mass

Equipment: An electronic or beam 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 0,1 kg (Norton *et al.*, 1996:37).

Figure 5.1 Body mass

- **Stature (body height)**

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 touch the scale. The measurer places the hands along the jaw of the subject with the fingers reaching to the mastoid processes. 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 0,1 cm. (Norton *et al.*, 1996:35)

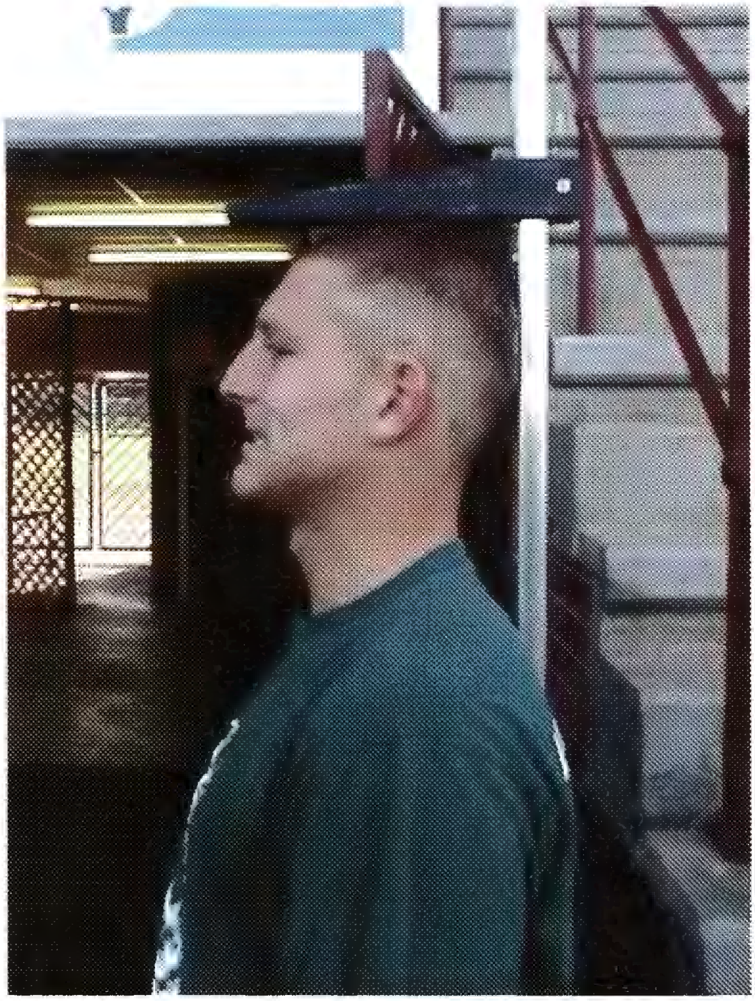


Figure 5.2 Stature

- **Skinfolds**

<u>Aim:</u> To measure all the skinfolds

<u>Equipment:</u> Skinfold callipers

<u>Technique:</u> The skinfold mark should be carefully located using the correct anatomical landmarks. The skinfold is grasped at the marked line. It should be grasped so that a double fold of skin plus the underlying subcutaneous adipose tissue is held between the thumb and index finger. The near edge of the thumb and finger are in line with the marked site. The back of the hand should be facing the measurer. Care must be taken

not to incorporate underlying muscle tissue in the grasp. In order to eliminate muscle, the finger and thumb should roll the fold slightly, thereby also ensuring that there is a sufficiently large grasp of the fold.

The nearest edge of the contact faces of the callipers are applied 1 cm lateral to the thumb and finger. If the callipers are placed too deep or too shallow, incorrect values may be recorded. The callipers should be placed at a depth of approximately mid-fingernail. The callipers are held at 90° to the surface of the skinfold site at all times. Measurement is recorded two seconds after the full pressure of the callipers have been applied. This standardization is necessary since adipose tissue is compressible.

Skin measurements are taken twice in rotation. If there is deviation of more than 1 mm, a third measurement is taken. The accuracy of measurement required is 0,2 mm (Norton *et al.*, 1996:44). The skinfolds that will be measured are as follows:

– ***Triceps skinfold***

The fold is vertical and parallel to the line of the upper arm. The skinfold 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.*, 1996:47).

Figure 5.3 Triceps skinfold

– ***Supraspinal skinfold***

This fold is raised at the point where the line from the iliospinal mark to the anterior axillary border intersects with the horizontal line of the superior border 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 45° angle (Norton *et al.*, 1996:51).

Figure 5.4 Supraspinal skinfold

– ***Subscapular skinfold***

The subject should be standing erect with the arms by the side. The thumb palpates the inferior angle of the scapula to determine the lowermost tip. The skinfold 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 45°) as determined by the natural fold lines of the skin (Norton *et al.*, 1996:47).

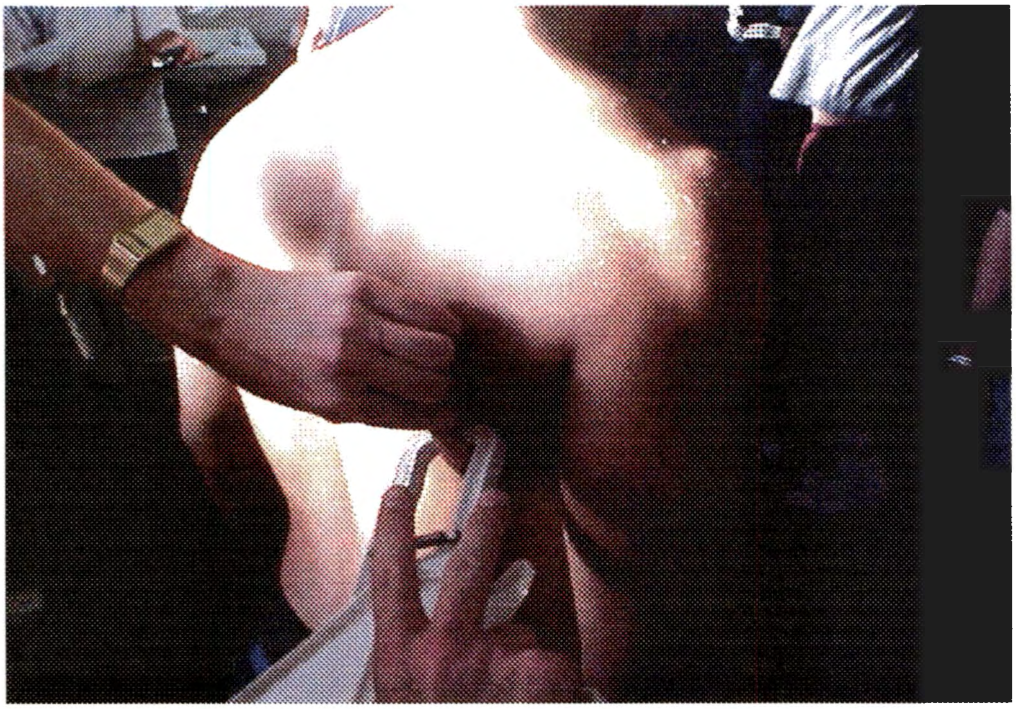


Figure 5.5 Subscapular skinfold

– ***Abdominal skinfold***

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). Note that the callipers are not placed inside the navel. The skinfold is taken vertically (Norton *et al.*, 1996:51).

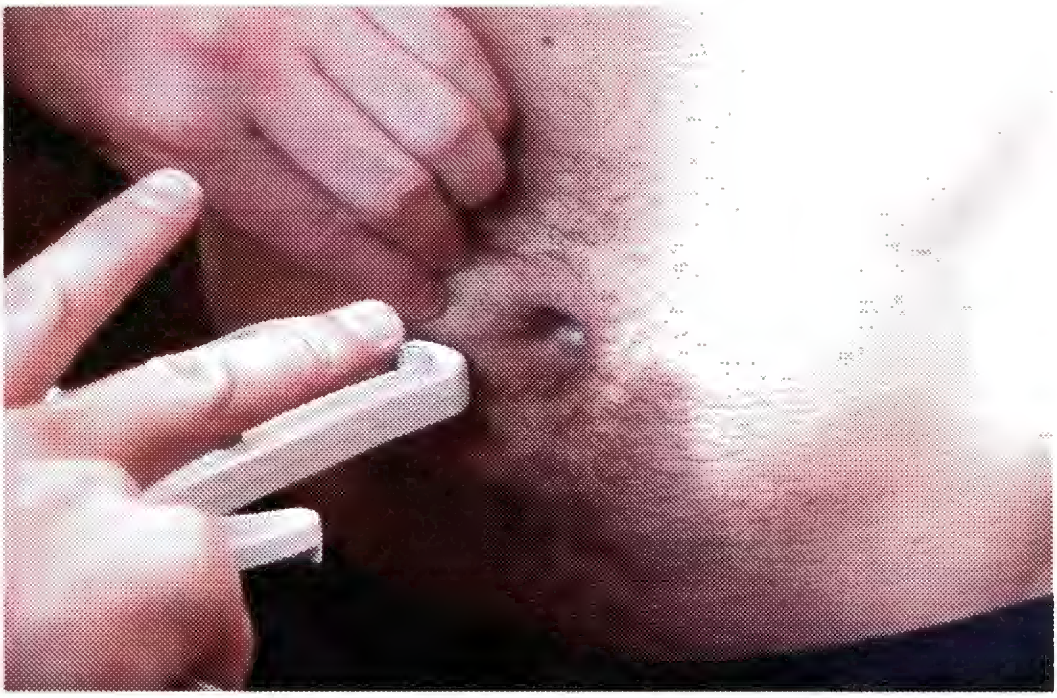


Figure 5.6 Abdominal skinfold

– ***Front thigh skinfold***

The measurer stands facing the right side of the subject on the lateral side of his thigh. The subject's knee is bent at a right angle by placing the right foot on a box or by the subject's being seated. The site is marked parallel to the long axis of the femur at the mid-point of the distance between the inguinal fold and the superior border of the patella (while the leg is bent). The skinfold measurement can be taken while the knee is bent or with the leg straight and resting on a box (Norton *et al.*, 1996:52).

Figure 5.7 Front thigh skinfold

– *Medial calf skinfold*

With the subject either seated or with the foot on a box (knee at 90°) and with the calf relaxed, the vertical fold is raised on the medial aspect of the calf at the level of maximal circumference (Norton *et al.*, 1996:53).

Figure 5.8 Medial calf skinfold

- **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 fingers of both hands are 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 eyes 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.*, 1996:53)

The following girths were taken:

– ***Arm flexed and tensed girth***

This is the maximum circumferences of the right upper arm which is raised anterior to the horizontal, with the forearm at about 45° 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, then ask the subject to "clench your fist, bring your hand toward your shoulder so your elbow is at about 45°, then fully tense the biceps and hold it" while the measurement is made (Norton *et al.*, 1996:55).

Figure 5.9 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 serial measurements in order correctly to locate the level of the maximum girth. It usually occurs just distal to the elbow (Norton *et al.*, 1996:56).

Figure 5.10 Forearm girth

– ***Calf girth***

This is the maximum girth of the calf. The subject stands facing away from the measurer in an elevated position, for example on a box or stool, with the weight distributed on both feet. The elevated position makes it possible for the measurer to align the eyes with the tape. 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.*, 1996:60).

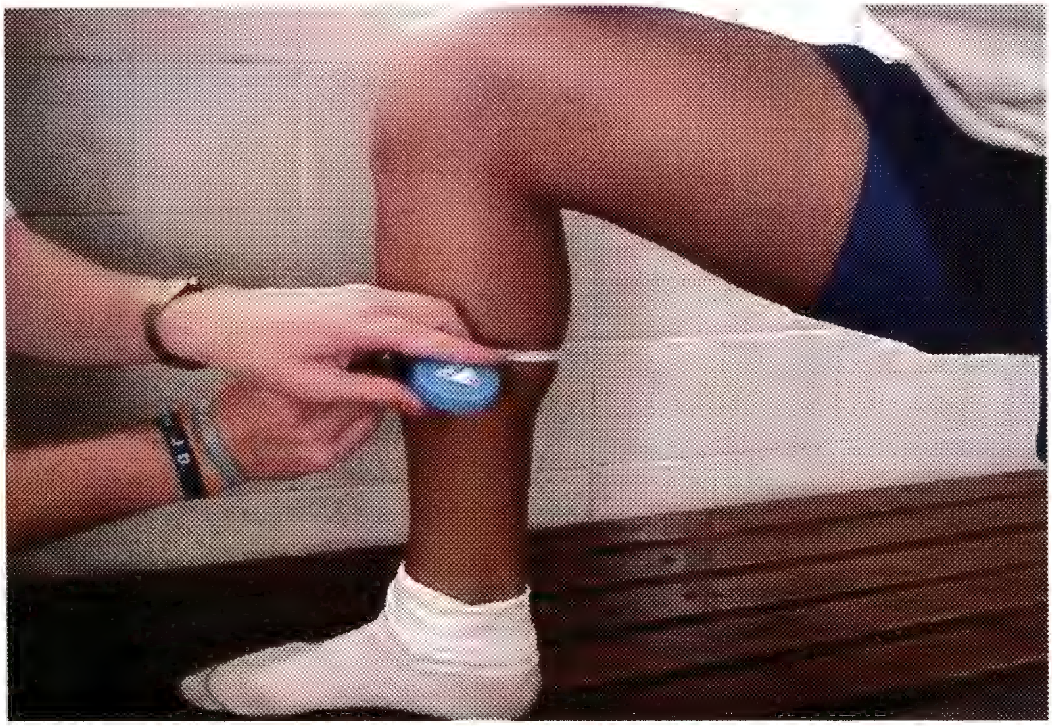


Figure 5.11 Calf girth

– ***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.*, 1996:60).

Figure 5.12 Ankle girth

- **Breadths**

Aim: To measure all the breadths

Equipment: Small sliding bone callipers

Technique: The callipers lie on the backs of the hands while the thumbs rest against the inside edge of the calliper arms, and the extended index fingers lie along the outside edges of the arms. In this position the fingers are able to exert considerable pressure to reduce the thickness of any underlying soft tissue and the middle fingers are free to palpate the bony landmarks on which the calliper faces are to be placed. The measurements are made when the callipers are in place, with the pressure maintained along the index fingers. The accuracy of measurement required is 0,1 cm (Norton *et al.*, 1996:66)

– ***Humerus breadth***

The distance is measured between the medial and lateral epicondyles of the humerus when the arm is raised anterior to the horizontal and the forearm is flexed at a right angle to the upper arm. With the sliding callipers gripped correctly, the middle fingers are used to palpate the epicondyles of the humerus, starting proximal to the sites. The bony points first felt are the epicondyles. The callipers are placed directly on the epicondyles so that the arms of the callipers point upward at about 45° angle to the horizontal plane. Maintain firm pressure with the index fingers as the value is read (Norton *et al.*, 1996:71).

Figure 5.13 Humerus breadth

– ***Wrist breadth***

This is the girth of the wrist, distal from the stiloid process of the ulna and radius (Norton *et al.*, 1996:72).

Figure 5.14: Wrist breadth

– ***Femur breadth***

The distance is measured between the medial and lateral epicondyles of the femur when the subject is seated and the leg flexed at the knee to form a right angle with the thigh. With the subject seated and the callipers in place use the middle fingers to palpate the epicondyles of the femur, beginning proximal to the sites. The bony points first felt are the epicondyles. Place the caliper faces on the epicondyles so that the arms of the callipers point downwards at about 45° angle to the horizontal. Maintain firm pressure with the index fingers until the value is read (Norton *et al.*, 1996:70).

Figure 5.15 Femur breadth

Transformation

The anthropometric variables (such as fat percentage and sum of skinfolds) of the players were determined by using transformation. The transformations are as follow:

- Age = test date – birth date;
- Fat percentage = sum of subscapular and calf skinfold
- The sum of 6 skinfolds = (triceps + subscapular + supraspinal + abdominal + thigh + calf)

5.3.2 Rugby-specific skills

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

– ***Ground skills***

Aim: To assess ground skill ability

Equipment: Stopwatch, markers and 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 5.15: Ground skills

– ***Side-step***

Aim: To assess side step ability

Equipment: Two tackle bags and a rugby ball

Execution of test: 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-steps (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 5.16: Side step

– *Aerial and ground kicks*

Aim: To assess aerial and ground kicking ability

Equipment: Five markers and a 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 5.17: Aerial and ground kicks

– ***Passing for distance***

Aim: To assess passing ability

Equipment: 50 m tape measurer and a 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 5.18: Passing for distance

– ***Passing for accuracy (4 m)***

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 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 4 m 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, 1998).

Figure 5.19: Passing for accuracy over 4m

– ***Passing for accuracy (7 m)***

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, and a 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 represents 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 5.20: Passing for distance over 7m

– ***Kicking for distance***

Aim: To assess kicking ability

Equipment: Tape measure and 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 5.21: Kicking for distance

– ***Kick-off for distance***

Aim: To assess kick-off ability

Equipment: Tape measure, kicking tee and 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).

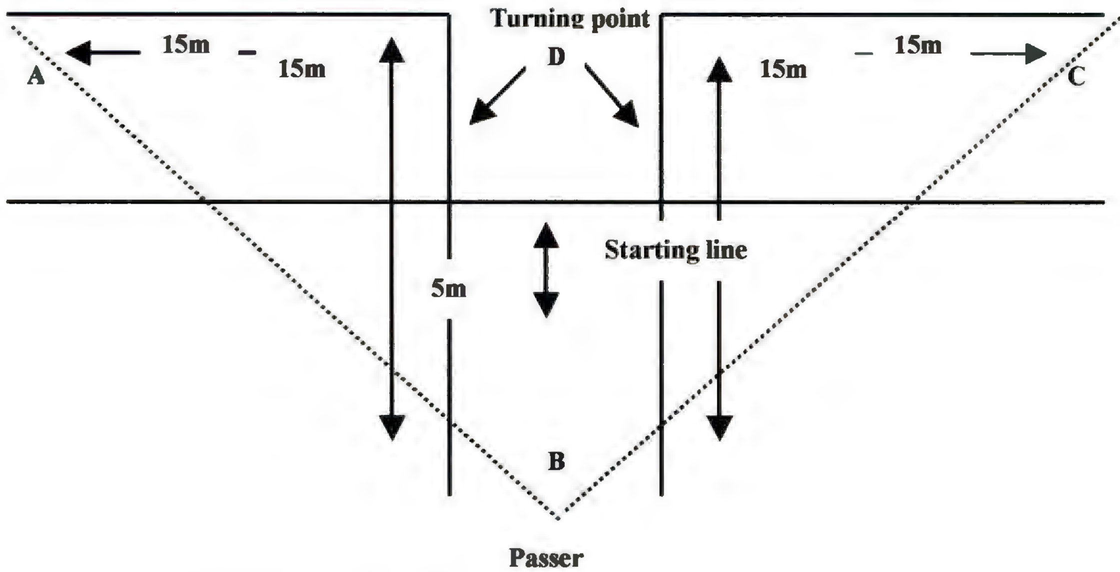
Figure 5.22: Kick-off for distance

– *Catching while running*

Aim: To assess catching ability while running

Equipment: Tape measurer, markers and rugby balls

Description: The subject runs on command from marker B (see figure 1) to marker D, then turns 90° to marker A. Between markers A and D the subject receives a ball from the thrower while the subject is running. He runs around marker A back to marker B and passes the ball back to the thrower. The action is then repeated to the right. Ten attempts are allowed to each side. For every successful catch the subject receives a point. The maximum score is then 20 points (AAHPER, 1966).



.... Passing line of the rugby ball

Figure 5.23: Illustration of catching while running

Figure 5.24: Catching while running

5.3.3 Physical and motor tests

The following test were done to assess the physical and motor capabilities of the rugby players.

– ***Adapted sit and reach test***

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. This 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).

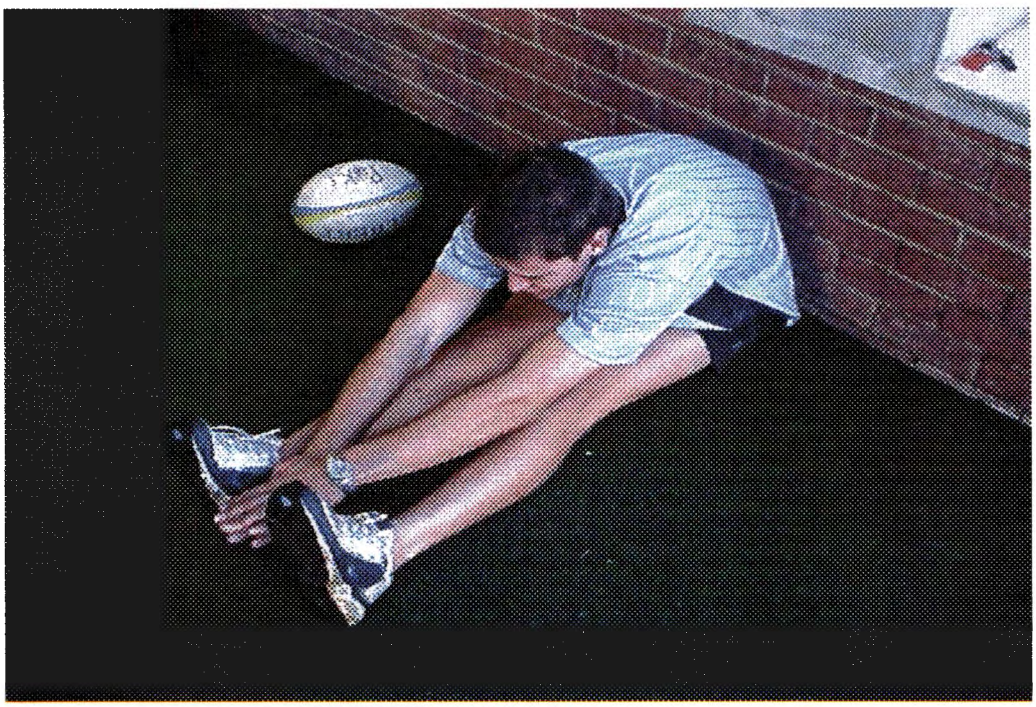


Figure 5.26: Adapted sit and reach

– *Vertical jump*

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

Equipment: Tape measure 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).

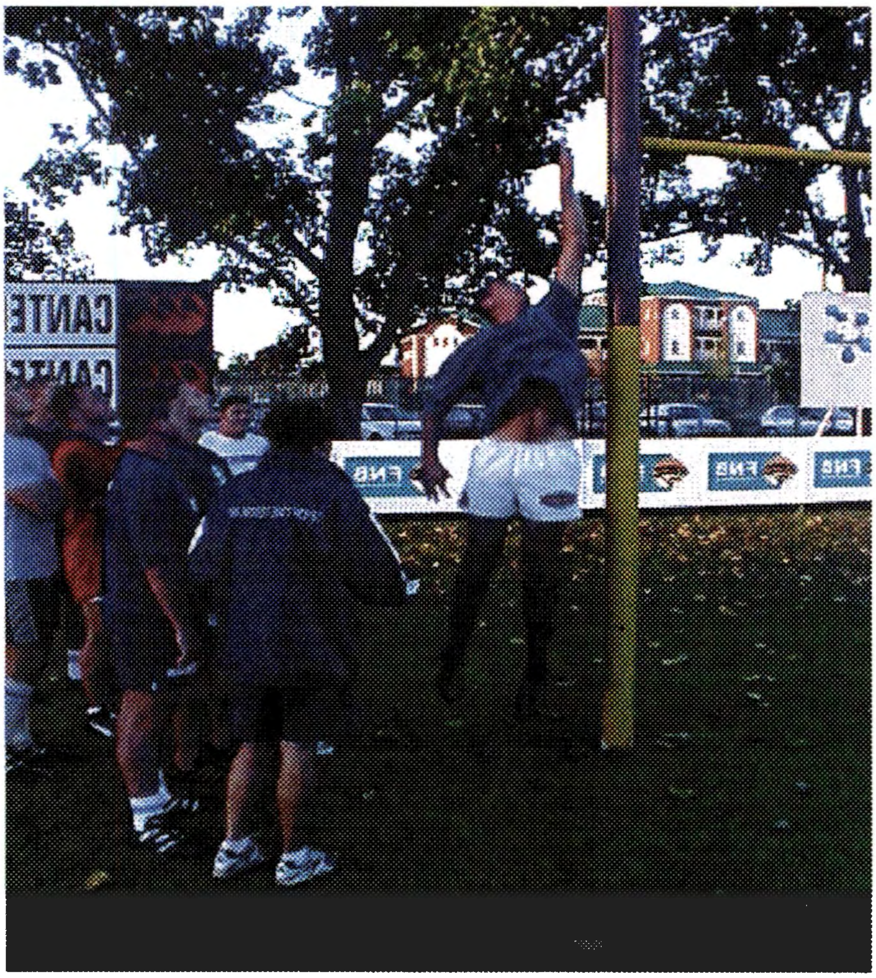


Figure 5.27: Vertical jump

- ***Speed endurance***

Aim: To assess speed endurance ability

Equipment: Tape measure, 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 in calculated as follows:

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

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

- $X1 + X2 \div 2$ = average X (where X1 and X2 represent the two slowest times)
- $Y1 + Y2 \div 2$ = 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.

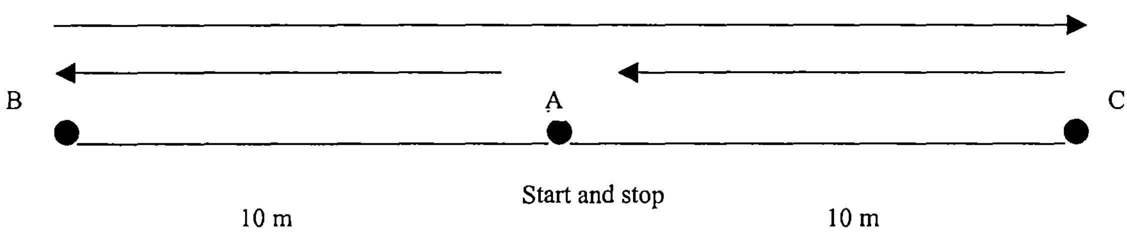


Figure 5.28: Illustration of speed endurance

Figure 5.29: Speed endurance

– ***Illinois agility test***

Aim: To assess agility ability

Equipment: Stop watch, rugby ball, tape measureand markers

Description: The subject stands at the start and on command sprints to and around marker A (see figure 2). He then sprints to marker B and zigzags up between the following four markers, runs around the last one and zigzags back down to marker B. He then sprints to and around marker C, and from there to the finish line. The subject must hold the ball with both hands. If the subject slips or touches one of the markers, the test must be done again. The subject is allowed three attempts and the best time is recorded (Badenhorst, 1998).

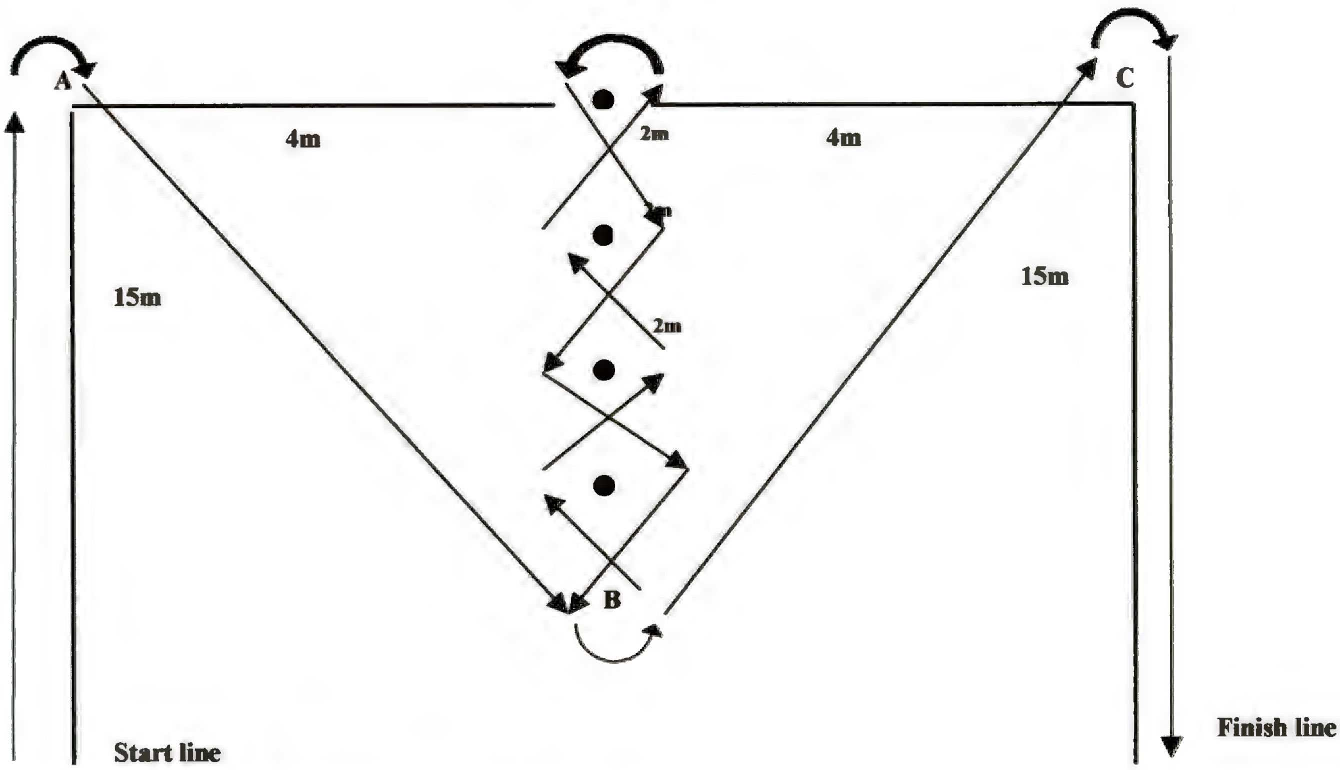


Figure 5.30: Illustration of Illinois agility test

Figure 5.31: Illinois agility test

- *T-test agility*

Aim: To assess agility ability

Equipment: Stop watch, tape measure and four markers

Description: The subject stands at the starting line, and on command he sprints to marker A (Figure 3) and touches it with both hands. He then shuffles to the left to marker B and touches it with his left hand. He then shuffles to the right to marker C and touches it with his right hand. He then shuffles to marker A, touches it with both hands and back-pedals to the starting line again. The subject receives three attempts and the best time is recorded (SISA, 1998).

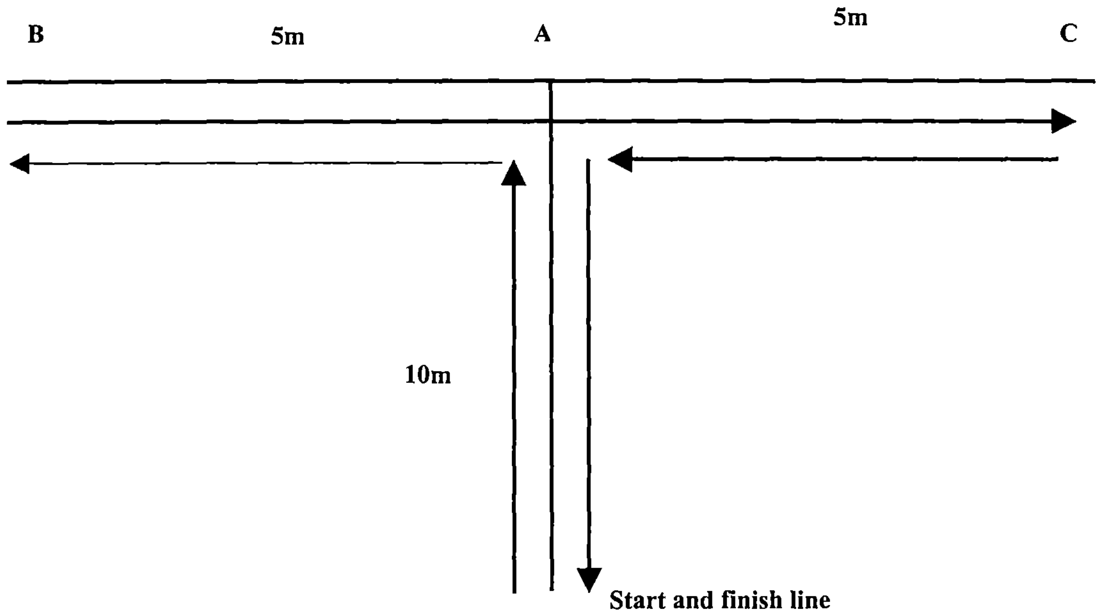


Figure 3.32: Illustration of "T" test agility

Figure 5.33: Illustration of "T" test agility

– ***Speed test***

Aim: To assess speed ability

Equipment: Stop watches, tape measure and markers

Description: The subject sprints 30 m on command. There are timekeepers at the 10 m and the 30 m who record the times. The subject has three attempts and the best time for both distances together are recorded (Hazeldine & McNab, 1991)

Figure 5.34: Speed test

– ***Pull-ups***

Aim: To assess strength ability

Equipment: Pull-up bar high enough so that the subject's feet cannot touch the ground while doing pull-ups

Description: The subject uses the overhand grip on the bar. The subject has to pull himself up so that his chin is above the bar. His arms have to be fully extended when going down. The subject has one trial to do as many pull-ups as possible (Norton & Atherton, 1997:1)

Figure 5.35: Pull-ups

– ***Flexed-arm hang***

Aim: To assess static (isometric) strength ability

Equipment: Stop watch and pull-up bar high enough so that the subject's feet cannot touch the ground while doing a flexed-arm hang

Description: The subject is asked to hang with hands in the overhand grip, with arms flexed and the chin above the bar. The subject has one trial to hang as long as possible. The chin has to stay above the bar. The time is then recorded (Norton & Atherton, 1997:1)

Figure 5.36: Flexed arm hang

– ***Seven stage abdominal strength test***

Aim: To assess abdominal strength ability

Equipment: 2,5 kg weight and 5 kg weight

Description: The subject lies on his back in a sit-up position, both feet are flat on the ground and the knees are bent at approximately 45°. If the feet lift off the ground the last stage completed is recorded (Ellis *et al.*, 1998:143-144).

