DE GRUYTER OPEN

Pol. J. Sport Tourism **2016**, *23, 212-215*
DOI: 10.1515/pjst-2016-0028

DIFFERENCES IN BODY BUILD AND PHYSICAL FITNESS OF PE STUDENTS FROM THE FACULTY OF PHYSICAL EDUCATION AND SPORT IN BIAŁA PODLASKA IN THE YEARS 1989, 2004, AND 2014

JERZY SACZUK[1], AGNIESZKA WASILUK[1], ROBERT WILCZEWSKI[2], ADAM WILCZEWSKI[1]

[1]Józef Piłsudski University of Physical Education in Warsaw, Faculty of Physical Education and Sport in Biała Podlaska, Department of Human Biological Development
[2]Doctoral Studies, Józef Piłsudski University of Physical Education in Warsaw, Faculty of Physical Education

Mailing address: Jerzy Saczuk, Faculty of Physical Education and Sport in Biała Podlaska, Department of Human Biological Development, 2 Akademicka Street, 21-500 Biała Podlaska, tel.: +48 83 3428740, fax: +48 83 3428800, e-mail: jerzy.saczuk@awf-bp.edu.pl

Introduction. In the current situation of the demographic decline and simultaneous tough competition on the educational market, the issues of not only teaching levels but also the competences and aptitudes of students themselves are raised more and more often. Therefore, this study sought to analyse differences in the body build and physical fitness of physical education (PE) students from the Faculty of Physical Education and Sport in Biała Podlaska in the years 1989, 2004, and 2014. ***Material and methods.*** The material included the results of the anthropometric measurements and physical fitness tests of second-year students examined in 1989 (n = 111), 2004 (n = 181), and 2014 (n = 127). Martin and Saller's technique was employed to measure anthropometric features necessary to establish body build types using the Heath-Carter method. Physical fitness was evaluated with the International Physical Fitness Test. Sample size (n), arithmetic mean ($\bar{x}$), standard deviation (SD), and the T point scale were applied to assess the collected variables. Differences in the sizes of the analysed features between the groups were estimated with the use of ANOVA and the Newman-Keuls test. ***Results.*** The analysis revealed a constant increase in basic somatic features and endomorphy and a decrease in mesomorphy and physical fitness in male subjects. The ectomorphy of students examined in 2014 was at a level similar to that recorded in 1989. The pace of the described changes was different depending on the study period. ***Conclusions.*** Secular trends in body build and physical fitness observed in the study may stem from deterioration in the biological potential of youths or may result from lowering physical education entrance exam criteria at the university.

Key words: students, physical education, body build type, physical fitness

Introduction

Civilisation changes affecting a number of countries in Europe and in the world have contributed to substantial scientific and technical progress. They have resulted in an improvement in the standard of living, better healthcare, and parents' increased awareness of the importance of raising children in a healthy way. Most scientists associate these factors with causes of secular changes in the levels and dynamics of the somatic development of female and male school students [1] as well as university students [2, 3]. Lifestyle changes noticed in various countries, and an excessive use of electronic devices in particular, have led to a decrease in physical activity [4] and, as a consequence, in physical fitness levels [5, 6, 7].

In the literature on the somatic build of university students, sportspeople, and particular professional groups, close similarities in morphological features with regard to groups working the same jobs, doing the same sports, or studying the same university courses may be observed [8, 9, 10]. Physical education (PE) students ought to demonstrate high levels of physical fitness and exhibit higher values of active tissue and lower values of fat tissue compared to their counterparts from other fields of study [2]. Recently, however, the validity of this view has been undermined in the literature [11], and pursuing higher education has ceased to be perceived as a privilege. These days, in Poland and several other developed countries, virtually anyone has access to higher education. According to the Central Statistical Office, there were 403,824 university students in Poland in the academic year 1989/1990. A decade later there were as many as 1,584,804 students, while in the year 2011/2012, there were 1,764,060 students. The highest number of students was observed in the year 2005/2006, when 1,953,832 individuals attended university courses. The last decade of the 20th century saw a massive increase in the number of both universities and students. Yet, this trend has slowed down quite markedly in recent years. This is associated with the constantly decreasing number of persons aged 19-24 years [12]. In the current situation of the demographic decline and simultaneous tough competition on the educational market, the issues of not only teaching levels but also the competences and aptitudes of students themselves are raised more and more often [13]. Taking into account the above-mentioned facts, this study sought to analyse changes in somatic features and motor abilities among male PE students from the Faculty of Physical Education and Sport in Biała Podlaska.

