CHAPTER 4

RESULTS

Chapter 4 is a presentation of the results obtained by administering the various tests outlined in Chapter 3. body mass, height, percentage body fat, lean body mass, somatotype components, VO_{2max}, running economy as well as components of muscle strength and endurance are highlighted as being those factors which may influence success in a triathlete.

4.1 Physical Characteristics

TABLE 4: General Physical Characteristics (mean ± standard deviations)

	Triathletes n = 12	**Runners n = 8**	**Swimmers n = 6**	**Cyclists n = 8**
Age (yr)	27.5 ± 5	25.5 ± 5.1	22.5 ± 7.3	26.75 ± 7.3
Mass (kg)	71.83 ± 4.9	* 64.00 ± 5.5	* 77.89 ± 9.0	72.84 ± 9.9
Height (cm)	179.08 ± 4.6	175.18 ± 7.3	182.95 ± 5.6	178.77 ± 8.3
Body Fat (%)	12.22 ± 1.7	9.47 ± 2.7	12.3 ± 2.5	11.38 ± 4.6
LBM (kg)	62.88 ± 4.3	* 57.72 ± 4.9	* 69.4 ± 8.7	64.09 ± 6.3

*** = significantly different from other * indicated values (eachother) ($p<0.05$)**

The mean values and standard deviations of the anthropometric characteristics and maximal aerobic capacities and running economies of the four groups are presented in Tables 4 – 9, and Figures 1 – 8.

The mean ages of the athletes in this study were very similar, ranging from 22.5 to 27.5 years. In all four anthropometric measurements namely height, body mass, percentage body fat and lean body mass, swimmers portrayed the highest mean values while runners portrayed the lowest.

Figure 1:

Body Mass measured in kilograms of Triathletes, Runners, Swimmers and Cyclists. (Means ± SD). *Runners vs Swimmers differ significantly ($p < 0.05$).

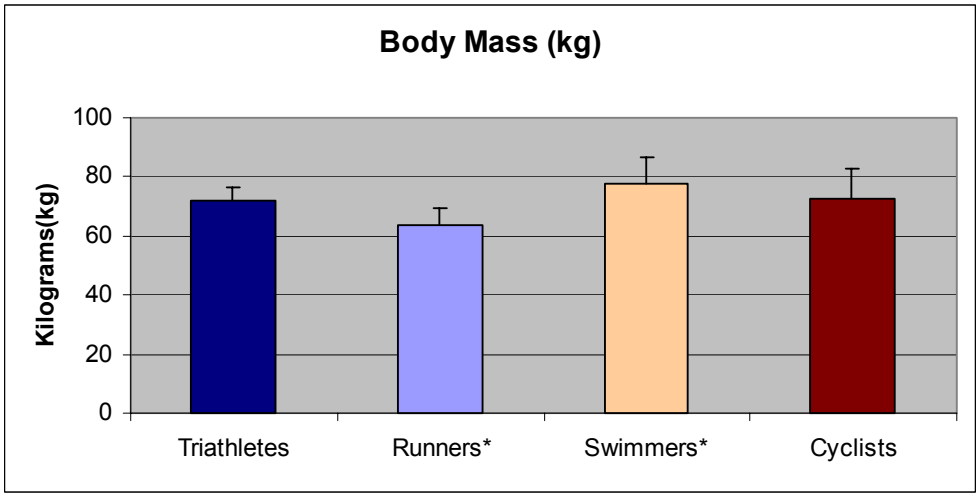


Figure 2:

Height measured in centimetres of Triathletes, Runners, Swimmers and Cyclists. (Means ± SD). No significant differences between the four groups.