The stages are as follows:

Stage 1: With the arms straight the subject touches his knees with his wrists

Stage 2: With the arms straight the subject touches his knees with his elbows

Stage 3: With his hands next to his ears, keeping them there, he touches his knees with his elbows

Stage 4: With his arms crossed over his chest, he attempts to touch his knees

Stage 5: With his hands behind his neck and the chest open, he attempts to touch his knees with his chest

Stage 6: With the 2,5 kg weight placed behind his head, and keeping the weight there, he attempts to touch his knees with his chest

Stage 7: With the 5 kg weight placed behind his head, and keeping the weight there, he attempts to touch his knees with his chest

Figure 5.37: Seven stage abdominal strength test

5.4 Testing procedures

The U/13, U/16 and U/18 players were all tested in June–July of 2002 during the provincial team training camp, held at a local high school in Potchefstroom. All the anthropometric measurements were taken first in the assembly hall of the school. The rugby-specific skill tests and physical and motor tests were done on the rugby field. The players were divided into groups for every test and worked on a rotation basis. The rotations were of such a nature that no test would be influenced by a prior test. The speed endurance test was done last. The U/19 players were tested in the July holidays at the PUK Rugby Institute of the Potchefstroom University. The same testing procedure was followed as with the school teams. The sports scientists of the PUK Rugby Institute were trained in the execution of all the tests, and were experienced in taking anthropometric measurements.

5.5 Statistical method

All data was processed by using Windows 1999 statistica program. Descriptive statistics were done in each age group. There after, one way analyses of variance (ANOVA) was done between playing groups. Practical significant differences were determined using Cohen's method (Thomas & Nelson, 1985), but only the MS Error of the ANOVA was used in stead of standard deviation, seeing that these subject were not randomly selected.

Calculating practical significant differences:

$$d = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{2 \text{MS Error}}}$$

d= Practical significant difference

$\bar{x}$ = mean of group

MS Error presented in ANOVA

Forward stepwise discriminant analyses were done between the playing groups to determine what components discriminated the most between the playing groups. After this a classification matrix was done to establish the percent of correct classification in playing groups. ANOVA was again performed to establish differences between playing positions and practical significant differences. The data was also standardised, meaning all components presented a mean of zero ($\bar{x}=0$). This data was then presented in a line plot graph (Thomas & Nelson, 1985). The data presented in the graph and the practical significant differences found in certain components, will assist in establishing a test battery for positional selection.

CHAPTER 6

RESULTS AND DISCUSSION

6.1 Introduction

6.2 Anthropometric components of U/13-, U/16-, U/18- and U/19 rugby players

6.3 Rugby specific skill components of U/13-, U/16-, U/18- and U/19 rugby players

6.4 Physical- and motor components of U/13-, U/16-, U/18- and U/19 rugby players

6.5 Comparisons of playing groups in terms of anthropometrical-, rugby specific skill-, physical- and motor components

6.6 Conclusion of comparisons of playing groups in terms of anthropometric-, rugby specific skill-, physical- and motor components

6.7 Classification of positional groups for the U/13-. U/16-, U/18- and U/19 rugby players in terms of anthropometrical-, rugby specific skills- and physical- and motor components

6.8 Rugby components that distinguish the most between different positions for the U/13-, U/16-, U/18- and U/19 rugby players

6.9 Conclusion of positional components that distinguish between different positions for the U/13-, U/16-, U/18- and U/19 rugby players

6.1 Introduction

The aim of this study is to compile a tests battery for positional selection among adolescent rugby players, in terms of anthropometric-, rugby specific skill, physical and motor components.

This chapter consists firstly of descriptive statistics (mean ($\bar{x}$), minimum, maximum and standard deviation (sd) for the U/13, U/16, U/18 and U/19 North West province elite provincial rugby players. Secondly, a one-way analysis of variance (ANOVA) will be discussed for each age group, and practical significantly differences will be noted between playing groups. Thirdly, a discriminant analysis will be done to determine the variables that discriminate the most between playing groups. According to discriminant analysis a classification matrix will then be done to classify the playing groups in terms of variables that were discriminant. Fourthly, analyses of variance will be done to determine practically significant differences between playing positions. The data will also be standardised for each age group and presented in a line plot graph to establish the variables necessary for positional selection in rugby.

De Ridder (1993) conducted a study to determine the morphological profile of primary and high school Craven week rugby players. Although the study might be out of date, it is the only study that could be found that might indicate the anthropometric components for U/13 and U/18 players in different positions. Pienaar and Spamer (1998) conducted a study in identifying rugby talent among ten- and eleven-year-old boys. Some of these boys tested in Pienaar and Spamer's (1998) study had previous experience in rugby, while others had none. References will be made to the boys that had previous experience in rugby. Hare (1997) conducted a study in talent identification among 16-year-old rugby players. He identified certain components that distinguish between successful and less successful rugby players. Certain comparisons will be drawn between the U/16 talented players and the U/16 players measured and tested in this study. Hanekom (2000) conducted a study among 17- and 18-year-old rugby players in the North West Province of South Africa that were classified as talented players by their coaches. Spamer and Winsley (2002) compared elite English and South African U/18 rugby players. Similar tests that were done in these studies will be compared with the findings of this study. Many studies do exist for adult players in terms of anthropometric, rugby-specific skill, physical and motor components. However, no comparisons will be done between adolescent and adult players, but some tendencies will be discussed.

6.2 Anthropometric components of U/13, U/16, U/18 and U/19 rugby players

Table 6.1 presents the average body mass (59,02 kg) for the U/13s in this study to be higher than the U/13s (55 kg) tested by De Ridder (1993:131). This was also the tendency when the average body mass of the U/16s (76,64 kg) of this study was compared to the U/16s (72,82 kg) measured in Hare's (1997:88) study. Again the same tendency was found among U/18s of this study in terms of average body mass (84,78 kg) when compared to the U/18s of De Ridder's (1993:163) study. A more recent study by Spamer and Winsley (2002:5), however, found that the average body mass for the elite U/18 English players (87,8 kg) and for the Northern Bulls high school Craven week (87,4 kg) team was higher than that of the U/18 players of this study. The average body mass for the U/19s (89,39 kg) in this study was much higher than for the U/19s (77,36 kg) that Hanekom (2000:56) measured. From these studies it seems that body mass among rugby players has increased over the past few years.

Table 6.1 also presents the mean stature for U/13s (169.38 cm) in this study, which was also lower (163,9 cm) than the U/13s measured in De Ridder's (1993:131) study. This was also the case for the U/16s of this study in terms of mean stature (180,86 cm) when compared to the talented U/16s (177,63 cm) measured in Hare's study (1997:88) and the U/17s measured in Hanekom's study (177.45 cm) (2000:56). The U/18s in this study were also on average taller (184,11 cm) than the U/18s (180.1 cm) measured in De Ridder's (1993:163). The U/18 English players presented with lower values in term of average stature (181,9 cm), while the Northern Bulls high school Craven week players presented with higher values for stature (185,6 cm) than the U/18 (184,11 cm) and U/19 (183.74 cm) players of this study (Spamer & Winsley, 2002:2). The U/19 players measured in Hanekom (2000:71) presented with lower values in stature (180,00 cm) than the U/19s (183.74 cm) in this study. These comparisons reveal that, just like body mass, stature has increased over the past few years among adolescent rugby players.

The mean percentage of fat (14,93 %) for the U/13 players in this study was lower than that of the U/13 (15,01 %) players of De Ridder's (1993:194) study (Table 6.1). The mean percentage of fat for the U/16 (15,96 %) players in this study was lower than the fat percentage for talented U/16 (18,77 %) players measured in Hare's (1997:88) study. The U/18 players in this study presented with a higher mean fat percentage (18,55 %) than the high school Craven week players (16,4 %) of De Ridder's (1993:198) study, as well as the Northern Bulls high school craven week team (15,8 %) (Spamer & Winsley, 2002:5). The U/18 English players presented with the highest mean fat percentage (22,1%) of all the groups tested in this study (Spamer & Winsley, 2002:5). The U/19s of this study presented with a higher mean fat percentage value (19,61 %) than the U/19s (10,24%) tested in Hanekom (2000:66). It is important to keep in mind that the method for calculating fat percentage could have differed from study to study. It seems that fat percentage in most age groups has decreased over the past few years.

In table 6.1 the mean sum of the skinfolds (58,79 mm) for U/13s was less than that of the U/13s (68,6 mm) measured in De Ridder's study (1993:158). This was also the tendency in the high school Craven week players (68,6 mm), who presented with a lesser value than the U/19s (72.54 mm) in this study in terms of sum of skinfolds (De Ridder , 1993:158). It seems that the sum of skinfolds has decreased in rugby players over the past few years, which is an indicator of the decrease in adipose fat.

The average flexed upper arm (28,23 cm), forearm (25,32 cm), ankle (22,51 cm) and calf girth (33,22 cm) of the U/13 players in this study were all higher than those of the U/13s tested in De Ridder's (1993:158) study. In terms of all the girths, only the flexed upper arm (32,57 cm) and ankle girth (24,14 cm) of the U/16s of this study were higher than the talented U/16 players measured in Hare's (1997:88) study. The U/18 players measured in De Ridder's (1993:182) study all presented with higher mean girths than the U/18 of this study. The girths of the U/18s in this study was also higher than all the players measured by Spamer and Winsley (2002:5), with exception of the calf girth (40,1 cm). It seems that muscle development has increased among players, with the exception of the U/18 players, and that this could be due to better physical conditioning of adolescent rugby players.

The U/13 players in this study presented with higher mean breadths in respect of all the measurements than the U/13s measured in De Ridder's (1993:147) study. The U/16 players in this study presented with higher mean values, in all the breadths, than the U/16s measured in Hare's study (1997:88), with the exception of the femur breadth (9,81 cm). The U/18 players in this study presented with higher mean values in all the breadths than the U/18s measured by De Ridder (1993:178). It also seems that the skeleton of adolescent rugby players has grown and has matured more over the past few years.

In conclusion it seems that the U/13, U/16 and U/18 rugby players in this study are heavier, taller, have lower fat percentage, lesser values in sum of skinfolds, higher values in breadths and girth, than their counterparts in De Ridder's (1993) and Hare's (1997) study. The only exception was the U/18 rugby players in terms of fat percentage and girths, which were higher than those of their counterparts in the previous studies. The U/19 rugby players were shorter in terms of stature than the U/18 rugby players measured by Spamer and Winsley (2002:5). It also seems that in most anthropometric measurements changes did occur over time among adolescent rugby players.

Table 6.1. Descriptive statistics of the anthropometrical components of the U/13-, U/16-, U/18- and U/19 rugby players

Variables	U/13 rugby players N=21				U/16 rugby players N=22				U/18 rugby players N= 18				U/19 rugby players N=19			
	x̄	Min	Max	sd	x̄	Min	Max	sd	x̄	Min	Max	sd	x̄	Min	Max	sd
Body mass (kg)	59.02	42.00	75.00	9.96	76.64	60.00	104.00	11.41	84.78	65.00	112.00	15.48	89.39	73.00	119.00	12.84
Stature (cm)	169.38	151.00	184.00	8.27	180.86	167.00	201.00	8.22	184.11	167.00	200.00	8.09	183.74	173.00	199.00	5.79
Tricep skinfold (mm)	9.10	5.00	13.00	2.79	8.02	4.00	15.00	2.81	9.81	4.50	22.00	5.07	10.39	5.00	17.00	3.92
Subscapular skinfold (mm)	7.93	5.00	17.00	2.98	10.32	6.00	17.00	2.77	11.84	5.00	31.00	6.12	12.61	7.00	30.00	6.54
Pectoral skinfold (mm)	5.17	2.00	14.00	3.05	5.73	2.00	10.00	2.30	5.81	3.00	15.00	2.79	6.45	4.00	13.00	2.34
Abdominal skinfold (mm)	11.81	5.00	35.00	7.92	12.64	5.00	28.00	6.52	15.00	5.00	39.00	10.02	16.50	6.00	37.00	8.82
Thigh skinfold (mm)	12.71	8.00	19.00	3.58	10.77	5.50	23.00	4.01	10.43	1.00	21.00	4.79	13.09	1.30	29.00	5.88
Calf skinfold (mm)	9.64	6.00	15.00	3.26	7.11	3.00	15.00	2.84	7.67	4.00	15.00	3.45	9.24	3.50	20.00	4.34
Sum of skinfolds (mm)	58.79	36.00	112.50	22.46	57.68	29.50	101.00	20.19	65.44	38.00	141.00	31.36	72.54	38.00	149.00	32.69
Fat percentage (%)	14.93	9.43	25.09	4.06	15.96	9.43	24.31	3.96	18.55	10.21	42.32	8.41	19.61	12.17	38.40	7.76
Flexed upper arm girths (cm)	28.23	25.40	33.00	2.07	32.57	27.10	37.40	2.83	34.40	30.00	39.50	2.77	37.82	34.00	42.00	2.30
Fore arm girths (cm)	25.32	22.00	29.00	1.85	27.93	23.20	30.80	1.91	29.54	26.50	33.00	1.80	31.04	28.00	33.80	1.50
Ankle girth (cm)	22.51	20.00	25.30	1.49	24.14	20.80	37.00	3.19	24.68	22.20	27.00	1.49	25.55	22.00	37.50	3.18
Calf girth (cm)	33.22	25.50	40.30	3.16	36.77	22.20	42.50	4.21	38.17	27.20	44.00	4.07	39.99	36.00	44.00	2.39
Humerus breadth (cm)	7.11	6.10	10.40	0.89	7.14	6.30	72.00	13.82	7.32	6.20	8.10	0.53	7.48	6.50	8.30	0.55
Femur breadth (cm)	9.36	7.70	10.50	0.62	9.81	4.80	12.00	1.36	9.99	8.90	10.60	0.50	9.91	8.90	11.40	0.65
Wrist breadth (cm)	5.61	5.00	6.10	0.31	5.96	5.20	6.60	0.36	5.92	5.20	6.60	0.36	6.05	5.50	7.90	0.51

6.3 Rugby-specific skill components of U/13, U/16, U/18 and U/19 rugby players

No data for rugby-specific skills could be found specifically for U/13 players in terms of rugby-specific skill components. However, Pienaar and Spamer (1998:50) tested 10-year old children in terms of rugby-specific skill tests. They found the boys with previous experience in rugby to perform better than those with no experience in most rugby-specific skill tests (Pienaar & Spamer, 1998:51). Spamer and Winsley (2002:4) also found practically significant differences between elite English and South African U/18 rugby players

The U/16s of this study presented with a better mean time (3,62 sec) than the U/16 players (5,68 sec) tested by Hare (1997:83) in terms of ground skills (table 6.2). According to Spamer and Winsley (2002:4) the U/18 English rugby players preformed poorer (3,8 sec) than the U/18s (3,59 sec) of this study in terms of ground skills. Only the Northern Bulls high school Craven week team performed better than both these teams in terms of ground skills (3,4 sec) (Spamer & Winsley, 2002:4). This skill, according to this study, improves with age, seeing that the U/19s achieved the best time in terms of ground skills (3,54 sec) than all the other players in this study. However, they did not perform better than the Northern Bulls high school Craven week team (3,4 sec).

The U/16 (5.50) players of this study performed better than the U/16s (4,46) tested by Hare (1997:83) in terms of the side-step test. The U/18 (6,28) of this study performed poorer than the English team (7,8) and Northern Bulls high school Craven week team (7,1) tested by Spamer and Winsley (2002:4) in terms of the side-step test. Both these teams also outperformed the U/19s (6,89) of this study. It seems that this skill did improve with age among adolescents, but does not necessarily improve with advancing age.

The U/16 players of this study performed better (5,19) than the U/16 players (4,60) tested by Hare (1997:83) in terms of aerial and ground kicks. According to table 6.2 the U/18 players of this study performed more poorly (5,33) than the U/18 English rugby team

(7,3) and Northern Bulls high school Craven week team (6,5) in terms of aerial and ground kicks (Spamer & Winsley, 2002:4). The U/19 players of this study performed best of all age groups in terms of aerial and ground kicks (6,89). It seems that this skill has improved over the past few years and that this skill also improves with age.

According to Pienaar and Spamer (1998:50) the 10-year-old boys with previous experience in rugby, average distance for passing was 10,2 m. The U/13s in this study achieved an average passing for distance of 17,49m (table 6.2). The U/16 players of this study performed better (21,14 m) than the U/16s (19,95m) tested by Hare (1997:83) in the passing for distance test. This was also the case with the U/18s of this study, who performed better (23,99 m) than the English players (19,7 m), but poorer than the Northern Bulls team (28,4 m) in terms of passing for distance (Spamer & Winsley, 2002:4). Thus, it is clear that this skill improves with advancing age and that it has improved over the past few years among adolescent rugby players as well.

The 10-year-old boys with previous experience in rugby achieved an average score of 4,7 in terms of passing for accuracy over 4 m (Pienaar & Spamer, 1998:50). This was better than the U/13s (3,76) of this study (Table 6.2). However, the U/16 players (4,50) of this study did perform better than the U/16 players (4,23) in the study by Hare (1997:83), but still more poorly than the 10-year-old players (4,7) tested by Pienaar and Spamer (1998:50). The mean passing for accuracy over 4 m of the U/18s of this study (5,61) was better than that of the U/19s of this study (5,47). The U/18 English players (6,4) and Northern Bulls high school Craven week players (6,3) performed better than the U/18s (5,61) and U/19s (5,47) of this study (Spamer & Winsley, 2002:4). It seems that this skill does not necessarily improve with advancing age and might be influenced more by experience in rugby and training.

The passing for accuracy over 7 m test showed similar results in terms of younger players outperforming older players. The U/13 players performed better (24,52) than the U/16 players (23,55), while the U/18 players (25,83) performed better than the U/19 players (25,11) in this study. The U/18s of this study performed better than their English U/18 counterparts (23,3) and Northern Bulls high school Craven week (24,5) players (Spamer & Winsley, 2002:4). It seems that this skill also does not necessarily improve with advancing age and also might be influenced by experience in rugby and training

The 10-year-old players with previous experience in rugby presented with an average kicking distance of 20,5 m (Pienaar & Spamer, 1998:50). The U/13 players in this study achieved an average distance of 33,80 m. The mean kicking for distance test also revealed that the U/16s (41,41 m) performed better than the U/18 (37,84 m) players in this study. However, the U/16 players in this study did perform better (41,41 m) than the U/16s tested by Hare (1997:83) in terms of kicking for distance (38,02 m). Hanekom (2000:56) revealed that the average kicking distance for U/17s is 41,15 m, which is further than in the case of the U/18s (37,84 m) who were tested in this study. The U/18 of this study, however, performed better than their English counterparts (33,2 m) but performed more poorly than the U/18 Northern Bulls (47,7 m). The U/19 players in this study performed better (50,47 m) than the U/19 players (43,26 m) tested by Hanekom (2000:56). It seems that this skill has develop over the past few years but has not necessarily improved with advancing age.

According to Pienaar and Spamer (1998:50) the average kick-off for distance for 10-year-old players with previous experience in rugby was 14,0 m. The U/13 players in this study presented with an average distance of 30,11 m, which is an indication that this skill improves with advancing age even at such an early age (Table 6.2). The U/18s of this study performed better than the English players (34,0 m), but more poorly than the Northern Bulls U/18 (48,4 m) players in terms of kick-off for distance (Spamer & Winsley, 2002:4). It seems that this skill has developed over the past few years, and that it also develops with advancing age.

The 10-year-old rugby players with previous experience in rugby achieved an average score of 12,5 in terms of catching the forward pass (Pienaar & Spamer, 1998:50). The U/13 achieved an average score of 18,24 in terms of catching while running (Table 6.2). The U/16 players of this study performed better than the U/16s (18,74) tested by Hare

Table 6.2. Descriptive statistics of the rugby specific components of the U/13-, U/16-, U/18- and U/19 rugby players

Variables	U/13 rugby players (n=21)				U/16 rugby players (n=22)				U/18 rugby players (n= 18)				U/19 rugby players (n=19)			
	x̄	Min	Max	sd	x̄	Min	Max	sd	x̄	Min	Max	sd	x̄	Min	Max	sd
Ground skills (sec)	4.03	3.40	5.20	0.55	3.62	3.20	4.08	0.25	3.59	2.98	4.38	0.44	3.54	2.90	4.17	0.30
Side steps (n)	4.52	2.00	8.00	1.47	5.50	2.00	8.00	1.40	6.28	4.00	10.00	1.78	6.89	5.00	8.00	0.99
Aerial and ground kicks (n)	4.43	2.00	6.00	1.25	5.19	4.00	7.00	0.93	5.33	3.00	8.00	1.41	6.89	5.00	10.00	1.24
Passing for distance (m)	17.49	11.80	22.20	3.06	21.14	10.20	28.90	4.34	23.99	12.32	31.20	4.57	24.92	16.30	30.30	3.74
Passing for accuracy (4m) (n)	3.76	0.00	8.00	1.97	4.50	0.00	10.00	2.28	5.61	2.00	9.00	1.97	5.47	2.00	8.00	2.14
Passing for accuracy (7m) (n)	24.52	19.00	28.00	2.62	23.55	1.00	30.00	5.76	25.83	20.00	29.00	3.01	25.11	21.00	28.00	1.78
Kicking for distance (m)	33.80	16.74	45.93	6.88	41.41	23.30	69.00	11.13	37.84	30.90	46.70	3.72	50.47	40.00	60.00	5.79
Kick-off for distance (m)	30.11	11.15	47.78	11.14	33.60	10.00	51.00	9.18	40.11	26.40	50.50	7.21	49.79	38.00	61.00	6.40
Catching while running (n)	18.24	12.00	20.00	2.10	19.27	18.00	20.00	0.88	19.44	2.00	40.00	6.68	19.89	18.00	20.00	0.46

(1997:83) in terms of catching while running. It seems that this skill is well developed in all players, seeing that the lowest success rate is 91,2% for the players tested in this study. It also seems that catching ability improves with advancing age and that the adolescents of this study performed better than their counterparts a few years ago.

In conclusion it is evident that not all rugby-specific skills develop with advancing age, for instance in the passing for accuracy over 4 m and 7 m, side-stepping ability and kicking for distance, younger players performed better than older players. This might be because of more exposure to the game at a younger age or more time spent at practising specific skills. What is very evident from this study and previous studies is that rugby-specific skills have developed over the past few years. These developments make it necessary to review and update present talent identification models for different age groups.

6.4 Physical and motor components of U/13, U/16, U/18 and U/19 rugby players

In a study by Pienaar and Spamer (1998:50) the 10-year-old players with previous experience in rugby achieved an average value of 0,4 cm for the modified sit-and-reach test. The U/13 players of this study achieved an average score of 3,75 cm in terms of modified sit-and-reach. The results of the modified sit-and-reach test in table 6.3 indicate that the U/16 players (5,91 cm) were the most flexible of all the players tested in this study. The U/16 players (5,91 cm) in this study performed better than the U/16 players (2,36 cm) tested by Hare (1997:86) in terms of the modified sit-and-reach test (Table 6.3). In this study the U/18 players performed worst (2,44 cm) of all the players tested in terms of flexibility; however, they still performed better than their English (-6,6 cm) and Northern Bulls (2,9 cm) counterparts. It was also noticeable that the U/19 players in this study performed more poorly in terms of lower back, hamstring and hip flexibility than the U/19s (4,51 cm) tested by Hanekom (2000:56). It seems that flexibility does not improve with advancing age but does improve over time among adolescent rugby players. It seems that the rugby players of this study improved up to the age of 16 years in terms of flexibility. The reason might be that these players experienced PHV (paragraph 3,29, 3,70) later. This explains the high scores among the U/16 players (3,70). Then the other reason might just be that the spurt in flexibility is not before PHV among these players tested. The U/16 players might also have been exposed to a flexibility programme, which might explain the good results in the modified sit-and-reach scores. It should also be kept in mind that these studies might have used different apparatus that was not used in this study, and therefore the different results.

According to Pienaar and Spamer (1998:50) the 10-year-old boys (29;5 cm) who had previous experience in rugby presented with lower mean values than the U/13 players (30,19 cm) in this study, in terms of vertical jump. The U/16 players (40,55 cm) of this study performed more poorly than the U/16 players (47,16 cm) tested by Hare (1997:86). The U/18s in this study performed better than their English (44,0 cm) but more poorly than their Northern Bulls (52.4 cm) counterparts in terms of the vertical jump. The same tendency was found among the U/19 players in this study, who performed better than the U/19 players (40.96 cm) tested in Hanekom's (2000:56) study. The spurt in performance in terms of power (explosive strength) occurs after PHV (paragraph 3,68). This does not seem to be the case among these adolescents, seeing that the U/16 players did not present with the best scores in terms of vertical jump. It appears as if, according to the results of this study and previous studies, power (explosive strength) improves linearly with advancing age among rugby players.

Table 6.3 shows that the U/13 (5,11%) players had a lesser decline in mean speed endurance than the 10-year-old boys tested by Pienaar and Spamer (1998:9). The boys tested in the study of Hare (1997:86) reported that the talented U/16 players had a lesser decrease in mean speed endurance (6,37 %) than the U/16 players (6,58 %) in this study. The U/19 players tested in this study (5,00 %) presented with a lesser decrease in mean speed endurance (6,65 %) than the U/19s tested in the study of Hanekom (2000:56). It is interesting to note that of all the players tested in this study, the U/13 players were fitter than the U/16 and U/18 players. This confirms the fact that an adolescent spurt is evident between 11 and 13 years of age in terms of anaerobic performance (which includes speed endurance) (paragraph 3,62).

According to table 6.3 the Illinois and T-test for agility improved with age in the players tested in this study. This supports the observation that agility improves in boys up to the age of 18 years (paragraph 3,72). Previous studies did not include these specific tests, so comparisons could not be made.

According to Hanekom's (2000:56) study the U/17 (2,21 sec) and U/19 players (2,31 sec) performed more poorly that the U/13 players (2,17 sec) tested in this study in terms of speed over 10 m. However, the U/16 players (1,89 sec) in this study did outperform the U/18 (2,02 sec) and U/19 players (2,04 sec) in terms of speed over 10 m (Table 6.3). It seems as if speed over 10 m does not improve with advancing age. However, the mean speed over 30 m presented different results, with the U/19 players (4,49 sec) outperforming all the younger players. In terms of speed, no adolescent spurt in performance is evident (paragraph 3,59); however, the U/16 players were faster over 10 m than the U/18 and U/19 players of this study . This might indicate a spurt in speed performance. Speed over 30 m of the U/19s in this study (paragraph 3,59) supports the views in the literature that speed improves with age.

In terms of the strength and muscle endurance tests (pull-ups, flexed-arm hang and seven-stage abdominal test), it seems as if the strength of the adolescent rugby player (paragraph 3.65) also increases with advancing age. In terms of muscle endurance (flexed-arm hang), no spurt as the literature suggests (paragraph 3,67) was evident among the adolescents who were tested in this study.

In conclusion it seems that most physical and motor components improve with age, with the exception of speed over 10 m, speed endurance and flexibility. The comparisons of the studies by Pienaar and Spamer (1998), Hare (1997), Hanekom (2000) and Spamer and Winsley (2002) on the relevant test seem to suggest that these players are performing better than their counterparts of other countries and better than a few years ago. This might be due to better physical conditioning of younger players. This information makes it necessary to review and update current talent identification models in rugby.

Table 6.3. Descriptive statistics of the physical- and motor components of the U/13-, U/16-, U/18- and U/19 rugby players

Variables	U/13 rugby players N=21				U/16 rugby players N=22				U/18 rugby players N= 18				U/19 rugby players N=19			
	x̄	Min	Max	sd	x̄	Min	Max	sd	x̄	Min	Max	sd	x̄	Min	Max	sd
Adapted sit and reach (cm)	3.75	0.00	11.00	3.51	5.91	0.00	20.00	6.80	2.44	0.00	14.00	3.85	4.37	0.00	15.00	5.05
Vertical jump (cm)	30.19	24.00	37.00	3.50	40.55	21.00	61.00	10.67	47.06	30.00	66.00	9.05	51.84	35.00	71.00	8.66
Speed endurance (%)	5.11	2.34	9.79	1.94	6.58	3.14	13.05	3.21	5.81	2.41	12.83	2.53	5.00	0.59	12.30	2.62
Illinois agility test (sec)	19.50	17.98	27.78	2.12	18.01	15.80	19.80	1.07	17.15	16.11	19.80	0.89	16.41	14.76	18.93	0.89
T-Test agility (sec)	13.62	12.11	18.39	1.40	13.27	11.11	18.10	1.61	11.48	10.82	13.02	0.57	11.09	9.93	12.37	0.69
Speed 10m (sec)	2.17	1.87	2.60	0.19	1.89	1.47	2.25	0.20	2.02	1.70	2.58	0.22	2.04	1.48	2.39	0.21
Speed 30m (sec)	5.08	4.07	6.01	0.50	4.56	4.07	5.25	0.34	4.53	4.18	5.89	0.40	4.49	3.90	5.21	0.38
Pull ups (n)	9.86	3.00	20.00	4.74	6.68	0.00	18.00	4.57	4.72	0.00	11.00	3.58	8.47	0.00	16.00	4.64
Abdominal strength (n)	3.52	1.00	7.00	1.72	4.10	1.00	7.00	2.23	3.89	1.00	7.00	1.68	5.00	2.00	7.00	1.49
Flexed arm hang (sec)	17.01	4.04	45.54	11.44	26.03	5.22	42.75	12.04	25.99	9.25	52.29	13.57	24.19	1.20	38.35	10.21

6.5 Comparisons of playing groups in terms of anthropometric, rugby-specific skills, physical and motor components

An analysis of variance (ANOVA) was performed to establish practically significant differences between playing groups in terms of anthropometric, rugby-specific skills, physical and motor components. The MS error was used from the ANOVA to establish practically significant differences. The playing groups were grouped into four groups, namely tight forwards (TF) (props, hookers and locks), loose forwards (LF) (flankers and eighth men), halves (H) (scrum- and fly-halves) and back-line players (BL) (centres, wings and full-backs). Practically significant differences between tight and loose forwards and between halves and back-line players will be discussed. There is no use to discuss the practically significant differences that exist between forwards and back-line players; however, the differences will be presented in the relevant tables. The relevant anthropometric measurements will be presented in the relevant tables but only the fat percentage, sum of skinfolds and girths and breadths will be discussed.

6.5.1 U/13 rugby players

- ***Anthropometric components***

The tight forwards presented with the highest mean body mass (66,18 kg), while the halves presented with the lowest mean body mass (48,00 kg) of all the U/13 playing groups (table 6.4). This was also the case in terms of mean stature, the tight forwards being the tallest (173,13 cm) while the halves were the shortest (160,50 cm) of all the playing groups.

The tight forwards had the highest mean fat percentage (17,75%). The halves presented with the second highest mean fat percentage (14,32%), with the back-line players (12,76%) and the loose forwards presenting with the lowest value in the team (12,59%). This was also the case in terms of the sum of skinfolds, with the exception that the halves presented with the lowest value.

