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Anthropometric and somatotype characteristics of undergraduate students of the National University of Science and Technology, Zimbabwe

Abstract

Objective: The present study aimed at evaluating anthropometric and somatotype characteristics of male and female part-time university students in the department of sports science and coaching.

Methods: 20 students were randomly selected for the investigation. The International Society for the Advancement of Kinanthropometry (ISAK 2011) standardised procedures were used to measure anthropometric variables. Measurements included body mass, stretch stature, 8 skinfolds, 5 girths and 2 bone breadths. The body composition variables calculated were body mass index (BMI), waist-to-hip ratio (WHR), percentage body fat (%BF), fat mass (FM), fat-free mass (FFM), fat mass index (FMI) and fat free mass index (FFMI). The Health and Carter method was applied to calculate subjects' somatotype.

Results: The participants' mean age was 38±12years, height 1.68±7.48m body mass 71.47±13.23kg, height 1.68±7.48m, sum of eight skinfolds 116.24±52.53mm, body mass index (BMI) 25.07±3.18, body fat (BF) of 1.05±0.14 %, waist-to-hip ratio (WHR) 0.81±0.09, fat mass (FM), was 1.37±6.35 kg, fat-free mass (FFM) 57.73±9.97 kg, fat-mass index (FMI) 4.81± 2.17 and free fat-mass index (FFMI) 20.1.06 ±2.12. From the above values; there was no warning of risk to hypokinetic health problems. No significant differences among final year male and female students in the sports science and coaching department in terms of all the variables, except for waist-to-hip ratio (WHR), fat-free mass (FFM) and fat-mass index (FMI). In regard to somatotype, the mean for male students was 1.60-0.95-0.88 (endomorphic mesomorph) and for female students was 2.02-1.28-0.90 (mesomorphic endomorph).

Conclusion: Body composition depends much on students' weight. It was established that the female students' fat tissue percentage was relatively high in comparison to their male counterparts. Differences in endomorphy and body composition indices had been observed. Physical activity against the students' nutritional habits, training and exercises and age are vital to parameters of body composition.

Keywords: anthropometry. body composition, somatotype, endomorphy, mesomorphy, ectomorphy

Volume 8 Issue 3 - 2018

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Received: April 13, 2018 | **Published:** June 04, 2018

Introduction

Anthropometric dimensions, body composition, and morphological characteristics have been known to lay fundamental role in success determination of an athlete's potential. To achieve excellence in specific sports, accurate evaluation of the above characteristics chiefly reflect different proportions required on the quantification of the body's structural components.[1–3] Physical characteristics such as the anthropometric profiles and somatotype profiles indicate the suitability of sportsperson's potential participate at peak level in sport.[4,5] An increased interest in anthropometric characteristics, body composition and Somatotype in various competitive sports has been witnessed over the last decades. This allows quantification of the key structural mechanisms of the body; muscle, bone and fat.[6,7]

From over a decade research showed a strong relationship existing between structure and performance[8–11] anthropometric measurements and body composition at universities[12,13] Today's world had greatly changed in the 21st century; the practicality of Sport Science in Zimbabwe is still at its infancy. The success of Zimbabweans globally calls for the scientific study of the uniqueness of the athletes. Zimbabwean university students who have experience and different levels 70 of sport codes qualification is scant. Therefore this study aimed describing data on anthropometric measurements, body composition and somatotyping of university sports science and coaching part-time male and female students.

Methodology

Design

This was a retrospective, observational, descriptive study. The following variables were analysed: anthropometric measurements consisted of height, weight, 8 skinfolds (triceps, subscapular, biceps, iliac crest, supraspinale, abdominal, front thigh and medial calf), 5 girths (arm relaxed, arm flexed and tensed, waist, gluteal, medial calf circumferences), and 2 bone breadths (humerus and femur).

Sample

In a class of 46 students, anthropometric data were collected from a sample of 20 Zimbabwean university part time students; 10 male and 10 female respectively. The age of the students was 38.5±12.5 years.

Students' data were collected during the final semester at National University of Science and Technology, in May 2014. The participants studied were physical education teachers with Diploma in Education and holders of national/international coaching certificates in at least one of the 10 sporting disciplines; athletics, basketball, chess, cricket, karate, netball, soccer, swimming, tennis and volleyball. The data were collected only from part-time Class of 2011 Intake 1.

