Somatotypes of Physical Education Students in Botswana
波斯尼亞體育本科生的體型分析

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Abstract

In the present study the somatotype characteristics of Physical Education students at the University of Botswana were evaluated. A second purpose of the study was to compare the physical characteristics of students across academic years of study. A total of 125 Physical Education students (52 males and 73 females) at the University of Botswana were measured. The students were attending certificate course, Diploma (year 1 and 2), Bachelor's degree in Education (B. Ed) (year 1 to 4) in Physical Education. All the students were measured by one of the authors and their mean ages ranged from 23.8 to 28.6 years for males and 25.8 to 30.8 years for females. Anthropometric measurements were taken according to the protocol of the International Society for the Advancement of Kinanthropometry (ISAK). These included body mass, stature, two breadths (humerus and femur), arm girths flexed and tense, calf girth and four skinfolds (triceps, subscapular, supraspinal and iliac crest). All the subjects were somatotyped using the Heath-Carter anthropometric somatotype method. Among the study group, the SAM values ranged from 1.2 to 2.1. The present sample is clustered in the mesomorph endomorph and mesomorphic endomorph categories with male students being more endomophic than female students. It is important in future studies to investigate the cultural diversity of the Botswana population as that might shed more light on the preponderance of endomorphy in the male group.

摘 要

本文旨在分析波斯尼亞大學體育本科生的體型結構，利用ISAK國際量度體型標準，量度了125 名年齡由 23 至 30 歲學生的體型，結果顯示學生體型的分佈狀況，與文化背境的因素可能有關。

Introduction

Physique refers to the body form of an individual or the configuration of the entire body rather than specific features. Physique is readily observed and is useful in assessing the outcomes of underlying growth and maturation process, thus leading to a better understanding of variation in both child and adult physique. Walker (1978), in studying adult physique maintains that it never changes since it is built into the definition of somatotyping.

Somatotyping is one of the most useful methods of evaluating physique. Somatotyping is a quantification of the present shape

and composition of the human body in terms of endomorphy (relative fatness), mesomorphy (relative muscularity robustness) and ectomorphy (relative linearity). The somatotype is a gestalt or overview of the total assessment that reduces many physical aspects to three-digit somatotype ratings (Heath & Carter, 1990). In studies of adults the Heath-Carter somatotype method is particularly important because it is related to a variety of behavioural, occupational, disease and performance variables primarily in adults (Claessens, 1981; Malina, 1985). Furthermore, it assists in demonstrating the similarities and differences among populations (Beunen, Claessens, & Van Esser, 1987; Takaishi, Higuchi & Kojima, 1990).

Previous studies on somatotyping of Physical Education students have shown that they have a fairly consistent pattern of dominance and moderately high mesomorphy and ectomorph mesomorph (Carter & Heath, 1990; Thomson, 1952). Carter, Stepnicka and Clarys (1973) and Carter, Stepnicka and Climie (1978) have reported the Physical Education students of San Diego State University to be clustered around the endomorphic mesomorph, mesomorphic endomorph and mesomorph ectomorph categories. Recently Shirinde, Monyeki, Du Plessis and De Ridder (1994) reported the somatotype of University of the North's Physical Education students to be predominantly mesomorphic endomorph. Similar somatotype was reported for the northern province volleyball team in South Africa, where the University of the North is situated (Monyeki & Toriola, 1997). Limited information is available on the somatotype of Botswana children and youth.

Physical Education was introduced in the University of Botswana in 1993 with students offering one-year certificate course. Subsequently, two-year diploma and four-year B.Ed programs were added. The program is teacher education based and is aimed at training both primary and secondary school teachers. In the present study, the somatotype characteristics of Physical Education students of the University of Botswana were evaluated. A second purpose of the study was to compare the physical characteristics of students across academic years of study, since it is assumed that regular participation in physical activity could promote development of desirable physical qualities.

Methods

Subjects

A total of 125 Physical Education students (52 males and 73 females) of the University of the Botswana were measured. These students were doing certificate course, Diploma 1 and 2, Bachelor in Education (B. Ed) year 1 to 4 in Physical Education. All the students were measured by one of the authors and their mean ages ranged from 23.8 to 28.6 years for males and 25. 8 to 30.8 years for females.

