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THE PHYSIOLOGICAL PROFILE OF A RUGBY PLAYER

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INTRODUCTION

Benjamin Franklin once wrote:
"In this world nothing can be said to be certain except death and taxes."

At the end of the twentieth-century there should be a modification to this statement and it should read: "In this world nothing can be said to be certain except death, taxes and being evaluated."

From the moment we are born to the moment we die, we are evaluated. Clearly, evaluation is an important part of our daily life. Evaluation is found in some form in all professions. In business and industry it is known as quality control or quality assurance. As can be seen measurement is a universal practice engaged in by humans in many aspects of their lives. Therefore, there are many possible answers to the question "Why measure?". In general, however, most intentional human behaviour consists of a process that involves the establishing of some value or criterion, the exercising of a judgment, and a follow-up involving a choice. Most of the time this process is informal. For instance, in all sport, evaluation occur whenever a player or coach must make a choice - when a rugby player kicks rather than passes to a teammate, when a rugby coach chooses his team. Most of the time the evaluation of their choices will be informal. Informal evaluation can sometimes, however, be inaccurate and even biased because of their highly subjective nature. Formal measurement is a prerequisite to evaluation that are more likely to be honest and accurate. So perhaps a general answer to the question of "Why measurement"? is to formalize the evaluation process. It must be realized that tests are merely the tools of measurement. The test itself never makes decisions, the test user does!

After thirty years of sport isolation the prediction and potential testing for participation in sport is priority number one in South Africa sport. Although factors such as muscular strength, power, and endurance are known to contribute to sport performance, few investigations have attempted to quantify this factors in rugby players. Profile evaluation is now considered to be an important part of screening sportsmen in various sports. The biggest problem, however, is the lack of norms and/or standards. The purpose of this study was to determine the physiological parameters that plays an important role in peak rugby performance and to draw up performance scales that can be used as normative data.

METHOD

One hundred eighty-five rugby players from senior clubs who participated in the first league were used as subjects. All the tests were conducted on one day, but adequate resting time was allowed between the tests. The players were allowed to drink water ad libitum. An intensive study on the game rugby was done to determine which physiological parameters plays an important role in peak rugby performance. The following parameters were identified: body composition, muscle strength of the legs and shoulder girdle, explosive power of the legs, flexibility, endurance of the abdominal muscles, speed, anaerobic power and aerobic power. In accordance with the above mentioned parameters the following tests were chosen:

1. Percent body fat:

Anthropometric fractionation of body mass is important for performance evaluation of sportsmen and the monitoring of training. Of important is that excess body fat serves no useful function for the athlete and represents extra weight to be carried around. The composition of the body is thus an important aspect of fitness. It is however not an indication of fitness. It plays an important role in the effective use of energy. The biceps-, triceps-, subscapular-, and supra-iliac skinfolds, in conjunction with the combined formulas of Siri (1956) and Durnin & Rahaman (1967), were used to estimate the percentage body fat of the rugby players.

2. Isokinetic muscle strength:

Isokinetic muscle strength is the ability of a muscle group to deliver a force against resistance in a single maximum effort. The more a muscle develops, the faster and stronger it contracts. Muscle strength is expressed as percentage of body weight so as to be more comparative. The higher the percentage, the higher the muscle strength development.
The peak torque ratio is indicative of the agonist-antagonist ratio, where the agonist is the muscle group which is involved in the action and the antagonist is the muscle which counteracts the motion to extreme values and so doing prevents injuries. The ratio is thus of the utmost importance in the prevention of injuries as well as to the contraction of the total muscle group of a limb. The peak torque values of the quadriceps- and hamstring muscle groups and their ration were assessed by the Cybex II isokinetic dynamometer.

3. Flexibility

Flexibility is an important aspect in the prevention of injuries. Sportsmen with muscles lacking in flexibility have a restricted range of motion in their joints and are therefore more injury prone than other sportsmen with good flexibility. A thorough stretching program must be followed, preferably every day and should form an integral part of your training program. It should, however, be preceded by a warm-up. With the sit-and-reach test the suppleness of the lower back and hamstring muscles are assessed. The 23 cm mark must be in line with the feet and the stretch must be held for at least 3 seconds. Flexibility of the lower back and legs are important for a healthy back and a touch-your-toe criterion is consistent with minimum standards needed for a healthy back. It is important for rugby players because it promotes freedom of movement, reduces muscle soreness, and helps to prevent muscle injuries.