The tight forwards presented with the highest mean values of all the playing groups in the flexed upper arm (29,26 cm), forearm-(26,41 cm) and ankle girth (23,35 cm). The loose forwards only presented with the highest values in the calf girth (34,00 cm), while the halves presented with the smallest mean values of all the playing groups in the flexed upper arm (26,55 cm), forearm (23,38 cm) and ankle girth (20,90 cm). The tight forwards only presented with the highest mean value in terms of humerus breadth (7,66 cm), while the loose forwards presented with the highest value of all the positions for the femur (9,63 cm) and wrist breadth (5,77 cm). The halves presented with the smallest mean humerus (6,33 cm), femur (9,08 cm) and wrist breadth (5,23 cm) of all playing groups.

There was a high practically significant difference between the tight and loose forwards in terms of fat percentage (d=1,44). The only high practically significant differences between the halves and back-line players were found in terms of body mass (d=1,07), stature (d=1,28), forearm girth (d=0,97), ankle girth (d=1,14) and wrist breadth (d=1,40).

In conclusion it seems that the U/13s at such a young age already presented with practically significant differences which distinguish between playing groups in terms of anthropometric components This also applied to adult players (paragraphs 4,32, 4,33, 4,34). Quarrie *et al.* (1996:56) found adult loose forwards to be taller than front row forwards, but shorter than locks. However, this was not the case with the U/13 players in this study. The only exception in the literature (paragraph 4,94) was the fat percentage and body mass of the halves and back-line players, where the halves did not present the smallest values of all the players.

Table 6.4. Practical significant differences between positional groups in terms of anthropometrical components for U/13 players

Variables	TF	LF	H	BL	MS Error	TF vs LF	TF vs H	TF vs BL	LF vs H	LF vs BL	H vs BL
	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$		d	d	d	d	d	d
Body mass (kg)	66.19	60.00	48.00	56.33	61.19	0.79	2.32***	1.26***	1.53***	0.47	1.07***
Stature (cm)	173.13	170.00	160.50	170.00	55.05	0.42	1.70***	0.42	1.28***	15.49***	1.28******
Tricep skinfold (mm)	10.63	7.20	9.50	7.75	6.75	1.32***	0.43	1.11***	0.89***	0.17	0.67
Supraspinale skinfold (mm)	11.19	5.67	5.25	5.33	16.51	1.36***	1.46***	1.44***	0.10	0.08	0.02
Subscapular skinfold (mm)	10.00	6.83	6.75	6.50	7.20	1.18***	1.21***	1.30***	0.03	0.12	0.09
Pectoral skinfold (mm)	6.81	3.33	5.50	3.67	8.26	1.21***	0.46	1.09***	0.75	0.12	0.64
Abdominal skinfold (mm)	17.88	7.17	9.13	7.83	45.39	1.59***	1.30***	1.49***	0.29	0.10	0.19
Thigh skinfold (mm)	13.81	10.33	13.75	11.75	12.96	0.97***	0.02	0.57	0.95***	0.39	0.56
Calf skinfold (mm)	11.19	8.67	8.88	8.58	10.68	0.77	0.71	0.80***	0.06	0.03	0.09
Sum of skinfolds (mm)	74.69	45.87	53.25	47.75	394.69	1.45***	1.08***	1.36***	0.37	0.09	0.28
Fat percentage (%)	17.75	12.59	14.32	12.76	12.91	1.44***	0.95***	1.39***	0.48	0.05	0.44
Flexed upper arm girth (cm)	29.26	28.37	26.55	27.90	3.81	0.46	1.39***	0.70	0.93***	0.24	0.69
Fore arm girth (cm)	26.41	25.87	23.38	24.90	2.45	0.35	1.94***	0.97***	1.59***	0.62	0.97***
Ankle girth (cm)	23.35	22.70	20.90	22.37	1.65	0.51	1.91***	0.76	1.40***	0.26	1.14***
Calf girth (cm)	33.66	34.00	31.43	33.45	10.78	0.10	0.68	0.06	0.78	0.17	0.62
Humerus breadth (cm)	7.66	7.13	6.33	6.88	0.63	0.67	1.68***	0.98***	1.02***	0.31	0.70
Femur breadth (cm)	9.36	9.63	9.08	9.40	0.42	0.42	0.44	0.06	0.86***	0.36	0.50
Wrist breadth (cm)	5.76	5.77	5.23	5.58	0.07	0.01	2.11***	0.71	2.12***	0.72	1.40***

High practical significance: d ≥ 0.8***

Medium practical significant differences: d=0.5

Low practical significant differences: d <0.2

- ***Rugby-specific skills components***

The halves presented with the best mean values for the rugby-specific components of all the playing groups. The loose forwards presented with the poorest results of all the playing positions in most tests.

There were high practically significant differences between the tight and loose forwards in terms of aerial and ground kicks (d=0,90) and passing for accuracy over 7 m (d=1,19). Back-line players and halves differed significantly in terms of ground skills (d=0,94), side-steps (d=1,21), aerial and ground kicks (d=1,01) and passing for accuracy over 7 m (d=1,19).

In conclusion it seems that the halves are the most skilled players in terms of rugby-specific skills components. Most literature supports the fact that back-line players (which include halves) are more skilled in terms of rugby-specific components than forward players (paragraph 4.114).

Table 6.5. Practical significant differences between positional groups in terms of rugby specific components for U/13 players

Variables	TF	LF	H	BL	MS Error	TF vs LF	TF vs H	TF vs BL	LF vs H	LF vs BL	H vs BL
	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$		d	d	d	d	d	d
Ground skills (sec)	4.01	4.02	3.74	4.27	0.32	0.02	0.48	0.46	0.50	0.44	0.94***
Side steps (n)	4.13	4.00	6.00	4.33	1.89	0.09	1.36***	0.15	1.45***	0.24	1.21***
Aerial and ground kicks (n)	4.38	3.33	5.50	4.33	1.35	0.90***	0.97***	0.04	1.87***	0.86***	1.01***
Passing for distance (m)	17.10	17.63	19.28	16.76	9.99	0.17	0.69	0.11	0.52	0.28	0.80***
Passing for accuracy (4m) (n)	2.88	2.33	5.50	4.50	2.94	0.32	1.53***	0.95***	1.85***	1.26***	0.58
Passing for accuracy (7m) (n)	22.75	25.33	27.25	24.67	4.72	1.19***	2.07***	0.88***	0.88***	0.31	1.19***
Kicking for distance (m)	31.07	34.35	38.59	33.96	46.68	0.48	1.10***	0.42	0.62	0.06	0.68
Kick-off for distance (m)	27.35	29.96	36.13	29.87	133.87	0.23	0.76	0.22	0.53	0.01	0.54
Catching while running (n)	18.38	17.67	19.25	17.67	4.74	0.33	0.40	0.33	0.73	0.00	0.73

High practical significance: d ≥ 0.8***

Medium practical significant differences: d=0.5

Low practical significant differences: d <0.2

- ***Physical and motor components***

The only high practical significant difference between tight and loose forwards was in speed endurance (d=1,69), while Quarrie *et al.* (1996:54) (paragraph 4,35) found the only differences between tight and loose forwards to be in the aerobic shuttle run and 30 m sprint. It seems that in terms of endurance, the players in this study presented the same tendencies. The halves and back-line players only differed significantly in terms of adapted sit-and-reach (d=1,04), speed endurance (d=0,83) and Illinois (d=0,91) agility test.

These differences are expected between halves and back-line players in terms of physical and motor components (paragraph 4.114). The back-line performed best in most physical and motor components of all playing positions, while the tight forwards performed the poorest (paragraph 4.114). These findings support the findings represented in literature (paragraph 4,35).

Table 6.6. Practical significant differences between positional groups in terms of physical - and motor components for U/13 players

Variables	TF	LF	H	BL	MS Error	TF vs LF	TF vs H	TF vs BL	LF vs H	LF vs BL	H vs BL
	x̄	x̄	x̄	x̄		d	d	d	d	d	d
Adapted sit and reach (cm)	2.88	3.33	2.43	6.00	11.92	0.13	0.13	0.90***	0.26	0.77	1.04***
Vertical jump (cm)	28.38	30.67	30.00	32.50	10.94	0.69	0.49	1.25***	0.20	0.55	0.76
Speed endurance (%)	5.07	7.78	3.55	4.88	2.58	1.69***	0.95***	0.12	2.64***	1.81***	0.83***
Illinois agility test (sec)	19.90	18.32	18.39	20.30	4.45	0.75	0.72	0.19	0.03	0.94***	0.91***
T-Test agility (sec)	13.85	12.94	13.28	13.86	2.15	0.62	0.39	0.01	0.23	0.63	0.40
Speed 10m (sec)	2.17	2.19	2.21	2.14	0.04	0.10	0.16	0.18	0.06	0.28	0.34
Speed 30m (sec)	5.27	5.03	5.00	4.90	0.26	0.46	0.53	0.71	0.06	0.25	0.18
Pull ups (n)	8.88	7.00	10.50	12.17	22.51	0.40	0.34	0.69	0.74	1.09***	0.35
Abdominal strength (n)	3.50	2.67	4.50	3.33	3.12	0.47	0.57	0.09	1.04***	0.38	0.66
Flexed arm hang (sec)	9.19	15.02	24.67	23.30	96.85	0.59	1.57***	1.43***	0.98***	0.84***	0.14

High practical significance: d ≥ 0.8***

Medium practical significant differences: d=0.5

Low practical significant differences: d <0.2

6.5.2 U/16 rugby players

- ***Anthropometric components***

The tight forwards presented the highest mean body mass (82,75 kg) and the highest value for stature (183,87 cm) of all playing positions. The halves presented the lightest mean body mass (68.00 kg) and shortest stature (172,50 cm) of all the playing positions. This supports the findings of many researchers in terms of differences between forwards and back-line players in terms of stature and body mass, which are presented in table 4.3.

The tight forwards presented with the highest mean values in fat percentage, breadths and girths of all the playing positions, with the exception of the ankle (23,5 cm) and calf girth (37,8 cm). The halves presented with the lowest mean values for all the anthropometric measurements, except for forearm girth (27,55 cm), calf girth (35,95 cm) and femur breadth (9,35 cm).

The fact that the tight forwards had the highest mean values in most anthropometric measurements supports the literature in paragraph 4,22 and 4,33. A high practically significant difference between tight and loose forwards was found in humerus breadth (d=10,47). The halves and back-line players only differed to a high practically significant extent in terms of stature (d=0,81) and ankle girth (d=2,41).

The humerus breadth, in respect of which there was the only high practical significant difference, and the highest femur and wrist breadth suggest that tight forwards might have a bigger skeleton than loose forwards. These findings support the findings of Carlson *et al.* (1994:406) in terms of breadths. The back-line players measured taller than the halves. This is in accordance with the findings of De Ridder (1993:131), Maud and Shultz (1984:17) and Rigg and Reilly (1988:198).

Table 6.7. Practical significant differences between positional groups in terms of anthropometrical components for U/16 players

Variables	TF	LF	H	BL	MS Error	TF vs LF	TF vs H	TF vs BL	LF vs H	LF vs BL	H vs BL
	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$		d	d	d	d	d	d
Body mass (kg)	82.75	77.50	68.00	72.25	61.19	0.67	1.89***	1.34***	1.21***	0.67	0.54
Stature (cm)	183.88	183.75	172.50	178.50	55.05	0.02	1.53***	0.72	1.52***	0.71	0.81***
Tricep skinfold (mm)	9.19	9.00	6.00	6.88	6.75	0.07	1.23***	0.89***	1.15***	0.82***	0.34
Supraspinale skinfold (mm)	10.75	9.25	5.50	7.50	16.51	0.37	1.29***	0.80	0.92***	0.43	0.49
Subscapular skinfold (mm)	12.25	10.25	7.50	9.13	7.20	0.75	1.77***	1.16***	1.02***	0.42	0.61
Pectoral skinfold (mm)	6.31	5.50	4.00	5.69	8.26	0.28	0.80***	0.22	0.52	0.07	0.59
Abdominal skinfold (mm)	16.75	11.75	8.00	10.13	45.39	0.74	1.30***	0.98***	0.56	0.24	0.32
Thigh skinfold (mm)	12.63	10.75	7.00	9.88	12.96	0.52	1.56***	0.76	1.04***	0.24	0.80
Calf skinfold (mm)	8.19	7.75	4.50	6.38	10.68	0.13	1.13***	0.55	0.99***	0.42	0.57
Sum of skinfolds (mm)	69.75	58.75	38.50	49.88	394.69	0.55	1.57***	1.00***	1.02***	0.45	0.57
Fat percentage (%)	18.39	16.67	12.17	14.13	12.91	0.48	1.73***	1.19***	1.25***	0.71	0.54
Flexed upper arm girth (cm)	33.60	32.95	31.21	31.70	3.81	0.33	1.22***	0.97***	0.89***	0.64	0.25
Fore arm girth (cm)	28.50	27.40	27.55	27.73	2.45	0.70	0.61	0.49	0.10	0.21	0.11
Ankle girth (cm)	23.50	23.83	22.30	25.40	1.65	0.25	0.93***	1.48***	1.19***	1.22***	2.41***
Calf girth (cm)	37.80	38.28	35.95	35.20	10.78	0.14	0.56	0.79	0.71	0.94***	0.23
Humerus breadth (cm)	7.413	7.20	7.00	6.88	0.5058	10.47***	10.72***	10.56***	0.25	0.09	0.16
Femur breadth (cm)	10.175	9.70	9.35	9.61	0.9372	0.73	1.27***	1.43***	0.54	0.69	0.15
Wrist breadth (cm)	6.19	6.00	5.65	5.79	0.07	0.73	2.11***	1.57***	1.37***	0.83***	0.54

High practical significance: d ≥ 0.8***

Medium practical significant differences: d=0.5

Low practical significant differences: d <0.2

- ***Rugby-specific skill components***

In table 6.8 the halves performed best of all the playing positions in most of the rugby-specific components except for the side-step (5,50), which the back-line players performed better (6,13). The tight forwards performed the worst in aerial and ground kicks (4,13), passing for distance (20,03 m), passing for accuracy over 4 m (4,25) and catching while running (19,13).

The loose and tight forwards only presented high practical significant differences in side-steps (d=1,45), passing over 7 m (d=2,01) and kicking for distance (d=1,60). The halves and back-line players only presented high practical significant differences in terms of aerial and ground kicks (d=0,86), passing for distance (d=1,59) and kicking for distance (d=2,76).

Table 6.8. Practical significant differences between positional groups in terms of rugby specific components for U/16 players

Variables	TF	LF	H	BL	MS Error	TF vs LF	TF vs H	TF vs BL	LF vs H	LF vs BL	H vs BL
	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$		d	d	d	d	d	d
Ground skills (sec)	3.72	3.66	3.44	3.54	0.32	0.11	0.50	0.32	0.39	0.21	0.18
Side steps (n)	3.50	5.50	5.50	6.13	1.89	1.45***	1.45***	1.91***	0.00	0.45	0.45
Aerial and ground kicks (n)	4.13	4.75	6.50	5.50	1.35	0.54	2.05***	1.19***	1.51***	0.65	0.86***
Passing for distance (m)	20.03	21.38	25.95	20.93	9.99	0.43	1.87***	0.29	1.45***	0.14	1.59***
Passing for accuracy (4m) (n)	4.25	4.50	5.00	4.63	2.94	0.15	0.44	0.22	0.29	0.07	0.22
Passing for accuracy (7m) (n)	21.13	25.50	25.50	24.50	4.72	2.01***	2.01***	1.55***	0.00	0.46	0.46
Kicking for distance (m)	39.10	28.18	59.50	40.65	46.68	1.60***	2.99***	0.23	4.58***	1.83***	2.76***
Kick-off for distance (m)	31.06	24.33	41.50	34.61	133.87	0.58	0.90***	0.31	1.48***	0.89***	0.60
Catching while running (n)	19.13	19.25	19.50	19.38	4.74	0.06	0.17	0.11	0.11	0.06	0.06

High practical significance: d ≥ 0.8***

Medium practical significant differences: d=0.5

Low practical significant differences: d <0.2

- ***Physical and motor components***

In table 6.9 the halves presented the best value of all playing positions for all of the physical and motor components, with the exception of the Illinois agility test (17,60 sec) and T-test for agility (12,76 sec). The back-line players only performed best in the Illinois agility test (17.09 sec), while the tight forwards performed best in the T-test for agility (12,01 sec).

The only high practical significance difference between the tight forwards and loose forwards was found in terms of abdominal strength (d=1,49). The halves and back-line players presented high practical significant differences in the modified sit-and-reach (d=1,67), vertical jump (d=3,51), speed endurance (d=2,62), pull-ups (d=0,97), abdominal strength (d=1,56) and flexed arm hang (d=0,96).

It seems from these results that there are not many differences between tight and loose forwards in terms of physical and motor components. As the tight forwards presented with the best results in the T-test for agility, it suggests that tight forwards are agile (paragraph 4,48). The back-line and halves presented with significant differences in more components, which suggests that these groups need specific physical and motor components training.

Table 6.9. Practical significant differences between positional groups in terms of physical- and motor components for U/16 players

Variables	TF	LF	H	BL	MS Error	TF vs LF	TF vs H	TF vs BL	LF vs H	LF vs BL	H vs BL
	x̄	x̄	x̄	x̄		d	d	d	d	d	d
Adapted sit and reach (cm)	6.75	5.50	10.00	4.25	11.92	0.36	0.94***	0.72	1.30***	0.36	1.67***
Vertical jump (cm)	37.63	35.75	46.00	34.38	10.94	0.57	2.53***	0.98***	3.10***	0.42	3.51***
Speed endurance (%)	4.44	5.44	3.42	7.62	2.58	0.62	0.64	1.98***	1.26***	1.36***	2.62***
Illinois agility test (sec)	18.91	18.24	17.60	17.09	4.45	0.32	0.62	0.87***	0.31	0.55	0.24
T-Test agility (sec)	12.01	13.08	12.76	13.08	2.15	0.73	0.51	0.73	0.22	0.00	0.22
Speed 10m (sec)	1.98	1.84	1.75	1.86	0.04	0.71	1.13***	0.57	0.41	0.14	0.56
Speed 30m (sec)	4.75	4.51	4.26	4.47	0.26	0.46	0.96***	0.55	0.49	0.09	0.40
Pull ups (n)	5.13	4.50	12.50	7.88	22.51	0.13	1.55***	0.58	1.69***	0.71	0.97***
Abdominal strength (n)	3.13	5.75	6.00	3.25	3.12	1.49***	1.63***	0.07*	0.14	1.42***	1.56***
Flexed arm hang (sec)	19.46	14.48	40.83	31.42	96.85	0.51	2.17***	1.22***	2.68***	1.72***	0.96***

High practical significance: d ≥ 0.8***

Medium practical significant differences: d=0.5

Low practical significant differences: d <0.2

6.5.3 U/18 rugby players

- ***Anthropometric components***

In table 6.10 the tight forwards presented with the highest mean anthropometric measurements of all the playing positions, except for stature (187,86 cm), calf girth (37,09 cm), humerus (7,41 cm) and femur breadth (10,11 cm) and ankle girth (25.00 cm). The loose forwards presented with the highest mean value of combined playing positions in terms of stature (188.00 cm), calf girth (39.88 cm) humerus (7,58 cm) and femur breadth (10,25 cm). The back-line players presented with the lowest mean values in fat percentage (14.03 %) and forearm girth (28,63 cm).

The tight forwards and loose forwards presented high practical significant differences in terms of body mass (d=1,67), fat percentage (d=1,92) and calf girth (d=0,85). The back-line and halves only presented with high practically significant differences in terms of body mass (d=1,13), stature (d=1,45), ankle girth (d=1,74) and humerus (d=0,97) breadth.

In conclusion the tight and loose forwards seem to present with more differences in terms of anthropometric components at this age than their younger counterparts. The halves are smaller and lighter than back-line players (paragraph 4,94) and the differences suggest that at this age there are a few anthropometric components that distinguish between halves and back-line players (paragraph 4.114).

Table 6.10. Practical significant differences between positional groups in terms of anthropometrical components for U/18 players

Variables	TF	LF	H	BL	MS Error	TF vs LF	TF vs H	TF vs BL	LF vs H	LF vs BL	H vs BL
	x̄	x̄	x̄	x̄		d	d	d	d	d	d
Body mass (kg)	96.57	83.50	68.67	77.50	61.19	1.67***	3.57***	2.44***	1.90***	0.77	1.13***
Stature (cm)	187.86	188.00	172.00	182.75	55.05	0.02	2.14***	0.69	2.16***	0.71	1.45***
Tricep skinfold (mm)	12.71	8.25	8.00	7.63	6.75	1.72***	1.81***	1.96***	0.10	0.24	0.14
Supraspinale skinfold (mm)	13.50	11.00	7.33	8.00	16.51	0.62	1.52***	1.35***	0.90***	0.74	0.16
Subscapular skinfold (mm)	15.36	11.03	9.50	8.25	7.20	1.61***	2.18***	2.65***	0.5	1.03***	0.47
Pectoral skinfold (mm)	7.21	5.50	3.67	5.25	8.26	0.60	1.23***	0.68	0.64	0.09	0.55
Abdominal skinfold (mm)	19.93	16.00	8.83	10.00	45.39	0.58	1.65***	1.47***	1.06***	0.89***	0.17
Thigh skinfold (mm)	11.71	11.25	7.33	9.70	12.96	0.13	1.22***	0.56	1.09***	0.43	0.66
Calf skinfold (mm)	8.86	8.00	5.00	7.25	10.68	0.26	1.18***	0.49	0.92***	0.23	0.69
Sum of skinfolds (mm)	82.07	65.53	46.00	50.83	394.69	0.83***	1.82***	1.57***	0.98***	0.74	0.24
Fat percentage (%)	23.58	16.69	15.30	14.03	12.91	1.92***	2.30***	2.66***	0.39	0.74	0.35
Flexed upper arm girth (cm)	34.81	34.25	33.50	34.50	3.81	0.29	0.67	0.16	0.38	0.13	0.51
Fore arm girth (cm)	30.13	30.00	28.77	28.63	2.45	0.08	0.87***	0.96***	0.79	0.88***	0.09
Ankle girth (cm)	25.00	24.70	23.07	25.30	1.65	0.23	1.50***	0.23	1.27***	0.47	1.74***
Calf girth (cm)	37.09	39.88	37.10	39.18	10.78	0.85***	0.00	0.64	0.85***	0.21	0.63
Humerus breadth (cm)	7.41	7.58	6.63	7.40	0.63	0.20	0.98***	0.02	1.19***	0.22	0.97***
Femur breadth (cm)	10.11	10.25	9.47	9.93	0.42	0.21	1.00***	0.29	1.21***	0.50	0.71
Wrist breadth (cm)	6.13	6.00	5.57	5.73	0.07	0.50	2.20***	1.58***	1.70***	1.08***	0.62

High practical significance: d ≥ 0.8***

Medium practical significant differences: d=0.5

Low practical significant differences: d <0.2

- ***Rugby-specific skill components***

The halves presented with the best value of all the playing positions in term of rugby-specific components, except for passing for accuracy over 4 m (6,67) and 7 m (27,67), kicking for distance (39,20 m) and catching while running (20,00). The back-line players performed the best of all playing positions in terms of passing for accuracy over 7 m (28,25) and kicking for distance (41,15 m). The loose forwards performed the best of all the playing positions in terms of catching while running (24,50) and passing for accuracy over 4 m (6,75).

There were high practical significant differences between the tight and loose forwards in terms of ground skills (d=1,07), side-steps (d=0,99), passing for accuracy over 4 m (d=1,35) and catching while running (d=3,90). There was also just one skill of high practical significantly difference between halves and back-line players, which was the side-step (d=0,91).

The number of differences between tight and loose forwards suggest that U/18 tight and loose forwards have different responsibilities during a game (paragraph 4,33). The few differences between halves and back-line players suggest that they do not differ much in terms rugby-specific skills components, which is in contrast with literature of adult players (paragraph 4,114).

Table 6.11. Practical significant differences between positional groups in terms of rugby specific components for U/18 players

Variables	TF	LF	H	BL	MS Error	TF vs LF	TF vs H	TF vs BL	LF vs H	LF vs BL	H vs BL
	x̄	x̄	x̄	x̄		d	d	d	d	d	d
Ground skills (sec)	4.05	3.45	3.20	3.22	0.32	1.07***	1.51***	1.46***	0.44	0.39	0.05
Side steps (n)	5.14	6.50	8.00	6.75	1.89	0.99***	2.08***	1.17***	1.09***	0.18	0.91***
Aerial and ground kicks (n)	4.43	5.25	6.67	6.00	1.35	0.71	1.93***	1.35***	1.22***	0.65	0.57
Passing for distance (m)	22.36	24.80	25.42	24.96	9.99	0.77	0.97***	0.82***	0.20	0.05	0.14
Passing for accuracy (4m) (n)	4.43	6.75	6.67	5.75	2.94	1.35***	1.30***	0.77	0.05	0.58	0.53
Passing for accuracy (7m) (n)	24.29	24.75	27.67	28.25	4.72	0.21	1.56***	1.82***	1.34***	1.61***	0.27
Kicking for distance (m)	36.44	35.98	39.20	41.15	46.68	0.07	0.40	0.69	0.47	0.76	0.29
Kick-off for distance (m)	34.83	40.73	45.17	44.93	133.87	0.51	0.89***	0.87***	0.38	0.36	0.02
Catching while running (n)	16.00	24.50	20.00	20.00	4.74	3.90***	1.84***	1.84***	2.07***	2.07***	0.00

High practical significance: d ≥ 0.8***

Medium practical significant differences: d=0.5

Low practical significant differences: d <0.2

- ***Physical- and motor components***

In table 6.12 the halves measured best of all playing positions in terms of all the physical and motor components, with the exception of the modified sit-and-reach (1,00 cm) and speed endurance (6,75 %). The back-line players presented with the highest value for the sit-and-reach (7,5 cm) of all playing positions. The tight forwards performed the best in terms of speed endurance (5,01 %).

The only high practical significant difference between tight and loose players was in terms of flexed-arm hang (d=1,74). The only high practical significant difference between halves and back-line players was the modified sit-and-reach (d=1,88).

In conclusion it seems that few differences exists between playing positions in terms of physical and motor components. This could be attributed to the fact that even at this young age all players are well conditioned, and therefore show few differences between playing groups in terms of physical and motor components, a finding which is in contrast with the literature for adult players (par. 4.35).

Table 6.12. Practical significant differences between positional groups in terms of physical- and motor components for U/18 players

Variables	TF	LF	H	BL	MS Error	TF vs LF	TF vs H	TF vs BL	LF vs H	LF vs BL	H vs BL
	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$		d	d	d	d	d	d
Adapted sit and reach (cm)	0.57	1.75	1.00	7.50	11.92	0.34	0.12	2.01***	0.22	1.67***	1.88***
Vertical jump (cm)	45.14	44.75	50.67	50.00	10.94	0.12	1.67***	1.47***	1.79***	1.59***	0.20
Speed endurance (%)	5.01	5.92	6.75	6.36	2.58	0.57	1.08***	0.84***	0.52	0.27	0.24
Illinois agility test (sec)	17.57	17.46	16.39	16.68	4.45	0.06	0.56	0.42	0.50	0.37	0.13
T-Test agility (sec)	11.93	11.39	10.90	11.23	2.15	0.37	0.70	0.48	0.33	0.11	0.23
Speed 10m (sec)	2.14	2.10	1.84	1.86	0.04	0.18	1.45***	1.34***	1.27***	1.16***	0.11
Speed 30m (sec)	4.79	4.49	4.25	4.32	0.26	0.57	1.05***	0.90***	0.48	0.33	0.15
Pull ups (n)	1.71	5.50	9.00	6.00	22.51	0.80***	1.54***	0.90***	0.74	0.11	0.63
Abdominal strength (n)	3.43	3.75	4.67	4.25	3.12	0.18	0.70	0.47	0.52	0.28	0.24
Flexed arm hang (sec)	13.89	30.99	35.65	28.43	96.85	1.74***	2.21***	1.48***	0.47	0.26	0.73

High practical significance: d ≥ 0.8***

Medium practical significant differences: d=0.5

Low practical significant differences: d <0.2

6.5.4 U/19 rugby players

- ***Anthropometric components***

In table 6.13 the tight forwards presented with the highest mean values of all playing positions in terms of anthropometric measurements, with the exception of the ankle girth (25,44 cm) and wrist breadth (6,04 cm). The halves and back-line players each had ten of the lowest measurements in terms of anthropometrical components.

High practical significant differences were found in all the anthropometric measurement between tight and loose forwards, with the exception of stature (d=0,22), pectoral skinfold (d=0,36), thigh skinfold (d= 0,74) and all the breadths. The back-line players and halves presented high practical significant differences in terms of forearm girth (d=0,98), ankle girth (d=1,43) and wrist breadth (d=1,10).

The tight and loose forwards at this age presented with more differences than their younger counterparts in terms of anthropometric components than halves and back-line players. This seems to suggest that forwards (tight and loose) develop more in terms of anthropometric components with advancing age than do halves and back-line players .

Table 6.13. Practical significant differences between positional groups in terms of anthropometrical components for U/19 players

Variables	TF	LF	H	BL	MS Error	TF vs LF	TF vs H	TF vs BL	LF vs H	LF vs BL	H vs BL
	x̄	x̄	x̄	x̄		d	d	d	d	d	d
Body mass (kg)	101.14	86.38	77	82.8	61.19	1.89***	3.09***	2.34***	1.2***	0.46	0.74
Stature (cm)	185.86	184.25	179.33	183	55.05	0.22	0.88***	0.39	0.66	0.17	0.49
Tricep skinfold (mm)	13.36	9	9.83	7.7	6.75	1.68***	1.36***	2.18***	0.32	0.50	0.82***
Supraspinale skinfold (mm)	14	9.75	9.67	7.5	16.51	1.05***	1.07***	1.6***	0.02	0.55	0.53
Subscapular skinfold (mm)	17.71	10.63	9.17	9.1	7.2	2.64***	3.19***	3.21***	0.54	0.57	0.02
Pectoral skinfold (mm)	6.79	5.75	7	6.2	8.26	0.36	0.07	0.20	0.43	0.16	0.28
Abdominal skinfold (mm)	22	14.38	13	12.6	45.39	1.13***	1.34***	1.4***	0.20	0.26	0.06
Thigh skinfold (mm)	16.29	13.63	11.17	9.36	12.96	0.74	1.42***	1.92***	0.68	1.18***	0.50
Calf skinfold (mm)	11.86	8.88	8	6.6	10.68	0.91***	1.18***	1.61***	0.27	0.7	0.43
Sum of skinfolds (mm)	95.21	66.25	60.83	52.86	394.69	1.46***	1.73***	2.13***	0.27	0.67	0.40
Fat percentage (%)	25.93	16.97	16.48	14.75	12.91	2.49***	2.63***	3.11***	0.14	0.62	0.48
Flexed upper arm girth (cm)	39.46	37.05	36	37.24	3.81	1.23***	1.77***	1.14***	0.54	0.10	0.63
Fore arm girth (cm)	32.06	30.6	29.4	30.94	2.45	0.93***	1.7***	0.71	0.77	0.22	0.98***
Ankle girth (cm)	25.44	28.2	23.17	25	1.65	2.14***	1.77***	0.34	3.91***	2.49***	1.43***
Calf girth (cm)	41.26	40.55	37.77	39.1	10.78	0.22	1.06***	0.66	0.85***	0.44	0.41
Humerus breadth (cm)	7.76	7.48	7.5	7.1	0.63	0.36	0.32	0.83***	0.03	0.47	0.5
Femur breadth (cm)	10.33	10.18	9.4	9.42	0.42	0.24	1.43***	1.4***	1.2***	1.17***	0.03
Wrist breadth (cm)	6.06	6	5.9	6.18	0.07	0.22	0.62	0.48	0.39	0.71	1.1***

High practical significance: d ≥ 0.8***

Medium practical significant differences: d=0.5

Low practical significant differences: d <0.2

- ***Rugby-specific skill components***

In table 6.14 the back-line performed the best of all playing positions in terms of side-steps (7,40), passing for accuracy over 4 m (6,4), kicking for distance (53,08 m) and catching while running (20,00). The halves performed the best of all the playing positions in terms of ground skills (3,24 sec), passing for distance (27,40 m), kicking for distance (51.33 m) and catching while running (20,00). The loose forwards performed best of all the playing positions in terms of aerial and ground kicks (7,50) and catching while running (20,00). The only test in which the tight forwards performed best of all playing positions was the passing for accuracy over 7 m (25,14).

There were high practical significant differences between tight and loose forwards in only the aerial and ground kick (d=0,92) and passing distance (d=1,55). The halves and back-line players presented high significant difference in terms of passing for accuracy over 7 m (d=3,13).

It seems that at this age there are few differences between tight and loose forward and halves and back-line players in terms of rugby-specific components. This might be due to the fact that players of this age are all well developed, irrelevant of positional group, in terms of rugby-specific components. This is in contrast with literature about positional differences of adult rugby players (Joubert & Groenewald, 1998:27).

