CHAPTER EIGHT

RESULTS AND DISCUSSION

8.1 INTRODUCTION

The second main aim is to provide an alternative sport and position-specific testing protocol as well as comparative results consisting of norms and scores that will adequately identify and select those capable of participating in elite age-group rugby union. As shown in chapter seven, the protocol used in this study underwent some evolution to arrive at its final form. As would be expected when holding to a main aim of the type noted in the opening sentence of this chapter, a certain amount of experimentation is inevitable, and as a consequence the results obtained from experimentations such as the ones contained in this study cannot always be guaranteed.

More recent rugby related studies focused on the age groups closest represented by this study are those of Spamer and Winsley (2003b) on elite 18-year old South African and English rugby players, the studies of Van Gent (2003) and Van Gent and Spamer (2005) on the positional determinants of adolescent rugby players of various age-groups, Plotz and Spamer (2006) on talented 18-year old South African and English youth rugby players, and Spamer and De la Port (2006) who focused on U/16 and U/18 elite rugby players. In Van Gent (2003) and Van Gent and Spamer (2005) there was an U/19 sample group, but since only 5.2% and 27.3% of the sample in this study were 18 and 19 years of age respectively, comparisons with these studies are impossible.

It must be noted that the sample for this study was selected with a very specific purpose in mind. The overwhelming majority of the players in this sample are elite age-group players with 94.8% of the sample between the ages of eighteen and twenty one. Five point two percent of the sample range between 22 and 25 years old. Therefore, the results and norms determined in this study can be regarded as

the best of the best and this protocol (with these associated norms) can therefore quite readily be used for the identification of the players who have the ability to play at “elite” age-group levels. This protocol and norms can even be used for selection purposes, with a specific aim at elite age-group rugby or as minimum requirements for senior elite teams.

With reference to the test protocol: with the anthropometrical, physical-motor and vision testing sections of this study, the results can be regarded as satisfactory with the intended aim achieved, i.e.: to establish norms of comparison for talent identification and selection purposes. On the sport-specific skills testing side, the results are satisfactory but need further elaboration. Since the overall sample sizes for the tests that were retained as well as discarded are small, this caution is justified. What these skills tests do serve to do, however, is to add to the already existing sport specific skills tests and further have potential for future utilisation and study. This will be discussed during the course of this chapter.

8.1.1 Statistical data analysis procedures:

The statistical data analysis procedures in this study were described in chapter seven and will not be discussed again.

8.1.2 Chapter outline

This chapter has been structured to include the statistical analyses in the following way:

Section one: description of the sample by means of frequencies

In this section the frequencies of the teams in the sample, the grouped positions, the general trends in age and the injury indications are provided.

Section two: description of the variables that did not remain the same across measurements

In this section, a description of those variables that were changed or discarded is included. Since the dicussion surrounding the reasons for dropping these variables has been conducted in chapter seven, only brief outlines and discussions of these variables are conducted in this section.

Section three: results of non-parametric one-way analysis of variance to determine differences in measurements between different positions
In this section, the results of the non-parametric one-way analysis of variance between the different positions are provided and discussed.

Section four: norm tables of variables that were comparable over all measurements
In this section, the simulated norm tables for this protocol are provided and discussed. This also incorporates the discussion surrounding the interpretation of the values pertaining to the S-Test.

Section five: summary of findings

8.2 DESCRIPTION OF THE SAMPLE BY MEANS OF FREQUENCIES

8.2.1 Data sampling

A sample can be defined as a subset of the population. A sampling plan can be described as a design, scheme of action or procedure that specifies how the participants are to be selected in a survey study (Rosnow & Rosenthal, 1996). The sample was drawn from rugby players of the following teams: the Blue Bulls Vodacom Cup squad consisting mainly of members of the Blue Bulls U/21 squad and some other players, the SA U/21 squad and the Tuks Rugby Academy squad.

A reminder of the note in chapter one regarding the Blue Bulls sample: the Blue Bulls Rugby Union aim to provide their age-group (U/21) players with the opportunity to play at Vodacom Cup level, and it is for this reason that almost the whole Vodacom Cup squad consisted of those who were part of the Blue Bulls U/21 Currie

Cup squad that participated in the U/21 Currie Cup competition in 2005. It is for this reason that the Blue Bull sample group is referred to as the Blue Bulls U/21 group, with the other, older players included in this sample group as well.

Before the data was analysed, data exploration was undertaken by looking at the frequency distribution and the shape of the distribution, means and standard deviations. This was done in order to identify outliers. Tabachnick and Fidell (1996) describe outliers as cases with such extreme values on one variable or a combination of variables that they distort the statistics.

Since these cases are not typical of the population and influence the distribution of data they were removed prior to the analysis. Two outliers were identified and removed. These were: 1) a case with a height of 164.5 cm and a weight of 70kg, and; 2) a case with a height of 186cm, a weight of 120,2kg and a 10m dash score of 2,9 seconds. The inclusion of these cases influenced the distribution of the variables affected in a negative way and was thus removed before further analysis commenced.

The results of this analysis are presented in tables 8.1 to 8.4.

Table 8.1: Teams included in the study

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Blue Bulls U/21	26	33.3	33.3	33.3
	S.A. U/21	29	37.2	37.2	70.5
	Tuks Rugby Academy	23	29.5	29.5	100.0
	Total	78	100.0	100.0	

After the exclusion of the two outliers 78 cases remained for analysis. Each team measured represented approximately a third of the sample with the Blue Bulls U/21

making up 33% of the sample, the SA U/21 making up 37.2% of the sample and the Tuks Rugby Academy making up 29.5% of the sample (see table 8.1).

Table 8.2: Grouped positions

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Tight-Forwards	21	26.9	26.9	26.9
	Loose-Forwards	27	34.6	34.6	61.5
	Backs	30	38.5	38.5	100.0
	Total	78	100.0	100.0	

As indicated earlier all the positions were grouped into three categories. Once again each category represented approximately a third of the sample with the tight-forwards making up 26.9%, the loose-forwards making up 34.6% of the sample and the backs making up 38.5% of the sample.

Table 8.3: Age

	Frequency	Percent	Valid Percent	Cumulative Percent	
Valid	18.00	4	5.2	5.2	5.2
	19.00	21	27.3	27.3	32.5
	20.00	35	45.5	45.5	77.9
	21.00	13	16.9	16.9	94.8
	22.00	1	1.3	1.3	96.1
	25.00	3	3.9	3.9	100.0
	Total	77	100.0	100.0	

The ages of players ranged between 18 and 25 years-old with almost half (45.5%) of the sample being 20 years of age. 27.3% of the sample were 19 years of age followed by 16.9% of the sample that were 21 years of age. Therefore, as stated earlier, the results from this study can most effectively be utilised for U/21 age-group

rugby. And, considering that as of 2008 age-group rugby is moving toward the U/20 format, the results of this study can still be utilised since this study has a cumulative 77.9% of the respondents being 20 years of age and younger.

Due to the elite nature of the subjects in this study, injuries during testing were of prime concern. The concerns of the coaches, medical staff and management were borne out in this regard and enquiries into injury status were conducted. The results of this enquiry can be found in table 8.4. Depending on the type and nature of the injuries concerned, the subjects were carefully managed during testing with the overall bias being conservative in this regard.

As an example, a subject with a thumb injury would still do physical-motor tests but would not do passing tests. A subject with a knee injury would not perform the 10/40m dash or other tests requiring the use of the lower extremities, but this subject would still participate in anthropometrical testing.

The results in table 8.4 indicate that more than half (65.4%) of the players indicated that they did not have any injuries. The most common injuries encountered during testing were those of the knee (9%), the hamstring (6.4%) and the ankle (5.1%). The incidence of other injuries was much lower and these can also be found in table 8.4 hereafter.

Table 8.4: Injuries indicated by players

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	None	51	65.4	65.4	65.4
	Hamstring	5	6.4	6.4	71.8
	Ankle	4	5.1	5.1	76.9
	Bicep	1	1.3	1.3	78.2
	Lower Back	1	1.3	1.3	79.5
	Groin	1	1.3	1.3	80.8
	Knee	7	9.0	9.0	89.7
	Shoulder	2	2.6	2.6	92.3
	Shoulder and Ankle	2	2.6	2.6	94.9
	Ribs	1	1.3	1.3	96.2
	Thumb	1	1.3	1.3	97.4
	Shoulder bone	1	1.3	1.3	98.7
	Foot	1	1.3	1.3	100.0
	Total	78	100.0	100.0	

8.3 DESCRIPTIVE STATISTICS OF VARIABLES THAT DID NOT REMAIN THE SAME ACROSS MEASUREMENTS OR VARIABLES WITH SMALL BASE SIZES

Due to the evolutionary nature of this test protocol, there were a number of tests that were changed or discarded between protocols. The following tables indicate these tests and the scores that were attained for these tests. These scores have not been used in the determination of the norms of comparison for this study.

8.3.1 Protocol 1/Test 1: Blue Bulls U/21

The results indicated in Table 8.5 show that not all the subjects were measured on all the variables. Some of the measurements were demarcated for position specific testing, as they were for all three testing sessions and protocols.

The “Hooker throw in at 6m, 8m and 10m” was not completed by any of the players and therefore no descriptive statistics are available for this measurement. It is as a result of the inconsistencies in testing this variable over the three testing opportunities and protocols as well as the lack of adequately simulating as closely as possible the real-life game environment that this test has been removed from the final testing protocol for this study.

Furthermore, only 2 subjects completed the scrumhalf tyre pass test and the results should be interpreted with caution. In subsequent testing this test was once again found to be inadequate in simulating the real-life game environment. As a result of this fact, as well as the very small sample sizes, this test was discarded from the final testing protocol for this study.

The same caution applies to the backs (all) kick for accuracy (quadrant) test as there were only 8 and 7 players left and right respectively that attempted this test with only one accurate attempt per foot encountered.