Measuring Instrument

Anthropometric measurements were taken according to the protocol of the International Society for the Advancement of Kinanthropometry (ISAK). These included body mass, stature, two breadths (humerus and femur), arm girths flexed and tense, calf girth and four skinfolds (triceps, subscapular, supraspinal and iliac crest).

All the subjects were somatotyped using the Heath-Carter anthropometric somatotype method (Carter & Heath, 1990). This method was reported to be applicable for the description of variation in the human species regardless of age, sex or different attribute of climate, diet, genetics, race, health or physical activity (Carter & Heath, 1990; Carter, 1996; Heath & Carter, 1971; Hebbelinck, Duquet & Ross, 1973). Calculations of somatotype attitudinal means (SAM), based on somatotype attitudinal distance (SAD) were performed using the special procedures for somatotype analyses (Carter, Ross, Duquet & Aubry, 1983; Carter & Heath, 1990).

Cressie, Withers and Craig (1986) claimed that using the SAD, which is the distance between any two somatopoints in three dimensions, pre-maturely collapses the three-components somatotype vector into scalar SAD value, thereby reproducing the degree of freedom for the F-ratio. They suggest increasing the degree of freedom to include those for the three components as separate variables, thus increasing the likelihood of type I errors when compared with the method of Carter et al. (1983). Their basic premise was that the three-somatotype components should be considered together in a one-way MANOVA. As a test of the whole somatotype, their premise was argued to be false by Carter, Duquet and Rempel (1998, 1999) because it denies the integrity of the whole somatotype and erroneously increases the degrees of freedom. Furthermore, Cressie (1998, 1999) argued that the SAD should be treated as any other derived variables and not be assigned degrees of freedom based on the variables from which it is derived. The procedures of Cressie et al. (1986) are not applicable to analysis of somatotype but could be applied as a secondary analysis to the separate components. However, they are not appropriate for the analysis of the whole somatotype (Carter, Mirwald, Heath-roll & Bailey, 1997) as used in this study.

Statistical Analysis

Descriptive statistics for the three-somatotype components were calculated. Frequency and percentage frequency for the

somatotype categories were also calculated. Somatotype ANOVAs for measurements the seven groups of students were calculated using SADs between the seven groups to examine any significant changes in three-dimensional distances between individual and group somatotype. The t-test was used to assess for the significant differences between the genders in each group.

Results

Table 1 presents descriptive statistics of the absolute body size and somatotype components as well as the somatotype attitudinal means of Physical Education students of the University of Botswana. Females were older than males and their age differences reached statistical difference at the B. Ed 2. Females were taller than males throughout the different levels of study. Even though the females were heavier than the males at all the levels of study, significant difference was found only in the B. Ed 2 group.

It is important to note that males were significantly fatter than females at all the levels of study except for the Diploma 2 and B. Ed 4 groups if we consider endomorphy. All the groups did show high mesomorphy (muscularity) with males exhibiting significant difference at Diploma 2. Ectomorphy in each group did not yield consistent pattern. It is not surprising that the majority of the students are categorized in the mesomorphic endomorph, mesomorph- endomorph and Endomorphic mesomorph categories (see Table 2).

Somatoplots are two-dimensional projections of the three-component somatotype; hence it is likely that the true distance between somatotypes is distorted. Therefore, the distance between somatotypes was calculated using the three-dimensional somatotype attitudinal distance, which is a true distance in component units between any two somatotypes (Carter et al., 1983; Heath & Carter, 1990). Differences among somatotype components and attitudinal means for each study group are given in Table 1. Among the study group, the SAM values ranged from 1.2 to 2.1. When the SAM values were analyzed, results indicated no significant differences (Table 3). There were no significant differences in the mesomorphy and somatotype attitudinal means throughout the group except for endomorphy, which showed significance at B. Ed 2 group. The B.Ed 2 were significantly most endomorphic than the rest of the groups. Certificate group differed significantly from the rest of the group in mesomorphy.

Physical Education students of the University of Botswana are clustered in the endomorphic mesomorph, balanced mesomorph, ectomorphic mesomorph and central category of the somatochart. The mean somatotype of male students in diploma 2, B.Ed 1 and B.Ed 3 are categories in the mesomorphic endomorph and balanced endomorph respectively (see Figure 1).