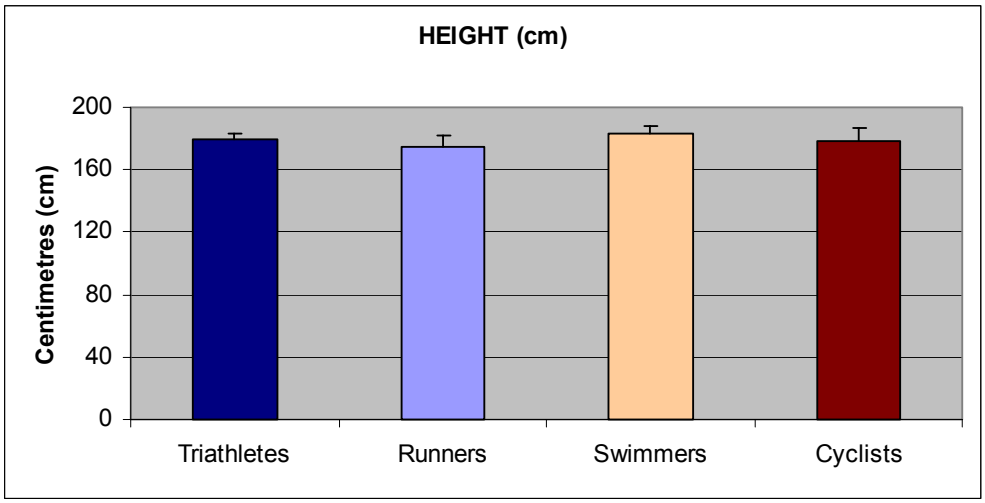


Figure 3:

% Body Fat of Triathletes, Runners, Swimmers and Cyclists. (Means ± SD). No significant differences between the four groups.

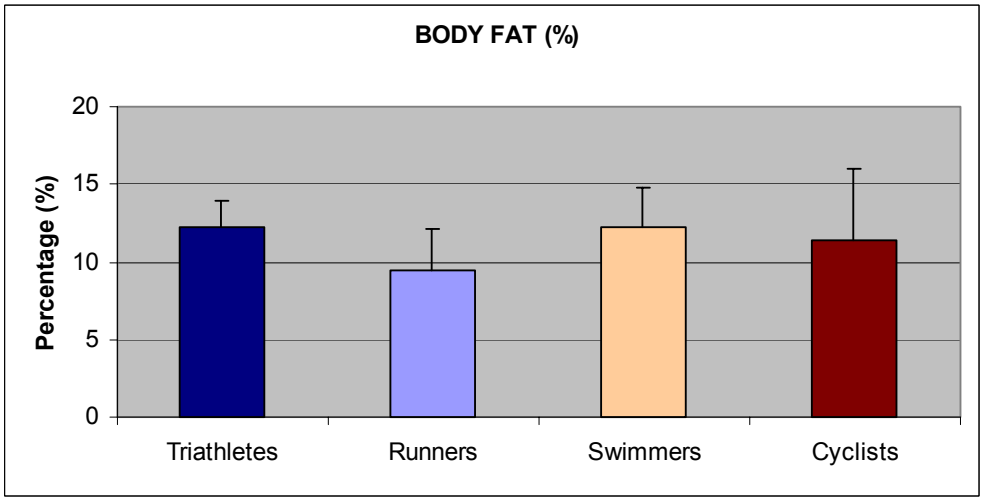
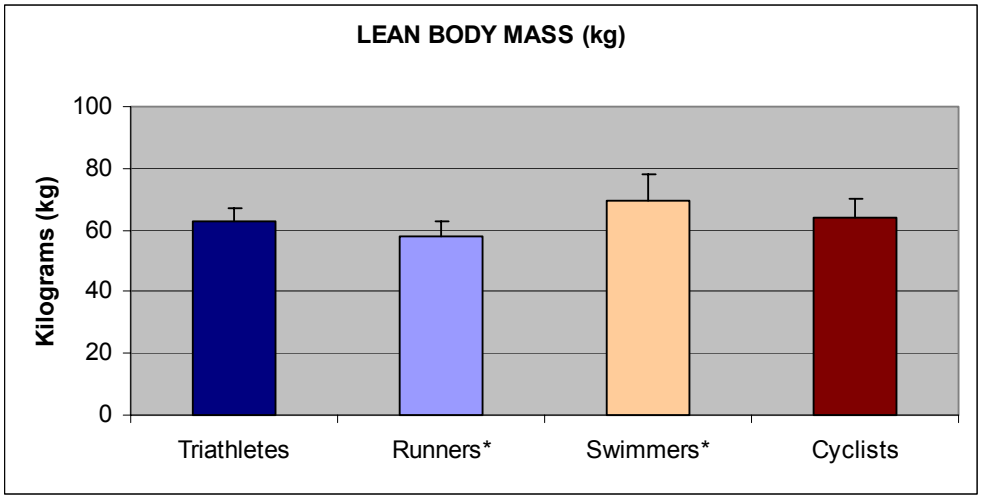