Table 8.5: Descriptive statistics for protocol one/test one-variables changed and with small base sizes (Blue Bulls U/21)

Test	n	Minimum	Maximum	Mean	Std. Deviation
S-Test total	21	29.00	30.00	29.86	0.36
Kick for distance (best attempt left) (m)	19	29.00	66.00	45.32	9.32
Kick for distance (best attempt right) (m)	19	35.00	65.00	49.05	9.70
Hooker throw in 6m (best attempt)	0				
Hooker throw in 8m (best attempt)	0				
Hooker throw in 10m (best attempt)	0				
Backs all kick for accuracy (quadrant) (highest score left)	8	3.00	3.00	3.00	0.00
Backs all kick for accuracy (quadrant) (highest score right)	7	3.00	3.00	3.00	0.00
Scrumhalf tyre pass (highest score left)	2	3.00	3.00	3.00	0.00
Scrumhalf tyre pass (highest score right)	2	3.00	3.00	3.00	0.00
Valid n (listwise)	0				

The mean and standard deviations must thus be interpreted with caution since it is based on such small number of players. Due to the inherent difficulty in accurately performing this test, it was removed from the testing protocol for protocol 2 and thereafter, but, this test does serve as a challenging training exercise.

The S-Test was completed by 21 of the 26 players. A minimum score of 29 and a maximum score of 30 were obtained by these players with a mean score of 29.86. The standard deviation is very low at 0.36, indicating that there was very little variation in the scores obtained by these players. During the first measurement each player was granted 5 attempts to each side with a maximum score of 3 per successful attempt. These scores were added to get a total out of 30. The results thus indicate that most players achieved an almost perfect score for each leg. This high level of success can be attributed to the "live" targets that were used for protocol one and the fact that they compensated for bad passes by making an effort to retrieve these wayward passes. Changes were brought about for protocol 2 as described in chapter seven.

The scores from the altered S-Test as attained in protocols and tests 2 and 3 have been used to determine some form of discrimination in the performance of players during the norm phase of this statistical analysis. This will be presented near the end of this chapter.

Finally, note the highlighted scores for the kick for distance test that can be used for future reference purposes. The best attempts with the left foot ranged between 29 and 66 metres with a mean of 45.32 metres. The standard deviation is 9.32 metres. The best attempts with the right foot ranged between 35 and 65 metres with a mean of 49.05 metres. The standard deviation is 9.70. These scores can be used for future reference purposes. An important note in this regard is that Pienaar and Spamer (1995) in Pienaar and Spamer (1998) originally designed this test to be performed with the dominant foot as opposed to both feet that were used in protocols one and two of this study.

8.3.2 Protocol 2/Test 2: South Africa U/21

The results indicated in table 8.6 show that once again the base sizes were very small for the Scrumhalf tyre pass and the Hooker throw in tests, so as a consequence the results should be interpreted with caution. The base sizes ranged between 2 and 3 players who completed this test.

Almost all the players completed the kick for distance test. Their best attempts on the left side ranged between 0 and 52.30 metres with a mean of 23.76 metres. The standard deviation is fairly high at 15.01 indicating that the best efforts differed considerably within this team. The best attempts on the right hand side were considerably higher ranging between 16.30 metres and 55.60 metres with a mean of 31.34 metres. The standard deviation was still fairly high at 12.36 metres indicating that best efforts on the right hand side also differed significantly. These high standard deviations could be as a result of the dominant foot preference of the kickers required to kick with their non-dominant foot.

The mean scores of this group for the kick for distance test differ significantly from those attained in the Blue Bulls U/21 group. No explanation for this phenomenon is forthcoming and it is suggested that if this test and scores are used for future reference, that the Blue Bulls U/21 scores be the preferred option.

The Accuvision1000 (120 lights) test had a base size of eleven subjects with the maximum efforts ranging between 48 accurate lights and 84 accurate lights. The mean for this test was 73.18 accurate lights in the allocated time. This test was discarded due to the time factor associated with this test in a field-testing scenario, but this should not detract from the fact that this test can be used for future purposes in a laboratory setting.

Table 8.6: Descriptive statistics for protocol two/test two-variables changed and with small base sizes (South Africa U/21)

Test	n	Minimum	Maximum	Mean	Std. Deviation
Kick for distance (best attempt left) (m)	29	.00	52.30	23.76	15.01
Kick for distance (best attempt right) (m)	29	16.30	55.60	31.34	12.36
Scrumhalf tyre pass (highest score left)	2	.00	5.00	2.50	3.54
Scrumhalf tyre pass (lowest seconds left)	2	3.410	3.560	3.485	0.106
Scrumhalf tyre pass (highest score right)	2	.00	5.00	2.50	3.54
Scrumhalf tyre pass (lowest seconds right)	2	3.340	3.650	3.495	0.219
Hooker throw in 6m (best attempt)	3	0.00	5.00	3.33	2.88
Hooker throw in 8m (best attempt)	3	5.00	5.00	5.00	0.00
Hooker throw in 10m (best attempt)	3	5.00	5.00	5.00	0.00
Accuvision1000 test (120 lights) (accurate lights)	11	48.00	84.00	73.18	11.27
Valid N (listwise)	0				

8.3.3 Protocol 3/Test 3: TUKS Rugby Academy

Once again a very small number of individuals completed the Scrumhalf tyre pass and the Hooker throw in tests (see table 8.7). The base size for both tests consisted of 2 subjects each and these results should be interpreted with caution. These tests have been discarded for the final testing protocol for this study.

Ten and seventeen out of the 23 subjects in this squad completed the kick for distance and accuracy test on the left and right hand side respectively. The best attempts on the left side ranged between 20 and 50 metres with a mean of 32.65 metres. The standard deviation is fairly high at 8.00 indicating that the best efforts differed considerably within this team. Best attempts on the right hand side were considerably higher ranging between 25.10 metres and 47.50 metres with a mean of 39.76 metres. The standard deviation was fairly high at 6.24 metres indicating that best efforts on the right hand side also differed to a fairly high extent. Once again, a dominant foot preference most probably played a role in this regard.

No norms could be determined for these variables, including the kick for distance and accuracy test that was retained in the final test protocol, since they either had base sizes that were too small or the manner in which they were measured changed over time. The means, minimum and maximum scores can be used to a limited extent to get some indication of performance, but only on those variables were the base size was larger, as indicated in table 8.7.

The scores of the kick for distance and accuracy test have been highlighted for future reference and comparison. These were lower than the scores obtained on the kick for distance test and it is proposed that the added stress of the accuracy component could have led to more care being taken in scoring valid kicks.

Table 8.7: Descriptive statistics for protocol three/test three-variables changed and with small base sizes (TUKS Rugby Academy)

Test	n	Minimum	Maximum	Mean	Std. Deviation
Kick for distance and accuracy (best attempt left) (m)	10	20.00	50.00	32.65	8.00
Kick for distance and accuracy (best attempt right) (m)	17	25.10	47.50	39.76	6.24
Scrumhalf tyre pass (highest score left)	2	.00	5.00	2.50	3.54
Scrumhalf tyre pass (lowest seconds left)	2	3.86	3.92	3.890	0.042
Scrumhalf Tyre Pass (highest score right)	2	0.00	5.00	2.50	3.53
Scrumhalf Tyre Pass (lowest seconds right)	2	3.82	4.57	4.195	0.530
Hooker throw in 6m (best attempt)	2	5.00	5.00	5.00	0.00
Hooker throw in 8m (best attempt)	2	5.00	5.00	5.00	0.00
Hooker throw in 10m (best attempt)	2	5.00	5.00	5.00	0.00

8.4 NON-PARAMETRIC ONE-WAY ANALYSIS OF VARIANCE AMONGST DIFFERENT GROUPED POSITIONS

In order to establish whether different norms can be determined for the different grouped positions on the measurements with sufficient base sizes and that stayed consistent in measurement over all three tests, the Kruskall-Wallis One-Way analysis of variance test was performed to determine whether statistically significant differences existed between these various grouped positions.

Only variables that were on ratio scale level were included in this analysis. The S-Test was recoded to include the points achieved combined with the time taken to complete the test and to determine a total final value. This value was however on a nominal level and only categorized the achievable points for this test into 4 different categories. Therefore, the Kruskall-Wallis test could not be performed on this variable.

The variables that are included in this analysis are the following:

1. Anthropometrical components:

This includes height, body mass, biceps skinfold, triceps skinfold, suprailiac skinfold, subscapular skinfold, total of skin folds in millimetres and the body fat % versus skin fold thickness.

2. Physical-motor components:

This includes the vertical jump (all attempts), the 10/40 meter dash tests (all attempts), the T-Tests (all attempts) and 3x5x22m Anaerobic Capacity Test (all three measurements).

3. Sport vision testing:

This consists of the Accuvision 30 lights test.

The results of the Kruskall-Wallis tests and descriptive statistics per group per variable are presented in tables 8.8 to 8.15. The results of these analyses are also presented in graphic form in figures 8.1 to 8.5. The results of all analyses are presented in Appendix D of this study. The figures only contain the results of best attempts on all measurements that were applicable.

Table 8.8: Results of Kruskall-Wallis Test on anthropometrical components

	Height (cm)	Body Mass (kg)	Biceps SF (mm)	Triceps SF (mm)	Suprailiac SF (mm)	Subscapular SF (mm)	Skin Total	Body Fat % vs. Skinfold Thickness
Chi-Square	12.486	28.335	4.789	3.139	5.287	9.615	6.680	6.879
Df	2	2	2	2	2	2	2	2
Asymp. Sig.	**.002**	**.000**	**.091**	.208	**.071**	**.008**	**.035**	**.032**

SF=Skinfold

Table 8.9: Descriptive statistics per group on anthropometrical components

Grouped Positions		n	Minimum	Maximum	Mean	Std. Deviation
Tight-Forwards	Age	21	18.00	21.00	19.71	0.78
	Height (cm)	21	171.50	202.00	184.96	8.29
	Body Mass (kg)	21	83.00	116.00	103.42	9.90
	Biceps SF (mm)	21	3.40	9.20	6.12	1.72
	Triceps SF(mm)	21	7.20	25.00	14.18	6.00
	Suprailiac SF (mm)	21	5.80	52.40	21.90	13.54
	Subscapular SF(mm)	21	7.60	27.20	16.20	6.14
	Skin total	21	27.20	104.00	58.40	24.83
	Body Fat % vs. skin fold thickness	21	11.91	25.00	19.44	4.63
	Valid n (listwise)	21				
Loose-forwards	Age	27	18.00	21.00	20.07	0.73
	Height (cm)	27	170.00	194.00	182.55	6.14
	Body Mass (kg)	27	71.00	106.50	92.88	8.12
	Biceps SF (mm)	27	3.10	9.20	5.19	1.61
	Triceps SF (mm)	27	5.00	19.20	10.88	3.25
	Suprailiac SF (mm)	27	6.70	44.80	13.93	7.09
	Subscapular SF(mm)	26	7.00	18.40	11.42	2.70
	Skin total	26	25.30	83.60	41.07	11.88
	Body Fat % vs. skin fold thickness	26	11.03	24.67	16.08	3.01
	Valid n (listwise)	26				

SF=Skinfold

Table 8.9: continued

Grouped Positions		n	Minimum	Maximum	Mean	Std. Deviation
Backs	Age	30	18.00	25.00	20.17	1.86
	Height (cm)	30	171.00	193.00	177.77	6.35
	Body Mass (kg)	30	64.50	112.10	85.82	9.77
	Biceps SF (mm)	30	3.40	11.00	5.27	1.75
	Triceps SF (mm)	30	5.40	18.80	11.22	3.49
	Suprailiac SF (mm)	30	5.40	37.20	15.47	8.25
	Subscapular SF(mm)	30	5.80	21.00	11.34	3.20
	Skin total	30	23.40	88.00	43.29	15.22
	Body Fat % vs. skin fold thickness	30	10.09	25.00	16.61	3.89
	Valid n (listwise)	30				

8.4.1 Anthropometrical components

Statistically significant differences were found between the height and body mass of the various positions. These statistical differences were statistically significant at the 5% level of significance. The height and body mass of the backs were significantly lower than those of the tight and loose-forwards, with the tight-forwards being both taller and heavier than the loose-forwards. The differences between these results can be seen in graphical form in figure 8.1.