Ethical consideration

Permission to conduct the study using students as subjects were obtained from the National University of Science and Technology (NUST), Sports science and coaching department. Before data collection, the participants were briefed on the purpose of the study, requirements and demands on them when they participate. Participation was voluntary and subjects could decide not to participate. A verbal consent was obtained from every subject before participation.

Instruments and procedures

The International Society for the Advancement of Kinanthropometry (ISAK 2011) protocols was followed for each assessment.[14]

Below instruments were used:

a. Seca 220R telescopic stadiometer (measuring range: 85-200cm; precision: 1mm.)

b. Seca 710R weighing scale, calibrated beforehand (capacity: 200kg; precision: 50g.)

c. Anthropometric tape (precision: 1mm.)

d. Cescorf Caliper (measuring range: 0-250mm; 116 precision: 1mm.)

e. Harpenden Caliper skinfold caliper (measuring range: 0-48mm; precision: 0.2mm; constant pressure of 10g/mm².)

f. Anthropometer (precision: 1mm.)

g. Additional equipment (a wax pencil for marking the individual, chalk dust.)

Anthropometry

Norton and Olds[15] anthropometric variables and techniques were used. These variables were measured following the International Society of the Advancement of Kinanthropometry (ISAK 2011) protocol.

Derived variables

I. For body composition the following variables were computed:

II. Body mass index (BMI)=Body Mass (BM)/height²

III. Fat mass=body weight (kg)×percentage body fat/100

IV. Fat-free mass=body weight (kg)-fat mass (kg)

V. Fat mass index (FMI) and fat-free mass index (FFMI) were calculated by dividing the fat mass and the fat-free mass by the stature-squared:

VI. Fat mass index=FM/height²

VII. Fat-free mass index=FFM/height²

VIII. Body density (BD) and Percent body fat (%BF) from body density were calculated using[16] equations respectively.

IX. BD=1.0988-0.0004 (X1)

$$\% \, BF = \left(4.570/BD - 4.142\right) X100$$

where: $X_1 = \Sigma 7$ skinfolds in mm (triceps+subscapular+biceps+supraspinale+abdominal+front thigh +medial calf)

The Brozek and Keys[16] equation was used in calculating % BF using the values derived for body density.

where BD is body density.

Sheldon's somatotype classification was useful in finding out the subjects' Somatotype characteristics.[17] The major three components of somatotype were computed using the equations for a decimalised anthropometric somatotype.

The components were completed 162 as follows:

$$Endomorphy = -0.7182 + 0.1451 \times \Sigma\, SF - 0.00068 \times \Sigma\, SF^2 + 0.0000014 \times \Sigma\, SF^3,$$

where: Σ SF = sum of skinfolds (triceps + subscapular + supraspinale).

Correct for height by;[15] $\Sigma\, 3SF \times 170.18 \div Ht\ (in\ cm)$

Mesomorphy= $0.858 \times Humerus\ breadth + 0.188 \times Corrected\ Arm\ girth + 0.161 \times Corrected\ Calf\ girth - Height \times 0.131 + 4.5.$

Ectomorphy = Height – Weight ratio (HWR) according to the following conditions:

a. If HWR≥40.75, then: Ectomorphy = HWR×0.732–28.58

b. If HWR<40.75 but >38.25, then: Ectomorphy = HWR×0.463–17.63

c. If HWR≤38.25, then: then: Ectomorphy = 0.1

Statistical analysis

Mean and standard deviation were calculated and presented (M±SD). Statistical Package in Social Sciences (SPSS) version 20 was used to compute descriptive data. Independent samples t-test was used to test if population means estimated by two independent samples differed significantly. Testing of the differences across sport specialty modules was performed 185 through a one way one-way analysis of variance (ANOVA). Statistical significance was set at probability level of ≤0.05. Somatotype and somatoplots were computed using the Heath-Carter's[18] method, while Somatotype Analysis of Variance (SANOVA) was calculated using the somatotype software Somatotype 1.1 software based on equations by Carter and Heath.[17] Somatoplots and somatotype category charts showing all the profiles from each of the 10 gender based sports were presented. Category charts for each of the gender based sports for 13 somatotype categories were plotted showing the percentage profiles (Table 1).