4 & 5 Strength testing

Functional strength and endurance of specific muscle groups is of utmost importance. These tests give an indication of the functional strength of these specific muscle groups in relation to body mass. The pull-up test was used to measure arm and shoulder girdle strength and endurance. The rugby player hangs from the bar using the overhand grip (palm forward) with the legs and arms fully extended. His feet should not touch the floor. He pulls himself upward until his chin is over the bar and then lower his body to a full hanging position. Body swinging, knee raising or leg kicking were not permitted. He repeats the exercise as many times as possible (Bosco & Gustafson, 1983). the 1RM bench press test was used to measure chest, arm and shoulder girdle strength. The grip is shoulder width (Barrow et al.,1989).

6. Trunk flexion

Trunk flexion indicates the endurance of the abdominal muscle groups. When as sportsman has weak abdominal his muscle endurance and respiration is also affected. When the sportsman can not lift his legs properly anymore he will tire and can not continue running. The improvement in endurance and strength of the abdominal muscle groups are also important for minimising lower back injuries as they support the spinal column.

7. Sargeant jump

Explosive power is the maximum explosive muscle strength achieved in a short powerful application using the large muscles of the legs. It is an indication of speed potential or fast strength application from a standing position. To make the Sargeant jump test more valid as a measure of the explosive leg power, the Lewis nomogram can be used (Fox et al.,1993) by using the body weight and distance jumped. The power output is expressed in Kg-m/sec.

8. 50 m Dash

To be a successful rugby player you must have speed. Sometimes the difference between a good and average player is the ability to accelerate and maintain a high speed over a short distance. With the 50 m dash this ability is measured. The player takes up position behind the starting line. On the command "go" he runs as fast as he can across the finish line. The score is the elapsed time to the nearest tenth of a second between the starting line and the finish line (Fox et al., 1993).

9. 10 x 22 Shuttle run

During a rugby game the distance covered by a rugby player are relatively short and fast, therefore the ATP-PC and lactic acid energy systems (anaerobic metabolism) are primary used to deliver the necessary energy during the activity. With the 10 x 22 m shuttle run both speed and anaerobic potential are tested. The player stands on the goal line. On the signal "go" the rugby player runs as fast as he can to the 22 m line, touch the ground with the hand on the opposite line of the 22 line and runs back to the goal line. He repeats this exercise 5 times as fast as possible and his score is the elapsed time in seconds and tenths of seconds.

10. 3000 m Cross-country

Both the aerobic and the anaerobic systems contribute ATP during exercise, however, their relative roles on the type of exercise performed and the state of training (Fox et al.,1993). the energy sources for a given activity are time and intensity dependant. The primary source of energy will be dependent on the performance time that can be maintained at a given intensity. If we look at a rugby game, we will see that it is a game in which long periods of low activity are interspersed with bursts of high-intensity action-sprinting after a ball or opponent. The percentage of emphasis that should be placed on training the various energy systems in rugby are as follows: ATP-PC and lactic acid 60%, lactic acid-oxygen 20% and oxygen 20%. A rugby player must have a "good" aerobic base with the ability to use the predominant systems when called on.

PERFORMANCE SCALES

In the drawing up of the percentage scales, the parameters which describe the normal distribution (arithmetic average (AA) and standard deviation (SD) were used. The exact absolute values of these parameters are determined by the absolute values of the raw data. The result is that all the measured values are arranged around the AA and SD in a predictable and symmetrical manner. It is however sometimes necessary to compare values from various populations or values which are not measured in the same units. This implies that the data needs to be transformed in order to transfer all values to a comparable standard. One of the best ways to do this is to use the z-transformation where the "new" AA of the data becomes 0 with a SD of ± 1. The disadvantage of this is that the performance scale runs through zero from a negative number to a positive number. Although these numbers seem logical, the absolute values within the scale are not obvious and explanatory as some other scales.

To solve this problem the z-transformation can be adjusted in order to display the final scale in percentages, which makes interpretation much easier. What happens in this case is that there is decided on a required AA and SD (as percentage) and all data is then arranged in a correct proportion around these two parameters, a in normal distribution. The selected parameters were as follows: AA = 60% and SD = 10%. The formula for this transformation is as follows:
performance as % = a + {[(x - AA)/(SD)].b}
where a = the chosen new AA as percentage
b = the chosen new SD as percentage
{(x - AA)/(SD)} = the Z- transformation.