It is indicated in result table 8.8 that there are statistically significant differences on all skinfold measurements except triceps skinfold. The total skinfolds in millimetres and the body fat % versus skinfold thickness as well as the subscapular skinfold show a significant difference at the 5% level of significance. The biceps and suprailiac skinfolds show significant differences at the 10% level of significance. These results are represented in graphical form in figure 8.2.

The results per variable measured and presented in table 8.9 can be interpreted as follows:

- The biceps skinfold score of the tight-forwards is significantly higher than the other two positions, with the loose-forwards having the lowest score.
- Even though the triceps skinfold score of the tight-forwards are higher than those of the other two positions, these differences are not statistically significant.
- The suprailiac scores of the tight-forwards are significantly higher than the score of the other two positions, with the loose-forwards having the lowest scores.
- The subscapular skinfold score of the tight-forwards is once again significantly higher than the other two positions with the backs having the lowest score.
- As could be expected, the skinfold total score of the tight-forwards is significantly higher than the other two positions with loose-forwards having the lowest scores.

- The body fat % score of tight-forwards is statistically significantly higher than the other two positions, with the loose-forwards having the lowest body fat%.

From these first anthropometrical tests, it can be that the loose-forwards outperform the tight-forwards and the backs in the body fat % (lowest %). They are then followed by the backs and then the tight-forwards. The tight-forwards outperform the loose-forwards and the backs in the body mass and body stature measures.

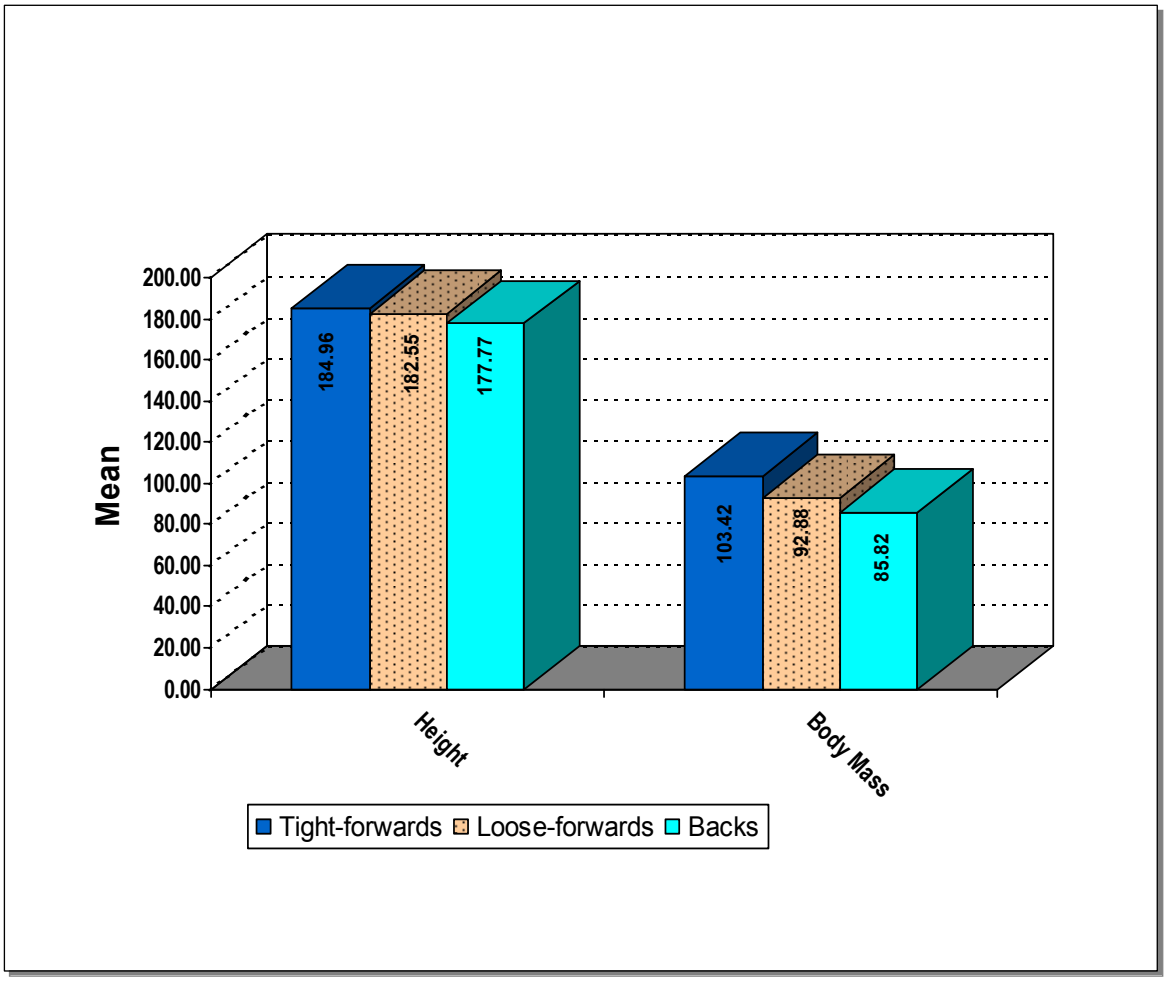

Figure 8.1: Differences between positions on anthropometrical components

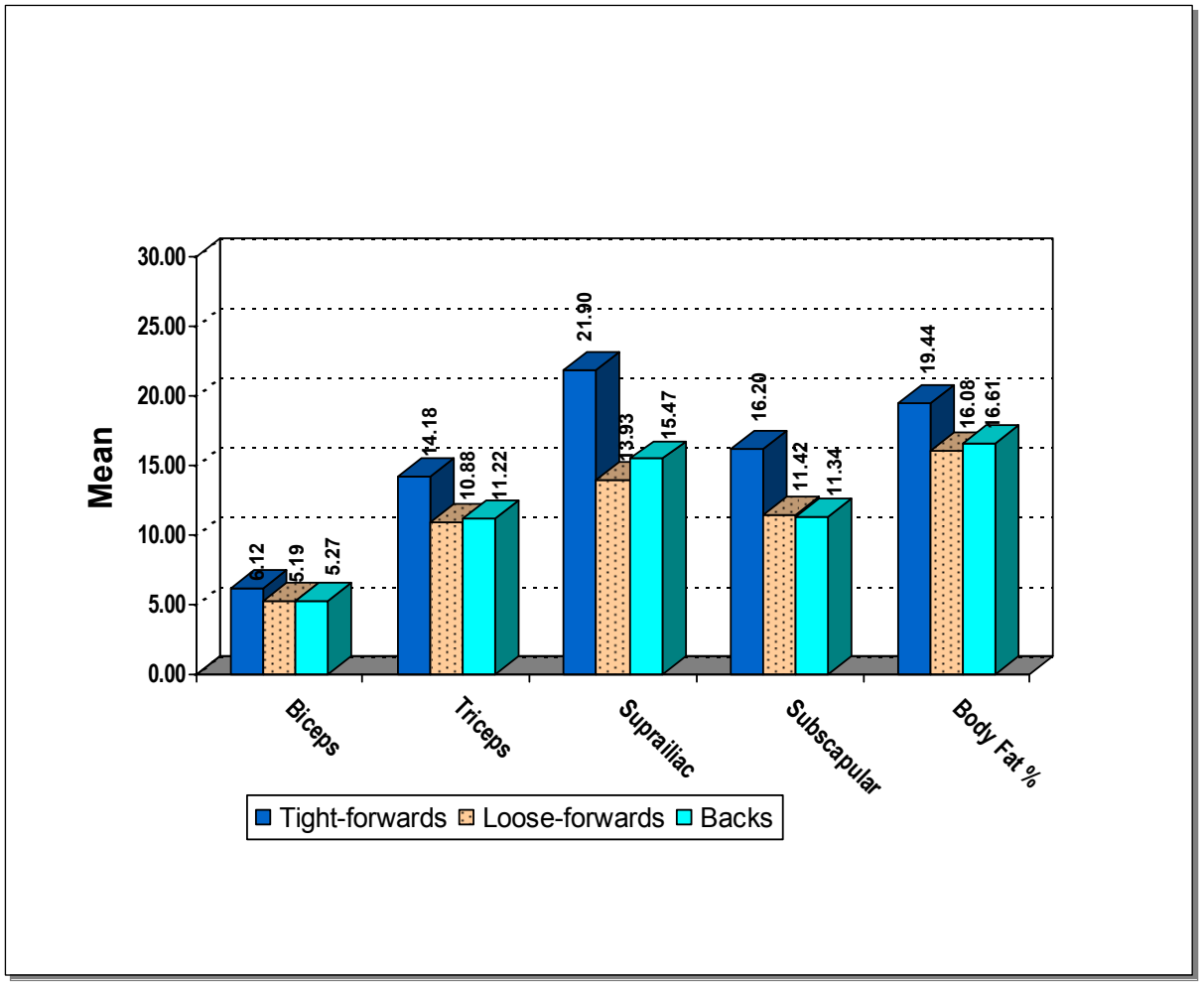

Figure 8.2: Differences between positions on anthropometrical components

Table 8.10: Results of Kruskall-Wallis Test on physical-motor variables (best- effort)