Table 6.14. Practical significant differences between positional groups in terms of rugby specific components for U/19 players

Variables	TF	LF	H	BL	MS Error	TF vs LF	TF vs H	TF vs BL	LF vs H	LF vs BL	H vs BL
	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$		d	d	d	d	d	d
Ground skills (sec)	3.81	3.42	3.24	3.43	0.32	0.68	1.00***	0.66	0.32	0.02	0.34
Side steps (n)	6.29	7.00	7.33	7.40	1.89	0.52	0.76	0.81***	0.24	0.29	0.05
Aerial and ground kicks (n)	6.43	7.50	7.33	6.80	1.35	0.92***	0.78	0.32	0.14	0.60	0.46
Passing for distance (m)	21.41	26.33	27.40	27.20	9.99	1.55***	1.89***	1.83***	0.34	0.28	0.06
Passing for accuracy (4m) (n)	4.71	5.25	6.00	6.40	2.94	0.31	0.75	0.98***	0.44	0.67	0.23
Passing for accuracy (7m) (n)	25.14	24.50	18.00	24.80	4.72	0.30	3.29***	0.16	2.99***	0.14	3.13***
Kicking for distance (m)	49.21	48.75	51.33	53.08	46.68	0.07	0.31	0.57	0.38	0.63	0.26
Kick-off for distance (m)	46.86	49.50	52.83	52.32	133.87	0.23	0.52	0.47	0.29	0.24	0.04
Catching while running (n)	19.71	20.00	20.00	20.00	4.74	0.13	0.13	0.13	0.00	0.00	0.00

High practical significance: d ≥ 0.8***

Medium practical significant differences: d=0.5

Low practical significant differences: d <0.2

- ***Physical and motor components***

The halves presented with the best value of all playing positions in terms of T-test agility (10,44 sec) and speed over 10 m (1,86 sec). The loose forwards presented with the best value of all playing positions in terms of speed endurance (3.38%), pull-ups (10.25) and abdominal strength (6.00). The back-line players performed the best of all playing positions in the sit-and-reach (5,00 cm), vertical jump (58,4 cm), Illinois agility test (15,71 sec), speed over 30 m (4,14 sec) and flexed-arm hang (29,41 sec).

High practical significant differences between tight forwards and loose forwards were in terms of vertical jump (d=2,62), speed endurance (d=1,28), speed over 10 m (d=0,96), pull-ups (d=0,93) and abdominal strength (d=1,13). The halves and back-line players presented high significant differences in terms of vertical jump (d=1,83) and flexed-arm hang (d=1,07).

At this age it seems that the tight and loose forwards present with more differences than the halves and back-line players in terms of physical and motor components. This indicates that tight and loose forwards need specific components for their positional responsibilities (4,35). The few differences between halves and back-line players suggest that at this age in terms of physical and motor components they require more or less the same components.

Table 6.15. Practical significant differences between positional groups in terms of physical - and motor components for U/19 players

Variables	TF	LF	H	BL	MS Error	TF VS LF	TF VS H	TF VS BL	LF VS H	LF VS BL	H VS BL
	x̄	x̄	x̄	x̄		d	d	d	d	d	d
Adapted sit and reach (cm)	4.57	4.25	3.00	5,00	11,92	0,09	0,46	0,12	0,36	0,22	0,58
Vertical jump (cm)	45,57	54,25	52,33	58,40	10,94	2,62***	2,04***	3,88***	0,58	1,25***	1,83***
Speed endurance (%)	5,43	3,38	5,73	5,24	2,58	1,28***	0,18	0,12	1,46***	1,16***	0,30
Illinois agility test (sec)	17,19	16,29	15,94	15,71	4,45	0,43	0,59	0,70	0,17	0,28	0,11
T-Test agility (sec)	11,66	11,05	10,44	10,73	2,15	0,41	0,83***	0,64	0,42	0,22	0,20
Speed 10m (sec)	2,20	2,00	1,87	1,94	0,04	0,96***	1,61***	1,26***	0,65	0,29	0,36
Speed 30m (sec)	4,87	4,47	4,18	4,14	0,26	0,78	1,35***	1,42***	0,57	0,65	0,08
Pull ups (n)	5,86	10,25	9,33	10,20	22,51	0,93***	0,73	0,92***	0,19	0,01	0,18
Abdominal strength (n)	4,00	6,00	5,00	5,60	3,12	1,13***	0,57	0,91***	0,57	0,23	0,34
Flexed arm hang (sec)	18,51	25,55	18,87	29,41	96,85	0,71	0,04	1,11***	0,68	0,39	1,07***

High practical significance: d ≥ 0,8***

Medium practical significant differences: d=0,5

Low practical significant differences: d <0,2

6.6 Conclusion of comparisons of playing groups in terms of anthropometric, rugby-specific skill, physical and motor components

- ***Anthropometric components***

In terms of anthropometric components the U/13 forwards (tight and loose) presented with more differences than the back-line players (halves and back-line). Among U/16 forward and back-line players few differences were found in terms of anthropometric components, which means that at this age all the players seemed relevantly similar, irrelevant of positions. The U/18 and U/19 forwards presented with more differences in terms of anthropometric components than the back-line players. Thus it seems that in terms of anthropometric components the forwards presented with many more differences in most age groups than the back-line players.

- ***Rugby-specific skill components***

The rugby-specific skill components presented many more differences between U/13 and U/16 back-line players than forward players. The U/18 and U/19 back-line players did not present with many differences in terms of rugby-specific skill components. This might be due to the fact that players of these ages are all well developed, irrelevant of positional group, in terms of rugby-specific skill components. however, this is still in contrast with the literature about positional differences of adult rugby players in terms of rugby-specific skill components (Joubert & Groenewald, 1998:27).

- ***Physical and motor components***

The physical and motor components differed much more among U/13 and U/16 back-line players than forward players. The U/18 and U/19 back-line players and forwards presented with many fewer differences in terms of physical and motor components than their younger counterparts. It seems that all the players are more or less the same, no matter what their positional group.

In conclusion it seems that forwards, and many coaches are of this opinion, develop much later in terms of anthropometric components. The back-line players present many more differences in terms of rugby-specific skill, physical and motor components. It is also interesting to note that the older the players, the fewer the differences that were apparent in terms of rugby-specific skill, physical and motor components. This might be due to better physical and motor conditioning as well as coaching of all players, irrelevant of positional group.

6.7 Classification of positional groups for the U/13, U/16, U/18 and U/19 rugby players in terms of anthropometric, rugby-specific skills and physical and motor components

A discriminant analysis was performed to establish what variables discriminated most between the four positional groups of each age group, in other words, which variables distinguished best between the four playing groups. Then a classification matrix was performed. This was done to establish the percentage of the correct classification of the players into playing groups in terms of the variables that discriminated between groups.

- *U/13 rugby players*

The variable that discriminated between the four playing groups in the U/13 players were body mass (d=0,000), speed endurance (d=0,031) and passing for distance (d=0,032). These variables are the variables that distinguished most between the playing positions. The classification matrix according to these variables is presented in Table 6.16.

Table 6.16: Classification matrix for the positional playing groups for the U/13 rugby players

Groups (n=21)	Percent correct	G_1:1	G_2:2	G_3:3	G_4:4
G_1:1*	100,0000	8	0	0	0
G_2:2*	66,6667	0	2	0	1
G_3:3*	75,0000	0	0	3	1
G_4:4*	83,3333	1	0	0	5
Total group	85,7143	9	2	3	7

G_1:1* = Tight forwards, G_2:2* = Loose forwards, G_3:3* = Halves, G_4:4* = Back-line players

The variables that were used to discriminate between the playing groups of the U/13 players classified the playing groups 85,71% correctly. The tight forwards were classified 100% correctly, while the loose forwards were classified only 66,66% correctly. One loose forward was classified as a back-line player. The halves were classified 75% correctly, with one player being classified as a back-line player. The back-line players were classified 83,33% correctly, with one player being classified as a tight forward. It is important to note that at this young age certain players perform and present the same value in certain measurements and tests, regardless of playing position. This might explain the wrong classification.

- *U/16 rugby players*

The variables that discriminated between the four playing position for U/16 players were Illinois agility test (d=0,009), abdominal strength (d=0,000), kicking for distance (d=0,000), speed over 10 m (d=0,000) and the sum of triceps and subscapular skinfolds (d=0,006). The classification according to these variables is presented in table 6.17.

Table 6.17. Classification matrix for the positional playing groups for the U/16 rugby players

Groups (n=22)	Percent correct	G_1:1	G_2:2	G_3:3	G_4:4
G_1:1*	100,0000	8	0	0	0
G_2:2*	100,0000	0	4	0	0
G_3:3*	50,0000	0	0	1	1
G_4:4*	87,5000	1	0	0	7
Total group	90,9091	9	4	1	8

G_1:1* = Tight forwards, G_2:2* = Loose forwards, G_3:3* = Halves, G_4:4* = Back-line players

The variables that were used to discriminate between the four playing groups of the U/16 players classified the playing groups 90,90% correctly. The tight and loose forwards were classified a 100% correctly. The halves were classified 50% correctly, with one player being classified as a back-line player. The back-line players were classified 87,50% correctly, with one player being classified as a tight forward.

In the variables that discriminated between playing positions, it is understandable that one player among the halves was classified as a back-line player, seeing that the two groups might not differ much in term of the variables that discriminated between them.

- *U/18 players*

The variables that discriminated between the four playing positions for U/18 players were ground skills (d=0,000), T-test for agility (d=0,002) and stature (d=0,014) The classification according to these variables is presented in table 6.18.

Table 6.18. Classification matrix for the positional playing groups for the U/18 rugby players

Groups (n=18)	Percent correct	G_1:1	G_2:2	G_3:3	G_4:4
G_1:1	100,0000	7	0	0	0
G_2:2	100,0000	0	4	0	0
G_3:3	100,0000	0	0	3	0
G_4:4	100,0000	0	0	0	4
Total group	100,0000	7	4	3	4

G_1:1* = Tight forwards, G_2:2* = Loose forwards, G_3:3* = Halves, G_4:4* = Back-line players

The variables that were used to discriminate between the four playing groups of the U/18 players classified the playing groups 100% correctly.

- *U/19 players*

The variables that discriminated between the four playing position for U/19 players were speed over 30 m (d=0,000), ankle girth (d=0,000), vertical jump (d=0,003), ground skills (d=0,001) and thigh girth (d=0,023). The classification according to these variables is presented in table 6.19.

Table 6.19. Classification matrix for the positional playing groups for the U/19 rugby players

Groups (n=19)	Percent correct	G_1:1	G_2:2	G_3:3	G_4:4
G_1:1	100,0000	7	0	0	0
G_2:2	100,0000	0	4	0	0
G_3:3	66,6667	0	0	2	1
G_4:4	80,0000	0	0	1	4
Total group	89,4737	7	4	3	5

G_1:1* = Tight forwards, G_2:2* = Loose forwards, G_3:3* = Halves, G_4:4* = Back-line players

The variables that were used to discriminate between the four playing groups of the U/18 players classified the playing groups 89,47% correctly. The tight and loose forwards were classified 100% correctly. The halves were classified only 66,66% correctly, with one player being wrongly classified as a back-line player. The back-line players were 80,00% correctly classified, with one player being classified among the halves.

The classification of the U/19 rugby players revealed that one of the halves and one of the back-line groups were wrongly classified. It is interesting to note that these two groups did not present many practically significant differences (table 6.13-6.15), and that this might be a reason for the wrong classification.

6.8 Rugby positional components that distinguish the most between different positions for the U/13, U/16, U/18 and U/19 rugby players

The positions were compared within each playing group, in other words all the positions of the tight forwards (props, hookers and locks), loose forwards (flankers and eighth men), halves (scrum- and fly-halves) and back-line players (centres, wings and full-backs) were compared with one another using analyses of variance (ANOVA) to establish differences. The MS error was used from the ANOVA to establish practically significant differences. The practically significant differences that were found between playing positions in terms of certain anthropometric, rugby-specific skill, physical and motor components suggest that these components could be included in a test battery for positional selection. Components such as psychological components were not included in this study, and it should be kept in mind that these components might also have an influence on positional selection.

The anthropometric measurements like skinfolds will not be discussed, although they will be presented in the relevant tables, but the fat percentage, sum of skinfolds, breadths and girths will be discussed. In some cases this is not possible, seeing that some teams only used one full-back or hooker. The U/16 and U/18 players also had some players were injured during the training camp and could not participate in this study. All the positions will be plotted on the line plot graph, although only the positions where one player was measured and tested will be discussed. The data for these graphs were standardised, meaning that all positions have the same mean (8=0). The components per position that presented relevant standardised data values ($z \geq 1/-1$) will be discussed. A summary of all components will be presented in chapter 7.

6.8.1 Rugby components of U/13 rugby players

- ***Anthropometric components***

Table 6.20 presents high practical significant differences for positions in the tight forward group. High practical significant differences were found between the props and hookers in terms of body mass (d=1,22), stature (d=2,38), sum of skinfolds (d=1,00), ankle girth (d=1,02) and wrist breadth (d=1,96). The only high practical significant differences between the props and locks were found in terms of calf girth (d=3,25) and humerus breadth (d=1,16). The hookers and locks presented with high practical significant differences in terms of stature (d=2,16), sum of skinfolds (d=1,00), calf girth (d=2,75), humerus breadth (d=1,93) and wrist breadth (d=1,41). In graph 6.1 the props presented with higher standardised data values than any other players in terms of body mass (z=1,14), wrist breadth (z=1,03) and calf girth (z=1,14). The hookers presented with the same tendency in terms of fat percentage (z=1,44) and sum of skinfolds (z=1,16), as did the locks in terms of humerus breadth (z=1,45).

Table 6.20. Practically significant differences between positions for the U/13 rugby players in terms of anthropometric measurements

Variables	Props (P)	Hookers (H)	Locks (L)	Scrum-halves (SH)	Fly-halves (FH)	Centres (C)	Wings (W)	MS ERROR	P vs H	P vs L	H vs L	SH vs FH	C vs W
	x̄	x̄	x̄	x̄	x̄	x̄	x̄		d	d	d	d	d
Body mass (kg)	70,33	60,75	65,67	44,50	51,50	63,50	53,33	62,19	1,22***	0,59	0,62	0,89***	1,29***
Stature (cm)	177,33	162,50	176,00	154,50	166,50	173,00	169,33	38,98	2,38***	0,21	2,16***	1,92***	0,59
Tricep skinfold (mm)	10,00	12,50	10,00	9,00	10,00	8,75	8,00	8,56	0,85***	0,00	0,85***	0,34	0,26
Supraspinale skinfold (mm)	11,50	12,50	10,00	5,00	5,50	6,00	5,33	24,47	0,20	0,30	0,51	0,10	0,13
Subscapular skinfold (mm)	9,33	12,00	9,33	6,50	7,00	7,00	6,67	9,88	0,85***	0,00	0,85***	0,16	0,11
Pectoral skinfold (mm)	6,50	9,00	5,67	4,25	6,75	4,50	2,67	10,37	0,78	0,26	1,04***	0,78	0,57
Abdominal skinfold (mm)	18,67	22,00	14,33	8,50	9,75	8,00	8,33	62,75	0,42	0,55	0,97***	0,16	0,04
Thigh skinfold (mm)	14,00	14,25	13,33	12,50	15,00	14,00	10,83	17,18	0,06	0,16	0,22	0,60	0,76
Calf skinfold (mm)	11,17	11,50	11,00	6,25	11,50	10,00	8,17	12,36	0,09	0,05	0,14	1,49***	0,52
Sum of skinfolds (mm)	16,74	20,78	16,74	13,74	14,91	13,93	13,08	16,29	1,00***	0,00	1,00***	0,29	0,21
Fat percentage (%)	74,67	84,75	68,00	47,75	58,75	53,75	47,33	544,08	0,43	0,29	0,72	0,47	0,28
Flexed upper arm girth (cm)	29,77	29,20	28,80	26,10	27,00	30,50	26,47	3,77	0,29	0,50	0,21	0,46	2,08***
Fore arm girth (cm)	26,50	26,30	26,40	22,30	24,45	26,80	24,00	2,30	0,13	0,07	0,07	1,42***	1,84***
Ankle girth (cm)	23,77	22,60	23,43	20,45	21,35	24,25	21,43	1,30	1,02***	0,29	0,73	0,79	2,47***
Calf girth (cm)	36,83	35,65	29,17	30,45	32,40	35,90	32,30	5,56	0,50	3,25***	2,75***	0,83***	1,53***
Humerus breadth (cm)	7,47	6,85	8,40	6,20	6,45	7,15	6,87	0,65	0,77	1,16***	1,93***	0,31	0,35
Femur breadth (cm)	9,67	9,10	9,23	9,05	9,10	9,20	9,63	0,57	0,75	0,57	0,18	0,07	0,57
Wrist breadth (cm)	5,93	5,46	5,80	5,20	5,25	5,80	5,47	0,06	1,96***	0,55	1,41***	0,20	1,36***

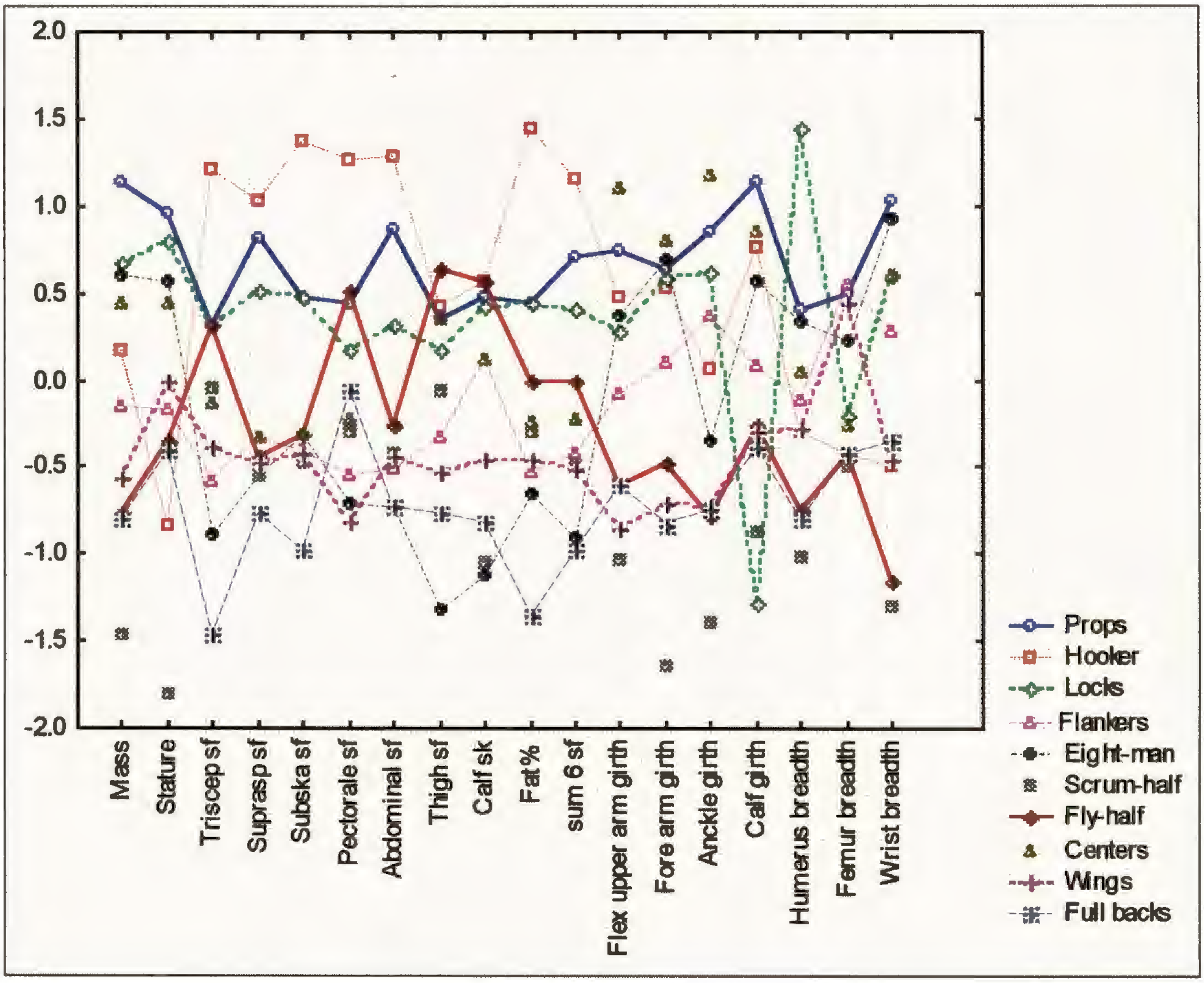
High practical significance: d ≥ 0,8***

Medium practical significant differences: d=0,5

Low practical significant differences: d <0,2

The locks presented lower standardised data values than any other players in terms of calf girth (z=1,28). This indicates that the props, hookers and locks differed most from the rest of the players in terms of these components.

Graph 6.1. Standardized data of anthropometrical measurements for different positions in U/13 rugby players



The scrum- and fly-halves presented with practically high significant differences in terms of body mass (d=0,89), stature (d=1,92), forearm girth (d=1,42) and calf girth (d=0,83) (table 6.20). The U/13 scrum-halves also presented with relatively lower standardised data values than any other players in terms of body mass (z=-1,46), stature (z=-1,80), flexed upper arm girth (z=-1,03), forearm girth (z=-1,64), ankle girth (z=1,38), humerus breadth (z=-1,02) and wrist breadth (z=-1,31) (graph 6.1). This indicates that scrum-halves differed the most than any other player in terms of these components. The only component in respect of which fly-halves presented with the lowest standardised data value of all players, with the exception of scrum-halves, was wrist breadth (z=-1,15).

In table 6.20 there were high practically significant differences between the centres and wings in terms of body mass (d=1,29), flexed upper arm girth (d=2,08), forearm girth (d=1,84), ankle girth (d=2,47), calf girth (d=1,53) and wrist breadth (d=1,36). The centres presented with the highest standardised data value than all the players in terms of flexed upper arm (z=1,10) and ankle girth (z=1,17). The full-backs only presented with the lowest standardised data value of all the players in terms of fat percentage (z=-1,36). The centres and full-back differed most from the other players in term of these components.

- ***Rugby-specific skill components***

The only high practically significant differences between props and hookers were found in terms of kick-off for distance (d=2,36) (table 6.21) The high practical significant differences found between locks and props were only in terms of kick-off for distance (d=2,91) and catching while running (d=0,97). The high practical significant differences between hookers and locks were found only in terms of passing for distance (d=0,83). The locks presented with the lowest standardised data value of all the players in terms of kick-off for distance (z=-1,12).

Table 6.21. Practically significant differences between positions for the U/13 rugby players in terms of rugby-specific skill components

Variables	Props (P)	Hookers (H)	Locks (L)	Scrum-halves (SH)	Fly-halves (FH)	Centres (C)	Wings (W)	MS ERROR	P vs H	P vs L	H vs L	SH vs FH	C vs W
	x̄	x̄	x̄	x̄	x̄	x̄	x̄		d	d	d	d	d
Ground skills (sec)	3,87	4,24	4,00	3,68	3,80	3,90	4,76	0,31	0,68	0,24	0,44	0,21	1,57***
Side steps (n)	4,33	4,50	3,67	5,50	6,50	5,00	3,33	2,14	0,11	0,46	0,57	0,68	1,14***
Aerial and ground kicks (n)	4,67	4,50	4,00	5,50	5,50	4,00	4,00	1,65	0,13	0,52	0,39	0,00	0,00
Passing for distance (m)	17,03	18,61	16,17	19,50	19,05	20,75	13,86	8,76	0,53	0,29	0,83***	0,15	2,33***
Passing for accuracy (4m) (n)	3,00	3,50	2,33	6,50	4,50	4,50	3,67	3,26	0,28	0,37	0,65	1,11***	0,46
Passing for accuracy (7m) (n)	23,00	23,00	22,33	27,00	27,50	26,50	22,67	4,94	0,00	0,30	0,30	0,22	1,72***
Kicking for distance (m)	32,79	28,99	30,75	31,66	45,53	41,66	27,32	27,97	0,72	0,39	0,33	2,62	2,71***
Kick-off for distance (m)	40,67	21,97	17,61	32,63	39,64	38,55	19,95	63,00	2,36***	2,91***	0,55	0,88***	2,34***
Catching while running (n)	19,33	18,50	17,33	20,00	18,50	19,00	16,00	4,26	0,40	0,97***	0,57	0,73	1,45***

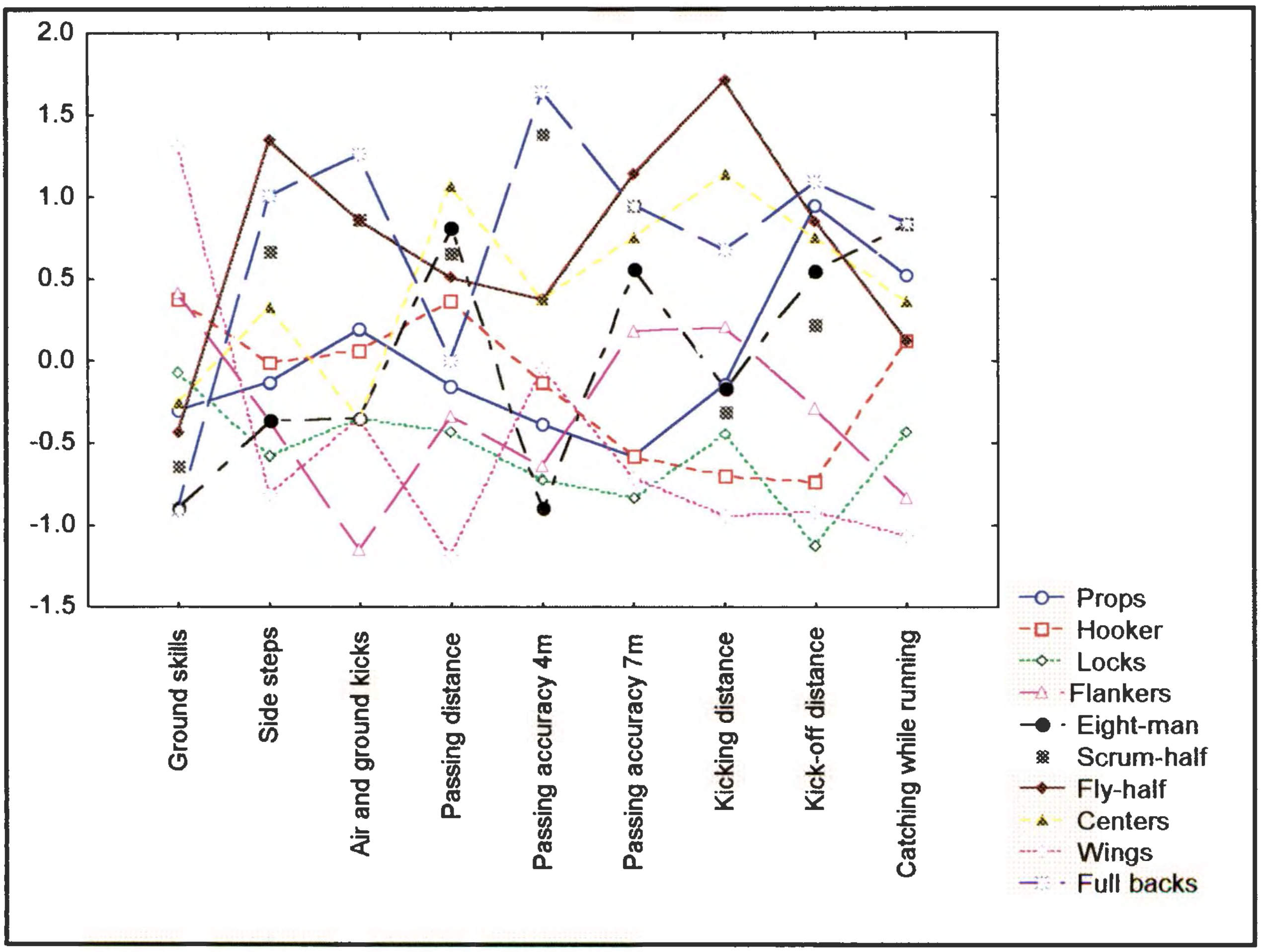
High practical significance: d ≥ 0,8***

Medium practical significant differences: d=0,5

Low practical significant differences: d <0,2

Of all the loose forwards, only the flanker presented with the lowest standardised data value of all the players in terms of aerial and ground kicks (z=-1,14). High practical significant differences between the halves were found in the passing for accuracy over 4 m (d=1,11) and kick-off for distance (d=0,88) . The scrum-halves presented with the second highest standardised data value of all the players in terms of passing for accuracy over 4 m (z=1,39). The fly-halves presented with the highest standardised data values of all the players in the side-step (z=1,34), passing for accuracy over 7 m (z=1,13) and kicking for distance (z=1,71). These components of scrum- and fly-halves differed most from other players in the team.

Graph 6.2. Standardized data of rugby specific skill components for different positions in U/13 rugby players



However, there were more practically significant differences found between the centres and wings in terms of rugby-specific skill components. The high practical significant differences were found in terms of ground skills (d=1,57), side-steps (d=1,14), passing for distance (d=2,33), passing for accuracy over 7 m (d=1,72), kicking for distance (d=2,71), kick-off for distance (d=2,34) and catching while running (d=1,45). The centres presented with the highest standardised data values of all the players in terms of passing for distance (z=1,06) and second highest value in kicking for distance (z=1,14). The wings presented with the highest standardised data values of all the players in terms of ground skills (z=1,32) and the lowest in passing for distance (z=-1,2) and catching while running (z=-1,07). The full-back presented with the highest standardised data values of all the players in terms of passing for accuracy over 4 m (z=1,64), kick-off for distance (z=1,09) and aerial and ground kicks (z=1,26), while the second highest value of all the players in the side-step (z=1,00).

- ***Physical and motor components***

In table 6.22 high practically significant differences were found between the props and hookers in terms of speed over 10 m (d=0,88), speed over 30 m (d=1,23) and abdominal strength (d=0,89). The components that differed to a high practical significant extent between props and locks were speed endurance (d=0,96), T-test agility (d=0,95) and abdominal strength (d=1,07).