Figure 4:

Lean Body Mass measured in kilograms of Triathletes, Runners, Swimmers and Cyclists. (Means ± SD). * Runners vs Swimmers differ significantly ($p<0,05$).



Body mass (kg) and lean body mass (kg) were significantly greater in the swimmers than in the runners ($P<0.05$). The lowest body mass recorded in this study was that of a runner (56.7kg) while the heaviest athlete in this study was a swimmer (92.kg).

Triathletes had a mean weight very similar to that of cyclists (71.8kg and 72.8kg respectively). The percentage body fat of triathletes was very similar to that of swimmers and cyclists, with runners being the only group of athletes with a body fat less than 10%.

4.2 Anthropometric measurements

TABLE 5: Means (± Standard Deviations) of Anthropometric Measurements

	Triathletes	**Runners**	**Swimmers**	**Cyclists**
Skinfolds (mm)				
Triceps:	8.55 ± 1.41	6.25 ±1.64	7.30 ± 1.49	6.87 ± 1.59
Subscapular:	8.68 ± 1.33	7.93 ± 1.86	9.92 ± 1.67	8.79 ± 3.54
Suprailiac:	5.32 ± 1.02	5.10 ± 1.38	6.13 ± 1.80	7.20 ± 3.60
Calf (medial):	6.22 ± 1.74	4.93 ± 1.13	5.31 ± 1.29	6.05 ± 1.29
Bone Widths (cm)				
Humerus	63.05 ± 6.10	61.77 ± 8.28	62.91 ± 7.47	60.91 ± 4.39
Femur	89.98 ± 6.50	82.50 + 5.95	92.00 ± 4.74	83.53 ± 3.94
Girths (cm)				
Biceps:	32.32 ± 1.16	30.96 ± 3.67	34.63 ± 3.45	32.20 ± 2.74
Calf:	37.55 ± 1.09	35.61 ± 1.71	36.92 ± 2.11	37.40 + 2.66

The anthropometric measurements that were used to calculate percentage body fat as well as the Heath-Carter somatotype components (namely skin folds, bone breadths and girths), did not differ significantly between the four groups of athletes.

4.3 Somatotype Rating

TABLE 6: The Heath-Carter Anthropometric Somatotype Components (Means ± Standard Deviations)

	Component I Endomorphy	Component II Mesomorphy	Component III Ectomorphy
Triathletes	2.0 + 0.33	3.8 + 0.91	2.8 + 0.57
Runners	1.8 + 0.65	3.1 + 1.29	3.5 + 1.13
Swimmers	2.0 + 0.5	3.9 + 0.89	2.7 + 1.15
Cyclists	2.0 + 1.06	4.0 + 1.55	2.8 + 1.25

TABLE 7: Mean Somatotype Component Ratings (to the nearest half unit as recommended for simplicity in conversation and written summaries by Carter, J. E. L., 2003)

	Component I (Endomorphy)	Component II (Mesomorphy)	Component III (Ectomorphy)
Anthropometric Somatotype of Triathletes	2	4	3
Anthropometric Somatotype of Runners	2	3	3,5
Anthropometric Somatotype of Swimmers	2	4	2,5
Anthropometric Somatotype of Cyclists	2	4	3

There were no statistically significant differences between the three somatotype components, namely endomorphy, mesomorphy and ectomorphy. While statistically non significant, the endomorph component portrayed runners as numerically having the lowest value of relative fatness while the other three groups were exactly the same.