	Vertical jump(cm) best effort	10m Dash sec (10m) Lowest Score (sec)	40m Dash sec (40m) lowest score (sec)	T-test lowest score
Chi-Square	.583	**7.471**	**14.464**	**8.570**
df	2	**2**	**2**	**2**
Asymp. Sig.	.747	**.024**	**.001**	**.014**

Table 8.11: Descriptive statistics per group on physical-motor variables (best effort)

Grouped Positions		N	Minimum	Maximum	Mean	Std. Deviation
Tight-forwards	Vertical jump difference between reach distance and best attempt (cm)	17	41.00	64.00	53.71	7.02
	Valid n (listwise)	17				
Loose-forwards	Vertical jump difference between reach distance and best attempt (cm)	24	39.00	67.00	53.63	6.84
	Valid n (listwise)	24				
Backs	Vertical jump difference between reach distance and best attempt (cm)	30	41.00	65.00	52.57	5.31
	Valid n (listwise)	30				
Tight-forwards	10m dash sec lowest score (sec)	16	1.82	2.35	2.161	0.177
	40m dash sec lowest score (sec)	18	5.32	6.57	5.944	0.358
	T-Test lowest score (sec)	18	10.45	13.36	11.437	0.890
	Valid n (listwise)	13				
Loose-forwards	10m dash sec lowest score (sec)	20	1.69	2.44	2.012	0.196
	40m dash sec lowest score (sec)	25	4.92	6.32	5.586	0.353
	T-Test lowest score (sec)	25	9.77	12.56	10.655	0.757
	Valid n (listwise)	18				
Backs	10m dash sec lowest score (sec)	25	1.75	2.39	2.006	0.173
	40m dash sec lowest score (sec)	25	5.03	6.37	5.542	0.320
	T-Test lowest score (sec)	26	9.21	12.88	10.745	0.919
	Valid n (listwise)	16				

8.4.2 Physical-motor components

The results in tables 8.10 and 8.11 can be interpreted as follows:

- There were no statistically significant differences on the vertical jump measures between positions even though, on the whole, the tight-forwards had higher scores than the other two positions. This finding could probably be attributed to the added power and strength requirements needed by the tight-forwards in the tight phases, most notably that of the scrums.
- A statistically significant difference was found between the positions on the 10 meter dash scores (lowest score). This difference was significant at the 5% level of significance. Backs and loose-forwards had significantly lower scores than the tight-forwards who had the highest scores. This implies that the backs completed the 10 meter dash in significantly shorter time, followed by the loose-forwards and the tight-forwards.
- A statistically significant difference was also found on the 40 meter dash (lowest score). This difference was significant at the 5% level of significance. In this instance, the backs once again had the lowest score followed by loose-forwards and tight-forwards who had the highest score. The tight-forwards thus completed the 40 meter dash at a significantly slower pace than the other two positions.
- A statistically significant difference was found on the best attempt on the T-Test. The lowest score indicates the shortest space of time in completing the test. The difference was significant on the 5% level of significance. The T-Test scores of the tight-forwards were significantly higher than the other two positions, indicating that it took them longer to complete this test. The loose-forwards had the best time, followed by the backs.

From the results it can be seen that the tight-forwards outperform the other positions in the vertical jump. The loose-forwards had the second best scores and the backs the worst scores in this test. The backs outperform the other positions in the 10m and 40m dash, with the loose-forwards having the second best scores and the tight-forwards having the worst scores. The loose-forwards outperform the other

positions in the in the T-Test with the backs having the second best scores, and the tight-forwards the worst scores.

These results are represented graphically in figure 8.3 hereafter.

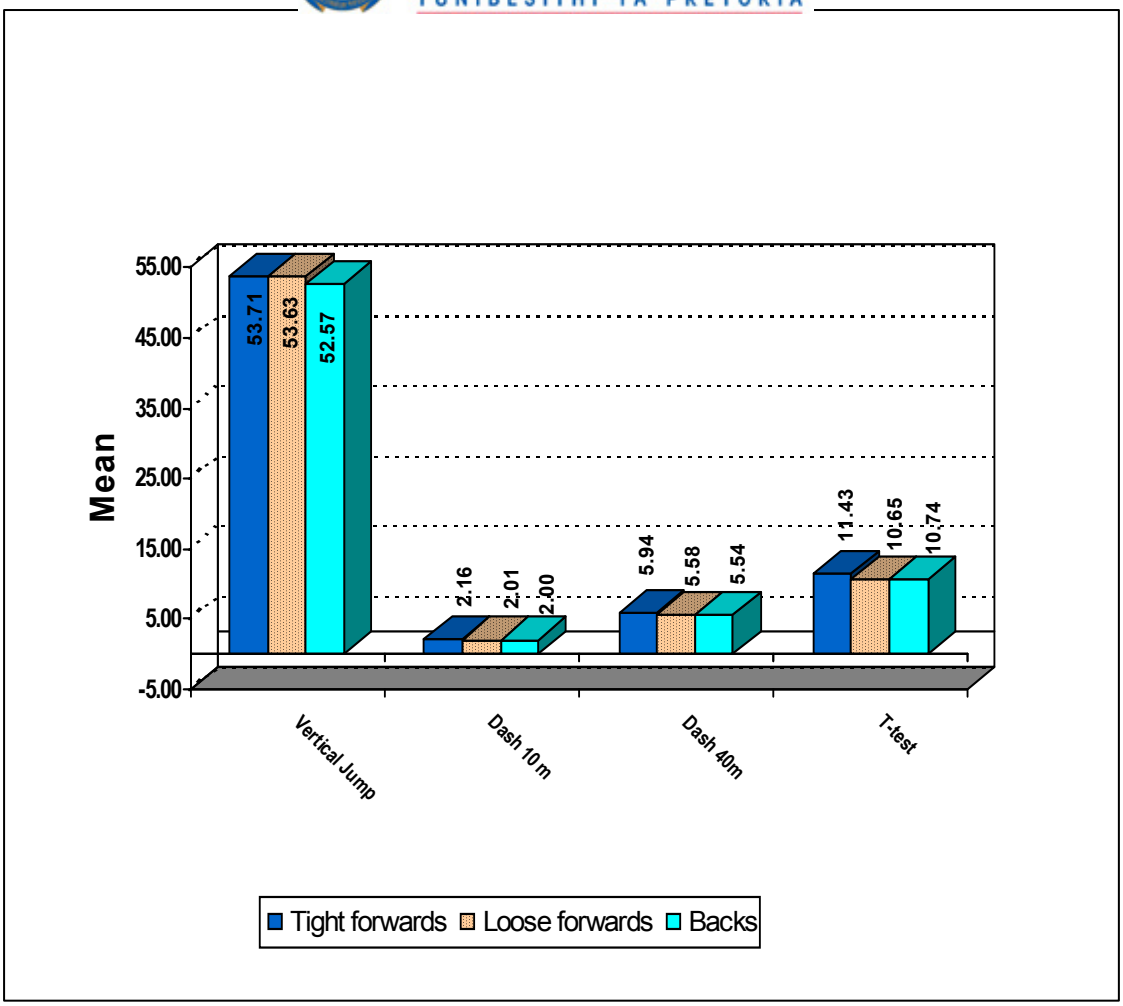

Figure 8.3: Differences between positions on physical- motor components (only best efforts)

Table 8.12: Results of Kruskall-Wallis Tests on 3x5x22m Anaerobic Capacity Test

	5x22m set 1 (sec)	5x22m set 2 (sec)	5x22m set 3 (sec)
Chi-Square	2.988	9.614	10.585
Df	2	2	2
Asymp. Sig.	.224	**.008**	**.005**

Table 8.13: Descriptive statistics per group on 3x5x22m Anaerobic Capacity Test

Grouped Positions		n	Minimum	Maximum	Mean	Std. Deviation
Tight-forwards	5x22m set 1 (sec)	18	20.47	23.21	22.119	0.914
	5x22m set 2 (sec)	18	21.16	27.10	23.869	1.499
	5x22m set 3 (sec)	17	21.83	27.36	24.459	1.953
	Valid n (listwise)	13				
Loose-forwards	5x22m set 1 (sec)	25	19.72	23.70	21.533	1.015
	5x22m set 2 (sec)	25	20.58	25.10	22.448	1.226
	5x22m set 3 (sec)	22	19.90	24.98	22.543	1.305
	Valid n (listwise)	16				
Backs	5x22m set 1 (sec)	25	19.00	23.70	21.744	1.259
	5x22m set 2 (sec)	25	19.96	27.84	22.837	1.699
	5x22m set 3 (sec)	25	20.75	27.03	22.826	1.450
	Valid n (listwise)	15				

The results in tables 8.12 and 8.13 indicate that no statistically significant differences were found between the scores of the three groups of positions on the first anaerobic capacity attempt. However, on the second and last attempt there were statistically significant differences at the 5% level of significance. In both the second and third attempt the scores of the tight-forwards were significantly higher than those of the other two positions. They thus took significantly longer to complete the test. The anaerobic capacity of the loose-forwards and backs remained fairly stable over the three measurements, but it was the tight-forwards that seemed to show a decrease in performance over time. The superiority of the loose-forwards in anaerobic capacity could probably be attributed to the relative workload that they produce to get through in the game. As can once again be seen, the loose-forwards outperform both the backs and the tight-forwards in this test as well.

These results are represented graphically in figure 8.4 hereafter.