Table 6.22. Practically significant differences between positions for the U/13 rugby players in terms of physical and motor components

Variables	Props (P)	Hookers (H)	Locks (L)	Scrum-halves (SH)	Fly-halves (FH)	Centres (C)	Wings (W)	MS ERROR	P vs H	P vs L	H vs L	SH vs FH	C vs W
	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$		d	d	d	d	d
Adapted sit and reach (cm)	3,00	2,00	3,33	0,50	4,35	2,50	7,67	12,56	0,28	0,09	0,38	1,09***	1,46***
Vertical jump (cm)	29,00	28,00	28,00	28,00	32,00	31,50	33,00	14,77	0,26	0,26	0,00	1,04	0,39
Speed endurance (%)	5,92	5,16	4,16	3,29	3,81	4,90	5,25	3,37	0,42	0,96***	0,54	0,29	0,19
Illinois agility test (sec)	19,94	19,31	20,27	18,67	18,12	23,52	18,73	3,90	0,32	0,17	0,49	0,28	2,42***
T-Test agility (sec)	13,45	13,38	14,56	13,57	12,99	16,27	12,82	1,37	0,06	0,95***	1,01***	0,50	2,94***
Speed 10m (sec)	2,10	2,29	2,17	2,36	2,06	2,03	2,27	0,04	0,88***	0,31	0,58	1,46***	1,19***
Speed 30m (sec)	5,03	5,71	5,21	5,37	4,63	4,98	4,82	0,30	1,23***	0,33	0,90***	1,35***	0,29
Pull ups (n)	10,00	9,50	7,33	11,50	9,50	13,00	13,67	29,17	0,09	0,49	0,40	0,37	0,12
Abdominal strength (n)	2,33	4,00	4,33	5,00	4,00	3,50	2,67	3,50	0,89***	1,07***	0,18	0,53	0,45
Flexed arm hang (sec)	11,55	6,58	8,58	27,79	21,56	28,90	12,16	57,87	0,65	0,39	0,26	0,82***	2,20***

High practical significance: d ≥ 0,8***

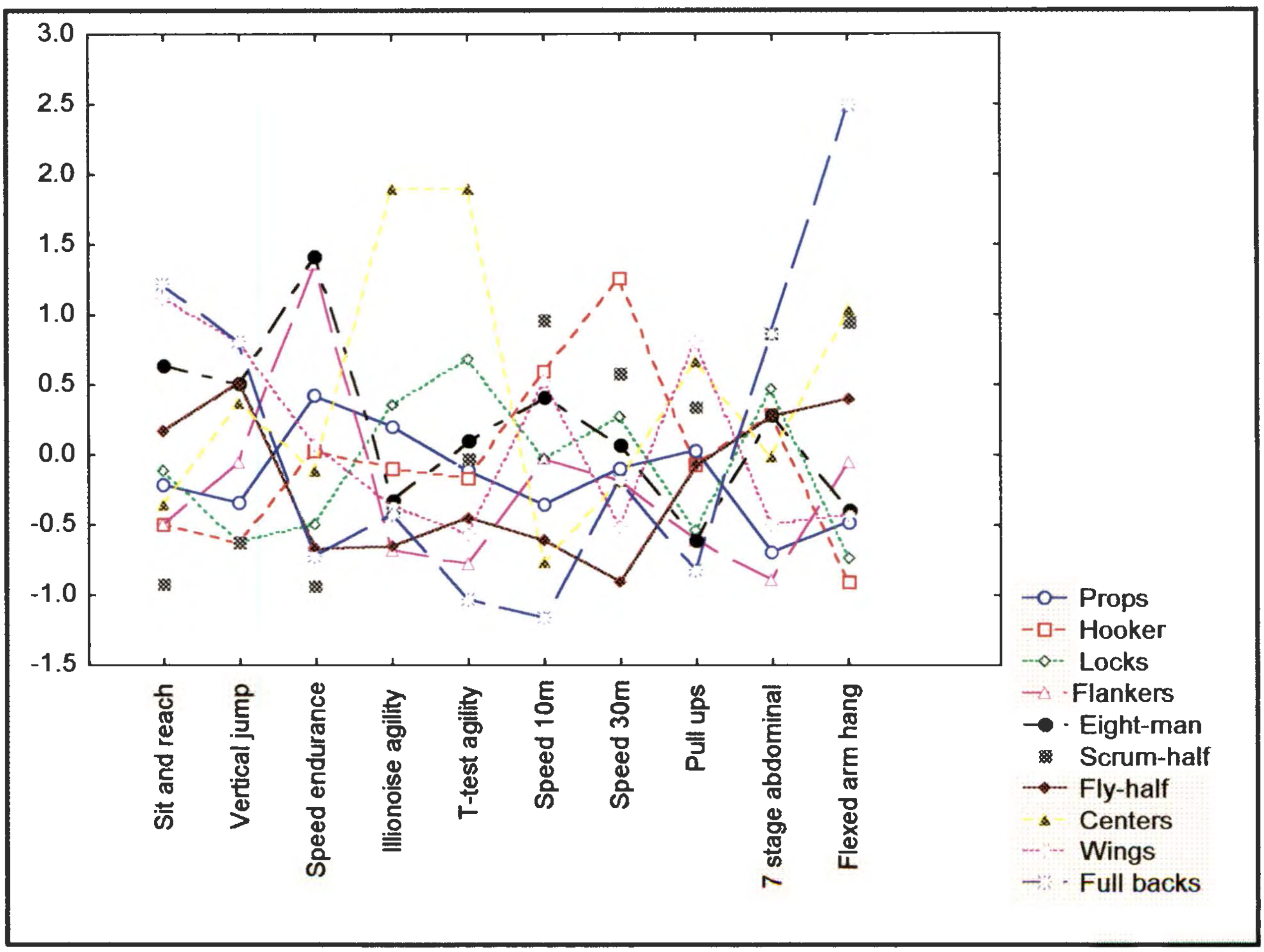
Medium practical significant differences: d=0,5

Low practical significant differences: d <0,2

The hooker and locks presented with the practically significant differences in T-test agility (d=1,01) and speed over 30 m (d=0,90). In graph 6.3 the hooker presented with the highest standardised data values of all the players in terms of speed over 30 m (z=1,26).

The only component in terms of which the eighth man presented with the highest standardised data values of all the players was speed endurance (z=1,42), while the flanker with regard to this component presented with the second highest value (z=1,35) of all the players (Graph 6.3).

Graph 6.3. Standardized data of physical- and motor components for different positions in U/13 rugby players



The halves presented with high practically significant differences in terms of modified sit-and-reach (d=1,09), speed over 10 m (d=1,46), speed over 30 m (d=1,35) and flexed-arm hang (d=0,82).

The wings and centres presented with practically significant differences in terms of the modified sit-and-reach (d=1,46), Illinois agility test (d=2,42), T-test for agility (d=2,94), speed over 10 m (d=1,19) and flexed arm hang (d=2,20). In graph 6.3 the centres presented with higher standardised data values than any other players in terms of Illinois agility (z=1,90), flexed arm hang (z=1,04) and T-test for agility (z=1,89). The wings presented with higher standardised data values than any other players in terms of sit-and-reach (z=1,12). The full-back presented with higher standardised data values than any other players in terms of sit-and reach (z=1,21), flexed upper arm hang (z=2,49) and T-test for agility (z=-1,03), and in terms of speed over 10 m (z=-1,16) they achieved the lowest of all the players. The centres, wings and full-backs differed most from other players in terms of these components.

6.8.2 Rugby components of U/16 rugby players

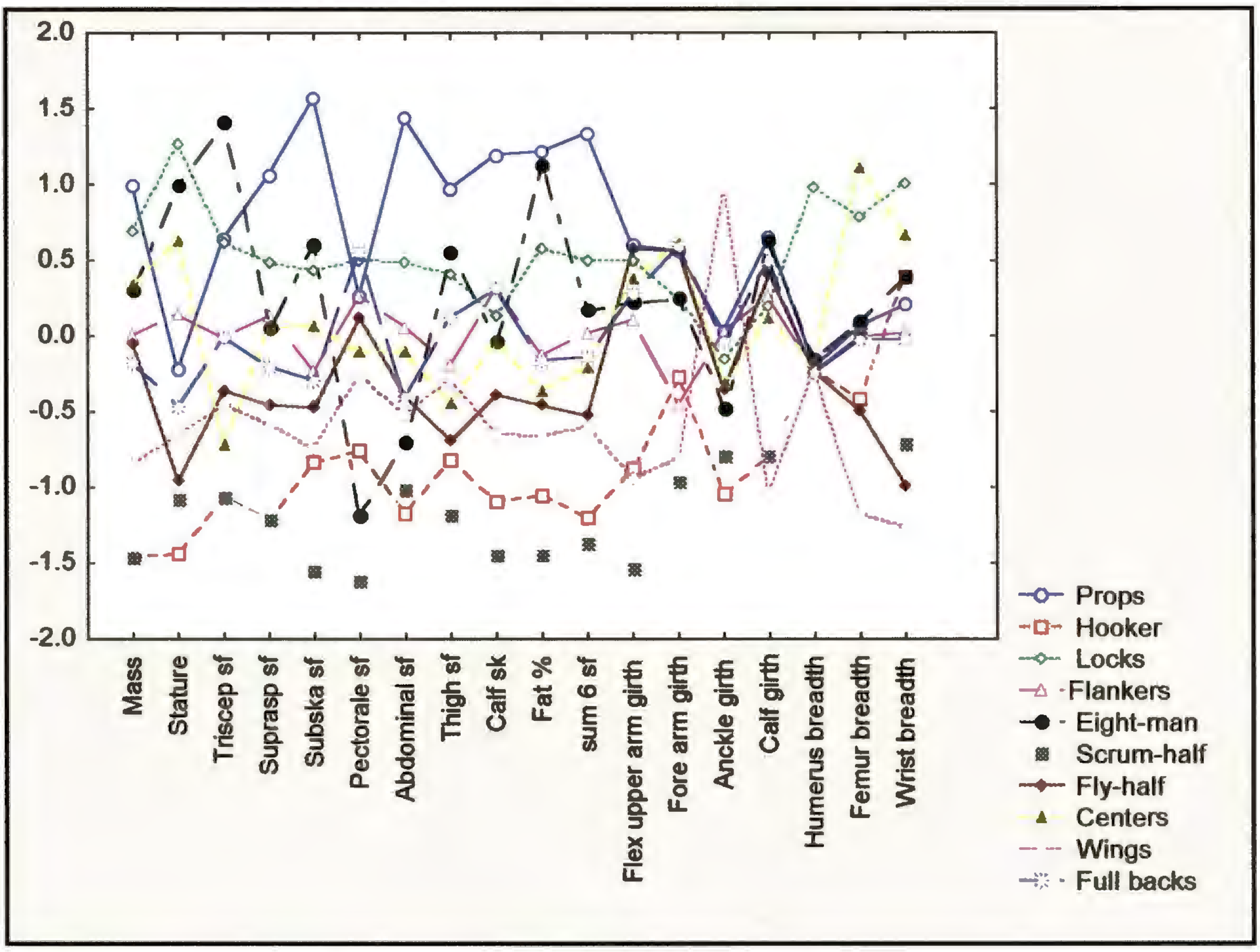
- ***Anthropometric components***

In table 6.23 the props and locks presented with high practical significant differences in terms of stature (d=1,55), sum of skinfolds (d=0,92), fat percentage (d=0,72) and wrist breadth (d=0,89). In graph 6.4 the props presented with higher standardised data values than any other players in terms of body mass (z=1,00), fat percentage (z=1,22) and sum of skinfolds (z=1,34). The hooker presented with the lowest standardised data values than any other players in terms of stature (z=-1,44), body mass (z=-1,46) fat percentage (z=-1,06), sum of skinfolds (z=-1,20) and ankle girth (z=-1,05). The locks presented with higher standardised, data values than any other players in terms of stature (z=1,26) and wrist breadth (z=1,01). This indicates that the props, hookers and locks differed most from the rest of the players in terms of these components.

In graph 6.4 the eighth man presented with the second highest standardised data values of all players in terms of fat percentage (z=1,12).

The scrum-half presented with the lowest standardised data values than any other players in terms of in body mass (z=-1,46), stature (z=-1,08), fat percentage (z=-1,45), sum of skinfolds (z=-1,37) and flexed upper arm girth (z=-1,54).

Graph 6.4. Standardized data of anthropometrical components for different positions in U/16 rugby players



The centres and wings presented with high practically significant differences in terms of body mass (d=1,24), stature (d=1,33), flexed upper arm girth (d=1,30), ankle girth (d=1,25), calf girth (d=1,14), femur breadth (d=3,23) and wrist breadth (d=2,14). High practically significant differences were found between centres and full-backs in terms of stature (d=1,14), femur breadth (d=1,60) and wrist breadth (d=0,76). Comparisons of wings and full-backs presented with high practical significant differences in terms of flexed upper arm girth (d=1,20), forearm girth (d=1,34), ankle girth (d=0,99), calf girth (d=1,51), femur breadth (d=1,63) and wrist breadth (d=1,38). The centres presented with higher standardised data values than any other players in terms of femur breadth (z=1,12). The wings presented with the lowest standardised data values than any other players in terms of femur- (z=-1,18), calf girth (z=-1,05) and wrist breadth (z=-1,26).

Table 6.23. Practically significant differences between positions for the U/16 rugby players in terms of anthropometric measurements

Variables	Props (P)	Locks (L)	Centres (C)	Wings (W)	Full-backs (FB)	MS ERROR	P vs L	C vs W	C vs FB	W vs FB
	x̄	x̄	x̄	x̄	x̄		d	d	d	d
Body mass (kg)	88,00	84,50	80,50	67,00	74,50	118,22	0,32	1,24***	0,55	0,69
Stature (cm)	179,00	191,25	186,00	175,50	177,00	62,78	1,55***	1,33***	1,14***	0,19
Tricep skinfold (mm)	9,83	9,75	6,00	6,75	8,00	7,38	0,03	0,28	0,74	0,46
Supraspinale skinfold (mm)	13,00	10,75	9,00	6,50	8,00	14,49	0,59	0,66	0,26	0,39
Subscapular skinfold (mm)	14,67	11,50	10,50	8,25	9,50	5,76	1,32***	0,94***	0,42	0,52
Pectoral skinfold (mm)	6,33	6,88	5,50	5,13	7,00	5,66	0,23	0,16	0,63	0,79
Abdominal skinfold (mm)	22,00	15,75	12,00	9,25	10,00	36,73	1,03***	0,45	0,33	0,12
Thigh skinfold (mm)	14,67	12,38	9,00	9,63	11,25	15,25	0,59	0,16	0,58	0,42
Calf skinfold (mm)	10,50	7,50	7,00	5,25	8,00	7,78	1,08***	0,63	0,36	0,99***
Sum of skinfolds (mm)	20,78	18,24	14,52	13,35	15,30	12,50	0,72	0,33	0,22	0,55
Fat percentage (%)	84,67	67,63	53,50	45,63	54,75	342,78	0,92***	0,43	0,07	0,49
Flexed upper arm girth (cm)	34,27	33,98	33,65	29,90	33,35	8,32	0,10	1,30***	0,10	1,20***
Fore arm girth (cm)	29,00	28,40	29,10	26,38	29,05	4,00	0,30	1,36***	0,02	1,34***
Ankle girth (cm)	24,23	23,63	23,15	27,23	24,00	10,59	0,19	1,25***	0,26	0,99***
Calf girth (cm)	39,50	37,63	37,25	32,35	38,85	18,52	0,44	1,14***	0,37	1,51***
Humerus breadth (cm)	7,30	7,55	7,80	6,95	6,80	0,51	0,35	1,20***	1,41	0,21
Femur breadth (cm)	9,77	10,75	11,20	8,08	9,65	0,94	1,02	3,23***	1,60***	1,63***
Wrist breadth (cm)	6,03	6,33	6,20	5,50	5,95	0,11	0,89***	2,14***	0,76	1,38***

High practical significance: d ≥ 0,8***

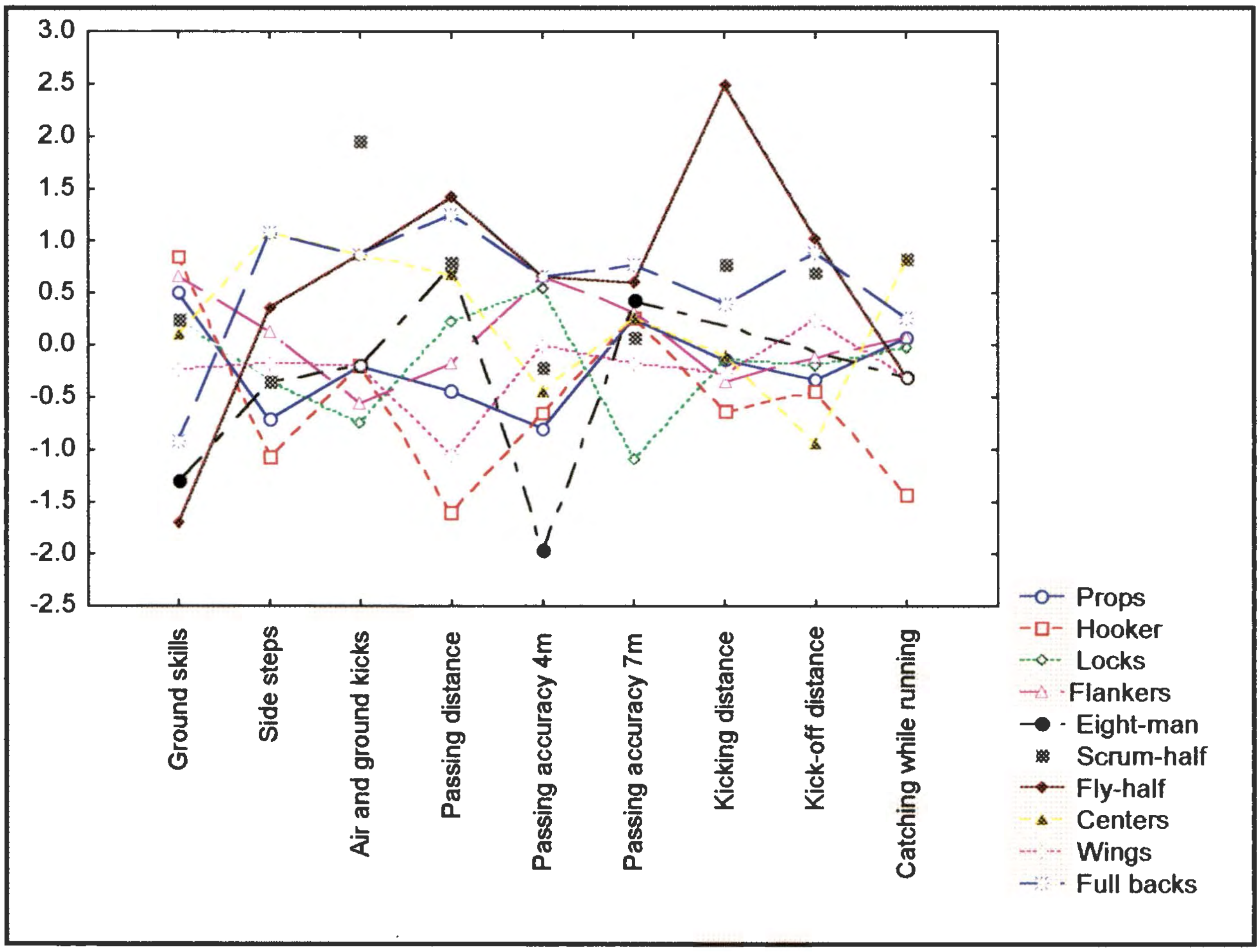
Medium practical significant differences: d=0,5

Low practical significant differences: d <0,2

❑ ***Rugby-specific skill components***

In table 6.24 high practical significant differences were found between the locks and props in terms of aerial and ground kicks (d=0,82), passing for distance (d=0,96), passing for accuracy over 4 m (d=1,44) and 7 m (d=1,26). According to graph 6.5 the hooker presented with the lowest value of all the players in terms of side-steps (z=-1,07), passing for distance (z=-1,60) and catching while running (z=-1,44). The locks presented with the lowest standardised, data value than any other players in terms of passing for accuracy over 7 m (z=-1,09).

Graph 6.5. Standardized data of rugby specific skill components for different positions in U/16 rugby players



The eighth man presented with the lowest standardised data values than any other players in terms of ground skills (z=-1,30) and passing for accuracy over 4 m (z=-1,97).

The scrum-half only presented with higher standardised data values than any other players in terms of aerial and ground kicks (z=1,95) and the lowest in terms of speed endurance (z=-1,02) (graph 6.5). The fly-half presented with higher standardised data values than any other players in terms of passing for distance (z=1,42), kicking for distance (z=2,48) and kick-off for distance (z=1,02) and the lowest value in ground skills (z=–1,70).

In table 6.24 the high practically significant differences between centres and wings were found in terms of side-steps (d=0,82), passing for distance (d=2,51), kick-off for distance (d=1,09) and catching while running (d=0,98). Comparing centres and full-backs revealed high practical significant differences in terms of ground skills (d=1,04), passing for distance (d=0,81), passing for accuracy over 4 m (d=1,17) and kick-off for distance (d=1,68). High practical significant differences that were found between wings and full-backs were in terms of side-steps (d=0,82), passing for distance (d=3,32) and passing for accuracy over 7 m (d=0,89). The centres presented with higher standardised data values than any other players in terms of side-step (z=1,07) (Graph 6.5). The wings presented with the lowest standardised, data values than any other players in terms of passing for distance (z=-1,06).

Table 6.24. Practically significant differences between positions for the U/16 rugby players in terms of rugby-specific skill components

Variables	Props (P)	Locks (L)	Centres (C)	Wings (W)	Full-backs (FB)	MS ERROR	P vs L	C vs W	C vs FB	W vs FB
	x̄	x̄	x̄	x̄	x̄		d	d	d	d
Ground skills (sec)	3,75	3,68	3,65	3,56	3,40	0,06	0,28	0,34	1,04***	0,69
Side steps (n)	3,00	3,75	7,00	5,25	7,00	4,51	0,35	0,82***	0,00	0,82***
Aerial and ground kicks (n)	3,33	4,50	6,00	5,00	6,00	2,03	0,82***	0,70	0,00	0,70
Passing for distance (m)	19,20	22,10	24,10	16,54	26,55	9,11	0,96***	2,51***	0,81***	3,32***
Passing for accuracy (4m) (n)	2,67	5,75	3,50	4,50	6,00	4,58	1,44***	0,47	1,17***	0,70
Passing for accuracy (7m) (n)	25,00	17,25	25,00	22,50	28,00	37,87	1,26***	0,41	0,49	0,89***
Kicking for distance (m)	39,77	39,78	40,25	38,33	45,70	120,99	0,00	0,18	0,50	0,67
Kick-off for distance (m)	30,53	31,83	25,00	35,85	41,75	99,38	0,13	1,09***	1,68***	0,59
Catching while running (n)	19,33	19,25	20,00	19,00	19,50	1,05	0,08	0,98***	0,49	0,49

High practical significance: d ≥ 0,8***

Medium practical significant differences: d=0,5

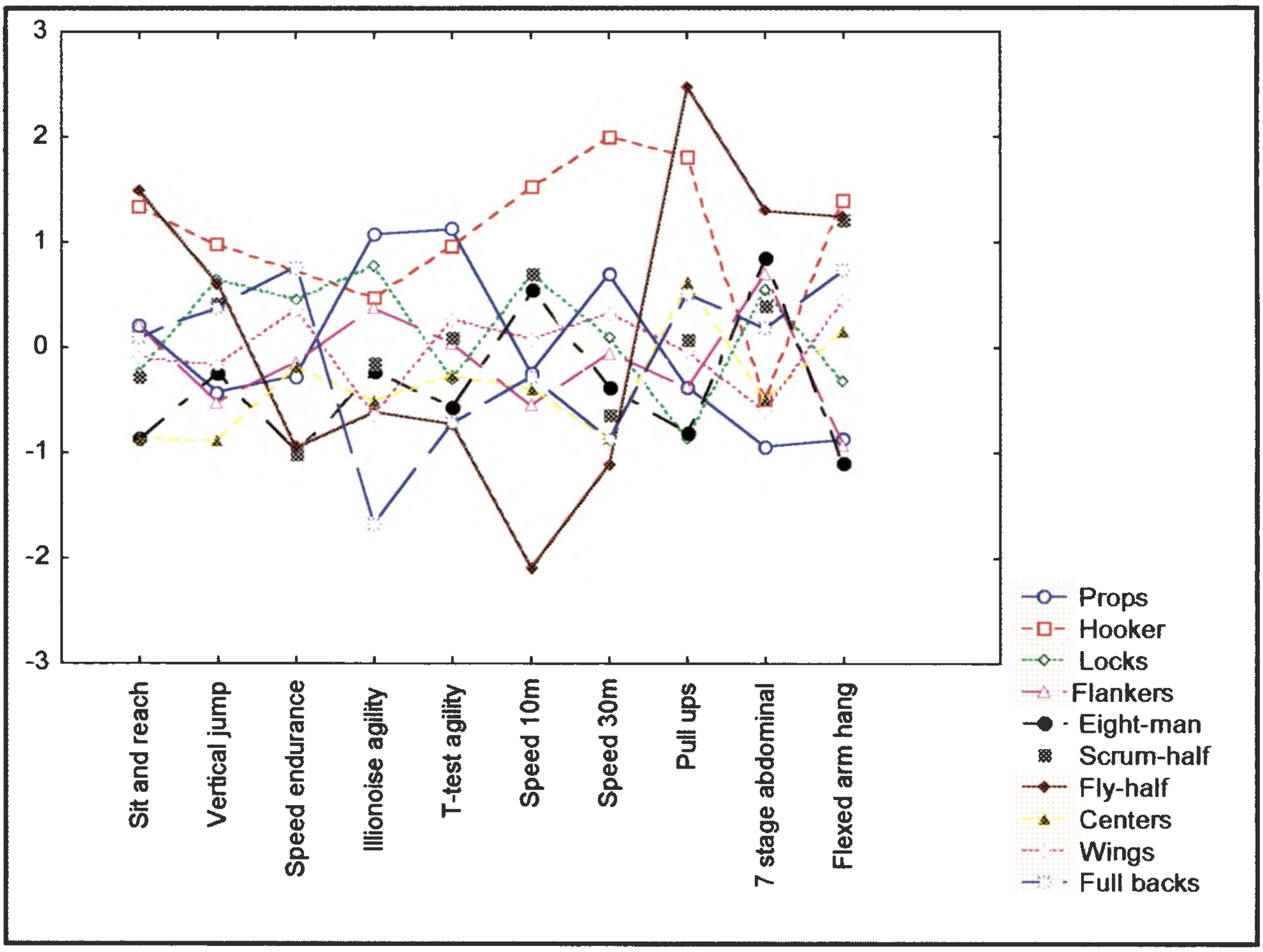
Low practical significant differences: d <0,2

The full-backs presented with the second highest standardised data values of all the players in terms of side-step (z=1,07) and passing for distance (z=1,25).

- ***Physical and motor components.***

In table 6.25 high practical significant differences were found between locks and props in terms of speed over 10 m (d=0,93) and abdominal strength (d=0,92). The props presented with higher standardised data values than any other players in terms of Illinois agility (z=1,07) and T-test for agility (z=1,12) (graph 6.6).

Graph 6.6. Standardized data of physical and motor components for different positions in U/16 rugby players



The hookers presented with higher standardised data values than any other players in terms of adapted sit-and-reach (z=1,34), flexed arm hang (z=1,39), speed over 10 m (z=1,53) and –30m (z=2,01) and the second highest value in terms of pull-ups (z=1,82). This indicates that the props differed most from the rest of the players in terms of these components.

The eighth man presented with lowest standardised, data values than any other players in terms of flexed upper arm hang (z=-1,09).

The scrum-half presented with the third highest standardised data values than any other players in terms of flexed arm hang (z=1,22). The fly-half presented with higher standardised data values than any other players in terms of adapted sit-and-reach (z=1,48), pull-ups (z=2,48), abdominal strength (z=1,30) and flexed arm hang (z=1,24), and the lowest value in terms of speed over 10 m (z=–2,09) and 30 m (z=–1,10) (graph 6.6).

Table 6.25. Practically significant differences between positions for the U/16 rugby players in terms of physical and motor components

Variables	Props (P)	Locks (L)	Centres (C)	Wings (W)	Full-backs (FB)	MS ERROR	P vs L	C vs W	C vs FB	W vs FB
	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$		d	d	d	d
Adapted sit and reach (cm)	7,33	4,25	0,00	5,25	6,50	50,44	0,43	0,74	0,92***	0,18
Vertical jump (cm)	36,00	35,50	15,50	38,75	44,50	273,81	0,03	1,41***	1,75***	0,35
Speed endurance (%)	3,80	6,03	5,99	7,75	9,01	13,59	0,60	0,48	0,82***	0,34
Illinois agility test (sec)	19,15	18,84	17,47	17,33	16,22	0,56	0,42	0,19	1,67***	1,48***
T-Test agility (sec)	10,05	12,78	12,85	13,69	12,11	11,92	0,79	0,24	0,21	0,46
Speed 10m (sec)	1,84	2,03	1,81	1,91	1,84	0,04	0,93***	0,47	0,12	0,35
Speed 30m (sec)	4,80	4,59	4,26	4,67	4,26	0,11	0,64	1,26***	0,00	1,26***
Pull ups (n)	5,00	2,75	9,50	6,50	9,00	17,85	0,53	0,71***	0,12	0,59
Abdominal strength (n)	2,00	4,00	3,00	2,75	4,50	4,73	0,92***	0,11	0,69	0,80***
Flexed arm hang (sec)	15,52	16,60	27,81	31,52	34,85	112,57	0,10	0,35	0,66	0,31

High practical significance: d ≥ 0,8***

Medium practical significant differences: d=0,5

Low practical significant differences: d <0,2

In table 6.25 high practical significant differences were found between centres and wings in terms of vertical jump (d=1,41), speed over 30 m (d=1,26), pull ups (d=0,71). Comparisons between centres and full-backs revealed that high practically significant differences exist in terms of adapted sit-and-reach (d=0,92), vertical jump (d=1,75) and Illinois agility test (d=1,67). Comparing wings and full-backs, high practical significant differences were found in term of Illinois agility test (d=1,48) and speed over 30 m (d=1,26). The full-backs presented with the lowest standardised, data values than any other players in terms of Illinois agility test (z=-167).

6.8.3 Rugby components for U/18 rugby players

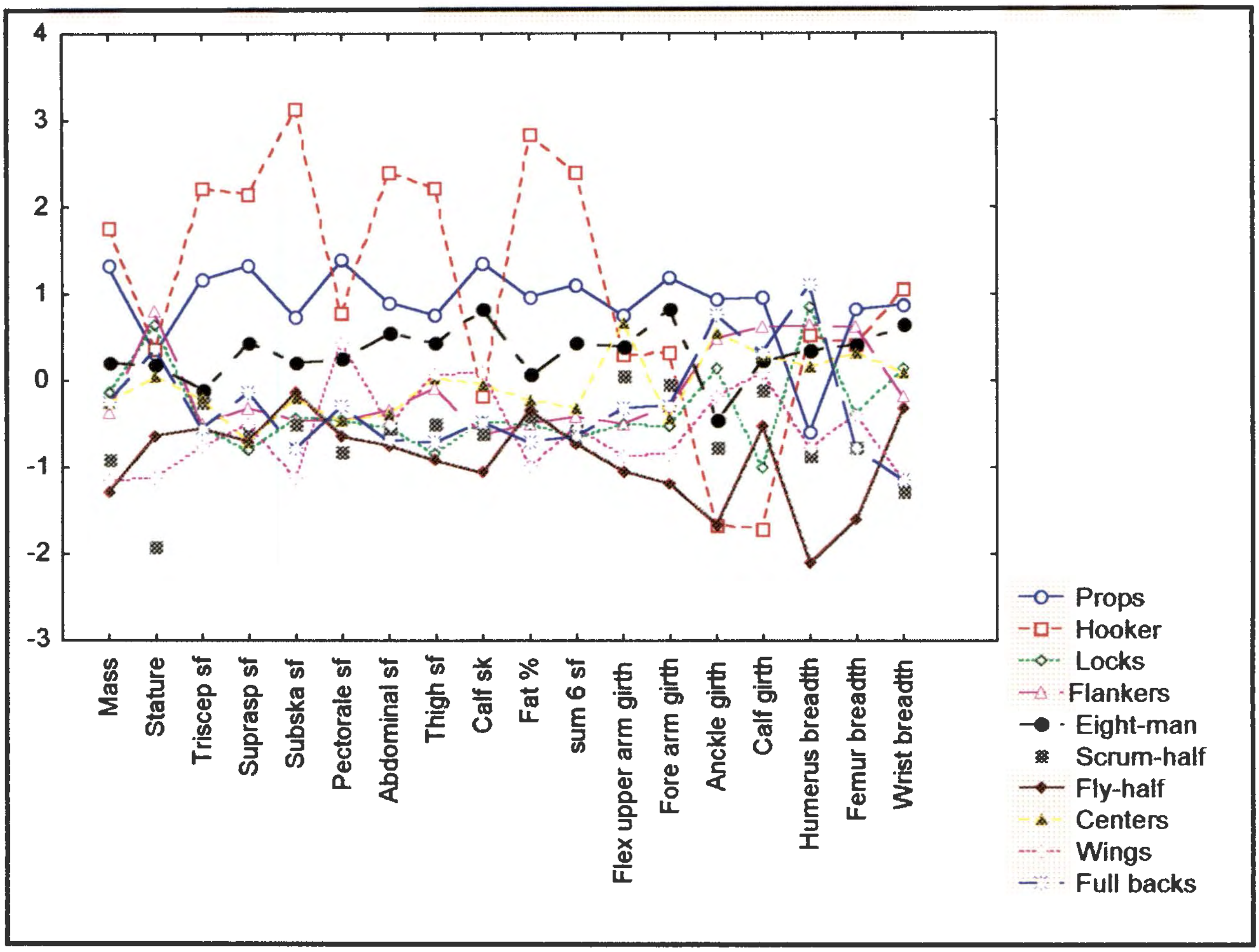
- ***Anthropometrical components***

In table 6.26 high practical significant differences were found between props and locks in terms of body mass (d=1,85), fat percentage (d=1,55), sum of skinfolds (d=1,84), flexed upper arm girth (d=1,16), forearm girth (d=1,68), ankle girth (d=0,85), calf girth (d=1,88), humerus breadth (d=1,65), femur breadth (d=1,29) and wrist breadth (d=0,85). In graph 6.7 the props presented with higher standardised data values than any other players in terms of forearm girth (z=1,18) and the second highest values in terms of body mass (z=1,33) and sum of skinfolds (z=1,10). The hooker presented with higher standardised data values than the other players in terms of body mass (z=1,76), fat percentage (z=2,82), sum of skinfolds (z=2,41) and wrist breadth (z=1,05) and the lowest value in terms of ankle- (z=-1,66) and calf girth (z=-1,71).