The mesomorph component portrayed runners as again having the lowest numerical value of relative muscle, while the other three groups were again very similar.

The ectomorph component showed runners as having the highest numerical value of relative thinness.

Figure 5:

Somatotype Components:

Endomorphy, Mesomorphy and Ectomorphy ratings of Triathletes, Runners, Swimmers and Cyclists. (Mean ± SD). No significant differences between the four groups.

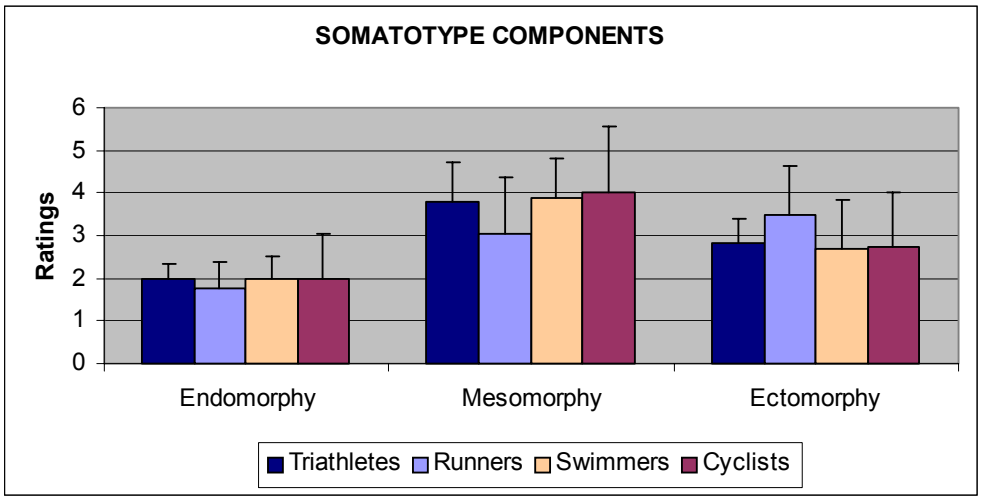
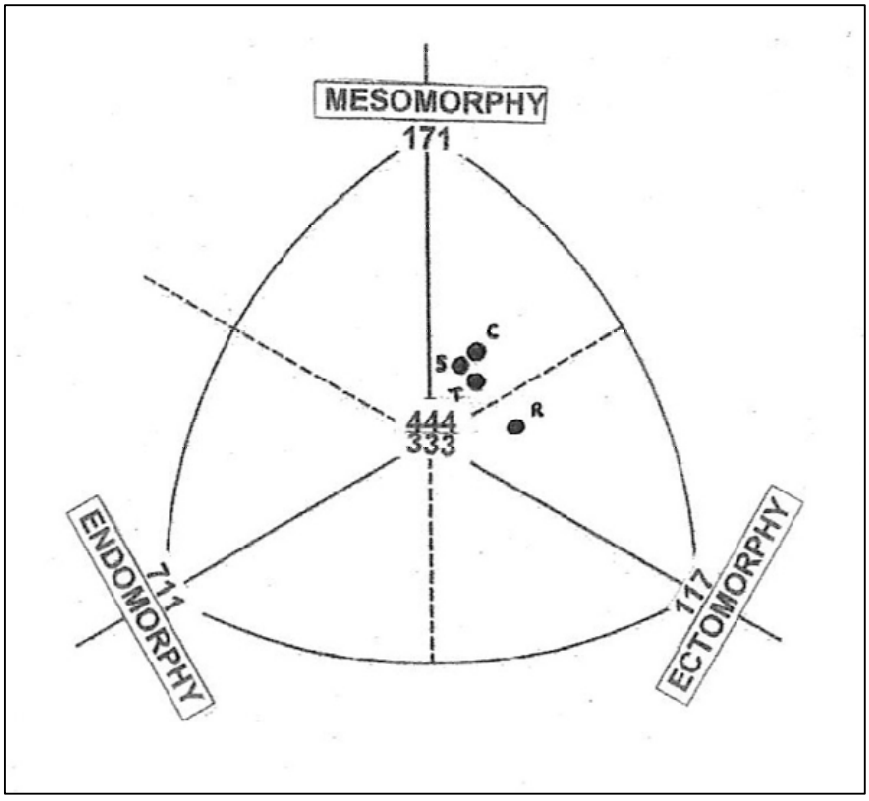