Discussion

The present study provides a unique opportunity to study the physique of Physical Education students registered at the University of Botswana. The present sample is clustered in the mesomorph endomorph and mesomorphic endomorph categories with male students being more endomorphic than female students. This might be attributed to the cultural diversity of Botswana population. Generally, women are expected to perform all household work and including cooking. Traditionally, the higher the education level of South African men the lesser the physical activity work they are likely to engage in (Monyeki, De Ridder & Pienaar, 1994). This is probably true of men in Botswana.

Male students from the University of Botswana are more clustered in the mesomorphic endomorph, mesomorph endomorph and the central categories while the females students are clustered in the endomorphic mesomorph, mesomorph ectomorph and the central categories. Male and female students of University of Botswana are different from those of the University of the North and San Diego State University who are clustered in the endomorphic mesomorph and mesomorphic endomorph categories, respectively (Shirende et al., 1994). The findings of this study which indicates the preponderance of endomorphy in the B.Ed 2 students suggest that they are probably fat. These findings have implications for physical Education fitness program development and implementation of activity that can promote desirable physical qualities in students.

It is important in future studies to investigate the cultural diversity of the Botswana population. This might shed more light on the preponderance of endomorphy in the male group as explained earlier on. Furthermore, investigation into the selection of students and the type of Physical Education programme the students engage in might also account for the surprisingly high muscularity of female students found in this study.

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Table 1. Descriptive Statistics of Absolute Body Size and Somatotype for the Registered Students of the Department of Physical Education, University of Botswana.

Variable	Certificate		Diploma 1		Diploma 2		B Ed 1		B Ed 2		BEd 3		B Ed 4	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
	m	m	m	m	m	m	m	m	m	m	m	m	m	m
	(sd)	(sd)	(sd)	(sd)	(sd)	(sd)	(sd)	(sd)	(sd)	(sd)	(sd)	(sd)	(sd)	(sd)
N	13	20	9	12	4	12	5	8	9	10	7	6	5	5
Age (years)	26.2	26.7	27.4	30.8	28.8	31.9	24.0	27.6	23.8*	29.0*	28.6	25.8	25.6	28.4
	(5.5)	(4.9)	(4.1)	(6.4)	(6.9)	(6.6)	(2.9)	(4.1)	(1.7)	(4.9)	(7.0)	(4.7)	(4.0)	(3.6)
Height (cm)	161.2*	171.7*	161.3*	173.2*	162.8*	172.4*	159.9*	173.2*	161.7*	173.8*	159.4*	170.7*	164.7*	173.8*
	(5.8)	(4.2)	(5.3)	(4.1)	(4.3)	(8.2)	(3.9)	(7.6)	(4.4)	(5.7)	(4.4)	(8.0)	(6.3)	(6.7)
Weight (kg)	57.9	61.5	62.7	64.6	74.5	67.5	60.9	65.0	54.3*	64.7*	59.5	63.5	59.3	62.2
	(6.0)	(7.8)	(10.1)	(5.7)	(14.6)	(14.0)	(3.6)	(10.0)	(6.7)	(6.6)	(13.5)	(10.1)	(4.1)	(6.8)
Endomorphy	3.8*	2.3*	5.2*	3.2*	5.9	3.1	4.6*	2.4*	3.2*	1.9*	3.8*	2.6*	3.7	3.6
	(1.2)	(0.9)	(1.1)	(1.0)	(1.8)	(1.7)	(0.9)	(1.2)	(1.0)	(0.3)	(1.1)	(0.7)	(1.4)	(0.8)
Mesomorphy	3.7	3.7	4.1	4.1	6.3*	4.1*	4.1	4.1	3.7	4.7	3.7	3.8	2.3	3.9
	(1.0)	(1.3)	(0.7)	(1.1)	(1.6)	(0.9)	(0.7)	(1.3)	(1.5)	(1.3)	(1.0)	(1.7)	(1.6)	(1.0)
Ectomorphy	2.1*	3.3*	1.4	3.1	0.6*	2.6*	1.3*	3.0*	2.8	3.1	1.8	3.0	2.4	3.6
	(1.1)	(1.1)	(0.8)	(0.8)	(0.4)	(1.2)	(0.4)	(1.0)	(1.2)	(0.8)	(1.6)	(1.8)	(1.2)	(0.7)
SAMs #	1.7	1.6	1.3	1.5	1.9	1.9	1.1*	1.7*	1.9	1.3	1.9	2.1	1.9	1.2
	(0.8)	(1.0)	(0.6)	(0.7)	(1.1)	(1.0)	(0.3)	(0.8)	(0.8)	(0.7)	(0.5)	(1.0)	(1.1)	(0.6)

Somatotype attitudinal means

Table 2. Frequency (n) and Percentage Frequency (%) of Somatotype Categories of Registered Students at the Department of Physical Education, University of Botswana.