High practical significant differences were found between flankers and eighth man in terms of sum of skinfolds (d=0,88), forearm girth (d=1,10), ankle girth (d=1,00) and wrist breadth (d=0,95).

In graph 6.7 the scrum-half presented with the lowest standardised, data values than any other players in terms of terms of stature (z=–1,93) and wrist breadth (z=–1,28). The fly-half presented with the lowest standardised, data values than any other players in terms of flexed upper arm girth (z=–1,05), fore arm girth (z=–1,19), humerus- (z=–2,10) and femur breadth (z=–1,59) and the second lowest ankle girth (z=-1,66).

Graph 6.7. Standardized data of anthropometrical measurements for different positions in U/18 rugby players



Comparing centres and wings presented with high practical significant differences in terms of body mass (d=1,14), stature (d=1,58), fat percentage (d=0,81), humerus breadth (d=1,08), wrist breadth (d=1,43) and flexed upper arm girth (d=1,41). The wings presented with the second lowest standardised, data values than any other players in terms of body mass (z=-1,15), wrist breadth (z=-1,15) and stature (z=-1,13). The full-back presented with the highest standardised data values than any other players in terms of humerus breadth (z=1,10), but the lowest value in terms of wrist breadth (z=-1,15).

Table 6.26. Practically significant differences between positions for the U/18 rugby players in terms of anthropometric measurements

Variables	Props (P)	Locks (L)	Flankers (F)	Eighth men (EM)	Centres (C)	Wings (W)	MS ERROR	P vs L	F vs EM	C vs W
	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$		d	d	d
Body mass (kg)	105,33	82,67	79,00	88,00	81,00	67,00	150,17	1,85***	0,73***	1,14***
Stature (cm)	186,67	189,33	190,50	185,50	184,50	175,00	36,26	0,44	0,83	1,58***
Tricep skinfold (mm)	15,67	7,00	7,25	9,25	8,75	6,00	24,24	1,76***	0,41	0,56
Supraspinale skinfold (mm)	17,67	6,50	9,00	13,00	7,00	8,00	25,23	2,22***	0,80***	0,20
Subscapular skinfold (mm)	16,33	9,17	9,00	13,05	10,50	5,00	34,32	1,22***	0,69	0,94***
Pectoral skinfold (mm)	9,67	4,50	4,50	6,50	4,50	7,00	7,38	1,90***	0,74	0,92***
Abdominal skinfold (mm)	24,00	9,50	11,50	20,50	11,00	10,00	94,24	1,49***	0,93***	0,10
Thigh skinfold (mm)	14,00	6,33	10,00	12,50	10,50	10,80	24,65	1,54***	0,50	0,06
Calf skinfold (mm)	12,33	6,00	5,50	10,50	7,50	8,00	12,11	1,82***	1,44***	0,14
Sum of skinfolds (mm)	26,66	14,26	14,32	19,06	16,67	10,21	64,25	1,55***	0,59	0,81***
Fat percentage (%)	100,00	44,50	52,25	78,80	55,25	47,80	913,91	1,84***	0,88***	0,25
Flexed upper arm girth (cm)	36,50	33,00	33,00	35,50	36,25	32,00	9,06	1,16***	0,83***	1,41***
Fore arm girth (cm)	31,67	28,60	29,00	31,00	28,75	28,00	3,32	1,68***	1,10***	0,41
Ankle girth (cm)	26,07	24,87	25,40	24,00	25,50	24,40	1,98	0,85***	1,00***	0,78***
Calf girth (cm)	42,07	34,07	40,70	39,05	39,35	38,50	18,19	1,88***	0,39	0,20
Humerus breadth (cm)	7,00	7,77	7,65	7,50	7,40	6,90	0,22	1,65***	0,32	1,08***
Femur breadth (cm)	10,40	9,80	10,30	10,20	10,15	9,80	0,22	1,29***	0,22	0,75
Wrist breadth (cm)	6,23	5,97	5,85	6,15	5,95	5,50	0,10	0,85***	0,95***	1,43***

High practical significance: d ≥ 0,8***

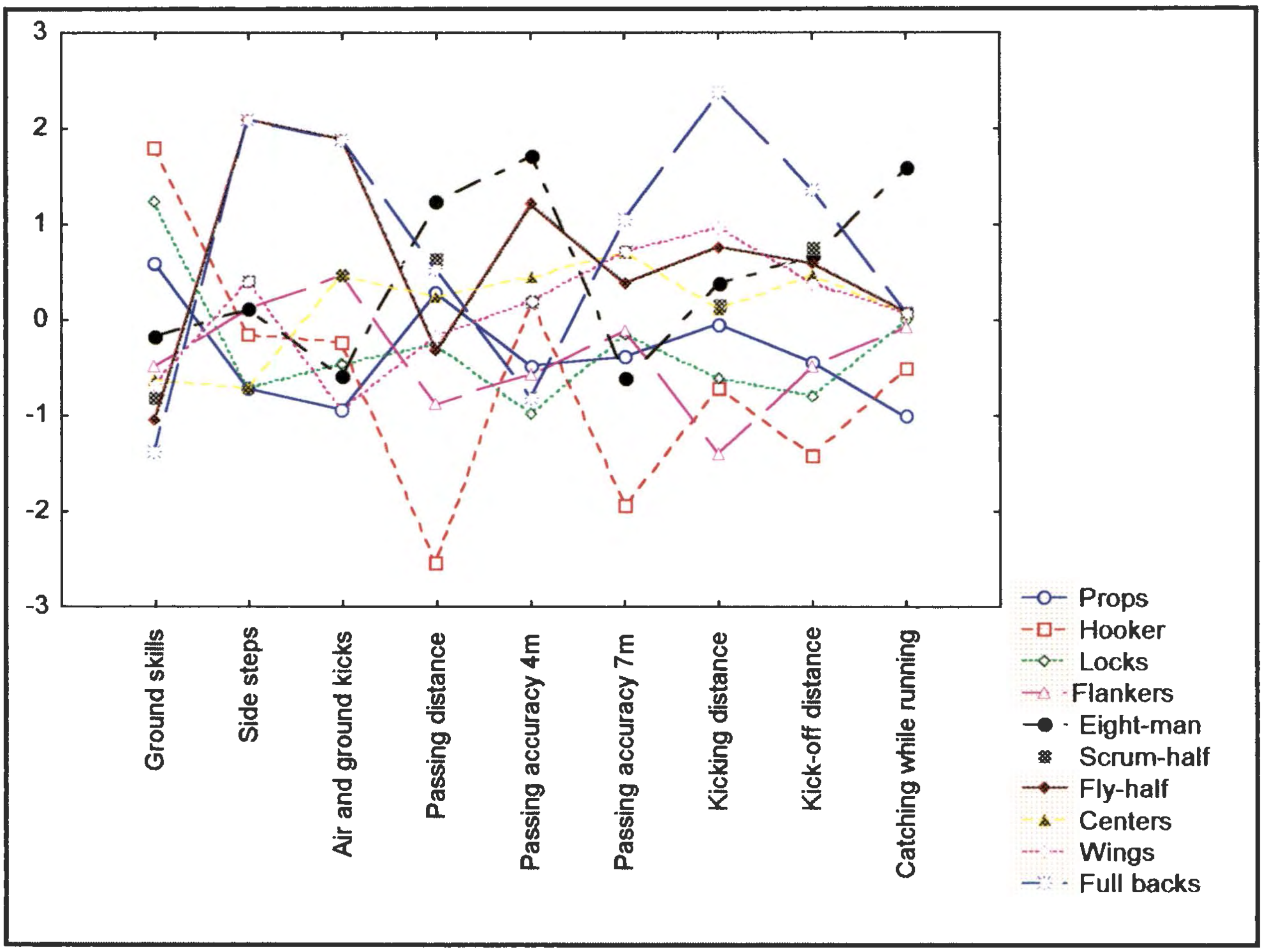
Medium practical significant differences: d=0,5

Low practical significant differences: d <0,2

- ***Rugby-specific skill components***

In table 6.27 the props and locks presented with practically significant differences in terms of ground skills (d=1,22) and catching while running (d=5,02). The props presented with the lowest standardised data values of all the players in terms of catching while running (z=-1,01) (Graph 6.8). The hookers presented with the highest standardised data values of all the players in terms of ground skills (z=1,79) and the lowest values in terms of passing for distance (z=–2,55), passing for accuracy over 7 m (z=–1,93) and kick-off for distance (z=–1,43). The locks presented with the second highest standardised, data values of all the players in terms of ground skills (z=1,24).

Graph 6.8. Standardized data of rugby specific skill components for different positions in U/18 rugby players



High practical significant differences were found in terms of aerial and ground kicks (d=1,22), passing for distance (d=2,02), kicking distance (d=1,98), kick-off for distance (d=1,37), passing for accuracy over 4 m (d=2,43) and catching while running (d=0,75), between eighth men and flankers. The flankers presented with lower standardised data values than any other players in terms of kicking for distance (z=-1,40). The eighth men presented with higher standardised data values than any other players in terms of passing for distance (z=1,24), passing for accuracy over 4 m (z=1,72) and catching while running (z=1,58).

The fly-half presented with higher standardised data values than any other players in terms of side-steps (z=2,10), aerial and ground kicks (z=1,89) and passing for accuracy over 4 m (z=1,21) and the second lowest value in terms of ground skills (z=-1,04).

High practical significant differences were found between centres and wings in terms of side-steps (d=1,27), aerial and ground kicks (d=1,63) and kicking for distance (d=0,94). The full-back presented with higher standardised, data values than any other players in terms of side-step (z=2,10) aerial and ground kicks (z=1,89), kicking for distance (z=2,38), passing for accuracy over 7m (z=1,05) and kick-off for distance (z=1,36), and the lowest value in terms of ground skills (z=–1,38).

Table 6.27. Practically significant differences between positions for the U/18 rugby players in terms of rugby-specific skill components

Variables	Props (P)	Locks (L)	Flankers (F)	Eighth men (EM)	Centres (C)	Wings (W)	MS ERROR	P vs L	F vs EM	C vs W
	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$		d	d	d
Ground skills (sec)	3,85	4,14	3,38	3,52	3,31	3,29	0,05	1,22***	0,60	0,09
Side steps (n)	5,00	5,00	6,50	6,50	5,00	7,00	2,47	0,00	0,00	1,27***
Aerial and ground kicks (n)	4,00	4,67	6,00	4,50	6,00	4,00	1,51	0,54	1,22***	1,63***
Passing for distance (m)	25,27	22,80	19,94	29,65	25,13	23,20	23,17	0,51	2,02***	0,40
Passing for accuracy (4m) (n)	4,67	3,67	4,50	9,00	6,50	6,00	3,42	0,54	2,43***	0,27
Passing for accuracy (7m) (n)	24,67	25,33	25,50	24,00	28,00	28,00	7,11	0,25	0,56	0,00
Kicking for distance (m)	37,69	35,60	32,65	39,31	38,25	41,40	11,29	0,62	1,98***	0,94***
Kick-off for distance (m)	36,93	34,40	36,55	44,91	43,45	42,90	37,01	0,42	1,37***	0,09
Catching while running (n)	12,67	19,33	19,00	20,00	20,00	20,00	1,77	5,02***	0,75***	0,00

High practical significance: d ≥ 0,8***

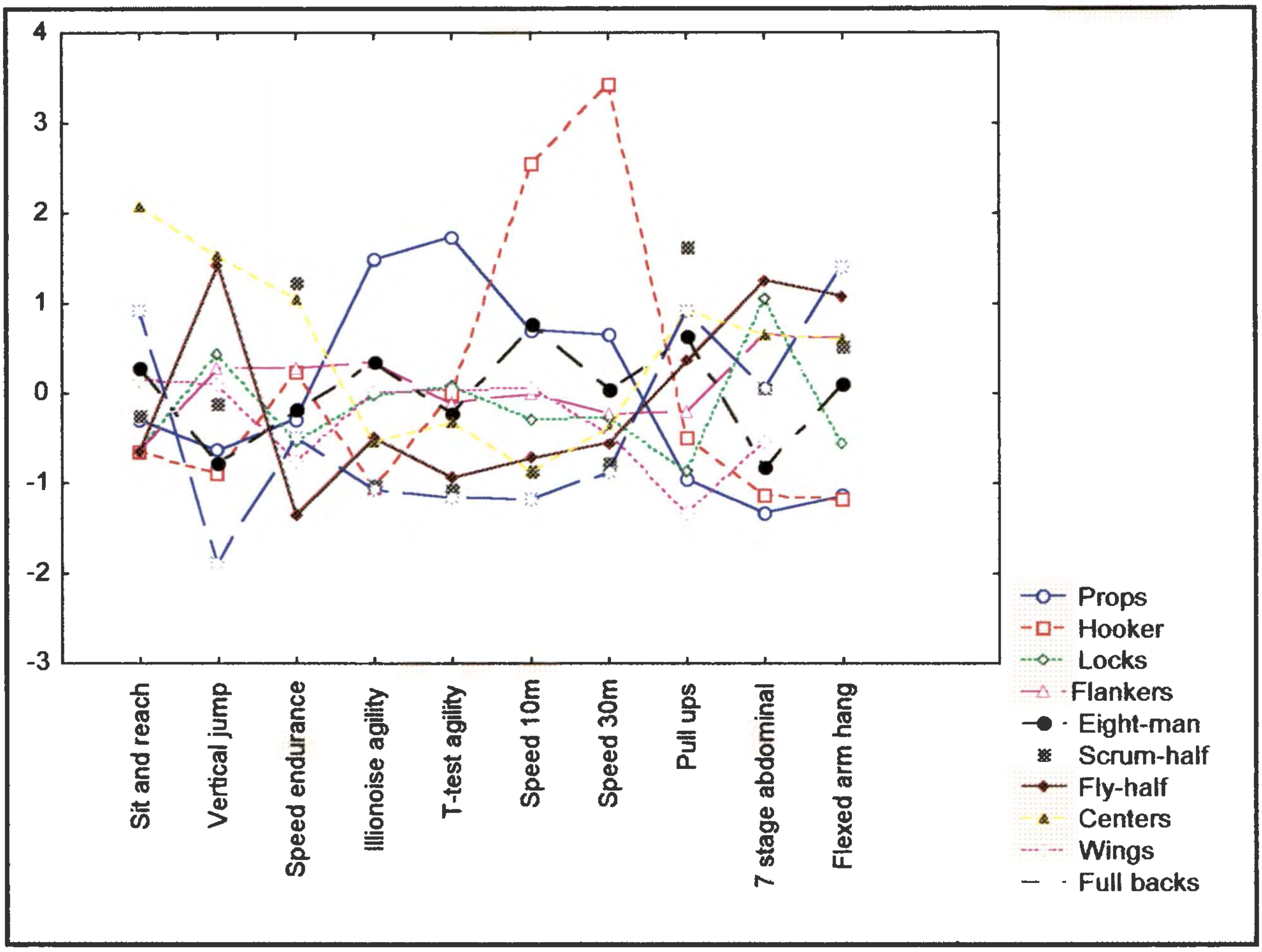
Medium practical significant differences: d=0,5

Low practical significant differences: d <0,2

- ***Physical and motor components***

Table 6.28 presents high practical significant differences between locks and props in terms of vertical jump (d=1,01), Illinois agility test (d=1,66), T-test for agility (d=2,10), speed over 10 m (d=1,16) and 30 m (d=1,03) and abdominal strength (d=2,26). The props presented with higher standardised data values than any other players in terms of Illinois agility test (z=1,48) and T-test for agility (z=1,74), and the lowest in abdominal strength (z=-1,33) and the second lowest in terms of flexed arm hang (z=-1,14).

Graph 6.9. Standardized data of physical- and motor components for different positions in U/18 rugby players



The hookers presented with higher standardised data values than any other players in terms of speed over 10 m (z=2,56) and –30m (z=3,42) and the second lowest in abdominal strength (z=1,13) and Illinois agility test (z=-1,03) and the lowest in terms of flexed arm hang (z=1,16). The locks presented the second highest standardised data values than any other players in terms of abdominal strength (z=1,06).

The flanker and eighth men presented with high practical significant differences in terms of modified sit-and-reach (d=1,21), vertical jump (d=1,00), speed over 10 m (d=0,90), pull-ups (d=1,18) and abdominal strength (d=1,41).

The scrum-half presented with higher standardised, data values than any other players in terms of speed endurance (z=1,23) and pull-ups (z=1,61), and the lowest in Illinois agility (z=-1,03) and T-test for agility (z=-1,06). The fly-half presented with higher standardised data values than any other players in terms of vertical jump (z=1,43), abdominal strength (z=1,26) and flexed upper arm hang (z=1,08) and the lowest in speed endurance (z=–1,34).

High practical significant differences were found between centres and wings in terms of modified sit-and-reach (d=2,59), vertical jump (d=1,36), speed endurance (d=1,70), speed over 10 m (d=1,06), pull-ups (d=3,15), abdominal strength (d=1,13) and flexed upper arm hang (d=2,75). The centres presented with higher standardised data values than any other players in terms of adapted sit-and-reach (z=2,09), vertical jump (z=1,54) and the second lowest value in speed endurance (z=1,06). The wings presented with lower standardised data values than any other players in terms of pull-ups (z=-1,32).

Table 6.28. Practically significant differences between positions for the U/18 rugby players in terms of physical and motor components

Variables	Props (P)	Locks (L)	Flankers (F)	Eighth men (EM)	Centres (C)	Wings (W)	MS ERROR	P vs L	F vs EM	C vs W
	x̄	x̄	x̄	x̄	x̄	x̄		d	d	d
Adapted sit and reach (cm)	1,33	0,00	0,00	3,50	10,50	3,00	8,39	0,46	1,21***	2,59***
Vertical jump (cm)	41,33	51,00	49,50	40,00	61,00	48,00	90,73	1,01***	1,00***	1,36***
Speed endurance (%)	5,09	4,47	6,50	5,35	8,48	3,92	7,15	0,23	0,43	1,70***
Illinois agility test (sec)	18,47	17,12	17,46	17,46	16,68	17,16	0,66	1,66***	0,00	0,60
T-Test agility (sec)	12,47	11,53	11,42	11,36	11,30	11,50	0,20	2,10***	0,13	0,44
Speed 10m (sec)	2,17	1,95	2,02	2,19	1,83	2,03	0,04	1,16***	0,90***	1,06***
Speed 30m (sec)	4,79	4,42	4,44	4,55	4,38	4,35	0,13	1,03***	0,29	0,08
Pull ups (n)	1,33	1,67	4,00	7,00	8,00	0,00	6,46	0,13	1,18***	3,15***
Abdominal strength (n)	1,67	5,67	5,00	2,50	5,00	3,00	3,13	2,26***	1,41***	1,13***
Flexed arm hang (sec)	10,55	18,45	34,43	27,55	34,37	0,00	156,61	0,63	0,55	2,75***

High practical significance: d ≥ 0,8***

Medium practical significant differences: d=0,5

Low practical significant differences: d <0,2

The full back presented with lower standardised data values than any other players in terms of vertical jump (z=–1,89), T-test for agility (z=–1–16), Illinois agility (z=-1,07) and speed over 10 m (z=–1,18), and the highest value in flexed arm hang (z=1,40).

6.8.4 Rugby components for U/19 rugby players

- *Anthropometric components*

In table 6.29 high practical significant differences found between props and hookers were in terms of body mass (d=2,18), sum of skinfolds (d=3,38), calf girth (d=2,17), fat percentage (d=2,55), flexed upper arm girth (d=1,74) and femur breadth (d=1,98). When props were compared to locks, high practical significant differences were found in terms of body mass (d=4,71), stature (d=1,62), fat percentage (d=7,42), flexed upper arm girth (d=4,99), calf girth (d=1,51) and forearm girth (d=1,67). Hookers were compared with locks and practically significant differences were found in terms of body mass (d=2,53), stature (d=1,36), sum of skinfolds (d=4,54), fat percentage (d=4,88), femur breadth (d=1,19), flexed upper arm girth (d=3,24) and forearm girth (d=1,67). The props presented with higher standardised data values than any other players in terms of body mass (z=1,96), fat percentage (z=2,12), sum of skinfolds (z=2,20), flexed upper arm girth (z=1,71) and calf girth (z=1,37). The hookers presented with the second lowest standardised, data values of all players in terms of fat percentage (z=1,21) and the highest value in femur breadth (z=1,53).

High practical significant differences were found between flankers and eighth men in terms of body mass (d=2,94), stature (d=1,05), sum of skinfolds (d=2,80), fat percentage (d=3,18), flexed upper arm girth (d=3,71), fore arm girth (d=1,76), ankle girth (d=2,11) and calf girth (d=2,76). The flanker presented the lowest standardised data values than any other players in terms of fore arm girth (z=-1,12), and the highest value in terms of ankle girth (z=1,01). The eighth man presented with higher standardised data values than any other players in terms of stature (z=1,02) and the second highest value in terms of calf girth (z=1,01).

Table 6.29. Practically significant differences between positions for the U/19 rugby players in terms of anthropometric measurements

Variables	Props (P)	Hookers (H)	Locks (L)	Flankers (F)	Eighth men (EM)	Centres (C)	Wings (W)	MS ERROR	P vs H	P vs L	H vs L	F vs EM	C vs W
	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$	$\bar{x}$		d	d	d	d	d
Body mass (kg)	114,50	102,00	87,50	79,00	95,83	84,50	82,50	32,80	2,18***	4,71***	2,53***	2,94***	0,35
Stature (cm)	180,00	181,50	189,50	183,50	189,67	183,50	184,00	34,52	0,26	1,62***	1,36***	1,05***	0,09
Tricep skinfold (mm)	16,50	16,00	7,75	5,50	12,67	7,25	7,00	1,17	0,46	8,08***	7,62***	6,62***	0,23
Supraspinale skinfold (mm)	27,50	12,00	6,50	8,25	9,50	8,50	5,75	13,69	4,19***	5,67***	1,49***	0,34	0,74
Subscapular skinfold (mm)	27,50	19,00	10,00	8,25	12,33	10,50	8,25	9,12	2,82***	5,80***	2,98***	1,35***	0,75
Pectoral skinfold (mm)	6,00	10,50	4,00	4,00	7,17	6,00	5,00	2,91	2,64***	1,17***	3,81***	1,86***	0,59
Abdominal skinfold (mm)	35,00	24,25	10,50	8,50	18,33	13,50	9,50	24,42	2,18***	4,96***	2,78***	1,99***	0,81***
Thigh skinfold (mm)	22,50	18,50	9,50	9,75	16,00	11,25	5,15	17,28	0,96***	3,13***	2,17***	1,50***	1,47***
Calf skinfold (mm)	15,50	14,50	6,00	6,50	11,17	7,00	5,50	6,69	0,39	3,67***	3,29***	1,80***	0,58
Sum of skinfolds (mm)	144,50	104,25	50,25	46,75	80,00	58,00	41,15	141,41	3,38***	7,93***	4,54***	2,80***	1,42***
Fat percentage (%)	36,05	29,01	15,50	12,37	21,18	15,50	13,54	7,66	2,55***	7,42***	4,88***	3,18***	0,71
Flexed upper arm girth (cm)	41,75	40,00	36,75	35,25	38,97	37,25	36,75	1,01	1,78***	4,99***	3,24***	3,71***	0,50
Fore arm girth (cm)	32,50	32,10	30,70	30,10	32,00	31,25	29,70	1,17	0,37	1,67***	1,30***	1,76***	1,43
Ankle girth (cm)	25,55	25,00	25,75	31,50	25,10	26,25	24,50	9,17	0,18	0,07	0,25	2,11***	0,58
Calf girth (cm)	43,25	39,80	40,85	38,00	42,40	39,75	40,00	2,54	2,17***	1,51***	0,66	2,76***	0,16
Humerus breadth (cm)	7,85	7,55	7,85	7,45	7,60	7,15	7,20	0,35	0,50	0,00	0,50	0,25	0,08
Femur breadth (cm)	9,90	10,90	10,30	10,35	10,03	9,65	9,30	0,26	1,98***	0,79	1,19***	0,63	0,69
Wrist breadth (cm)	6,00	6,10	5,95	6,05	6,07	6,75	5,85	0,34	0,17	0,09	0,26	0,03	1,54

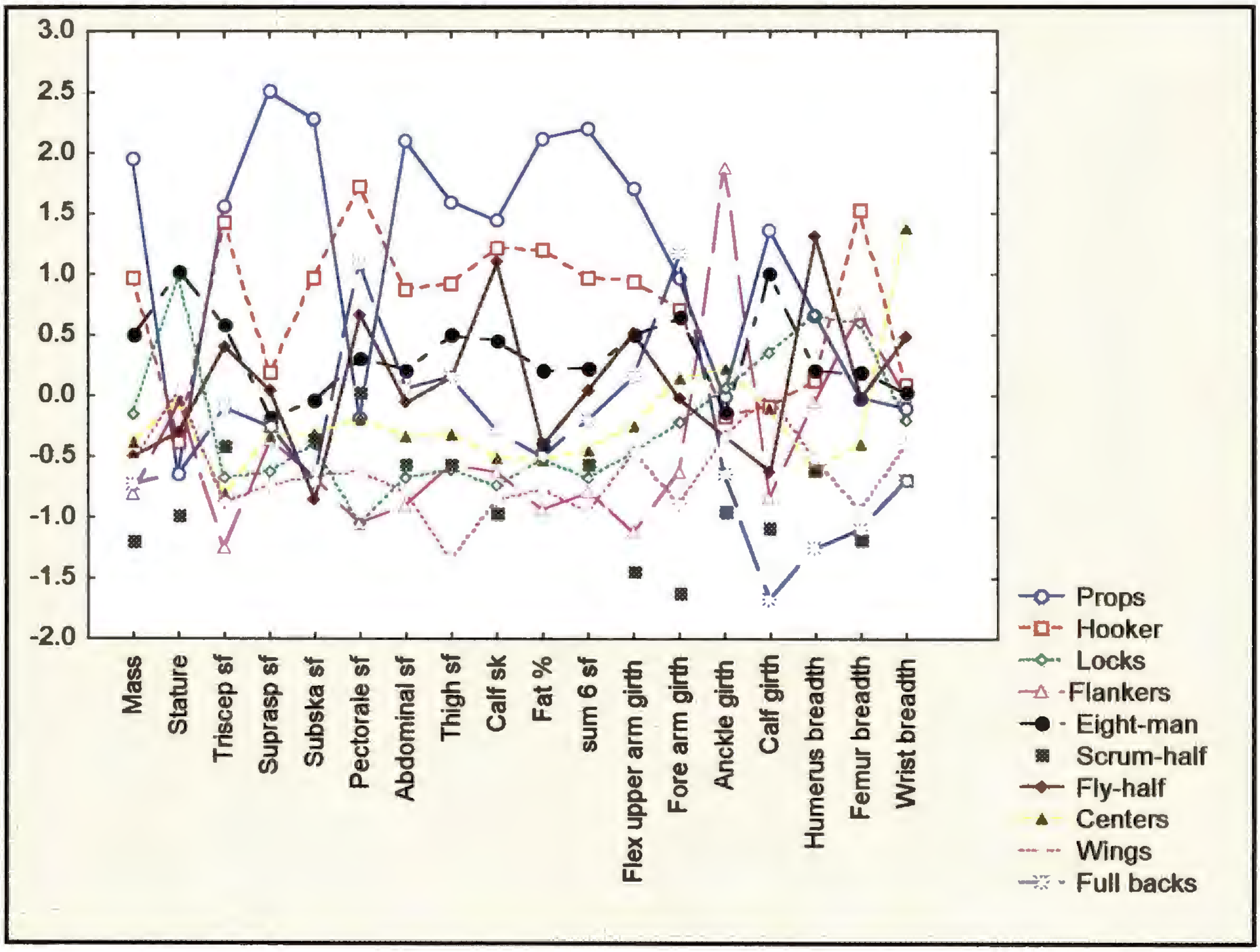
High practical significance: $d \geq 0,8$***

Medium practical significant differences: $d = 0,5$

Low practical significant differences: $d < 0,2$

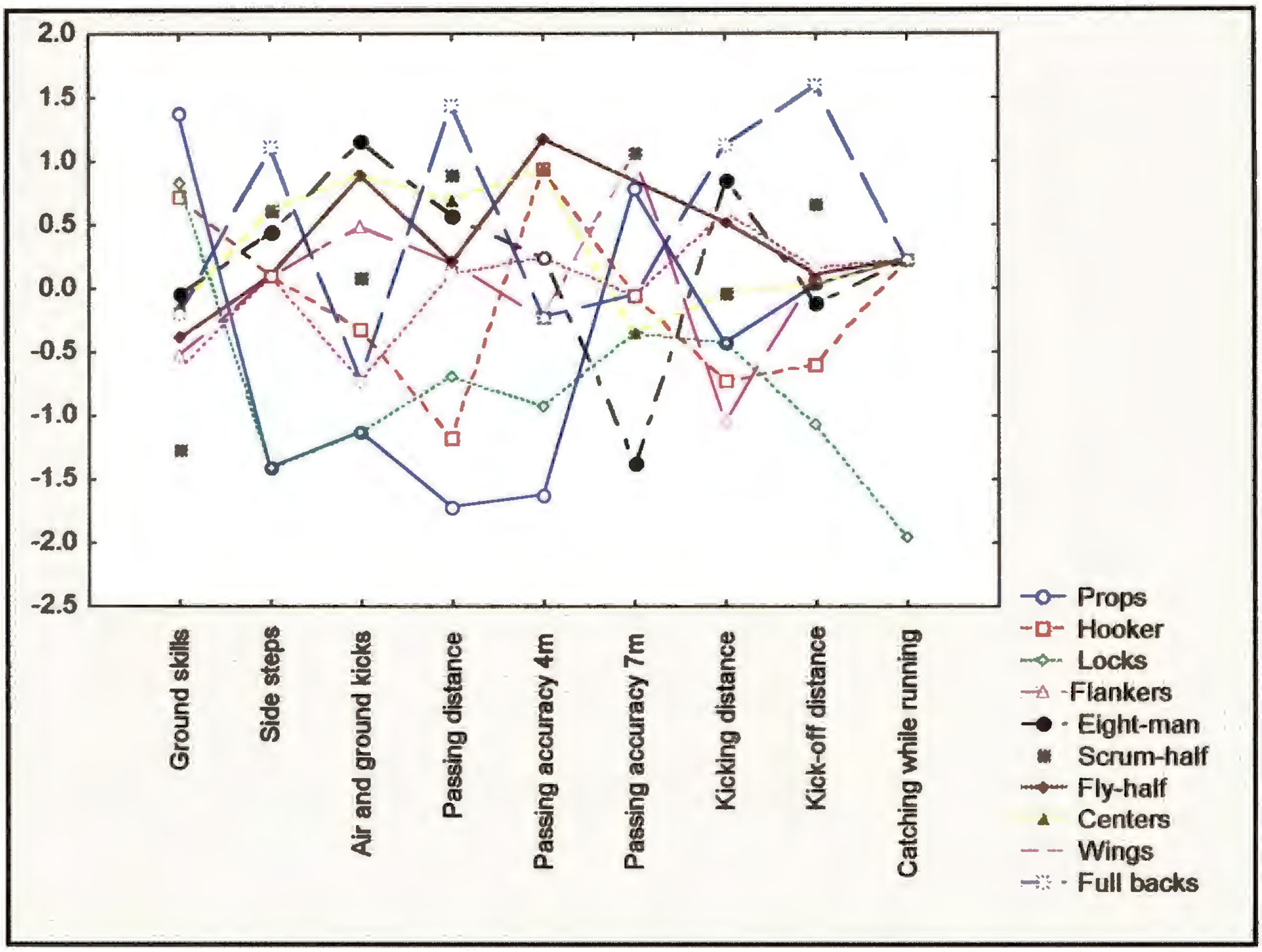
The scrum-halves presented with lower standardised data values than any other players in terms of body mass (z=–1,20), flexed upper arm girth (z=–1,44), forearm girth (z=–1,63), calf girth (z=–1,08), and femur breadth (z=–1,18). The fly-half presented with higher standardised, data values than any other players in terms of humerus breadth (z=1,31).

Graph 6.10. Standardized data of anthropometrical measurements for different positions in U/19 rugby players



Comparisons of wings and centres revealed high practical significant differences in sum of skinfolds (d=1,42). The centres presented with higher standardised data values than any other players in terms of wrist breadth (z=1,38). The full-back presented with higher standardised data values than any other players in terms of forearm girth (z=1,18) and the second lowest in terms of calf girth (z=–1,67), humerus breadth (z=–1,25) and the second lowest value in femur breadth (z=–1,10).