Figure 6:

Mean Somatotypes for Triathletes (T), Runners (R), Swimmers (S) and Cyclists (C) as plotted on a Heath-Carter Somatochart.



Triathletes, Swimmers and Cyclists are clearly Ectomorphic Mesomorph. Runners are clearly Mesomorphic Ectomorph.

4.4 Physiological Components

TABLE 8: Physiological profile of the triathletes, runners, swimmers and cyclists (Means ± Standard Deviation)

	Triathletes	Runners	Swimmers	Cyclists
VO2max. (ml/kg.min)	62.59 ± 3.90	* 64.51 ± 4.37	* 57.13 ± 4.26	62.00 ± 2.57
Running Economy (ml02/kg.km)	187.62 ± 5.10	184.9 ± 13.86	210.85 ± 13.41	200.40 ± 23.18

* = Significantly different from each other (P< 0.05)

Swimmers had the lowest mean VO2max. value (57ml/min.kg) and the least favourable running economy ie, the highest energy cost of running (211mlO2/kg.km) of the four groups of athletes.

Runners on the other hand, displayed the highest mean VO2max. value (65mlO2/min.kg) and the most favourable running economy of the four groups (185mlO2/kg.km). The difference in VO2max. between runners and swimmers was statistically significant (P<0.05).

The VO2max. values of triathletes and cyclists were almost identical, however triathletes, as would be expected, had a more favourable running economy. The aerobic capacity of triathletes was most similar to that of runners.

Figure 7:

VO_{2max}. (mlO2.kg.min^{-1}) of Triathletes, Runners, Swimmers and Cyclists (Mean + SD). * Runners vs Swimmers differ significantly (P< 0,05).