It is very important to remember that the formula as given implies that a direct proportional ration exists between the absolute data value and the percentage allocated. However, if the relationship is inverse proportional, the plus (+) must be replaced by a minus (-) (Krüger et al. 1992). By using the z-transformation a performance scale for each test could be drawn up (Tables I - X), and with performance scales it was possible to award a percentage to each performance. The mean of the ten tests were calculated, and that value was used to describe the physiological profile of the player. That value could then be used by the selectors as an additional parameter to choose between two players who compete for the same position. Now for the first time subjectivity does not play such a big role in the selection of a rugby team.

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TABLE I: NORMATIVE SCALE FOR PERCENTAGE BODY FAT

PERCENTAGE BODY FAT	
%	VALUE (%)
20	31.5
25	29.5
30	27.5
35	25.5
40	23.5
45	21.8
50	19.0
55	17.0
60	15.0
65	13.0
70	11.0
75	9.8

TABLE II: NORMATIVE SCALE FOR PEAK ISOKINETIC MUSCLE STRENGTH (ABSOLUTE AND RELATIVE).

PEAK TORQUE				
QUADRICEPS			HAMSTRING	
ABS (Nm)	REL (Nm/kg)	%	ABS (Nm)	REL (Nm/kg)
135	1.00	40	65	0.55
160	1.60	45	80	0.85
185	2.20	50	98	1.20
210	2.90	55	113	1.50
235	3.40	60	128	1.80
265	4.00	65	143	2.15
290	4.60	70	158	2.50
315	5.20	75	173	2.80
340	5.80	80	190	3.10

HAMSTRING:QUADRICEPS RATIO = 0.54

TABLE III: NORMATIVE SCALE FOR THE SIT-AND-REACH TEST

SIT-AND-REACH	
%	VALUE (cm)
20	+16
25	+14
30	+12
35	+10
40	+8
45	+6
50	+4
55	+2
60	0
65	-2
70	-4
75	-6
80	-8
85	-10
90	-12
95	-14

TABLE IV: NORMATIVE SCALE FOR PULL-UPS

PULL-UPS	
%	VALUE (n)
45	1
50	3
55	5
60	7
65	9
70	11
75	13
80	15
85	17
90	19
95	21
100	23

TABLE VII: NORMATIVE SCALE FOR THE SARGEANT JUMP (EXPLOSIVE POWER)

SARGEANT JUMP (LEWIS NOMOGRAM)	
%	VALUE (kg-m/sec)
20	9
25	14
30	22
35	37
40	49
45	64
50	79
55	94
60	106
65	122
70	137
75	149
80	164
85	179
90	192

TABLE VIII: NORMATIVE SCALE FOR THE 50m DASH

50m DASH	
%	VALUE (sec)
20	8.90
25	8.65
30	8.40
35	8.15
40	7.90
45	7.65
50	7.40
55	7.18
60	6.95
65	6.70
70	6.45
75	6.20
80	5.95
85	5.70

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SARGEANT JUMP (LEWIS NOMOGRAM)	
%	VALUE (kg-m/sec)
20	9
25	14
30	22
35	37
40	49
45	64
50	79
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60	106
65	122
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85	179
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TABLE VIII: NORMATIVE SCALE FOR THE 50m DASH

50m DASH	
%	VALUE (sec)
20	8.90
25	8.65
30	8.40
35	8.15
40	7.90
45	7.65
50	7.40
55	7.18
60	6.95
65	6.70
70	6.45
75	6.20
80	5.95
85	5.70

TABLE V: NORMATIVE SCALE FOR THE BENCH PRESS

BENCH PRESS	
%	VALUE (kg)
20	5
25	11
30	18
35	25
40	33
45	40
50	48
55	54
60	62
65	69
70	76
75	81
80	90
85	98
90	104
95	112

TABLE VI: NORMATIVE SCALE FOR TRUNK FLEXION

TRUNK FLEXION	
%	VALUE (n)
20	22
25	32
30	42
35	52
40	62
45	72
50	82
55	92
60	102
65	112
70	122
75	132
80	142
85	152

TABLE IX: NORMATIVE SCALE FOR THE 10 x 22m SHUTTLE RUN

10 x 22m SHUTTLE RUN	
%	VALUE (sec)
20	59.5
25	58.0
30	58.9
35	56.8
40	56.0
45	54.2
50	52.5
55	51.2
60	50.4
65	49.0
70	47.8
75	46.5
80	45.5
85	44.2

TABLE X: NORMATIVE SCALE FOR THE 3000m CROSS COUNTRY RUN

3000m CROSS COUNTRY	
%	VALUE (sec)
20	1475
25	1410
30	1340
35	1280
40	1215
45	1150
50	1090
55	1020
60	960
65	900
70	835
75	775
80	710
85	650

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