Material and methods

In 1989, a group of 111 male second-year PE students from the Faculty of Physical Education and Sport in Biała Podlaska

were included in the study (group 1). Anthropometric measurements necessary to establish body build types were made with the Heath-Carter method [14]. Physical fitness levels were evaluated with the use of the International Physical Fitness Test [15]. This test was selected because of its diagnostic value and due to the fact that its particular components were easy to perform. The same test was applied at further stages of the research as it made it possible to assess intergenerational changes. We used the same examination methods both in 2004, while evaluating 181 male second-year PE students (group 2) in our previous research (no. VII/146), and in 2014, during the assessment of 127 male second-year PE students (group 3) under project no. 172 of the University of Physical Education in Warsaw. The mean age of the students examined in 1989 was 21.52 ± 1.01 years. In 2004, it was 21.90 ± 0.78 years, while in 2014, it was 20.97 ± 1.21 years. PE students from the Faculty of Physical Education and Sport in Biała Podlaska mainly come from eastern regions of the country. The research was carried out in compliance with the rules outlined in the Declaration of Helsinki and was approved by the Senate Research Ethics Committee of the University of Physical Education in Warsaw.

Sample size (n), arithmetic mean ($\bar{x}$), and standard deviation (SD) were applied to assess the collected variables. In order to standardise the points obtained in the fitness test, the T point scale was used to compare the results achieved in 2014 to those from 1989 and 2004. Differences in the analysed features between the examined groups were estimated with ANOVA and the Newman-Keuls test [16].

Results

Long-term trends in the changes in basic somatic features and body build components were determined on the basis of differences in mean absolute values (tab. 1-2). Drawing on these results, it was observed that, compared to their counterparts from 25 years before, males currently studying at the faculty in Biała Podlaska exhibited significantly higher values of body height (by 3.44 cm) and body mass (by 4.43 kg). Furthermore, they demonstrated higher values of endomorphy (by 1.19 pts) and lower values of mesomorphy (by 0.92 pts). In both examinations, ectomorphy was at a similar level. The analysis revealed slight and not significant differences in basic somatic features between male students from 2004 and 2014. They differed in body height by 0.87 cm and in body mass by 0.05 kg. Greater differences were found in body build components. Students assessed in 2014 manifested higher values of endomorphy (by 0.69 pts) and lower values of both mesomorphy (by 0.37 pts) and ectomorphy (by 0.26 pts) than their peers from 2004. The differences were significant.

Table 1. Values of basic somatic features and body build components in male PE students from the Faculty of Physical Education and Sport in Biała Podlaska in the years 1989, 2004, and 201

Feature	1989 (n = 111)		2004 (n = 181)		2014 (n = 127)	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
Body height	177.14	5.78	181.45	6.23	180.58	6.52
Body mass	74.02	9.11	78.5	9.57	78.45	10.63
Endomorphy	2.56	1.33	3.06	1.03	3.75	1.28
Mesomorphy	4.92	1.22	4.37	0.98	4.00	1.65
Ectomorphy	2.53	1.16	2.81	0.98	2.55	1.14

Table 2. Values of one-way analysis of variance and the Newman-Keuls test calculated for differences in mean basic somatic features and body build components between successive stages of research

Feature	ANOVA	Newman-Keuls Test		
		Group 1 vs. 2	Group 1 vs. 3	Group 2 vs. 3
Body height	17.29*	8.15*	6.03*	1.71
Body mass	8.47*	5.37*	4.93*	0.66
Endomorphy	30.13*	4.92*	10.86*	7.07*
Mesomorphy	15.45*	5.05*	7.83*	3.54*
Ectomorphy	3.21*	3.04*	0.20	2.94*

* = differences are significant at the level of $p < 0.05$ (Newman-Keuls test).

Based on mean absolute values and points on the T scale, we assessed the changes in the physical fitness levels of second-year PE students from the Faculty of Physical Education and Sport in Biała Podlaska (tab. 3-4, fig. 1). The analysis revealed slight insignificant differences between the subjects examined in 2014 and the 1989 study participants in the 4 x 10 m shuttle run (0.06 s and 1.20 pts) and 30 s sit-ups (1.08 sit-ups and 3.05 pts). As far as the remaining tests are concerned, the subjects from 2014 achieved significantly lower results, with the following differences – 50 m run: –0.56 s (16 pts); sit-and-reach test: 7.66 cm (15.34 pts); standing broad jump: –25.11 cm (14.93 pts); 1000 m run: –20.66 s (13.54 pts); pull-up test: –4.16 pull-ups (12.42 pts); and handgrip test: –2.23 kG (4.16 pts).