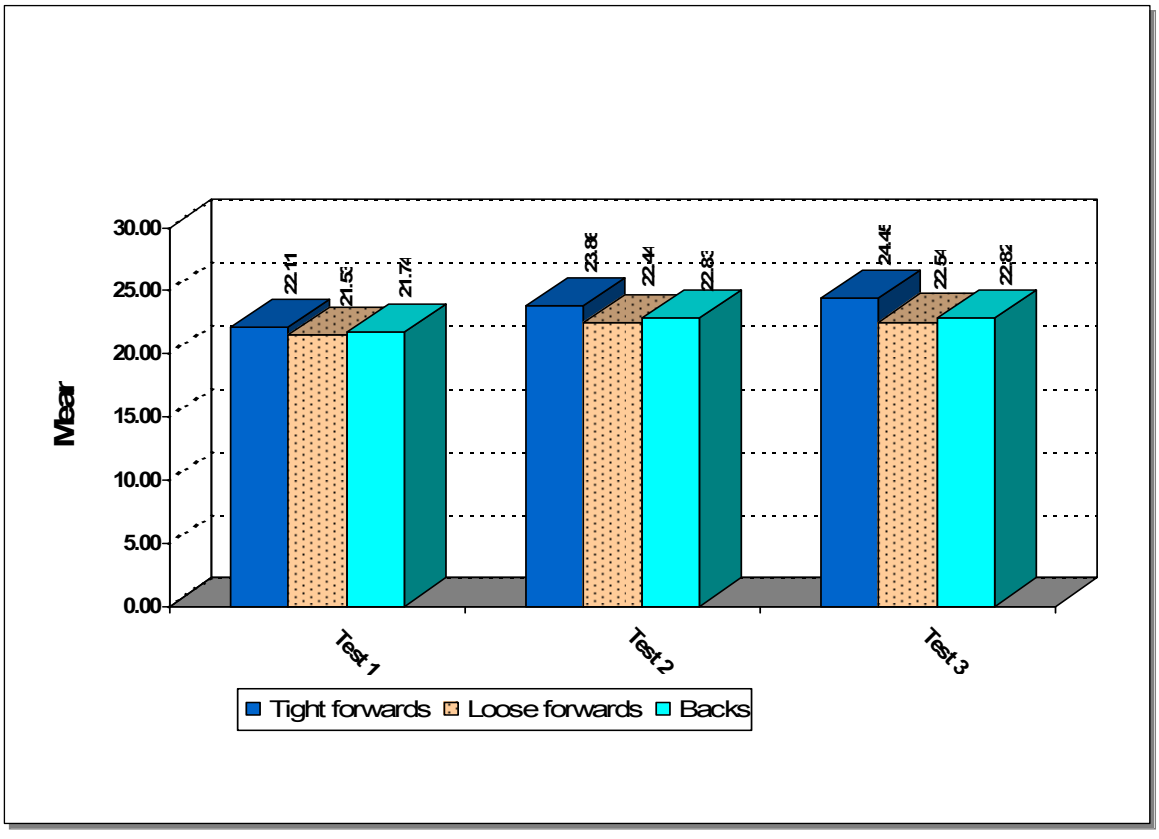

Figure 8.4: Differences between positions on 3x5x22m Anaerobic Capacity Test

Table 8.14: Results of Kruskall-Wallis Test on Accuvision 1000 "30 accurate lights in fastest time test"

	Accuvision1000 Test (30 lights test) (sec)
Chi-Square	4.119
df	2
Asymp. Sig.	.127

Table 8.15: Descriptive statistics per group on Accuvision1000 "30 accurate lights in fastest time test"

Grouped Positions		n	Minimum	Maximum	Mean	Std. Deviation
Tight-forwards	30 lights test (sec)	15	19.00	29.00	24.333	3.331
	Valid n (listwise)	12				
Loose-forwards	30 lights test (sec)	18	18.00	28.00	21.778	3.474
	Valid n (listwise)	17				
Backs	30 lights test (sec)	18	17.00	29.00	22.778	4.387
	Valid n (listwise)	17				

8.4.3 Sport vision testing

The results of the Accuvision1000 "30 accurate lights in fastest time" test are presented in tables 8.14 and 8.15. There were no statistically significant differences between positions even though the tight-forwards scored a worse time (longer time) in this test than the other two positions. The loose-forwards scored the best times (shorter time) in this test, followed once again by the backs and the tight-forwards.

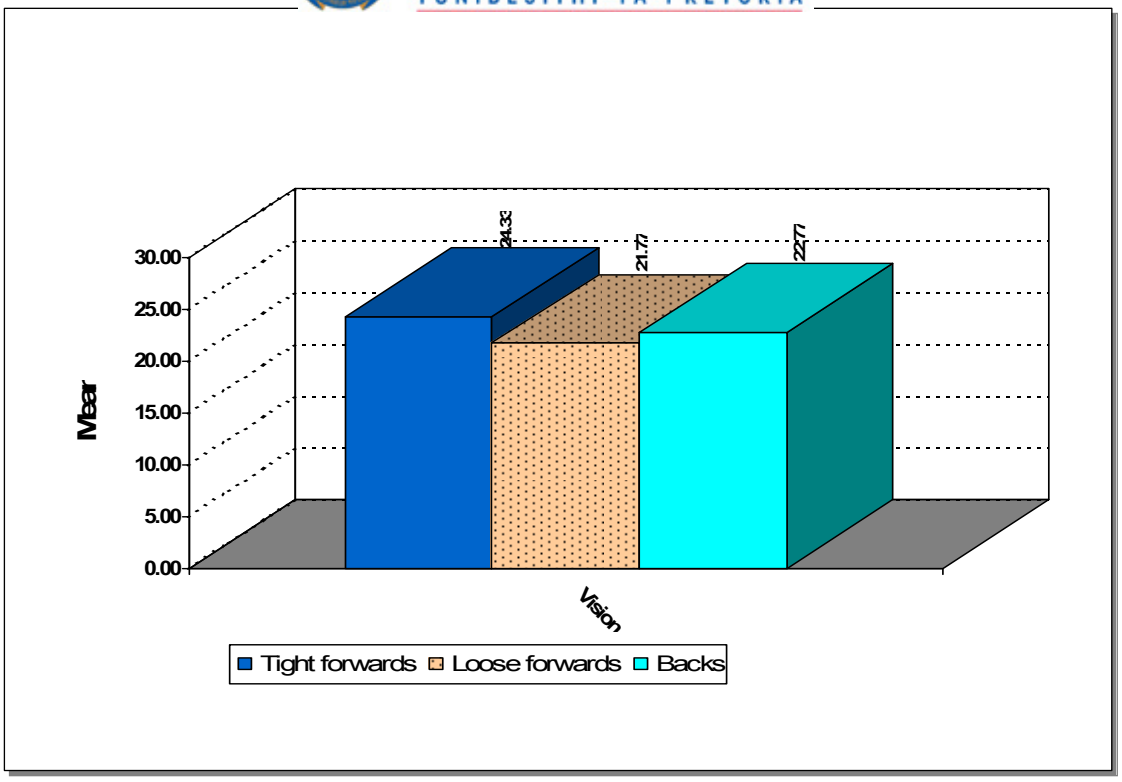

Figure 8.5: Differences between positions on the Accuvision1000 "30 lights in fastest time" test (best efforts only)

8.5 NORM TABLES OF COMPARABLE VARIABLES

Norms were determined for those variables that were comparable across the three measurements of the three protocols. There are certain conditions that need to be met in order to be able to calculate norms. These conditions are defined by Smit (1986) as follows:

a) The reliability of the normative scale is determined by the size and representativeness of the normative sample. In the case of this study, the normative sample is relatively small with some of the variables. Simulations were used to increase the sample size based on descriptive results of the original sample in order to simulate the normal distribution of scores.

b) Other information regarding the normative sample can add to the utilisation possibilities of the results. An example of this is the level of functioning; in this case it is elite age-group rugby players. Furthermore, in this study it can be assumed that due to the high level of sport participation that this study examines and measures, the performance on these variables needs to be at a corresponding high level and will thus not apply to the selection of lower level players such as school level participants. The application of these norms is therefore highly specific to elite age-group rugby.

c) A further consideration is the number of normative samples on which the norms are based.

Since the base sizes were relatively small on some of the variables and the assumption of the normal distribution of variables could not be assumed, truncated simulations were used. Base sizes were as little as 18 players completing some of the tests. The simulations were based on the mean, standard deviation, minimum and maximum scores of all the variables used over the three tests and protocols.

The function of the simulations was to simulate scores obtained on these variables as if they occurred in a much larger sample and to further simulate the normal distribution of these variables. The simulations were done by means of 250 iterations, thus simulating the results as if 250 individuals completed these tests. The means and standard deviations were compared to the original data in order to determine whether they were still representative of the sample used in this study. The means and standard deviations were found to be very comparable and these were therefore used to determine the norms on each variable. The norms were calculated separately for every positional grouping.

The means and standard deviations of the simulated data are provided in Appendix E.

As indicated earlier stanine scores were calculated for each variable. Performance scores on all the variables measured are divided into nine categories that will provide an indication of the relative position of a score in the total population.

According to Smit (1986) the scores obtained can be categorized as follows:

1	=	low performance
2 & 3	=	below average
4.5 & 6	=	average
7 & 8	=	above average
9	=	high performance

For some variables a higher value constituted a better performance (for example vertical jump in centimetres) whereas in other variables a lower score represented better performance (for example time taken to complete a 10 meter dash). The variables in the tables to follow were grouped to include all those where a higher score is positive, in one table and those where a lower shore is positive in another table. This was done for practical considerations.

The stanine scores with their accompanying percentile rankings are indicated in each table with the raw score representing that table. Smit (1986) lists, amongst others, the following important advantages of stanine scales: 1) the equality of scale units are an advantage since the difference in performance of a stanine of 7 compared to 5 is just as significant as the difference between a stanine of 2 and of 4. The performance on various variables or tests thus reflects the relative intensity of performance accurately; 2) stanines almost automatically indicate an individual/subject's position relative to the normative sample, and; 3) stanines allow for the statistical manipulation of variables without sacrificing accuracy.

The only disadvantage to stanines is that it is an approximated scale with only 9 scale units. In the case of this study the score represented by the stanine scores

are relatively close together and the practical application thereof should thus be investigated. It might be useful to look at the broader classification of low, below average, average, above average and high performance as indicators for selection purposes. The levels or categories of performance are indicated in different colours in the norm tables. Poorer performances are indicated in tones of red with higher performance in shades of blue, or, alternatively, the poorest performance is indicated in the darkest shade of grey, with the subsequent lighter shades indicating better performances.

The norms for tight-forwards are presented in tables 8.16 to 8.19, the norms for loose-forwards are presented in tables 8.20 to 8.23 and the norms for backs are presented in tables 8.24 to 8.27.