Graph 6.11. Standardized data of rugby specific skill components for different positions in U/19 rugby players



- ***Rugby-specific skill components***

In table 6.30 high practical significant differences were found between props and hookers in terms of side-steps (d=1,74), aerial and ground kicks (d=1,16), passing for distance (d=0,99), passing for accuracy over 4 m (d=3,27) and 7 m (d=1,12). When comparing locks with props high practical significant differences were found in terms of passing for distance (d=1,90), kick-off for distance (d=0,97), catching while running (d=2,12), passing for accuracy over 4 m (d=0,89) and 7 m (d=1,49).

High practical significant differences were found between locks and hookers in terms of side-steps (d=1,74), aerial and ground kicks (d=1,16), passing for distance (d=0,91), passing for accuracy over 4 m (d=2,38) and catching while running (d=2,12).

The props presented with higher standardised data values than any other players in terms of ground skills (z=1,37) and the lowest value in terms of side-step (z=-1,40), aerial and ground skills (z=-1,12), passing distance (z=-1,72) and passing for accuracy over 4 m (z=-1,62). The hookers presented with the second lowest standardised data value of all the players in terms of passing for distance (z=-1,18). The locks presented with lower standardised data values than any other players in terms of side-step (z=-1,40), aerial and ground kicks (z=-1,12), kick-off for distance (z=-1,06) and catching while running (z=-1,95).

High practical significant differences were found between flankers and eighth men in terms of aerial and ground kicks (d=0,97), passing for accuracy over 7 m (d=3,23) and kicking for distance (d=1,80). The flankers presented with lower standardised, data values than any other players in terms of kicking for distance (z=-1,03) and the highest value in terms of passing for accuracy over 7m (z=1,06). The eighth men presented with higher standardised data values than any other players in terms of aerial and ground kicks (z=1,16) and the lowest value in terms of passing for accuracy over 7 m (z=-1,37).

The scrum-half presented with higher standardised data values than any other players in terms of passing for accuracy over 7 m (z=1,06) and the lowest value in terms of ground skills (z=—1,28).

The fly-half presented with higher standardised, data values than any other players in terms of accuracy over 4 m (z=1,18).

Table 6.30 Practically significant differences in between positions for the U/19 rugby players in terms of rugby-specific skill components

Variables	Props (P)	Hookers (H)	Locks (L)	Flankers (F)	Eighth men (EM)	Centres (C)	Wings (W)	MS ERROR	P vs H	P vs L	H vs L	F vs EM	C vs W
	x̄	x̄	x̄	x̄	x̄	x̄	x̄		d	d	d	d	d
Ground skills (sec)	3,96	3,76	3,79	3,38	3,52	3,50	3,35	0,07	0,75	0,62	0,13	0,54	0,56
Side steps (n)	5,50	7,00	5,50	7,00	7,33	7,50	7,00	0,74	1,74***	0,00	1,74***	0,39	0,58
Aerial and ground kicks (n)	5,50	6,50	5,50	7,50	8,33	8,00	6,00	0,74	1,16***	0,00	1,16***	0,97***	2,32***
Passing for distance (m)	18,50	20,50	22,35	25,65	27,07	27,50	25,35	4,10	0,99***	1,90***	0,91***	0,70	1,06***
Passing for accuracy (4m) (n)	2,00	7,50	3,50	5,00	6,00	7,50	6,00	2,83	3,27***	0,89***	2,38***	0,59	0,89***
Passing for accuracy (7m) (n)	26,50	25,00	24,50	27,00	22,67	24,50	25,00	1,80	1,12***	1,49***	0,37	3,23***	0,37
Kicking for distance (m)	48,00	46,25	48,00	44,50	55,33	50,25	53,95	36,07	0,29	0,00	0,29	1,80***	0,62
Kick-off for distance (m)	50,00	46,00	43,00	50,50	49,00	50,00	50,80	52,36	0,55	0,97***	0,41	0,21	0,11
Catching while running (n)	20,00	20,00	19,00	20,00	20,00	20,00	20,00	0,22	0,00	2,12***	2,12***	0,00	0,00

High practical significance: d ≥ 0,8***

Medium practical significant differences: d=0,5

Low practical significant differences: d <0,2

Comparisons of wings and centres revealed high practical significant differences in terms of aerial and ground kicks (d=2,32), passing for distance (d=1,06) and passing for accuracy over 4 m (d=0,89). The full-back presented with higher standardised, data values than any other players in terms of side-step (z=1,11), passing for distance (z=1,44), kicking for distance (z=1,13), and kick-off for distance (z=1,59)

- ***Physical and motor component***

In table 6.31 high practical significant differences between props and hookers were found in terms of vertical jump (d=1,84), Illinois agility test (d=2,72), T-test for agility (d=0,94), speed over 30 m (d=1,20), pull-ups (d=0,82) and flexed arm hang (d=0,96). High practical significant differences were found between props and locks in terms of modified sit-and-reach (d=1,80), Illinois agility test (d=3,13), speed over 30 m (d=2,88), pull-ups (d=1,34), abdominal strength (d=3,15) and flexed arm hang (d=1,30). High practical significant differences were found between hookers and locks in terms of modified sit-and-reach (d=1,10), vertical jump (d=3,54), speed over 10 m (d=0,81) and 30 m (d=1,68) and abdominal strength (d=3,78).

The props presented with higher standardised data values than any other players in terms of Illinois agility test (z=2,06), T-test for agility (z=1,40) and speed over 30 m (z=1,72), and the lowest values in terms of vertical jump (z=-1,89), pull-ups (z=-1,50), abdominal strength (z=-1,34) and flexed upper arm hang (z=-1,69). The hookers presented with higher standardised data values than any other players in terms of speed over 10m (z=1,07) and second highest in speed over 30m (z=1,22). They presented with lower standardised data values than any other players in terms of abdominal strength (z=-1,68) and second lowest in terms of vertical jump (z=-1,14). The locks presented with the second highest standardised data value of all the players in terms of sit-and-reach (z=1,12).

Table 6.31. Practically significant differences between positions for the U/19 rugby players in terms of physical and motor components

Variables	Props (P)	Hookers (H)	Locks (L)	Flankers (F)	Eighth men (EM)	Centres (C)	Wings (W)	MS ERROR	P vs H	P vs L	H vs L	F vs EM	C vs W
	x̄	x̄	x̄	x̄	x̄	x̄	x̄		d	d	d	d	d
Modified sit-and-reach	1,00	4,50	10,00	3,00	4,00	11,00	1,50	25,06	0,70	1,80***	1,10***	0,20	1,90***
Vertical jump	35,50	42,00	54,50	53,00	55,33	52,00	66,50	12,46	1,84***	5,38***	3,54***	0,66	4,11***
Speed endurance	4,60	6,14	4,48	4,16	4,27	5,27	4,79	5,47	0,66	0,05	0,71	0,05	0,21***
Illinois agility test	18,26	16,97	16,78	16,12	16,42	16,02	15,12	0,22	2,72***	3,13***	0,40	0,64	1,91***
T-Test agility	12,06	11,52	11,75	10,96	11,09	10,74	10,48	0,34	0,94***	0,53	0,40	0,22	0,44
Speed 10 m	2,22	2,27	2,14	1,93	2,09	1,93	1,85	0,03	0,28	0,53	0,81***	1,02***	0,47
Speed 30 m	5,14	4,95	4,69	4,45	4,51	4,26	3,96	0,02	1,20***	2,88***	1,68***	0,40	1,93***
Pull-ups	1,50	5,50	8,00	12,00	9,33	10,00	9,50	23,57	0,82***	1,34***	0,51	0,55	0,10
Abdominal strength	3,00	2,50	5,50	5,50	6,33	4,50	6,50	0,63	0,63	3,15***	3,78***	1,05***	2,52***
Flexed arm hang	6,98	18,09	22,02	29,92	25,93	23,10	31,26	134,15	0,96***	1,30***	0,34	0,34	0,70

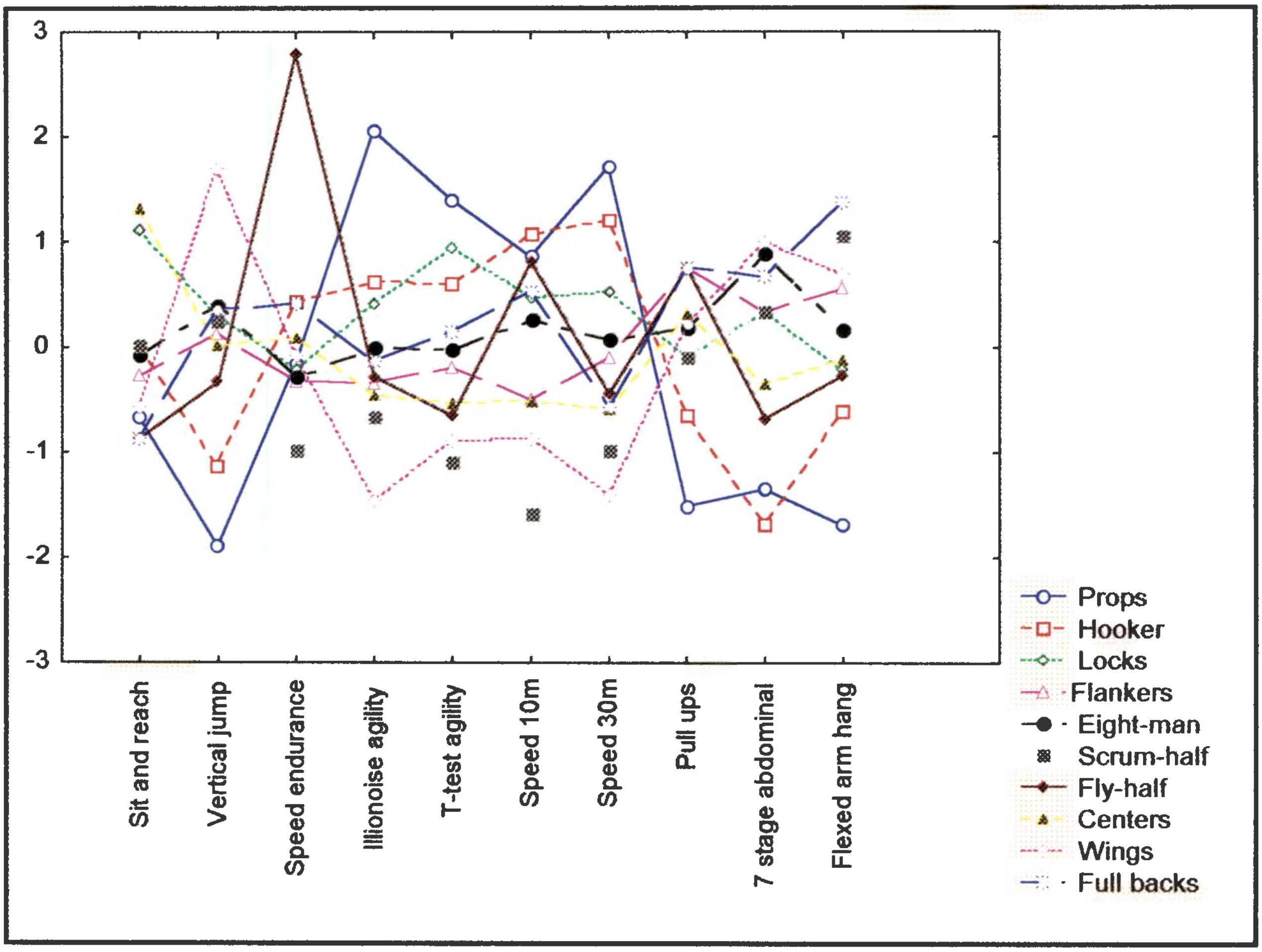
High practical significance: d ≥ 0,8***

Medium practical significant differences: d=0,5

Low practical significant differences: d <0,2

The high practical significant differences between flanker and eighth men are presented in table 6.31, and were found in terms of speed over 10 m (d=1,02) and abdominal strength (d=1,05).

Graph 6.12: Standardized data of physical- and motor components for different positions in U/19 rugby players



The scrum-half presented with the second highest standardised, data value of all the players in terms of flexed upper arm hang (z=1,06) and the lowest in T-test for agility (z=–1,10) and speed over 10 m (z=–1,59). The fly-half presented with higher standardised data values than any other players in terms of in speed endurance (z=2,79).

High practical significant differences between centres and wings were found in terms of adapted sit-and-reach (d=1,90), vertical jump (d=4,11), Illinois agility test (d=1,91), speed over 30 m (d=1,93) and abdominal strength (d=2,52). The centres presented with higher standardised data values than any other players in terms of sit-and-reach (z=1,31). The wings presented with higher standardised data value than any other players in terms of vertical jump (z=1,70), abdominal strength (z=1,01) and the lowest values in terms of Illinois agility test (z=-1,89) and speed over 30 m (z=-1,39). The full back presented with higher standardised data value than any other players in terms of the flexed arm hang (z=1,39).

6.9 Conclusion of positional components that distinguish between different positions for the U/13, U/16, U/18 and U/19 rugby players

- **U/13 players**

The tight forwards (props, hookers and locks) presented twenty-one anthropometric, eight rugby-specific skill and thirteen physical and motor components necessary to distinguish between different playing positions among the tight forwards. The loose forwards (flankers and eighth men) presented with no anthropometric, one rugby-specific skill and two physical and motor component. The halves (scrum- and fly-halves) presented with eleven anthropometric, five rugby-specific skill and eight physical and motor components that should be included in a positional selection test battery. The back-line (centres, wings and full-back) presented with fourteen anthropometric, seventeen rugby-specific skill and fourteen physical and motor components. All these components will be presented and discussed in chapter 7.

It is important to note that of all the positions the tight forwards and back-line players presented the most anthropometric and rugby specific components than any other group. It seems that even at such a young age positional differences are much more among forwards than among back-line players in terms of anthropometric components. All the positions differed more or less the same in terms of physical and motor components.

- **U/16 players**

The tight forwards (props, hookers and locks) presented twelve anthropometric, eleven rugby-specific and physical and motor components necessary to distinguish between different playing positions among the tight forwards. The loose forwards (flankers and eighth men) presented with one anthropometric, one rugby-specific skill and two physical and motor component. The halves (scrum- and fly-halves) presented with five anthropometric, five rugby-specific skill and nine physical and motor components that should be included in a positional selection test battery. The back-line (centres, wings and full-back) presented with twenty-two anthropometric, seventeen rugby-specific skill and nine physical and motor components.

Among the U/16 players it seems that they present the opposite of U/13 players in terms of anthropometric and rugby specific components, in other words there were more positional differences among back-line players than among forward players. In terms of physical and motor components all positions differed.

- **U/18 players**

The tight forwards (props, hookers and locks) presented twenty-six anthropometric, seven rugby-specific skill and fifteen physical and motor components necessary to distinguish between different playing positions among the tight forwards. The loose forwards (flankers and eighth men) presented with eight anthropometric, twelve rugby-specific skill and ten physical and motor component. The halves (scrum- and fly-halves) presented with seven anthropometric, four rugby-specific skill and seven physical and motor components that should be included in a positional selection test battery. The back-line (centres, wings and full-back) presented with fourteen anthropometric, thirteen rugby-specific skill and seventeen physical and motor components.

The U/18 players presented with the same tendency as U/13 players in terms of positional differences in terms of anthropometric components. The back-line players presented the most differences in terms of rugby-specific skill and physical and motor components.

- **U/19 players**

The tight forwards (props, hookers and locks) presented twenty-four anthropometric, nineteen rugby-specific skill and twenty-five physical and motor components necessary to distinguish between different playing positions among the tight forwards. The loose forwards (flankers and eighth men) presented with six-teen anthropometric, six rugby-specific skill and four physical and motor component. The halves (scrum- and fly-halves) presented with six anthropometric, three rugby-specific skill and four physical and motor components that should be included in a positional selection test battery. The back-line (centres, wings and full-back) presented with seven anthropometric, ten rugby-specific skill and ten physical and motor components.

However, The U/19 players presented with more positional differences among forward players, especially tight forwards, in terms of anthropometric, rugby-specific skill and physical and motor components than any other positions. This seems to suggest that older players present with more differences among forwards than back-line players in terms of all components. This is in accordance with what some coaches believe, namely that forwards develop much later than back-line players.

CHAPTER 7

SUMMARY, CONCLUSION AND RECOMMENDATIONS

7.1 Introduction

Rugby is seen as one of the most popular sports today. In many countries, such as Australia, England, New Zealand and South Africa, rugby forms an important part of the culture (Quarrie *et al.*, 1996:44). The need for talented players at an early age is essential for the national team of a country to be successful.

The aim of this study was to compile a test battery to determine positional requirements in adolescent rugby players. This chapter will include a summary of the main results found in this study; these results will also, where possible, be compared to previous studies. Conclusions will be made in accordance with the aim and findings of this study, and recommendations for further studies and regarding possible shortcomings of this study will also be made.

7.2 Summary of positional playing groups of U/13-, U/16-, U/18- and U/19 rugby players in terms of anthropometrical-, rugby specific skill-, physical- and motor components.

The aim of this study was to compile a test battery for the determination of positional requirements in adolescent rugby players. This was done by measuring and testing U/13, U/16, U/18 and U/19 elite players selected for the North West provincial team. Some studies that have been done among adolescents, but literature is limited in terms of anthropometric, rugby-specific, physical and motor components necessary for each position. De Ridder's (1993) is one study that tries to establish the morphological profile of U/13 and U/18 Craven week rugby players according to position. Hare (1997) established differences between talented and less talented U/16 players, though not according to position. Hanekom (2000) found differences between advantaged and previously disadvantage U/17 and U/19 rugby players. He only referred to three positional groups, tight and loose forwards and back-line players.

Pretorius (1997) attempted to establish positional differences between 10-year-old players in the North West province. Studies for adult rugby players are common. Quarrie *et al.* (1995) found differences between different levels of players in New Zealand. Carlson *et al.* (1994) compared US rugby players in terms of forward and back-line players. Quarrie *et al.* (1996) found differences between playing positions among adult New Zealand rugby players. Maud and Shultz (1984) compared forward and back-line players according to physiological and anthropometric components. Babić *et al.* (2001) compared forwards and back-line players in terms of anthropometric components. Pienaar and Spamer (1998) compared 10-year-old potentially talented rugby players with previous and no previous experience in rugby. Bell (1995) attempted to establish the body density of Wales rugby union players on different playing levels, but no reference was made to position. Spamer and Winsley (2002) compared elite U/18 England players with the U/18 Craven week team of the Northern Bulls, but no references were made to positions. It is thus clear from these studies that a need exists to establish the positional components of adolescent rugby players.

Descriptive statistics were used to establish the mean values of each age group in terms of anthropometric, rugby-specific skills and physical and motor components. A variance of analyses (ANOVA) was then done to establish practically significant differences among positional groups for each age group in terms of anthropometric, rugby-specific skills and physical and motor components. After this a discriminant analysis was performed to establish which variables discriminated most between the playing groups for each age group. A classification matrix was drawn up to establish the correct percentage of positional classification for each group. Analyses of variance (ANOVA) was then done between playing positions to determine the practical significance of the differences found between each age group. Data were then standardised and presented as a line plot graph to determine the variables necessary for positional selection.

7.2.1 Positional group differences in U/13 rugby players

- ***Anthropometric components***

The significant differences found between the U/13 tight and loose forwards in terms of most anthropometric data were in accordance with the findings of only one study of adult players, that of Quarrie *et al.* (1996:54), who reported statistically significant differences for body mass and stature. Studies by Babić *et al.* (2001:252), Maud and Shultz (1984:88) and Carlson *et al.* (1994:407) found differences between forwards and back-line players, but did not report significance. Quarrie *et al.* (1996:54) also reported statistically significant differences between the inside, midfield and outside backs in terms of body mass and stature. This does not seem to be the case between the halves and back-line players in this study, who did not differ significantly in terms of most anthropometric measurements.

It is interesting to note that there are many more practically significant differences between the tight and loose forwards than between the halves and back-line players in terms of anthropometric components. This suggests that even at such an early age anthropometric components of tight and loose forwards are apparent.

- ***Rugby-specific components***

Studies on rugby-specific skills components are very rare and the only data that could be found were those of Hare (1997) and Spamer and Winsley (2002). They did not report positional group differences. There were only two skills in respect of which the loose and tight forwards differed to a practically significant extent. It would be expected according to the literature on adult players that more differences would be noted between these two playing positions. however, there were practically significant differences between the halves and back-line players.

It is also interesting to note that in terms of rugby-specific skill components more practically significant differences exist between the halves and back-line players than between tight and loose forwards. On the other hand, U/13s are very young and have just started playing the game, so it is acceptable that not many differences would exist. Overall the findings do suggest that between the halves and back-line players there are differences that distinguish between these playing groups in terms of rugby-specific skills.

- ***Physical and motor components***

The literature on physical and motor skills of rugby players is limited too. Different test are also used by different researchers and comparisons of these test are difficult. The practically significant differences that do exist between tight and loose forwards in terms of endurance is relevant; loose forwards are expected to be fitter that tight forwards.

The significant differences between halves and back-line players are not many but that the halves are more agile than the back-line players is to be excepted, due to their responsibilities during a game. The study by Quarrie et al (1995:29) reported that positional differences did exist between adult forwards and back-line players in terms of physical and motor components. However, no literature could be found for the positional groups that were used in this study.

In conclusion it seems that tight and loose forwards present with more or less the same physical and motor components, seeing that few practically significant differences were found between them. On the other hand, the back-line and halves presented practically significant differences between them in three physical and motor components, which suggests that at this young age there are physical and motor components specific to positional playing groups.

7.2.2 Positional group differences in U/16 rugby players

- ***Anthropometric components***

The practical significance between tight and loose forwards in the U/16 players is less than in the U/13 players. It would have been expected that among U/16 players the differences between playing positions in terms of anthropometric data would be much more with the advance in age. The same could be said for the halves and back-line players. Studies by Quarrie *et al.* (1996:54), reported statistically significant differences for body mass and stature. Studies by Babić *et al.* (2001:252), Maud and Shultz (1984:88) and Carlson *et al.* (1994:407) found differences between forwards and back-line players, but did not report significance.

These practically significant differences suggest that in terms of anthropometric components there are few components that distinguish between playing groups at this age. This might be due to the fact that most of these boys have just finished their growth spurt (3.22), and that this fact might have influenced the anthropometric components of these players.

- ***Rugby-specific skill components***

Studies on rugby-specific skills components are very rare and the only data that could be found were those of Hare (1997). He did not report positional group differences. The practically significant differences found between tight and loose forwards are acceptable. As loose forwards have more ball in hand than tight forwards, one of their responsibilities would be to deliver good ball to the back-line players. The differences found between halves and back-line players seem to suggest that the halves present much better skills in term of kicking and passing skills than back-line players; halves are expected to be the link between the forwards and back-line players and good passing for distance assists them in providing good ball to the backs. They are also the decisions-makers, and they use abilities like aerial and ground kicks.

Both the tight and loose forwards, and halves and back-line players presented practically significant differences in the same numbers of rugby-specific skill components. Literature supports the fact that back-line players (including halves) are more skilled than forwards (4.114).

- ***Physical and motor components***

In terms of physical and motor abilities, it was expected that the tight and loose forwards would present with more significant differences. There were many more practically significant differences between the halves and back-line players. The halves presented much better results than the back-line players in most physical and motor and tests. The assumption can be made that at the age of 15 years the tight and loose forwards perform almost the same in terms of physical and motor components. However, the halves and back-line players presented with many more differences in terms of physical and motor components. Again this might be because forwards mature later than the average back-line player.

It seems from these results that not many differences are found between tight and loose forwards in terms of physical and motor components. The back-line and halves did present significant differences in more components, which suggests that these groups require specific physical and motor components.

7.2.3 Positional groups differences in U/18 rugby players

- ***Anthropometric components***

Anthropometric differences between the tight and loose forwards are present to a much greater extent among the U/18 player than among the younger players. The halves and back-line players presented fewer significant differences in terms of anthropometric measurements. It seems that halves and back-line players at this age differ less than at a younger age, but the opposite seems to be true in the case of tight and loose, forwards. However, the study by Quarrie et al (1996:54) did report significance differences among adult back-line players. This does not seem to be the case with U/18 halves and back-line players.

In conclusion the tight and loose forwards seem to present more differences in terms of anthropometric components at this age than their younger counterparts. Some coaches are of the opinion that forwards develop and mature much later in terms of rugby, and this seems to be the case with anthropometric components as well.

- ***Rugby-specific skill components***

Again the literature for rugby-specific skills components is very limited. The practical significance found between tight and loose forwards seems relevant, as it reflects their different positional responsibilities. however, this was not the case with halves and back-line players, who only differed practically significantly in terms of side-step. The same assumption can be made that was made for the U/16 players, namely that the older the halves and back-line players get the fewer the differences that are found between them.

In conclusion it seems that the differences in terms of rugby-specific skill components between tight and loose forwards become more and the differences between halves and back-line players become fewer with an advance in age.

- ***Physical and motor components***

With regard to physical and motor components the U/18 tight and loose forwards only presented with differences in terms of strength. It would be expected of tight forwards to be stronger than loose forwards, but again this finding could be due to the nature of the tests. There was only one component in respect of which the halves and back-line players differed.

The study by Quarrie *et al.* (1996:54) presented statistical differences between forwards and back-line players in terms of physical and motor components.

In conclusion, it seems that few differences exists between playing groups in terms of physical and motor components. This could be attributed to the fact that even at this age all players are well conditioned, and therefore represent few differences between playing groups in terms of physical and motor components, which is in contrast with literature concerning adult players (4.35).

7.2.4 Positional groups differences in U/19 rugby players

- ***Anthropometric components***

The U/19 tight and loose forwards presented with practically significant differences in term of most anthropometric components. It could be said that the U/19 tight and loose forwards can be classified according to anthropometric components, and it also seems that with an advance in age more differences are found in the groups of forwards. The halves and back-line players again presented fewer significant differences than younger halves and back-line players. It also seems here as if the older the back-line players and halves are, the fewer differences are found between them.

The tight and loose forwards at this age present with more differences than their younger counterparts in terms of anthropometric components than halves and back-line players do. This seems to suggest that forwards (tight and loose) develop more in terms of anthropometric components with an advance in age than halves and back-line players do.

- ***Rugby-specific skill components***

In terms of rugby-specific skills components fewer differences were found between tight and loose forwards as well as between halves and back-line players. The passing for accuracy over 7 m seems relevant to halves, seeing that they require much longer passes than the rest of the back-line players.

It seems that at this age there are few differences between tight and loose forwards and halves and back-line players in terms of rugby-specific components. This might be due to the fact that players at this age are all well developed, irrelevant of positional group, in terms of rugby-specific components.

- ***Physical and motor components***

The U/19 tight and loose forwards presented with more practically significant differences in terms of physical and motor components. The halves and back-line players only presented with practically significant differences in terms of two motor and physical components. Studies by Quarrie *et al.* (1996:54) presented statistically significant differences between forwards and back-line players. It also seems that, just like the U16- and U/18 players of this study, the older the halves and back-line players are, the fewer differences are found between them.

At this age it seems that the tight and loose forwards present with more differences than the halves and back-line players in terms of physical and motor components. This indicates that tight and loose forwards need specific components for their positional responsibilities (4.35).

7.3 Summary of classification of positional groups for U/13-, U/16-, U/18- and U/19 rugby players in terms of anthropometrical-, rugby specific skills-, physical- and motor components

A discriminant analysis was used to determine the components that distinguished most between the four different playing groups. Thereafter a classification matrix was drawn up to establish how many players had been correctly classified, according to discriminant components, into positional groups. The results are presented according to age.

7.3.1 U/13 rugby players

The classification matrix for the U/13 rugby players presented a total of 85,71% of positional groups who were classified correctly (table 6.16). It seems according to this classification that one loose forward presented with the same profile as back-line players in terms of the discriminant variables. This was also the case in terms of one half who was classified as a back-line player and one back-line player who was classified as a tight forward. This is not uncommon for young players, seeing that they are still young and have just started the game, so that similarities between playing groups are to be expected.

7.3.2 U/16 rugby players

The total number of correctly classified U/16 rugby players presented in the classification matrix was 90.9% (Table 6.17). The halves were only classified 50% correctly, seeing that one player was classified as a back-line player. One back-line player was also classified as a tight forward. It is evident that with an increase in age the tight and loose forwards are classified more correctly than the halves and back-line players.

7.3.3 U/18 rugby players

According to table 6.18 all the players , in terms of the variables that discriminated between playing positions, were classified 100% correctly. It seems that at this age players are established in specific positional groups.

7.3.4 U/19 rugby players

In table 6.19 the total correct classification, according to variables that discriminated between playing positions, was 89.47%. Again the tight and loose forwards were classified 100% correctly. The halves had one player that was classified as a back-line player, and one back-line player was classified as a half. It seems that at this age there might be some similarities between back-line and half players or that according to the discriminant variables these wrongly classified players should play in the positional group they are more suited for.

7.3.5 Conclusion

The U/13 rugby players presented with the lowest percentage of correct classification of all the groups in terms of components discriminated. This might be due to the young age of the players, in other words, some of these players present the same components in terms of positional group. The U/16 and U/18 rugby players could be placed in the correct playing groups according to this classification matrix. The U/19s could also be identified according to positional group using this classification matrix. It seems that this classification matrix is an effective method for identifying and classifying rugby players according to positional groups responsibilities.

7.4 Summary of positional components of U/13-, U/16-, U/18- and U/19 rugby players in terms of anthropometrical-, rugby specific skill-, physical- and motor components

The aim of this study was to establish a test battery for determination of positional selections among adolescent rugby players. There is very little information regarding positional requirements among adolescent rugby players. The need for such information might assist with talent identification as well as talent development in the specific position that best suites the adolescent. One way analyses of variance was done to establish the practical significant differences that exist between different playing positions. The data was also standardised and presented in a line plot graph. These graphs indicate what components are relevant for each playing position. This will enable sport scientist, coaches and teachers to identify certain components that specific adolescents have, and develop those components for that specific playing position.

The discussion in this section will take place per position, the reason for this being that not many studies exist in terms of positional components for different ages. Thus comparisons will be made to some studies and literature with regard to adult players. The value included in the tables is the mean value of the specific position and might be used by teachers and coaches as a norm for that position.

- ***Props***

The literature represented in paragraphs 4,37 and 4,38 suggests that for props, body mass is an important component. This was also the case for all the players tested in this study, with the exception of the U/16 props. The same tendency was found in terms of stature for all the props tested (par. 4.39), except for the U/18 props (table 7.1). In terms of literature about breadths and girths, all props in this study presented with some components (par. 4.40, 4.41). It is interesting to note that no previous studies or literature mentions wrist breadth, although all the props measured in this study presented with this component as relevant, except for the U/19 props.

In terms of rugby-specific skill components, the literature mentions handling skills (par. 4.45) as important for props. The props tested in this study all presented with catching while running as an important component, except for U/16 props, Passing for accuracy or distance constituted as important components for all the props tested, except for U/13 and U/18 players.

Table 7.1: Positional components for props

U/13	U/16	U/18	U/19
Body mass ($\bar{x}$=70.33)		Body mass ($\bar{x}$=105.33)	Body mass ($\bar{x}$=114.50)
Stature ($\bar{x}$=177.33)	Stature ($\bar{x}$=179.00)		Stature ($\bar{x}$=180.00)
Sum of skinfolds ($\bar{x}$=16.74)	Sum of skinfolds ($\bar{x}$=84.67)	Sum of skinfolds ($\bar{x}$=100)	Sum of skinfolds ($\bar{x}$=144.50)
	Fat percentage ($\bar{x}$=20.78)	Fat percentage ($\bar{x}$= 26.66)	Fat percentage ($\bar{x}$=36.05)
		Flexed upper arm girth ($\bar{x}$=36.50)	Flexed upper arm girth ($\bar{x}$=41.75)
Calf girth ($\bar{x}$=36.83)		Calf girth ($\bar{x}$=42.07)	Calf girth ($\bar{x}$=43.25)
		Fore arm girth ($\bar{x}$=31.67)	Fore arm girth ($\bar{x}$=32.50)
Ankle girth ($\bar{x}$=23.77)		Ankle girth ($\bar{x}$=26.07)	
Wrist breadth ($\bar{x}$=5.93)	Wrist breadth ($\bar{x}$=6.03)	Wrist breadth ($\bar{x}$=6.23)	
Humerus breadth ($\bar{x}$=7.47)		Humerus breadth ($\bar{x}$=7.00)	
		Femur breadth ($\bar{x}$=10.40)	Femur breadth ($\bar{x}$=9.9)
		Ground skills ($\bar{x}$=3.85)	Ground skills ($\bar{x}$=3.96)
			Side steps ($\bar{x}$=5.50)
	Aerial and ground kicks ($\bar{x}$=3.33)		Aerial and ground kicks ($\bar{x}$=5.50)
	Passing for distance ($\bar{x}$=19.20)		Passing for distance ($\bar{x}$=18.50)
	Passing for accuracy over 4m ($\bar{x}$=2.67)		Passing for accuracy 4m ($\bar{x}$=2.00)
	Passing for accuracy over 7m ($\bar{x}$=25.00)		Passing for accuracy 7m ($\bar{x}$=26.50)
Kick-off for distance ($\bar{x}$=40.67)			Kick-off for distance ($\bar{x}$=50.00)
Catching while running ($\bar{x}$=19.33)		Catching while running ($\bar{x}$=12.67)	Catching while running ($\bar{x}$=20.00)
Speed over 10m ($\bar{x}$=2.1)	Speed over 10m ($\bar{x}$=1.84)	Speed over 10m ($\bar{x}$=2.17)	
Speed over 30m ($\bar{x}$=5.03)		Speed over 30m ($\bar{x}$=4.79)	Speed over 30m ($\bar{x}$=5.14)
Abdominal strength ($\bar{x}$=2.33)	Abdominal strength ($\bar{x}$= 2.00)	Abdominal strength ($\bar{x}$=1.67)	Abdominal strength ($\bar{x}$=3.00)
Speed endurance ($\bar{x}$=5.92)			
T-test agility ($\bar{x}$=13.45)	T-test ($\bar{x}$=10.05)	T-test ($\bar{x}$=12.47)	T-test agility ($\bar{x}$=12.00)
	Illinois agility ($\bar{x}$=19.15)	Illinois agility ($\bar{x}$=18.47)	Illinois agility ($\bar{x}$=18.26)
		Vertical jump ($\bar{x}$=41.33)	Vertical jump ($\bar{x}$=35.50)
			Adapted sit and reach ($\bar{x}$=1.00)
		Flexed arm hang ($\bar{x}$=10.55)	Flexed arm hang ($\bar{x}$=6.98)
			Pull-ups ($\bar{x}$=1.50)

In contrast with the literature, some of the props presented with kick-off for distance or kicking for distance as relevant components. This might be due to the props' leg strength and not necessarily to the use of this ability during games.