The differences found when comparing the results from the last decade were smaller. Current students obtained higher scores than their counterparts examined in 2004 in the 30 s sit-up test (by 3.43 sit-ups, i.e. 9.69 pts on the T scale) and in the 4 x 10 m shuttle run (by 0.25 s, i.e. 5.0 pts). Slight insignificant differences were noted in the handgrip test (1.06 kG and 1.88 pts). As for the remaining tests of the International Physical Fitness Test, the 2014 study subjects achieved significantly lower results in several tests – 50 m run: –0.42 s (12.0 pts); 1000 m run: –14.27 s (8.99 pts); sit-and-reach: –3.21 cm (6.51 pts); pull-up test: –2.10 pull-ups (6.27 pts); and standing broad jump: –8.10 cm (4.82 pts).

Assuming that a mean of point differences is a statistical notion defining differences in physical fitness, we can state that over a period of the last 25 years, the level of physical fitness in male second-year PE students from the Faculty of Physical Education and Sport in Biała Podlaska decreased by 9.28 pts, with a decrement of 2.74 pts in the last decade.

Table 3. Physical fitness test scores achieved by male PE students from the Faculty of Physical Education and Sport in Biała Podlaska in the years 1989, 2004, and 2014

Test	1989 (n = 111)		2004 (n = 181)		2014 (n = 127)	
	$\bar{x}$	SD	$\bar{x}$	SD	$\bar{x}$	SD
50 m run	6.60	0.35	6.74	0.61	7.16	0.88
Standing broad jump	252.07	16.82	235.06	22.73	226.96	21.70
Handgrip	53.97	5.36	50.68	9.39	51.74	8.19
Pull-ups	10.38	3.35	8.32	3.81	6.22	4.35
4 x 10 m shuttle run	10.57	0.5	10.88	0.66	10.63	1.44
Sit-ups	28.38	3.54	26.03	4.61	29.46	4.79
Sit-and-reach	62.04	4.93	57.59	9.36	54.38	17.36
1000 m run	211.17	15.88	217.56	27.55	231.83	34.06

Table 4. Values of one-way analysis of variance and the Newman-Keuls test calculated for differences in mean physical fitness test scores between successive stages of research

	ANOVA	Newman-Keuls Test		
		Group 1 vs. 2	Group 1 vs. 3	Group 2 vs. 3
50 m run	31.66*	4.30*	10.98*	7.84*
Standing broad jump	45.59*	4.52*	13.01*	9.90*
Handgrip	5.66*	4.75*	2.99*	1.59
Pull-ups	34.30*	6.24*	11.70*	6.33*
4 x 10 m shuttle run	5.24*	4.25*	1.04	3.25*
Sit-ups	24.40*	6.25*	2.66	9.50*
Sit-and-reach	12.66*	4.47*	7.10*	3.32*
1000 m run	18.41*	2.74	8.23*	6.38*

* = differences are significant at the level of $p < 0.05$ (Newman-Keuls test).

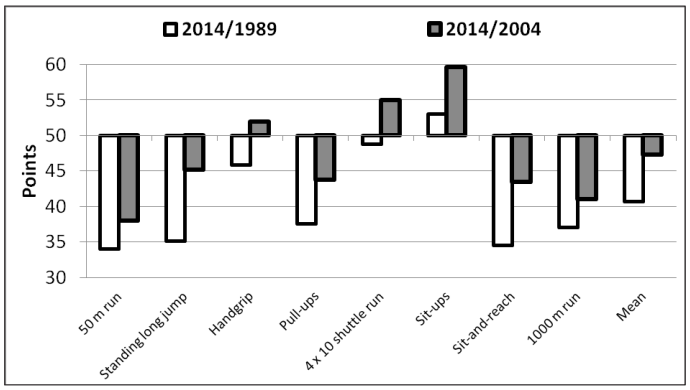

Figure 1. T scale values of physical fitness tests of males studying at the Faculty of Physical Education and Sport in Biała Podlaska in 2014 normalised to the results obtained by their counterparts in 1989 and 2004