For the proper interpretation of these norm tables it is important to note to following: as stated earlier, a stanine of 9 is good and a stanine of 1 is bad but one needs to be careful how one interprets the stanine vs. percentiles. When it comes to body fat % (and speed, anaerobic endurance etc.) you want your body fat % score to be low, therefore it has a stanine of 9 (which is good), but, it has been assigned a percentile of 4 indicating that your fat % is only higher than 4% of the population and therefore, by implication it is lower than the remaining 96% of the population. When it comes to vertical jump in which you want your score to be as high as possible, however, your stanine is once again 9 but your percentile is 100% because your score is higher than 100% and therefore lower than 0% of the population.

NORMS FOR TIGHT-FORWARDS

Table 8.16: Norms for tight-forwards on anthropometrical components

	Percentiles	Stanines	Biceps SF (mm)	Triceps SF (mm)	Suprailiac SF (mm)	Subscapular SF (mm)	Skin total	Body fat % vs. skinfold thickness
n	Valid		250	250	250	250	250	**250**
Percentile	4	9	3.83	8.08	7.97	8.83	31.18	**13.01**
	11	8	4.37	9.40	11.06	10.48	37.29	**14.46**
	23	7	5.03	11.30	15.40	12.70	45.56	**16.20**
	40	6	5.77	13.55	20.71	15.18	55.27	**18.09**
	60	5	6.56	16.12	26.75	17.94	66.13	**20.04**
	77	4	7.32	18.62	32.78	20.56	76.79	**21.80**
	89	3	8.01	21.01	38.77	23.04	86.96	**23.27**
	96	2	8.64	23.09	44.76	25.22	95.84	**24.33**
	100	1	9.19	24.89	51.96	27.17	103.44	**24.99**

Table 8.17: Norms for tight-forwards on physical-motor: vertical jump

	Stanines	Percentiles	Vertical jump Best effort (cm)
n		Valid	**250**
Percentiles	1	4	**43.35**
	2	11	**45.77**
	3	23	**48.69**
	4	40	**51.76**
	5	60	**54.92**
	6	77	**57.92**
	7	89	**60.45**
	8	96	**62.68**
	9	100	**63.72**

Table 8.18: Norms for tight-forwards on physical-motor skills: 10/40m dash and T-Test

	Stanines	Percentiles	10m dash (1) (sec)	10m dash (2) (sec)	*10m dash lowest score (sec)*	40m dash (1) (sec)	40m dash (2) (sec)	*40m dash lowest score (sec)*	T-Test (1) (sec)	T-Test (2) (sec)	*T-Test lowest score*
n		Valid	250	250	***250***	250	250	***250***	250	250	***250***
Percentiles	9	4	1.892	1.914	***1.883***	5.513	5.428	***5.434***	10.677	10.594	***10.577***
	8	11	1.973	1.984	***1.950***	5.641	5.563	***5.558***	10.903	10.804	***10.767***
	7	23	2.064	2.054	***2.024***	5.795	5.719	***5.704***	11.211	11.104	***11.043***
	6	40	2.160	2.125	***2.097***	5.965	5.884	***5.862***	11.579	11.467	***11.380***
	5	60	2.261	2.195	***2.173***	6.146	6.064	***6.028***	12.007	11.884	***11.771***
	4	77	2.356	2.255	***2.238***	6.318	6.226	***6.186***	12.432	12.288	***12.153***
	3	89	2.443	2.305	***2.290***	6.483	6.368	***6.333***	12.856	12.674	***12.543***
	2	96	2.516	2.339	***2.328***	6.630	6.483	***6.456***	13.303	13.037	***12.910***
	1	100	2.574	2.358	***2.349***	6.761	6.565	***6.563***	13.957	13.338	***13.326***

Table 8.19: Norms for tight-forwards on physical-motor skills: 3x5x22m Anaerobic Capacity and sport vision skills: Accuvision1000 "30 lights in fastest time" test

	Stanines	Percentiles	Anaerobic Capacity 5x22m set 1 (sec)	Anaerobic Capacity 5x22m set 2 (sec)	Anaerobic Capacity 5x22m set 3 (sec)	Accuvision 1000 Test (30 lights test) (sec)
n		Valid	250	250	250	250
Percentiles	9	4	20.748	21.672	22.179	19.81
	8	11	21.082	22.239	22.665	20.87
	7	23	21.443	22.876	23.333	22.12
	6	40	21.829	23.545	24.091	23.48
	5	60	22.221	24.274	24.930	24.96
	4	77	22.569	24.961	25.707	26.29
	3	89	22.860	25.639	26.405	27.47
	2	96	23.076	26.322	26.956	28.36
	1	100	23.208	27.049	27.347	28.95

NORMS FOR TIGHT-FORWARDS

Table 8.16: Norms for tight-forwards on anthropometrical components

	Percentiles	Stanines	Biceps SF (mm)	Triceps SF (mm)	Suprailiac SF (mm)	Subscapular SF (mm)	Skin total	Body fat % vs. skinfold thickness
n	Valid		250	250	250	250	250	**250**
Percentile	4	9	3.83	8.08	7.97	8.83	31.18	**13.01**
	11	8	4.37	9.40	11.06	10.48	37.29	**14.46**
	23	7	5.03	11.30	15.40	12.70	45.56	**16.20**
	40	6	5.77	13.55	20.71	15.18	55.27	**18.09**
	60	5	6.56	16.12	26.75	17.94	66.13	**20.04**
	77	4	7.32	18.62	32.78	20.56	76.79	**21.80**
	89	3	8.01	21.01	38.77	23.04	86.96	**23.27**
	96	2	8.64	23.09	44.76	25.22	95.84	**24.33**
	100	1	9.19	24.89	51.96	27.17	103.44	**24.99**

Table 8.17: Norms for tight-forwards on physical-motor: vertical jump

	Stanines	Percentiles	Vertical jump Best effort (cm)
n		Valid	**250**
Percentiles	1	4	**43.35**
	2	11	**45.77**
	3	23	**48.69**
	4	40	**51.76**
	5	60	**54.92**
	6	77	**57.92**
	7	89	**60.45**
	8	96	**62.68**
	9	100	**63.72**

Table 8.18: Norms for tight-forwards on physical-motor skills: 10/40m dash and T-Test

	Stanines	Percentiles	10m dash (1) (sec)	10m dash (2) (sec)	*10m dash lowest score (sec)*	40m dash (1) (sec)	40m dash (2) (sec)	*40m dash lowest score (sec)*	T-Test (1) (sec)	T-Test (2) (sec)	*T-Test lowest score*
n		Valid	250	250	***250***	250	250	***250***	250	250	***250***
Percentiles	9	4	1.892	1.914	***1.883***	5.513	5.428	***5.434***	10.677	10.594	***10.577***
	8	11	1.973	1.984	***1.950***	5.641	5.563	***5.558***	10.903	10.804	***10.767***
	7	23	2.064	2.054	***2.024***	5.795	5.719	***5.704***	11.211	11.104	***11.043***
	6	40	2.160	2.125	***2.097***	5.965	5.884	***5.862***	11.579	11.467	***11.380***
	5	60	2.261	2.195	***2.173***	6.146	6.064	***6.028***	12.007	11.884	***11.771***
	4	77	2.356	2.255	***2.238***	6.318	6.226	***6.186***	12.432	12.288	***12.153***
	3	89	2.443	2.305	***2.290***	6.483	6.368	***6.333***	12.856	12.674	***12.543***
	2	96	2.516	2.339	***2.328***	6.630	6.483	***6.456***	13.303	13.037	***12.910***
	1	100	2.574	2.358	***2.349***	6.761	6.565	***6.563***	13.957	13.338	***13.326***

Table 8.19: Norms for tight-forwards on physical-motor skills: 3x5x22m Anaerobic Capacity and sport vision skills: Accuvision1000 "30 lights in fastest time" test

	Stanines	Percentiles	Anaerobic Capacity 5x22m set 1 (sec)	Anaerobic Capacity 5x22m set 2 (sec)	Anaerobic Capacity 5x22m set 3 (sec)	Accuvision 1000 Test (30 lights test) (sec)
n		Valid	250	250	250	250
Percentiles	9	4	20.748	21.672	22.179	19.81
	8	11	21.082	22.239	22.665	20.87
	7	23	21.443	22.876	23.333	22.12
	6	40	21.829	23.545	24.091	23.48
	5	60	22.221	24.274	24.930	24.96
	4	77	22.569	24.961	25.707	26.29
	3	89	22.860	25.639	26.405	27.47
	2	96	23.076	26.322	26.956	28.36
	1	100	23.208	27.049	27.347	28.95

NORMS FOR LOOSE-FORWARDS

Table 8.20: Norms for loose-forwards on anthropometrical components

	Percentiles	Stanines	Biceps SF (mm)	Triceps SF (mm)	Suprailiac SF (mm)	Subscapular SF (mm)	Skin total	Body fat % vs. skinfold thickness
n	Valid		250	250	250	250	250	**250**
Percentiles	4	9	3.39	6.13	7.64	7.76	27.45	**11.88**
	11	8	3.80	7.34	9.05	8.64	30.65	**12.94**
	23	7	4.35	8.74	11.14	9.75	34.86	**14.18**
	40	6	5.01	10.20	13.78	10.93	39.74	**15.52**
	60	5	5.74	11.79	16.89	12.23	45.23	**16.97**
	77	4	6.48	13.32	20.07	13.49	50.78	**18.41**
	89	3	7.21	14.87	23.36	14.76	56.50	**19.86**
	96	2	7.80	16.46	27.00	16.09	62.65	**21.45**
	100	1	9.16	18.88	35.74	18.33	75.35	**24.49**

NORMS FOR LOOSE-FORWARDS

Table 8.20: Norms for loose-forwards on anthropometrical components

	Percentiles	Stanines	Biceps SF (mm)	Triceps SF (mm)	Suprailiac SF (mm)	Subscapular SF (mm)	Skin total	Body fat % vs. skinfold thickness
n	Valid		250	250	250	250	250	**250**
Percentiles	4	9	3.39	6.13	7.64	7.76	27.45	**11.88**
	11	8	3.80	7.34	9.05	8.64	30.65	**12.94**
	23	7	4.35	8.74	11.14	9.75	34.86	**14.18**
	40	6	5.01	10.20	13.78	10.93	39.74	**15.52**
	60	5	5.74	11.79	16.89	12.23	45.23	**16.97**
	77	4	6.48	13.32	20.07	13.49	50.78	**18.41**
	89	3	7.21	14.87	23.36	14.76	56.50	**19.86**
	96	2	7.80	16.46	27.00	16.09	62.65	**21.45**
	100	1	9.16	18.88	35.74	18.33	75.35	**24.49**