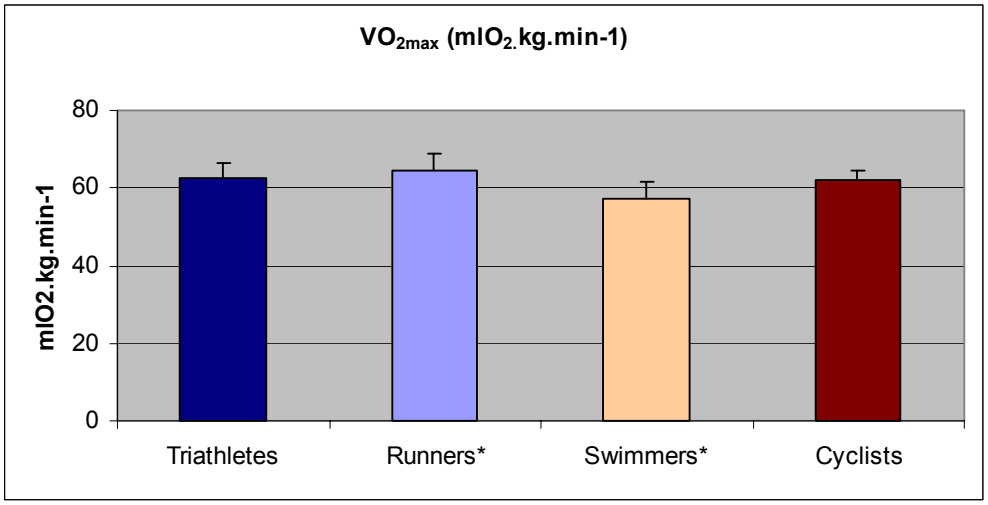
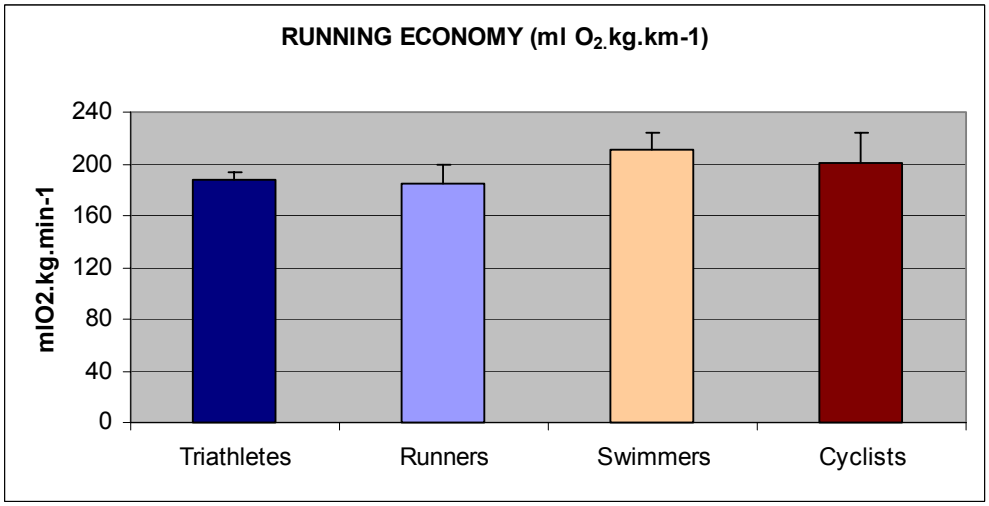


Figure 8:

Running Economy measured in $mlO_2.kg.min^{-1}$ of Triathletes, Runners, Swimmers and Cyclists (Mean + SD). No significant differences between the four groups.



4.5 Muscle strength and endurance

TABLE 9: **Muscle Strength and Endurance for the triathletes, runners, cyclists and swimmers**

MUSCLE STRENGTH AND ENDURANCE	T	R	C	S
Knee flexion / extension at 60°/s				
Peak Flex Torque (Nm)	152.28 ± 22.19	137.12 ± 9.78	149.24 ± 25.26	140.98 ± 29.18
Flex Torque / BW ratio ($Nm.kg^{-1}$)	2.10 ± 0.30	2.18 ± 0.18	2.15 ± 0.34	1.8 ± 0.20
Peak Ext Torque (Nm)	267.31 ± 23.37	240.19 ± 31.13	278.99 ± 66.81	248.62 ± 47.09
Ext Torque to BW ratio ($Nm.kg^{-1}$)	3.67 ± 0.27	3.68 ± 0.39	3.98* ± 0.57	3.19* ± 0.34
Peak Flex / Ext Torque (%)	59.07 ± 10.10	57.86 ± 7.87	46.43 ± 18.25	57.35 ± 10.84
Shoulder flexion / extension at 60°/s				
Peak Flex Torque (Nm)	61.83 ± 22.97	71.95 ± 6.58	67.55 ± 24.90	64.31 ± 15.16
Flex Torque / BW ratio ($Nm.kg^{-1}$)	1.01 ± 0.23	1.14 ± 0.12	1.17 ± 0.30	1.03 ± 0.28
Peak Ext Torque (Nm)	113.07 ± 16.08	95.29 ± 19.99	105.38 ± 26.85	107.45 ± 27.42
Ext Torque / BW ratio ($Nm.kg^{-1}$)	1.55 ± 0.19	1.50 ± 0.25	1.53 ± 0.43	1.4 ± 0.42
Peak Flex / Ext Torque (%)	65.97 ± 17.65	78.31 ± 17.79	79.29 ± 25.61	83.64 ± 46.98
Knee Flexion / Extension at 160°/s				
Peak Flex Torque (Nm)	171.50 ± 32.0	168.16 ± 25.94	170.42 ± 27.69	171.37 ± 48.06
Work done during Flex (J)	1695.7 ± 425.53	1429.11 ± 227.16	1717.50 ± 389.32	1460.99 ± 276.97
Work done to BW ratio	23.49	22.32	23.90	18.66