Table 1 Intake I Block release students body composition descriptive data and ANOVA for females and males (n=20)

	All N=20	Females N=10	Males N=10	ANOVA	
Variable	Mean±SD	Mean±SD	Mean±SD	P value	Significance
Age (yrs)	38.5± 12.5	38.5±12.5	38.5±7.5	0.203	NS
Mass(kg)	71.47± 13.23	66.43±9.39	76.52±14.99	0.088	NS
Height(m)	1.68±0 .07	1.65±0.07	1.70±0 .06	0.102	NS
BMI	25.07±3.18	24.18±2.66	25.96±3.54	0.22	NS
%BF	10.6±0.14	10.5±0.05	10.6±0.13	0. 100	NS
$\sum 8SKF$	116.24±52.53	133.24±55.04	99.23±46 .41	0.152	NS
WHR	0. 81±0.09	0.74±0.05	0.89±0 03	0.000*	s
FM (kg)	13.7±6.35	14.4±6.15	13.0±6.80	0.651	NS
FFM (kg)	57.73±9.97	52 .02±6.09	63.44±10 .01	0.006*	s
FM1	4.81± 2.17	5.25±2.26	4.38±2.10	0.385	NS
FFMI	201.06±2.12	18.92±1.06	21.58±2.12	0.002*	s

Db, body density; BMI, body mass index; WHR, waist-hip-rntio; 2:8SJF, smn of skinfolds; %BF, percentage body fat; FM, fat mass; FFM, fat free mass; FMI, fat mass index; FFMI, fat free mass index.

Results

Body composition measurements

Sports science students indicated significance relationship (0.000) based on gender based waist hip ratio, fat-free mass (0.006) and fat-free mass index (0.002). However, there was a slightly higher adiposity of 10.6% as their average percent body fat (%BF).

Somatotype variables

Table 2 below presents somatotype and body composition of the subjects. Although Carter & Heath[18] defined the 13 categories; the present study showed that all the university students who participated in this study fell into only 5 categories. The mean somatotype of the male students was 3.53-4.99-1.28 and for female students was 4.53-4.04-1.54 hence the part-time sports science intake was categorised as either endomorphic-mesomorphs or mesomorphic – endomorphs; thus muscle-skeletal development succeeds over the other components (adiposity and linearity) (Table 3). There were no significant differences in somatotype between gender groups and speciality module (p>0.05), although male students presented the highest mesomorphy and least ectomorphy. Females had the highest endomorphic component value (4.53±2.02) (Figure 1) (Figure 2). However, both genders were highly developed in mesomorphic component while endomorphic component was greater compared to ectomorphic component (Table 4).

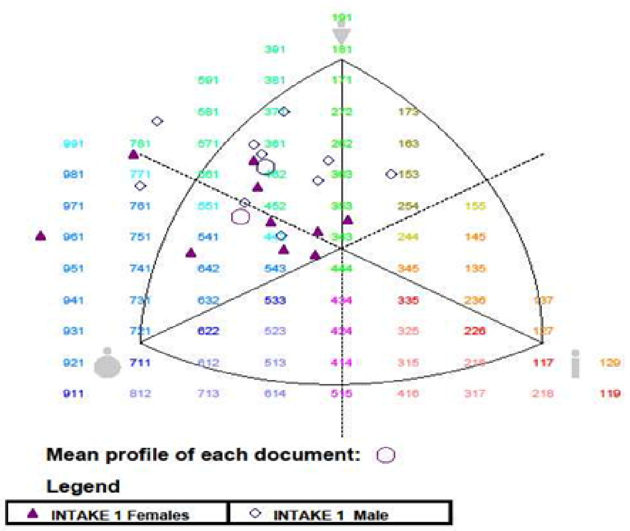

Figure 1 Distribution of somatoplots for intake 1 block release students (n=20).

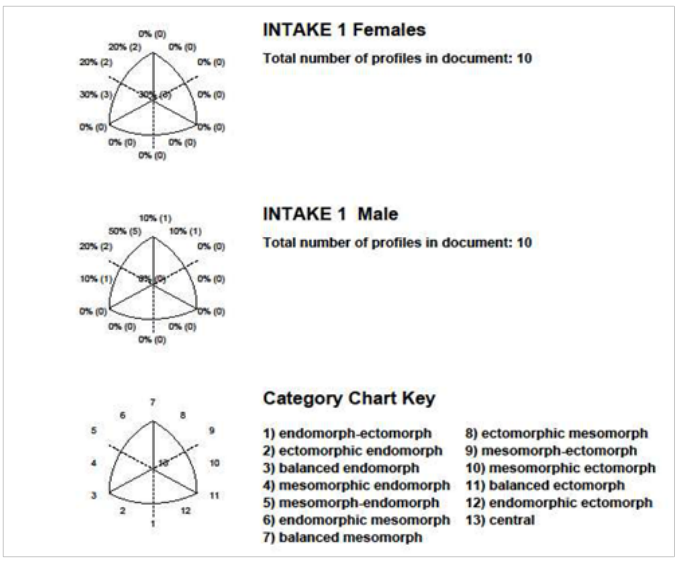

Figure 2 Distribution of somatoplots for intake 1 block release students (n=10).