Table 8.21: Norms for loose-forwards on physical-motor skills: vertical jump

	Stanines	Percentiles	Vertical jump best effort (cm)
n		Valid	**250**
Percentiles	1	4	**42.50**
	2	11	**45.49**
	3	23	**48.71**
	4	40	**51.92**
	5	60	**55.23**
	6	77	**58.42**
	7	89	**61.32**
	8	96	**64.32**
	9	100	**66.31**

Table 8.22: Norms for loose-forwards on physical- motor skills: 10/40m dash and T-Test

	Stanines	Percentiles	10m dash (1) (sec)	10m dash (2) (sec)	*10m dash lowest score (sec)*	40m dash (1) (sec)	40m dash (2) (sec)	*40m dash lowest score (sec)*	T-Test (1) (sec)	T-Test (2) (sec)	*T-Test lowest score*
n		Valid	250	250	***250***	250	250	***250***	250	250	***250***
Percentiles	9	4	1.719	1.744	***1.743***	5.076	5.327	***5.058***	10.039	9.905	***9.887***
	8	11	1.804	1.812	***1.809***	5.237	5.411	***5.193***	10.237	10.094	***10.059***
	7	23	1.9034	1.890	***1.889***	5.424	5.520	***5.345***	10.505	10.356	***10.304***
	6	40	2.0112	1.979	***1.974***	5.626	5.644	***5.507***	10.824	10.667	***10.599***
	5	60	2.127	2.075	***2.068***	5.841	5.787	***5.676***	11.192	11.023	***10.940***
	4	77	2.238	2.166	***2.158***	6.047	5.923	***5.840***	11.550	11.373	***11.275***
	3	89	2.344	2.257	***2.245***	6.251	6.056	***5.999***	11.894	11.722	***11.625***
	2	96	2.441	2.344	***2.3367***	6.446	6.183	***6.146***	12.221	12.090	***11.976***
	1	100	2.529	2.426	***2.435***	6.662	6.309	***6.306***	12.553	12.515	***12.496***

Table 8.23: Norms for loose-forwards on physical-motor skills: 3x5x22m Anaerobic Capacity and sport vision skills: Accuvision1000 "30 lights in fastest time" test

	Stanines	Percentiles	Anaerobic Capacity 5x22m set 1 (sec)	Anaerobic Capacity 5x22m set 2 (sec)	Anaerobic Capacity 5x22m set 3 (sec)	Accuvision 1000 Test (30 lights test) (sec)
n		Valid	**250**	**250**	**250**	**250**
Percentiles	9	4	**20.049**	**20.868**	**20.490**	**18.46**
	8	11	**20.438**	**21.247**	**21.026**	**19.20**
	7	23	**20.860**	**21.717**	**21.615**	**20.23**
	6	40	**21.318**	**22.236**	**22.211**	**21.49**
	5	60	**21.803**	**22.815**	**22.843**	**22.97**
	4	77	**22.269**	**23.369**	**23.432**	**24.40**
	3	89	**22.727**	**23.917**	**23.994**	**25.77**
	2	96	**23.191**	**24.470**	**24.501**	**26.96**
	1	100	**23.686**	**25.059**	**24.961**	**27.90**

NORMS FOR BACKS

Table 8.24: Norms for backs on anthropometrical components

	Percentiles	Stanines	Biceps SF (mm)	Triceps SF (mm)	Suprailiac SF (mm)	Subscapular SF (mm)	Skin total	Body fat % vs. skinfold thickness
n	250		250	250	250	250	250	**250**
Percentiles	4	9	3.64	6.40	6.78	6.82	26.09	**11.18**
	11	8	4.00	7.57	8.73	7.95	30.11	**12.53**
	23	7	4.54	9.00	11.45	9.30	35.44	**14.12**
	40	6	5.20	10.53	14.73	10.73	41.65	**15.84**
	60	5	5.98	12.19	18.48	12.29	48.65	**17.68**
	77	4	6.77	13.79	22.24	13.80	55.72	**19.49**
	89	3	7.58	15.37	26.05	15.34	62.99	**21.25**
	96	2	8.49	16.90	30.09	16.99	70.70	**23.02**
	100	1	10.68	18.66	36.55	20.72	84.45	**24.96**

Table 8.25: Norms for backs on physical-motor skills: vertical jump

	Stanines	Percentiles	Vertical jump best effort (cm)
n		Valid	**250**
Percentiles	1	4	**43.66**
	2	11	**46.31**
	3	23	**48.69**
	4	40	**51.30**
	5	60	**53.92**
	6	77	**56.52**
	7	89	**59.03**
	8	96	**61.72**
	9	100	**64.91**

Table 8.26: Norms for Backs on Physical Motor Skills – Dash and T-test

	Stanines	Percentiles	10m dash (1) (sec)	10m dash (2) (sec)	*10m dash lowest score (sec)*	40m dash (1) (sec)	40m dash (2) (sec)	*40m dash lowest score (sec)*	T-Test (1) (sec)	T-Test (2) (sec)	*T-test lowest score*
n		Valid	250	250	***250***	250	250	***250***	250	250	***250***
Percentiles	9	4	1.797	1.893	***1.788***	5.197	5.182	***5.117***	9.573	9.726	***9.480***
	8	11	1.860	1.938	***1.840***	5.306	5.322	***5.219***	9.943	9.957	***9.790***
	7	23	1.939	1.994	***1.906***	5.447	5.465	***5.346***	10.335	10.290	***10.165***
	6	40	2.028	2.058	***1.978***	5.608	5.608	***5.487***	10.746	10.695	***10.571***
	5	60	2.123	2.129	***2.059***	5.785	5.764	***5.639***	11.189	11.166	***11.014***
	4	77	2.215	2.197	***2.138***	5.958	5.910	***5.790***	11.611	11.624	***11.435***
	3	89	2.302	2.263	***2.215***	6.132	6.052	***5.941***	12.019	12.067	***11.864***
	2	96	2.378	2.326	***2.296***	6.303	6.194	***6.095***	12.430	12.492	***12.281***
	1	100	2.442	2.381	***2.385***	6.511	6.354	***6.333***	12.946	12.862	***12.825***

Table 8.27: Norms for backs on physical-motor skills: 3x5x22m Anaerobic Capacity and sport vision skills: Accuvision1000 "30 lights in fastest time" test

	Stanines	Percentiles	Anaerobic Capacity 5x22m set 1 (sec)	Anaerobic Capacity 5x22m set 2 (sec)	Anaerobic Capacity 5x22m set 3 (sec)	Accuvision 1000 Test (30 lights test) (sec)
n		Valid	**250**	**250**	**250**	**250**
Percentiles	9	4	**19.655**	**20.465**	**21.060**	**17.74**
	8	11	**20.236**	**21.066**	**21.468**	**18.84**
	7	23	**20.798**	**21.767**	**22.012**	**20.28**
	6	40	**21.376**	**22.519**	**22.622**	**21.93**
	5	60	**21.965**	**23.350**	**23.308**	**23.80**
	4	77	**22.504**	**24.148**	**23.981**	**25.50**
	3	89	**22.990**	**24.964**	**24.673**	**27.02**
	2	96	**23.401**	**25.870**	**25.421**	**28.17**
	1	100	**23.694**	**27.506**	**26.832**	**28.93**

8.5.1 Norm tables of S-Test as determined for the second and third measurement combined

As indicated earlier, it was not possible to simulate the results obtained for the S-Test due to the fact that total scores obtained were on a nominal level. Simulations would result in scores that would not typically be obtained during the testing process and would thus not be practical for future reference and use. Since the second and third measurement of the S-Test included 2 aspects, namely accuracy and time taken to complete the test, a combined score was determined to get a total score for the S-Test. This was done for the following reason: some players scored zero points but took less time to complete the test. By simply looking at the time taken to complete the test, an inaccurate impression of the relative performance could be created since zero points could be scored in a shorter space of time as opposed to 10 points over a longer space of time. It was thus decided to combine the points scored with the time taken to complete the task to get a total score.

For the S-Test, higher scores are associated with a better performance, but, since there is also a time factor involved with this test, as mentioned before, possible discrepancies could arise as to the true reflection of the scores obtained in this test. To address this potential problem and in order to rule out the discrepancy between longer times taken to complete the task resulting in higher performance scores as opposed to less time taken to score the same number of points, the following solution was devised: the mean score in terms of time taken to complete the test is used to categorise performance into two groups.

These two groups consist of the following: 1) those subjects who took less than and equal to the average time (sec) taken by that grouped position to complete the task; they are assigned 2 “multiplier” points; 2) those subjects who completed the task in longer than the average time (sec) for that grouped position; they are assigned 1 “multiplier” point. A total and final score for this S-Test is then calculated by multiplying the points scored for accuracy (best attempt) with the “multiplier” points (1 or 2) that the subject receives for performing the task relative to the mean time of

completion for a particular positional grouping. The final score for the S-Test is then a computed score that takes into account the accuracy of the subject in performing this task while also considering the time taken to perform this task.

The results of this S-Test are discussed hereafter. For the two sample groups, the mean scores on the recorded time taken to complete the S-Test per positional grouping were analysed. This was followed by a computation of the time taken versus accuracy attained, where the relative scores were assigned multiplier points of 1 or 2 respectively and multiplied with these points. The means scores on recorded time taken per positional grouping are presented in table 8.28 followed by the frequency distributions of the computed totals in tables 8.29 to 8.31.

A full explanation of the implications of this scoring system for this test per position is provided thereafter.