Somatotype Categories	Certificate		Diploma 1		Diploma 2		B Ed 1		B Ed 2		BEd 3		B Ed 4	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F
	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)	n(%)
N	13	20	9	12	4	12	5	8	9	10	7	6	5	5
1 Balanced endomorph													1(20.0)	1(20.0)
2 Mesomorphic endomorph	2(15.4)	1(5.0)	2(22.2)		1(25.0)	2(16.7)	3(60.0)	1(12.5)	1(11.1)		1(14.3)			
3 Mesomorph-endomorph	4(30.8)		6(66.7)	2(16.7)	1(25.0)	1(8.3)	1(20.0)		1(11.1)		2(28.6)		1(20.0)	
4 Endomorphic mesomorph	1(7.7)	6(30.0)	1(11.1)	2(16.7)	2(50.0)	3(25.0)	1(20.0)	1(12.5)	2(22.2)		1(14.3)	1(16.7)	1(20.0)	
5 Balanced mesomorph	1(7.7)	2(10.0)		2(16.7)				1(12.5)		4(40.0)		2(33.3)		
6 Ectomorphic mesomorph				1(8.3)		1(8.3)		1(12.5)		3(30.0)				
7 Mesomorph-ectomorph	1(7.7)	2(10.0)		1(8.3)		3(25.0)		2(12.5)		2(20.0)				
8 Mesomorphic ectomorph		3(15.0)		1(8.3)				2(12.5)		1(10.0)				
9 Balanced ectomorph		4(20.0)							3(33.3)					1(20.0)
10 Endomorphic ectomorph												3(50.0)		
11 Endomorph-ectomorph													1(20.0)	1(20.0)
12 Ectomorphic endomorph		1(5.0)									1(14.3)		1(20.0)	
13 Central	3(23.1)	1(5.0)		3(25.0)		2(16.7)			2(22.2)		2(28.6)			2(20.0)

Table 3. Differences among Somatotype Components and Somatotype Attitudinal Mean for Different Groups of Male Physical Education Students at the University of Botswana.

Endomorphy	B Ed 2	Diploma 1	Diploma 2	B Ed 1	Certificate	B Ed 3	B Ed 4
Mesomorphy	Certificate	Diploma 1	Diploma 2	B Ed 1	B Ed 2	B Ed 3	B Ed 4
Ectomorphy	Certificate	Diploma 1	Diploma 2	B Ed 1	B Ed 2	B Ed 3	B Ed 4
SAMs*	Certificate	Diploma 1	Diploma 2	B Ed 1	B Ed 2	B Ed 3	B Ed 4

Groups jointly underlined are homogeneous, but are significantly different ($p<0.05$) from those that are not underlined.
* Somatotype attitudinal means

Table 4. Differences among Somatotype Components and Somatotype Attitudinal Means for Various Groups of Female Physical Education Students of the University of Botswana.

Endomorphy	Diploma 1	B Ed 2	Diploma 2	B Ed 1	Certificate	B Ed 3	B Ed 4
Mesomorphy	Certificate	Diploma 1	Diploma 2	B Ed 1	B Ed 2	B Ed 3	B Ed 4
Ectomorphy	Certificate	Diploma 1	Diploma 2	B Ed 1	B Ed 2	B Ed 3	B Ed 4
SAMs#	Certificate	Diploma 1	Diploma 2	B Ed 1	B Ed 2	B Ed 3	B Ed 4

Somatotype attitudinal means

Figure 1. Mean Somatotype of Physical Education Students in Botswana.

1=Certificate male, 2=Diploma 1 male, 3=Diploma 2 male, 4=B Ed 1 male, 5= B Ed 2 male, 6= B Ed 3 male, 7= B Ed 4 male, 8=Certificate female, 9=Diploma 1 female, 10=Diploma female 2, 11= B Ed 1 female, 12= B Ed 2 female, 13=B Ed 3 female and 14= B Ed 4 female.