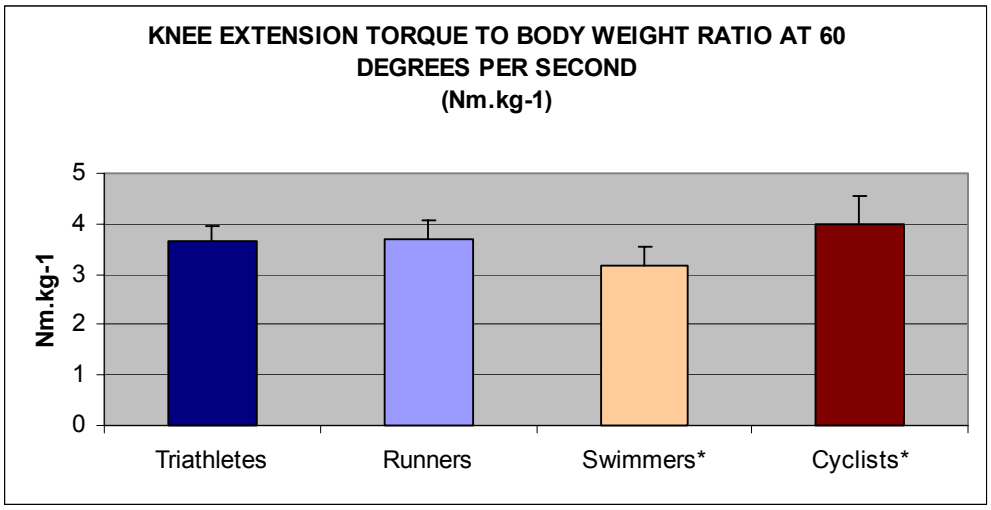
($J.kg^{-1}$)	± 6.15	± 2.18	± 4.23	± 2.14
Peak Ext Torque (Nm)	220.52 ± 63.69	184.11 ± 36.00	216.64 ± 46.66	218.82 ± 28.15
Work done during Ext (J)	2523.76 ± 472.58	2062.63 ± 471.28	2533.46 ± 695.36	2427.53 ± 328.95
Work done / BW ratio ($J.kg^{-1}$)	34.97 ± 7.09	32.03 ± 5.13	35.19 ± 7.85	31.19 ± 2.67
Shoulder Flexion / Extension at 160°/s				
Peak Flex Torque (Nm)	83.26 ± 10.01	76.86 ± 9.22	76.47 ± 21.41	67.25 ± 30.46
Work done during Flex (J)	965.08 ± 144.32	935.30 ± 243.48	976.59 ± 344.67	1209.43 ± 465.67
Work done / BW ratio ($J.kg^{-1}$)	13.28 ± 1.81	14.56 ± 3.51	13.46 ± 3.67	15.29 ± 4.39
Peak Ext Torque (Nm)	121.96 ± 19.84	99.21 ± 15.47	118.82 ± 20.14	135.01 ± 33.01
Work done during Ext (J)	1517.15 ± 320.90	1164.41 ± 349.47	1276.96 ± 412.07	1223.7 ± 614.95
Work done / BW ratio ($J.kg^{-1}$)	20.73 ± 3.30	17.97 ± 4.87	17.87 ± 6.14	20.31 ± 7.19
Knee Flexion / Extension at 245°/s				
Endurance ratio for flex (%)	91.59 ± 18.89	98.39 ± 34.42	84.35 ± 9.40	104.86 ± 17.83
Endurance ratio for ext (%)	75.18 ± 12.48	78.57 ± 12.00	79.09 ± 8.68	89.81 ± 9.75
Shoulder Flexion / Extension at 245°/s				
Endurance ratio for flex (%)	93.33 ± 10.20	82.89 ± 11.48	88.89 ± 15.95	97.63 ± 23.11
Endurance ratio for ext (%)	95.77 ± 10.84	79.32 ± 14.88	97.76 ± 18.85	89.50 ± 18.61