Citation: Dube A, Gundani PM. Anthropometric and somatotype characteristics of undergraduate students of the National university of Science and Technology, Zimbabwe. *Adv Obes Weight Manag Control.* 2018;8(3):188–192. DOI: 10.15406/aowmc.2018.08.00240

Table 2 Somatotype of students according to gender

Variable	Somatotype			
	Endomorphy	Mesomorphy	Ectomorphy	P-value
Males (n=10)	3.53±1.60	4.99 ±0.95	1.28±0.88	
Females (n=10)	4.53±2.02	4 .04±1.28	1.54±0.90	
ALL (n=20)	4.03± 1.81	4 .52±1.12	1.41±0.89	0.056

Table 3 Somatotype Analysis of Variance (ANOVA) (n=20)

Group	Count	Mean	SD
Females	10	4 .53-4.04- 1.54	2.02-1.28-0.90
Males	10	3.53-4.99-1.28	1.60-0.95-0.88
ANOVA	F=l.83	p=0.19	

Table 4 Selected Studies of national athletes/ students from the literature

Author	Mass (Kg)	Height(m)	%BF	BMI	Somatotype
Salgado et al. 2008	70.5 ± 7.9	1.75± 0.06	16.1±4.3	-	3.03- 4.78-2.55
Helgerud et al. 2001	72.2 ± 0.11	1.81±0.06	-	21.97	-
Adhikari & McNeely 2015	76.5± 8.0	178.1 ±6.1	23.4±2 .9	-	3.1-4. 1-2.3*
Present Study	71.47±13.23	1.71 ± 0.07	10.5 ± 0.14	25.07±3.18	M 3.53-4.99-1.28 F 4.53-4.04-1.54*

*Females

Discussion

In the present study, anthropometric characteristics of Sports science and coaching part-time students were evaluated according to gender and not as athletes, coaches or non-athletes. All students under study classified as adults. The students were of medium stature; males 1.70±0.06m and their female counterparts 1.65±0.07m. Height is critical in an individual's development; hence lays a strong base tin relation to other anthropometric measurements.[19] Consistency in physical characteristic of the students showed the trend of specific sporting they majored in. Similar findings were reported by Mayhew et al.[20]

The university students showed BMI values for female as 24.18±2.66 and males 25.96±3.54 respectively. There was no significant relationship (0.220) in BMI between female and their male counterparts. The classification of BMI according to the World Health Organization (WHO, 2004), most of the male students are overweight and pre-obese whilst their female counterparts are with normal BMI. Part time sports science students who had BMI above the normal, had muscle mass and not excessive body fat as witnessed (Table 1).[21–25]

The students presented a slightly higher adiposity of 10.6% as their average percent body fat (%BF) which though was lower than most of the sports university students. This however was not in accordance to the American Council of Exercise (2009) which indicated that students' body fat ranged from 14–20% and 18–24%; for males and females respectively which they considered to be medium. The present study was similar to recent studies on for university students which stipulate that students who were athletes had higher BMI and body weight which reflected greater muscle mass than greater adiposity.[26–29] The average somatotype characteristic of part-time sports science students indicated as mesomorph-endomorph (males 3.53-4.99-1.28; and females 4.53-4.04-1.54). Both females and male students were average in muscularity and only a quarter of the group from both gender had ectomorphic component. The results were different from the other researches carried out elsewhere. Therefore, Zimbabwean students are muscular but lean despite having average endomorphic components.[30–32]

Conclusion

The results of Zimbabwean university students showed no much difference in body weight, anthropometric measurements and body composition. Using applied science, sport scientists provide answers to questions often asked by coaches and technical personnel in such areas like talent identification, physical fitness monitoring, team selection and training methods. Periodic completion of precise and correct evaluations of body composition relative to the training period and intensity provide enhanced chances to assess current status and training adaptability of an athlete.

Limitations of the study

The subjects involved were the first intake for the block-release programme. These were a working class, who were working in schools with teaching experience stretching more than three years. The program was still at its infancy, hence was mostly marketed to manpower in the education sector.

Acknowledgements

The Department of Sports science and coaching.

Conflicts of interest

No conflict of interests is declared.

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