Discussion

The big differences regarding the increase in body height at the end of the 20th century and the slowdown of this trend at the beginning of the 21st century, observed by authors who have investigated trends in students' somatic features [17, 18, 19], are also reflected in our data. As far as motor development is concerned, however, we observed a considerable decrease in physical fitness until 2004 as well as a slower pace of these changes in the last decade. Similar trends were revealed among students from sports universities [7] and those taking other courses [20, 21]. As for the decelerating trend concerning body height and mass, it should be assumed that after the standard of living of families had improved in the period of turbulent socio-economic transformations, their living standards stabilised. In the case of the described long-term trends of changes in somatic and motor development, the selection of candidates for physical education studies plays an important role. Entrance examination criteria contribute to the fact that individuals who take up physical education studies demonstrate high levels of motor development as well as higher levels of somatic features and developmental indices which result in enhanced physical performance compared to students from other fields of study [2, 9]. Cabryć et al. [22] and Pasiut [23] confirm that PE students manifest higher levels of physical development. These authors point to candidate selection as a significant factor. Mleczko and Januszewski [7] highlight the fact that those currently taking up PE studies present levels of somatic development higher than motor development levels, which is in line with secular trends in youths who graduate from upper-secondary schools [1, 24, 25]. This stems from a low motor-related potential of upper-secondary school graduates who apply for PE courses.

In 1987, there were 4.73 candidates per place for a physical education course at the Faculty of Physical Education and Sport in Biała Podlaska. The candidates had to take four theoretical and four practical exams. In 2002, this ratio was 1.25 candidates per place and the entrance exam included three out of four sports disciplines (to choose from) and an interview. Currently, candidates for a PE course are obliged to take one physical fitness exam. Furthermore, points scored in the upper-secondary school-leaving exam as well as points received for having recognised sporting achievements are taken into consideration in the enrolment process. Lowering entrance-exam requirements (particularly in the case of physical fitness) combined with the demographic decline has resulted in the fact that candidate rejection is limited. As a consequence, any upper-secondary school graduate capable of meeting these lowered exam criteria can become a PE student.

As far as students from Biała Podlaska are concerned, it was already a decade ago that candidates for a PE course were found to demonstrate somatic build with high adiposity and a poorly developed musculoskeletal system. Therefore, it may be concluded that probably the only motivation for them to take up these studies was the need to have a university diploma. Such a conclusion was drawn based on the observation that, in terms of body build, candidates applying for a PE course at that time differed substantially from their counterparts studying at other universities as well as from those who practised sports actively [11]. Our research results also revealed a gradual increase regarding endomorphy with a simultaneous reduction in mesomorphy. After an initial increase in ectomorphy in 2004, this component decreased to the level exhibited by the male students from 1989. Such differences were not found at universities where entrance exams still act as selection criteria in the enrolment process [3].

It is common knowledge that individuals with excessive body mass (overweight people in particular) demonstrate lower levels of physical fitness than their peers with proper height-weight proportions [26]. The authors of publications concerning correlations of somatic features with physical performance levels and results achieved in various sports [27, 28, 29] noted that, in addition to having body build typical of a given sport, it is necessary to have adequate body composition and adequate proportions between fat tissue and non-fat body mass. They also stressed that training effects that differentiate tissue components depend on the specificity and duration of the training process, the age of the subjects, as well as the sports disciplines themselves. The higher number of practical classes held in the course of sports studies exerts an influence on the size of somatic features [30]. Therefore, it may be inferred that greater differences between the groups of males under investigation will be noticeable in the next years of their university education due to the fact that physical exercises affect energetic balance and body tissue composition. This relationship was also observed by Yildiz et al. [31] when examining students from the School of Physical Education and Sports in Aydın, Turkey.

To summarise the results of our research on changes in the body height and mass as well as the physical fitness of students, it may be stated that they are in line with the findings of other authors. Different observations regard an increase in adiposity and a simultaneous decrease in muscle mass and skeleton mass

among males. Thus, it may be concluded that secular trends in the body build and physical fitness of students can be interpreted as a confirmation of a deterioration in the biological potential of youths living in the areas where PE students from the Faculty of Physical Education and Sport in Biała Podlaska come from. Also, the trends are likely to stem from lowering physical education entrance exam criteria at the university.

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Submitted: October 6, 2016
Accepted: November 15, 2016