Table 8.28: Mean scores on recoded time taken to complete the S-Test per positional grouping

Grouped Positions		S-Test 1 (Sec)	S-Test 2 (Sec)
Tight-forwards	N	Valid	14
		Missing	1
	Mean	7.630	7.604
	Median	7.585	7.630
	Mode	6.91(a)	7.66
Loose-forwards	N	Valid	17
		Missing	1
	Mean	7.299	7.002
	Median	7.230	6.980
	Mode	6.27(a)	5.65(a)
Backs	N	Valid	18
		Missing	1
	Mean	7.709	7.339
	Median	7.680	7.395
	Mode	6.68(a)	7.50

(a) Multiple modes exist. The smallest value is shown

Table 8.29: Frequencies for tight-forwards best attempt on S-Test computed total

	Score obtained	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	.00	2	13.3	14.3	14.3
	5.00	4	26.7	28.6	42.9
	10.00	7	46.7	50.0	92.9
	20.00	1	6.7	7.1	100.0
	Total	14	93.3	100.0	
Missing	System	1	6.7		
Total	15	100.0			

Table 8.30: Frequencies for loose-forwards best attempt on S-Test computed total

	Score obtained	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0.00	1	5.6	5.9	5.9
	5.00	2	11.1	11.8	17.6
	10.00	10	55.6	58.8	76.5
	20.00	4	22.2	23.5	100.0
	Total	17	94.4	100.0	
Missing	System	1	5.6		
Total	18	100.0			

Table 8.31: Frequencies for backs best attempt on S-Test computed total

	Score obtained	Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0.00	1	5.3	5.6	5.6
	5.00	1	5.3	5.6	11.1
	10.00	11	57.9	61.1	72.2
	20.00	5	26.3	27.8	100.0
	Total	18	94.7	100.0	
Missing	System	1	5.3		
Total	19	100.0			

8.5.1.1 Implications of the scoring system for the S-Test

There are a number of implications that can be derived from the scoring system adopted for this S-Test. These are discussed hereafter, as well as the results from tables 8.29 to 8.31 presented earlier:

8.5.1.1.1 Zero score

A score of zero means that the subject was inaccurate with all their passes, irrespective of the time taken to complete the course itself. This is a poor reflection on the subject's passing skills. 14.3% of the tight-forwards, 5.9% of the loose-forwards and 5.6% of the backs achieved this score.

8.5.1.1.2 Five score

According to the scoring system for this test, obtaining five computed points for this test means the subject only had one accurate pass and that they completed the course in more time than the mean time. This is therefore a bad reflection on the subject's ability to pass accurately at speed or under pressure. 28.6% of the tight-forwards, 11.8% of the loose-forwards and 5.6% of the backs obtained this score.

8.5.1.1.3 Ten score

The computed score of 10 points can be interpreted according to two possible scenarios:

a) The first possible interpretation is that while the accuracy of the subjects in this category score was high (10 points=2 accurate passes, 1 left and 1 right), their overall time taken to complete the test was more than the mean time, earning them one multiplier point and a computed score of ten.

b) The other alternative is that the subjects were less accurate (5 points=1 accurate pass), but they completed the test in less than the mean time, earning them two multiplier points so that they therefore receive a computed score of ten for this test.

While this category is obviously better than the preceding two categories, it is still not the ideal. It could reflect that while the subjects are more accurate in their passing at speed, they need more time in which to complete their accurate passes, implying a possible inability to operate under pressure. In the high-pressure game of rugby, which is often played at high speed, this could present a problem.

By far the largest majority of all the positional groupings fell into this category, with 50% of the tight-forwards, 58.8% of the loose-forwards and 61.1% of the backs achieving this score.

8.5.1.1.4 Twenty score

Obtaining a computed score of 20 implies that the subject is highly skilled in passing at speed and under pressure since they are accurate with their passes to both sides (10 points = 2 accurate passes, 1 left and 1 right) and they managed to complete the course in less time than the mean, accruing two multiplier points to take the computed total to 20 points. This is by far the ideal score to achieve for this test. 7.1% of the tight-forwards, 23.5% of the loose-forwards and 27.8% of the backs achieved this score.

From the results of tables 8.29 to 8.30, it seems that while a computed total S-Test score of 20 is *obviously* the ideal; a more realistic computed total S-test score of 10 can be used as the norm to differentiate between good and poor performances. In suggesting this, however, it must be remembered that the different positions as grouped in this study and in general often have divergently different tasks to perform on field. While the tight-forwards tend to be more focused on set-phases (scrums and line-outs), the loose-forwards and backs tend to be more involved in the running and open play requiring a higher passing ability. The scores seem to reflect the general trends in rugby today. Higher numbers of backs achieved scores of 10 (61.1%) and 20 (27.8%) as opposed to both loose-forwards (55.6% and 22.2%) and tight-forwards (46.7% and 6.75) respectively, showing that the loose-forwards and backs have better handling skills than the tight-forwards.

The value of this test is further underscored by the fact that while norms have been provided for future reference, the intra-group passing ability can also be determined. As a result, the weaker passers in the team can be identified and these individuals can be further addressed.

While rugby is constantly changing and while the rugby-specific skills, as proposed by Robbie Deans, are becoming more generic with all positions required to perform them, for the time being it seems as if the status quo remains, particularly in South African rugby.

8.6 SUMMARY OF RESULTS

As indicated throughout this document, the focus was on young elite (age-group) rugby players represented by the U/21 Blue Bulls squad, the South African U/21 squad and the Tuks Rugby Academy squad. Approximately a third of the sample was represented by tight-forwards, loose-forwards and backs respectively. Their ages ranged between 19 and 25 but, 94.8% of the sample were 21 years and younger. Almost two thirds (65.4%) of the sample group were injury free. The most common injuries encountered during testing were those of the knee (9%), the hamstring (6.4%) and the ankle (5.1%). As a result, the testing approach to these injured individuals accommodated their injuries as safely as possible.

8.6.1 Summary of inconsistent tests

As a result of this protocol evolving from test to test, the measurement of some of the variables were not kept consistent over the three measurements. Therefore norms could only be determined for those variables that were measured consistently since these variables consisted of a reasonable base size. Descriptive statistics for these inconsistent variables have been provided for reference purposes.

The Scrumhalf tyre pass and the Hooker Throw in at 6m, 8m and 10m had very small base sizes and did not adequately simulate the game environment. It is for this reason that these tests were discarded. The Kick for Accuracy (quadrant) was

incredibly difficult and was discarded as a result, with the associated suggestion being that this test be modified into a training drill for kicking accuracy. The Accuvision1000 “120 lights” test took too long to perform and was discarded as a field testing test, with the associated suggestion being that it be used for laboratory testing.

Further brief commentary will be provided for the S-Test, the Kick for Distance and the Kick for Distance and Accuracy tests.

In the first S-Test measurement (protocol 1), most players had an almost perfect score out of 30 with a mean of 29.86. This high level of success was attributed to the “live” targets that were used for protocol one and the fact that they compensated for bad passes by making an effort to retrieve these wayward passes. Changes were brought about for protocol 2 as described in chapter seven.

The scores and the scoring process were discussed in the preceding section of this chapter. The final S-Test in its current form has been included in the final test protocol for this study. What can be said about this test, however, is that the backs outperformed the tight-forwards and loose-forwards and therefore have better passing (under pressure) skills at speed than do the forwards. The further intra-group advantage of this test has been discussed earlier.

For the Kick for Distance test, the Blue Bulls U/21 showed a higher average kick for distance score with means between 45 and 49 metres followed by the South Africa U/21 with means ranging between 23 and 31 metres. The large differences between these groups cannot be explained and the suggestion has been made that the scores of the Blue Bulls U/21 be used for future reference and comparison. While this test was modified to form the kick for distance and accuracy test when testing the Tuks Rugby Academy in test 3/protocol 3, it is still a very valid and reliable test for kicking ability and can also be used in the future. Means and standard deviations have been provided for this purpose. With the Kick for Distance and Accuracy as

performed on the TUKS Rugby Academy, means ranging between 32 and 39 have been provided for future reference and comparison. This Kick for distance and accuracy test has been included in the final test protocol suggested by this study. To be remembered, however, is that in all three these cases, dominant foot preference is also sure to have played a role in performance.

8.6.2 Summary of consistent tests

From the results of the Kruskall-Wallis tests that tested for statistically significant differences between the three groupings of players the following can be stated:

1) The height and body mass of backs were significantly lower than those of tight-forwards and the loose-forwards. Statistically significant differences were found on all but the triceps skinfold measurement where anthropometrical components were concerned. The measurements of the tight-forwards were statistically significantly higher than the loose forwards and backs. This was especially true for the Body Fat % versus Skinfold measurement.

2) As far as the Physical Motor skills are concerned, no statistically significant difference was found on the vertical jump scores. The backs and the loose-forwards performed significantly better on the 10 metre dash test, with backs performing best in the 10m and 40m metre dash, followed by the loose-forwards. Both performances were statistically significantly higher than the other positions.

Tight-forwards had statistically significant higher T-Test scores than the other two positions, indicating that they took significantly longer to complete the test. Statistically significant differences were also found amongst the tight-forwards on the second and last 3x5x22m Anaerobic Capacity Test. The tight-forwards once again had statistically significant higher scores, indicating a poorer performance on this test.

There were no statistically significant differences found on the Accuvision1000 “30 accurate lights in the fastest time” test although the loose-forwards outperformed the backs who in turn outperformed the tight-forwards.

The norms tables are not summarised and are indicated in prior tables. It should be noted that the categories are non-adjacent from one level to the next. This is caused by, amongst other things, the fact that the data that was worked with was done so on a ratio level with 2 decimal places and that with the relatively small sample sizes, all the possibilities could not be included, even in the simulations.

It is advised that all the scores obtained in subsequent testing according to this protocol and associated norms be measured against these tables by rounding down to the lower category. Therefore, if category one ends at 2.3 and category two starts at 2.5, all measurements lower than 2.5 be considered to fall in category one.

The results of the calculated S-Test total score could not be simulated due to the categorical nature of the data. Players could score 0, 5, 10 and 20 respectively and it was simply not practical to simulate these scores for a bigger sample. The results of frequency distributions per position were thus used to get an indication of performance.

These results indicated that across the grouped positions, a total calculated S-Test score of 10 seems to discriminate between poor and better performances. A smaller proportion of tight-forwards scored 10 points and larger proportion scored five points or less, possibly indicating the differences in roles between the grouped positions. The number of players against which these score were determined was low however, and should this specific test should be investigated further in other studies.

In conclusion of this section, the loose-forwards outperformed the tight-forwards and the backs in everything except body mass, stature and vertical jump in which the tight forwards had the highest scores, as well as the subscapular skinfold, the S-Test

for passing accuracy, the 10m and the 40 metre dash in which the backs had the better scores. In these tests, however, the loose-forwards consistently had the second best scores followed by the remaining position. It is common knowledge that South Africa is “blessed” with multitude of skilled and able loose-forwards and this continued tend is confirmed by these tests. In chapter nine, conclusions and recommendations are made based on the two main aims of this study. Conclusions and recommendations will also be made regarding the empirical design and approach adopted by this study.