Muscle strength and muscle endurance for knee and shoulder flexors and extensors, showed only one significant difference. Knee extension torque to body weight ratio at 60º/sec was significantly less in swimmers (3.19Nm.kg^{-1}) than in cyclists (3.98Nm.kg^{-1}).

The triathletes showed no significant differences to any of the single sport athletes.

Figure 9:

Knee Extension Torque to Body Weight Ratio at 60°/s measured in Nm.kg^{-1} (Mean ± SD). ***** Swimmers vs Cyclists differ significantly (P<0,05).



From the data collected on elite South African triathletes in this study, a mean profile of elite South African triathletes has been tabulated.

TABLE 10: Profile of Physical and Physiological Characteristics of an elite South African Triathlete

VARIABLE (Units)	TRIATHLETE **(n = 12)**	**STANDARD DEVIATION (+)**
Age (years)	27.5	5
Mass (kg)	71.83	4.9
Height (cm)	179.08	4.6
Body Fat (%)	12.22	1.7
LBM (kg)	62.88	4.3
Skinfolds (mm)		
Triceps	8.55	1.41
Subscapular	8.68	1.33
Suprailiac	5.32	1.02
Calf (medial)	6.22	1.74
Bone Breadths (cm)		
Humerus	6.30	0.61
Femur	8.99	0.65
Girths (cm)		
Biceps	32.32	1.16
Calf	37.55	1.09
Endomorph	2.0	0.33
Mesomorph	3.8	0.91
Ectomorph	2.8	0.57
VO2max. (ml/kg.min)	62.59	3.90
Running Economy (ml.kg.km)	187.62	5.10

TABLE 11: Muscle Strength and Endurance of an Elite South African Triathlete

KNEE FLEXION / EXTENSION AT 60 DEGREES PER SECOND	TRIATHLETE **(n = 12)**	**STANDARD DEVIATION (±)**
Peak flexion torque (Nm)	152.28	22.19
Peak extension torque (Nm)	267.38	23.37
Flexion torque to body weight ratio ($Nm.kg^{-1}$)	2.096	0.3
Extension torque to body weight ratio ($Nm.kg^{-1}$)	3.674	0.27
Peak flexion to extension torque (%)	59.07	10.10
KNEE FLEXION / EXTENSION AT 160 DEGREES PER SECOND		
Knee flexion (Nm)	171.5	32.0
Knee extension (Nm)	220.52	63.69
Work done during flexion (J)	1695.69	425.53
Work done to body weight ratio ($J.kg^{-1}$)	23.49	6.15
Work done during extension (J)	2523.76	472.58
Work done to body weight ratio ($J.kg^{-1}$)	34.97	7.09
SHOULDER FLEXION / EXTENSION AT 245 DEGREES PER SECOND		
Shoulder endurance ratio for flexion (%)	93.33	10.20
Shoulder endurance ratio for extension (%)	95.77	10.84