In terms of literature props should possess strength, speed and speed endurance (par. 4.49-4.51). All the props in this study presented with speed as an important component. Literature did not mention agility as an important component for props but all the props tested in this study presented with it as a component, which should then be included in a positional test battery. In terms of arm strength (pull-ups and flexed upper arm hang) these were only present in the older props (U/18 and U/19). However, all presented with abdominal strength as an important component, which the literature did not mention.

- ***Hookers***

According to the literature the anthropometric components that hookers should possess are body mass (par. 4.53), stature (par. 4.52), girths and breadths (par. 4.54, 4.55) and sum of skinfolds and fat percentage (par. 4.56. 4.57). All the hookers measured in this study presented with body mass and stature as important components, with the exception of the U/18 hookers, who did not present with stature (table 7.2). All the hookers also presented with some girths and breadths that are important for positional selection, with the exception of the U/16s, who did not present with breadth. In terms of fat percentage and sum of skinfolds, all hookers tested in this study presented with these components as relevant for positional selections.

Literature mentions one rugby-specific component for hookers that is relevant, namely ball handling. All the hookers in this study presented with some handling skill (passing for accuracy, passing for distance and catching while running). The only hookers that presented running skills (side-steps) were the U/16 and U/19 hookers. Many hookers presented with kicking ability (kick-off for distance, kicking for distance and aerial and ground kicks), although literature does not mention this as a characteristic of hookers. It might be because of leg strength that the kicking ability of hookers are so good.

Table 7.2: Positional components for hookers

U/13	U/16	U/18	U/19
Body mass (x̄=60.75)	Body mass	Body mass	Body mass (x̄=102.00)
Stature (x̄=162.50)	Stature		Stature (x̄=181.5)
Sum of skinfolds (x̄=20.78)	Sum of skinfolds	Sum of skinfolds	Sum of skinfolds (x̄=104.25)
Fat percentage (x̄=20.78)	Fat percentage	Fat percentage	Fat percentage (x̄=29.01)
			Flexed upper arm girth (x̄=40.00)
Calf girth (x̄=35.65)		Calf girth	Calf girth (x̄=39.80)
			Fore arm girth (x̄=32.10)
Ankle girth (x̄=22.60)	Ankle girth	Ankle girth	
Wrist breadth (x̄=5.46)		Wrist breadth	
Humerus breadth (x̄=6.85)			
			Femur breadth (x̄=10.9)
	Side steps		Side steps (x̄=7.00)
			Aerial and ground kicks (x̄=6.50)
Passing for distance (x̄=18.61)	Passing for distance	Passing for distance	Passing for distance (x̄=20.50)
			Passing for accuracy 4m (x̄=7.50)
		Passing for accuracy 7m	Passing for accuracy 7m (x̄=25.00)
Catching while running (x̄=18.50)	Catching while running		Catching while running (x̄=20.00)
		Ground skills	
Kick-off for distance (x̄=21.97)			
		Kick-off for distance	
Speed over 10m (x̄=2.29)	Speed over 10m	Speed over 10m	Speed over 10 m (x̄=2.27)
Speed over 30m (x̄=5.71)	Speed over 30m	Speed over 30m	Speed over 30m (x̄=4.95)
	Modified sit-and reach		Adapted sit and reach (x̄=4.50)
		Illiniose agility	Iliniose agility (x̄=16.97)
			Vertical jump (x̄=42.00)
	Flexed arm hang	Flexed arm hang	Flexed arm hang (x̄=18.09)
	Pull-ups		Pull-ups (x̄=5.50)
Abdominal strength (x̄=4.00)		Abdominal strength	Abdominal strength (x̄=2.50)
T-test agility (x̄=13.38)			T-test agility (x̄=11.52)

The physical and motor components with which a hooker should present include speed, agility (par. 4.61), strength, power (par. 4.60) and speed endurance (par. 4.62). All the hookers tested in this study presented speed and agility as important components for positional selection. All the hookers presented with strength in the arms as an important component, with the exception of the U/13 hookers. In terms of power (vertical jump), only the U/19 hookers presented with this as important.

- ***Locks***

The anthropometric components that are the most important for locks, according to the literature, are stature (par. 4.64), body mass (par. 4.63), breadths and girth (par. 4.67), sum of skinfolds (par. 4.65) and fat percentage (par. 4.66). All the locks in this study presented with stature as an important component, with the exception of the U/18 locks (table 7.3). All the locks also presented with body mass, with the exception of the U/16s. All the locks presented with one or more breadths and girths, with the exception of the U/16 locks, who did not present with girths. Sum of skinfolds seems to be relevant among all locks, with the exception of the U/16 locks.

The rugby-specific components that should be presented by locks include ball-handling skills (par. 4.69). All the locks in this study presented with some form of ball handling skill.

In terms of physical and motor components the locks should have power, strength, speed (par. 4.71) and agility (par. 4.70). The U/18 and U/19 locks in this study presented with power (vertical jump) to be important. Strength in the arms (pull-ups and flexed upper arm hang) were only presented by U/19, while all the locks presented with abdominal strength as important. Speed and agility was presented by all locks in this study, with the exception of the U/13 locks which did not present agility.

Table 7.3: Positional components for locks

U/13	U/16	U/18	U/19
Body mass (x̄=65.67)		Body mass (x̄=82.67)	Body mass (x̄=87.50)
Stature (x̄=176.00)	Stature (x̄= 191.25)		Stature (x̄=189.50)
Sum of skinfolds (x̄=16.74)		Sum of skinfolds (x̄=44.50)	Sum of skinfolds (x̄=50.25)
	Fat percentage (x̄=18.24)	Fat percentage (x̄=14.26)	Fat percentage (x̄=15.5)
		Flexed upper arm girth (x̄=33.00)	Flexed upper arm girth (x̄=36.75)
		Fore arm girth (x̄=28.60)	Fore arm girth (x̄=30.70)
Calf girth (x̄=29.17)		Calf girth (x̄=34.07)	Calf girth (x̄=40.85)
Wrist breadth (x̄=5.80)	Wrist breadth (x̄=6.33)	Wrist breadth (x̄=5.97)	
		Ankle girth (x̄=24.87)	
Humerus breadth (x̄=8.40)		Humerus breadth (x̄=7.77)	
		Femur breadth (x̄=9.80)	Femur breadth (x̄=10.30)
			Side steps (x̄=5.50)
		Ground skills (x̄=4.14)	
	Aerial and ground kicks (x̄=4.50)		Aerial and ground kicks (x̄=5.50)
Passing for distance (x̄=16.17)	Passing for distance (x̄=22.10)		Passing for distance (x̄=22.35)
	Passing for accuracy over 4m (x̄=5.75)		Passing for accuracy 4m (x̄=3.50)
	Passing for accuracy over 7m (x̄=17.25)		Passing for accuracy 7m (x̄=24.50)
Kick-off for distance (x̄=17.61)			Kick-off for distance (x̄=43.00)
Catching while running (x̄=17.33)		Catching while running (x̄=19.33)	Catching while running (x̄=19.00)
	Speed over 10m (x̄=2.03)	Speed over 10m (x̄=1.95)	Speed over 10 m (x̄=2.14)
Speed over 30m (x̄=5.21)		Speed over 30m (x̄=4.42)	Speed over 30m (x̄=4.69)
Abdominal strength (x̄=4.33)	Abdominal strength (x̄=4.00)	Abdominal strength (x̄=5.67)	Abdominal strength (x̄=5.50)
Speed endurance (x̄=4.16)			
T-test agility (x̄=14.56)		T-test (x̄=11.53)	
		Vertical jump (x̄=51.00)	Vertical jump (x̄=54.50)
		Illinois agility (x̄=17.12)	Illinois agility (x̄=16.78)
			Adapted sit and reach (x̄=10.00)
			Pull-ups (x̄=8.00)
			Flexed arm hang (x̄=22.02)

- ***Flankers***

The anthropometric components that are the most important for flankers, according to literature, are stature, body mass (par. 4.74), breadths and girth (par. 4.75, 4.76), sum of skinfolds and fat percentage (par. 4.77). The U/13 and U/16 flankers did not present any anthropometric components (table 7.4). The U/18 and U/19 flanker did however present some anthropometric components for instance fat percentage, fore arm- and ankle girth was presented by both age groups.

The rugby-specific components that should be important for flankers include ball handling (par. 4.78). All the flanker in this study did use some handling skill with the exception of U/13 and U/16 flankers. Although kicking skills were not included as important components for flanker in literature, all the flankers in this study did present some kicking ability, with the exception of the U/16 flanker.

The physical and motor component that are necessary for flankers include speed, agility (par. 4.80) and speed endurance (par. 4.81). All the flankers, with the exception of the U/13 and U/16 flanker, presented with speed as an important component. Agility was however not presented by any flanker in this study. Speed endurance was also just presented by the U/13 flankers.

Table 7.4: Positional components for flankers

U/13	U/16	U/18	U/19
			Body mass (x̄=79)
			Stature (x̄=183.5)
			Sum of skinfolds (x̄=46.75)
		Fat percentage (x̄=14.32)	Fat percentage (x̄=12.37)
		Fore arm girth (x̄=29.00)	Fore arm girth (x̄=30.10)
		Ankle girths (x̄=25.40)	Ankle girth (x̄=31.5)
		Wrist breadth (x̄=5.85)	
			Flexed upper arm girth (x̄=35.25)
			Calf girth (x̄=38.00)
Aerial and ground kicks		Aerial and ground kicks (x̄=6.00)	Aerial and ground kicks (x̄=7.50)
		Passing distance (x̄=19.94)	
		Passing for accuracy over 4m (x̄=4.50)	
			Passing for accuracy 7m (x̄=27.00)
		Kicking for distance (x̄=32.65)	Kicking for distance (x̄=44.50)
		Kick-off for distance (x̄=36.55)	
		Catching while running (x̄=19.00)	
Speed endurance			
		Vertical jump (x̄=49.50)	
		Speed over 10m (x̄=2.02)	Speed over 10m (x̄=1.93)
		Pull-ups (x̄=4.00)	
		Abdominal strength (x̄=5.00)	Abdominal strength (x̄=5.50)

- ***Eight-men***

The anthropometric components that are the most important for eighth men, according to literature, are stature, body mass (par. 4.87, 4.83), breadths and girth (par. 4.85, 4.86), sum of skinfolds (par. 4.87) and fat percentage (par. 4.88). The only component that were presented by all eighth men was fat percentage, with the exception of the U/13 eighth man (table 7.5). Only the U/18 and U/19 eighth men presented with one or more girths, while only the U/18 eighth men presented with breadths.

The rugby-specific components that literature suggest to be important for eighth men include ball handling skills. All the eighth men tested in this study presented with passing for accuracy and/or passing distance and catching while running, with the exception of the U/13 eighth man, with the exception of the U/13 eighth man. The U/16 eighth men presented with ground skills also to be important. They use this skill quite often when picking up the ball at the back of a scrum (par. 4.89). Aerial and ground kicks were also presented by the U/18 and U/19 eighth men. They might use this skill together with the scrum-half to launch attacks around the scrum (par. 4.90).

The physical and motor components that literature suggest to be important for eighth men include speed, agility, strength (par. 4.92) and speed endurance (par. 4.93). The U/18 and U/19 eighth men in this study presented with speed as an important component, while no eighth men presented with agility as a component. In terms of strength in the arms (pull-ups and flexed upper arm hang) only the U/16 and U/18 players presented with this as a relative component.

Table 7.5: Positional components for eight-men

U/13	U/16	U/18	U/19
			Body mass ($\bar{x}$=95.83)
			Stature ($\bar{x}$=189.67)
	Fat percentage	Fat percentage ($\bar{x}$=19.06)	Fat percentage ($\bar{x}$=21.18)
			Sum of skinfolds ($\bar{x}$=80.00)
		Fore arm girth ($\bar{x}$=31.00)	Fore arm girth ($\bar{x}$=32.0)
			Flexed upper arm girth ($\bar{x}$=38.97)
		Ankle girths ($\bar{x}$=24.00)	Ankle girth ($\bar{x}$=25.1)
		Wrist breadth ($\bar{x}$=6.15)	
			Calf girth ($\bar{x}$=42.4)
	Ground skills		
		Passing distance ($\bar{x}$=29.65)	
	Passing for accuracy over 4m	Passing for accuracy over 4m ($\bar{x}$=9.00)	
			Passing for accuracy 7m ($\bar{x}$=22.67)
		Kicking for distance ($\bar{x}$=39.31)	Kicking for distance ($\bar{x}$=55.33)
		Kick-off for distance ($\bar{x}$=44.91)	
		Catching while running ($\bar{x}$=20.00)	
Speed endurance			
		Adapted sit and reach ($\bar{x}$=3.50)	
		Vertical jump ($\bar{x}$=40.00)	
		Speed over 10m ($\bar{x}$=2.19)	Speed over 10m ($\bar{x}$=2.09)
		Pull-ups ($\bar{x}$=7.00)	
		Abdominal strength ($\bar{x}$=2.50)	Abdominal strength ($\bar{x}$=6.33)
	Flexed upper arm hang		

- ***Scrum-halves***

The anthropometric components that literature suggest to be important for scrum-halves include body mass, stature (par. 4.97), breadths, girths (par. 4.98), sum of skinfolds (par. 4.98) and fat percentage (par. 4.99). The scrum-halves in this study presented with body mass as an important component, with the exception of the U/18 scrum-half (table 7.6). The same tendency was observed in terms of stature, with the exception of the U/19 scrum-half. In terms of girths all the players presented with some girths, with the exception of the U/18 scrum-half. In terms of breadths, all scrum-halves presented with some breadth, with the exception of the U/16 scrum-halves. Only the U/16 scrum-halves presented with fat percentage and sum of skinfolds as relevant components.

In terms of rugby-specific skill components, scrum-halves should present with the following components: good handling abilities, and kicking abilities. The U/13 and U/19 scrum-halves in this study presented with handling skills in terms of passing for accuracy. Kicking abilities only presented in the case of the U/16 scrum-halves, as well as ground skills, which are used in picking up the ball at the end of a scrum (par. 4.102).

The physical and motor components of scrum-halves, according to the literature, should be speed, agility, speed endurance and strength (par. 4.104). The only scrum-halves in this study who presented with speed as an important component were the U/13 and U/19 players. In terms of agility only the U/18 and U/19 players presented with agility as an important component. The U/16s and U/18s also presented with speed endurance as an important component. In terms of strength in the arms (pull-ups and flexed arm hang) all presented with this as an important component.

Table 7.6: Positional components for scrum-halves

U/13	U/16	U/18	U/19
Body mass (x̄=44.50)	Body mass		Body mass
Stature(x̄=154.50)	Stature	Stature	
	Fat percentage		
	Sum of skinfolds		
Wrist breadth (x̄=5.20)		Wrist breadth	
	Flexed upper arm girth		Flexed upper arm girth
Fore arm girth (x̄=22.30)			Fore arm girth
Calf girth (x̄=30.45)			Calf girth
Humerus breadth (x̄=6.20)			
			Femur breadth
	Aerial and ground kicks		
			Ground skills
Passing for accuracy (4m) (x̄=6.5)			
			Passing for accuracy 7m
Adapted sit and reach (x̄=.50)			
Speed over 10m (x̄=2.36)			Speed over 10m
Speed over 30m (x̄=5.37)			
Flexed arm hang (x̄=27.79)	Flexed arm hang		Flexed arm hang
	Pull ups		
		Illinois agility	
		T-test for agility	T-test agility
	Speed endurance	Speed endurance	

- ***Fly-halves***

The anthropometric components that literature suggest to be important for fly-halves include body mass, stature (par. 4.106), breadths, girths (par. 4.107, 4.108), sum of skinfolds and fat percentage (par. 4.109). Only the U/13 fly-halves of this study presented with body mass and stature as important components (table 7.7). In terms of girths and breadth all presented important components except for the U/16s, and the U/19s presented with only breadth as important component. None of the fly-halves in this study presented with fat percentage and sum of skinfolds .

Important rugby-specific skill components for fly-halves include kicking skills, handling skills and running skills. The fly-halves in this study all presented with handling skills (passing for distance and passing for accuracy), with the exception of the U/19 fly-halves, who did not present with any kicking skill. Only the U/13 and U/18 fly-halves presented with running skill (side-step). However The U/16 and U/18 fly-halves presented with ground skills. Literature does not mention this as an important component, but fly-halves often receive a poor ball from scrum-halves and do need this skill.

The physical and motor components are more or less the same as for scrum-halves and include speed, agility (par. 4.112) and strength (4.113). The U/13 and U/16 fly-halves were the only ones to present with speed as an important component in this study. The U/18 and U/19 fly-halves presented with speed endurance as important. However, none of the fly-halves presented with agility (Illinois and T-test for agility) . Strength in the arms (flexed arm hang and pull-ups) was present in all except for the U/19 fly-halves. However, flexibility, which was not an important component, was present in U/16 and U/18 fly-halves.

Table 7.7: Positional components for fly-halves

U/13	U/16	U/18	U/19
Body mass (x̄=51.50)			
Stature (x̄=166.50)			
Fore arm girth (x̄=24.45)		Fore arm girth	
		Flexed upper arm girth	
Calf girth (x̄=32.40)			
Wrist breadth (x̄=5.25)			
		Ankle girth	
		Humerus breadth	Humerus breadth
		Femur breadth	
	Ground skills	Ground skills	
	Passing for distance		
		Air and ground skills	
Side step (x̄=6.50)		Side step	
Kicking for distance (x̄=45.53)	Kicking for distance		
Passing for accuracy (4m) (x̄=4.50)		Passing for accuracy for 4m	Passing for accuracy 4m
Passing for accuracy over 7m (x̄=27.50)			
	Kick-off for distance		
		Vertical jump	
Adapted sit and reach (x̄=4.35)	Adapted sit and reach		
Speed over 10m (x̄=2.06)	Speed over 10m		
Speed over 30m (x̄=4.63)	Speed over 30m		
Flexed arm hang (x̄=21.56)	Flexed upper arm hang	Flexed upper arm hang	
	Pull-ups		
	Abdominal strength	Abdominal strength	
		Speed endurance	Speed endurance

- ***Centers***

The anthropometric components that literature suggests to be important for centres include body mass, stature (par. 4.116), breadths, girths (par. 4.117, 4.118), sum of skinfolds and fat percentage (par. 4.119). The centres in this study presented with body mass and stature as an important component, with the exception of the U/13 and U/19 players (table 7.8). In terms of girths all the centres in this study presented with some, with the exception of U/19 players. The breadths were presented in all age groups. The sum of skinfolds was presented by all as an important component, with the exception of the U/13 centres. However, fat percentage was only present in the case of U/18 centres.

In terms of rugby-specific skill components the centre should possess good handling abilities, running skills and kicking skills (par. 4.121). All the centres tested presented with good handling skills, with the exception of the U/18 centres. Running skills were only presented by U/13, U/16 and U/18 centres, while kicking skills were presented by all, with the exception of U/19 centres.

The physical and motor components that centres should present are speed, agility, power, strength and speed endurance (par. 4.123). The centres in this study presented with speed as an important component. Only the U/13, U/16 and U/19 centres presented with agility as a component. Power (vertical jump) was only present in the U/18 and U/19 centres. Strength (pull-ups and flexed arm hang) was present in all, with the exception of U/19 centres. The U/18 centres were the only to present with speed endurance as a relevant component.

Table 7.8: Positional components for centers

U/13	U/16	U/18	U/19
Body mass (x̄=63.50)	Body mass (x̄=80.50)	Body mass (x̄=81.00)	
	Stature (x̄=186.00)	Stature (x̄=184.50)	
		Sum of skinfolds (x̄=55.25)	Sum of skinfolds (x̄=58.00)
Flexed upper arm girth (x̄=30.50)	Flexed upper arm girth (x̄=33.65)	Flexed upper arm girth (x̄=36.25)	
Fore-arm girth (x̄=26.80)			
Ankle girth (x̄=24.25)	Ankle girth (x̄=23.15)		
Calf girth (x̄=35.90)	Calf girth (x̄=37.25)		
Wrist breadth (x̄=5.80)	Wrist breadth (x̄=6.20)	Wrist breadth (x̄=5.95)	Wrist breadth (x̄=6.75)
		Humerus breadth (x̄=7.40)	
	Femur breadth (x̄=11.20)		
Ground skills (x̄=3.90)	Ground skills (x̄=3.65)		
		Aerial and ground kicks (x̄=6.00)	Aerial and ground kicks (x̄=8.00)
Side steps (x̄=5.00)	Side steps (x̄=7.00)	Side steps (x̄=5.00)	
Passing for distance (x̄=20.75)	Passing for distance (x̄=24.10)		Passing for distance (x̄=27.50)
Passing for accuracy over 4m (x̄=4.50)	Passing for accuracy 4m (x̄=3.50)		Passing for accuracy 4m (x̄=7.50)
Kicking for distance (x̄=41.66)		Kicking for distance (x̄=38.25)	
Kick-off for distance (x̄=38.55)	Kick-off for distance (x̄=25.00)		
Catching while running (x̄=19.00)	Catching while running (x̄=20.00)		
Adapted sit and reach (x̄=2.50)	Adapted sit and reach (x̄=0.00)		Adapted sit and reach (x̄=11.00)
		Vertical jump (x̄=61.00)	Vertical jump (x̄=52.00)
Illinois agility (x̄=23.52)	Illinois agility (x̄=17.47)		Illinois agility (x̄=16.02)
Speed over 10 m (x̄=2.03)		Speed over 10m (x̄=1.83)	
		Sit and reach (x̄=10.50)	
	Speed over 30m (x̄=4.26)		Speed over 30m (x̄=4.26)
		Abdominal strength (x̄=5.00)	Abdominal strength (x̄=4.50)
		Speed endurance (x̄=8.48)	
Flexed upper arm hang (x̄=28.90)			
T-Test agility (x̄=16.27)			
	Pull-ups (x̄=9.50)	Pull-ups (x̄=8.00)	
		Flexed arm hang (x̄=34.37)	

- ***Wings***

The anthropometric components that literature suggests as important for wings include body mass, stature (par. 4.125), breadths, girths (par. 4.126, 4.127), sum of skinfolds and fat percentage (par. 4.128). Body mass was present as an important component in all centres in this study, with the exception of the U/19 wings. Only the U/16 and U/18 wings presented with stature as important (table 7.9) The sum of skinfolds was only present in the U/18 and U/18 wings as important. No wing presented with fat percentage as important.

Rugby-specific skill components that are important for wings are handling skills, running skills and kicking skills (par. 4.130). The wings in this study all presented with handling skills (passing for accuracy, catching while running and passing for distance) and kicking skills (kicking for distance, kick-off for distance and air and ground skills), with the exception of the U/18 wings which did not present any handling skill. Running skills (side-step) were presented by all wings, with the exception of the U/19 wings.

In terms of physical and motor components the wing should possess speed, speed endurance, agility and strength (par. 4.131, 4.132). The wings tested in this study all presented with speed, strength and agility as important components, with the exception of the U/19 wings, who did not present with agility nor strength in the arms. Only the U/18 wings presented with speed endurance as an important component. Power was only present in the U/18 and U/19 wings as an important component.

Table 7.9 Positional components for wings

U/13	U/16	U/18	U/19
Body mass (x̄=53.33)	Body mass (x̄=67.00)	Body mass (x̄=67.00)	
Flexed upper arm girth (x̄=26.47)	Stature (x̄=175.5)	Stature (x̄=175.00)	
		Sum of skinfolds (x̄=47.80)	Sum of skinfolds (x̄=41.15)
Fore-arm girth (x̄=24.00)			
	Flexed upper arm girth (x̄=29.9)	Flexed upper arm girth (x̄=32.00)	
Ankle girth (x̄=21.43)	Ankle girth (x̄=27.23)		
Calf girth (x̄=32.30)	Calf girth (x̄=32.35)		
	Fore arm girth (x̄=26.38)		
		Humerus breadth (x̄=6.90)	
	Femur breadth (x̄=8.08)		
Wrist breadth (x̄=5.47)	Wrist breadth (x̄=5.50)	Wrist breadth (x̄=5.50)	Aerial and ground kicks (x̄=6.00)
Ground skills (x̄=4.76)			
Side steps (x̄=3.33)	Side steps (x̄=5.25)	Side steps (x̄=7.00)	
		Aerial and ground kicks (x̄=4.00)	
Kicking for distance (x̄=27.32)		Kicking for distance (x̄=41.40)	
Passing for distance (x̄=13.86)	Passing for distance (x̄=16.54)		Passing for distance (x̄=25.35)
Passing for accuracy over 4m (x̄=3.67)			Passing for accuracy 4m (x̄=6.00)
Kick-off for distance (x̄=38.55)	Kick-off for distance (x̄=35.85)		
Catching while running (x̄=16.00)	Catching while running (x̄=19.00)		
	Passing for accuracy 7m (x̄=22.50)		
Adapted sit and reach (x̄=7.67)		Sit and reach (x̄=30.00)	Adapted sit and reach (x̄=1.50)
Speed over 10 m (x̄=2.27)			
Flexed arm hang (x̄=12.16)			
Illinois agility (x̄=18.73)	Illinois agility (x̄=17.33)		Illinois agility (x̄=15.12)
T-Test agility (x̄=12.82)			
	Speed over 30m (x̄=4.67)		Speed over 30m (x̄=3.96)
		Vertical jump (x̄=48.00)	Vertical jump (x̄=66.50)
		Speed endurance (x̄=3.92)	
		Speed over 10m (x̄=2.03)	
		Abdominal strength (x̄=3.00)	Abdominal strength (x̄=6.50)
	Pull-ups (x̄=6.50)		

- ***Full-backs***

The anthropometric components that literature suggest to be important for full-backs include body mass, stature (par. 4.133), breadths, girths (par. 4134, 4.135), sum of skinfolds (par. 4.136) and fat percentage (par. 4.137). No full-back tested in this study presented with body-mass as an important component and only the U/16 presented with stature as important (table 7.10). Breadths and girth were present as important components in all full-backs, with the exception of U/13.

The rugby-specific components that every full-back should possess include handling abilities, kicking abilities (par. 4.138) and running abilities (par. 4. 139). The full-backs in this study presented with all handling and kicking abilities. Running abilities were only present in the U/18 and U/19 full-backs.

In terms of physical and motor abilities the full-back must present with speed, agility, strength (par. 4.140) and speed endurance (par. 4.141). Speed and agility were present in all the full-backs tested except for the U/19 full-back. Strength was also presented in the case of all full-backs except for U/16s. Speed endurance was only presented by the U/18 full-back.

Table 7.10: Positional components for full-backs

U/13	U/16	U/18	U/19
	Stature ($\bar{x}$=177)		
Fat percentage			
	Flexed upper arm girth ($\bar{x}$=33.35)		
	Fore arm girth ($\bar{x}$=29.05)		Fore arm girth
	Calf girth ($\bar{x}$=38.85)		Calf girth
		Humerus breadth	Humerus breadth
	Femur breadth ($\bar{x}$=9.65)		Femur breadth
	Wrist breadth ($\bar{x}$=5.95)	Wrist breadth	
	Ankle girth ($\bar{x}$=24.00)		
Side step	Side steps ($\bar{x}$=7.00)	Side steps	Side step
	Passing for distance ($\bar{x}$=26.55)		Passing distance
	Ground skills ($\bar{x}$=3.40)	Ground skills	
Aerial and ground kicks		Aerial and ground kicks	
		Kicking for distance	Kicking for distance
Kick-off for distance	Kick-off for distance ($\bar{x}$=41.75)	Kick-off for distance	Kick-off for distance
Passing for accuracy over 4m	Passing for accuracy 4m ($\bar{x}$=6.00)		
	Passing for accuracy 7m ($\bar{x}$=28.00)	Passing accuracy for 7m	
Adapted sit and reach	Adapted sit and reach ($\bar{x}$=6.50)		
Speed over 10 m		Speed over 10m	
	Speed over 30m ($\bar{x}$=4.26)		
Flexed arm hang		Flexed arm hang	Flexed arm hang
		Vertical jump	
T-Test agility		T-test for agility	
	Illinois agility ($\bar{x}$=16.22)	Illinois agility	

Conclusion

In conclusion it seems that some of the players presented with more or less the same components that literature mentions. However, there are many components that literature did not mention and components also differ between age groups. Thus, it seems essential for positional selection to take place, that it be done in specific age groups.

7.5Conclusion of the study

In conclusion the aim of this study was to establish positional requirements for U/13-. U/16, U/18 and U/19 rugby players. This aim was achieved.

7.6Recommendations

From this study the following recommendations are made:

7.6.1 The changes that were observed in terms of anthropometric, rugby-specific skill-, physical and motor components might also provide coaches with norms for the different components at different ages. The coach and teacher might also use these norms to evaluate players' progression in specific positions during adolescents.

7.6.2 The results from this study contribute to talent identification per position at different ages. No study of this nature among adolescents could be found. This might help adolescents master the fundamental and complex motor tasks involved in a specific position. This study, together with previous studies about talent identification and development, might also assist coaches, teachers and sports scientists in identifying potential talent and developing this young talent to its maximum. Less time will be wasted on learning non-specific skills and better quality players will be developed for future participation in rugby. Teachers and coaches might also use this study in assisting positional selection for different ages.

7.6.3 It is recommended that for future studies of this nature, more elite players of different ages and positions should be tested. This might have an influence on the number of components included in test batteries for positional selection, as well as on the norms. It should just be kept in mind that to establish these kinds of differences in respect of the different components only elite players should be used.

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APPENDIX A

DATA SHEET

NAME:
BIRTH DATE:
TELEPHONE NO:
DOMINANT HAND:
DOMINANT FOOT:

ANTHROPOMETRIC DATA

Body weight (kg)	
Stature (cm)	
Tricep skinfold	
Midaxillav skinfold	
Supraspinal skinfold	
Subscapilar skinfold	
Pectoral skinfold	
Abdominal skinfold	
Thigh skinfold	
Calf skinfold	
Flexed upper arm girth	
Fore arm girth	
Ankle girth	
Calf girth	
Hemerus breadth	
Femur breadth	
Gewrigs breadth	

RUGBY SPECIFIC TEST

ground skill (sec)	
Side steps (n)	
Air and ground kicks (n)	
Passing for distance (m)	
Passing for accuracy over 4m (n)	
Passing for accuracy over 7m (n)	
Kicking for distance	
Kick-off for distance (m)	
Catching while running (n)	

PHYSICAL- AND MOTOR TEST	attempt1			attempt 2		
Sit and reach test (cm)			.			.
Vertical jump - Reach height ( )			.			.
Speed endurance (sec)						
1			.			
2			.			
3			.			
4			.			
5			.			
6			.			
Illinois agility test (sec)			.			.
T-Test for agility (sec)			.			.
Speed 10m (sec)			.			.
30m (sec)			.			.
Pull-ups (n)						
7-stage abdominal strength test (n)						
Flexed arm hang (sec)			.			