ORIGINAL ARTICLE

TRENDS in
Sport Sciences
2020; 27(**1**): 29-34
ISSN 2299-9590
DOI: 10.23829/TSS.2020.27.1-5

Changes in the somatic build and physical fitness of physical education students in the years 2004 and 2014

AGNIESZKA WASILUK, JERZY SACZUK

Abstract

Introduction. In the current situation of the demographic low and strong competition on the educational market, such issues as the level of education as well as competences and predispositions of students are under discussion more and more frequently. Aim of Study. The aim of this study was to analyse differences in body build and physical fitness of physical education (PE) students in the years 2004 and 2014. Material and Methods. In 2004 the authors examined 112 females and 287 males who were second-year students. The tests were repeated in 2014 and included 98 females and 242 males. Anthropometric features were measured according to Martin and Saller guidelines, and these measurements, in turn, were used to calculate body build type according to Heath–Carter method. Physical fitness was assessed with the use of Eurofit test. Results. In the assessed decade only slight changes in basic somatic features and negative changes in body build (especially in men) were noted. Physical fitness of students was similar to the results obtained 10 years earlier. Conclusions. The observed secular trends in body build and physical fitness may be interpreted as the effects of the improvement of living conditions of the male subjects and the improvement of admission process at the university.

KEYWORDS: secular trend, Heath–Carter method, somatotype, Eurofit.

Received: 18 December 2018
Accepted: 14 January 2020

Corresponding author: agnieszka.wasiluk@awf-bp.edu.pl

Jozef Pilsudski University of Physical Education in Warsaw, Faculty of Physical Education and Health in Biala Podlaska, Biała Podlaska, Poland

Introduction

The development of science and technology which serve as the foundation of socio-economic progress has led to a significant improvement of living conditions. Civilization changes are not a linear process; they differ depending on the pace of economic development and geographic location. They influence the pace at which a young generation develops. The improvement of living conditions combined with an increased consumption of food products and a lower level of physical activity leads to an increase in the occurrence of overweight and obesity in the population [3, 4]. It is highly distressing, especially with regard to a younger generation [11, 12, 26]. In the literature devoted to academic youth we can find studies revealing positive changes in physical growth and negative changes in motor abilities at the end of the 20th century, and then the slowdown of this trend at the beginning of the 21st century. Such conclusions were reached, inter alia, by Mleczko and Januszewski [13], Stachoń et al. [23], Avila et al. [1] and Ręba cz-Maron [18]. Authors dealing with the issue of the somatic build of academic youth, athletes and particular professional groups indicate close similarities concerning morphological features with regard to groups of people performing the same jobs, practising the same sport or studying the same courses at university [21, 22, 27]. Students from the University of Physical Education should demonstrate a high level of physical fitness and have more active tissue and less fat tissue compared to the academic youth from other fields of study [14].

Aim of Study

Taking into account the aforementioned facts, it was decided that this study should analyse changes in somatic and motor predispositions of female and male PE students in the years 2004 and 2014.

Material and Methods

In 2004 the authors examined 112 female and 287 male second-year PE students from the Faculty of Physical Education and Sport in Biala Podlaska. Anthropometric features were measured according to Martin and Saller guidelines, and these measurements, in turn, were used to calculate body build type according to Heath–Carter method [5]. The level of physical fitness was measured with Eurofit test [2]. The results were collected within the authors' own research No. VII/146. The same research methods were applied in 2014 when examining 98 females and 242 males within statutory activity No. 172. The research was carried out in compliance with the rules included in the Declaration of Helsinki and was accepted by the Senate Ethics Commission.

The collected variables were described with the use of sample size (n), arithmetic mean ($\widetilde{x}$) and standard deviation (SD). The data gathered in the physical fitness tests were converted to points on T scale. Calculated from the formula:

$$T = (\left(\frac{x_i - \tilde{x}}{SD}\right) * 10 + 50)$$

x_i – mean of 2014 results
$\tilde{x}$ – mean of 2004 results
SD – standard deviation of 2004 results

Afterwards, the results obtained in 2014 were normalised to the findings from 2004. In test attempts, when a lower result means a better result (e.g. agility), the order of the means was changed in the formula. In such calculations, the 2004 group results are 50 points. Differences between the selected groups concerning the analysed features were estimated with the use of the Student's t-test for independent trials at the level from $p \leq 0.05$ to $p \leq 0.001$. All statistical analyses were conducted using Statistica Software 10.0 (StatSoft Inc., 2011). The detailed p-values were presented in the tables.

Results

Long-term tendencies of changes in basic somatic features and body build components were defined on the basis of mean differences in absolute values (Table 1). It was concluded that women currently studying were taller by 0.47 cm and heavier by 0.32 kg than female students from ten years before. Moreover, the endomorphy

Table 1. Values of basic somatic features and body build components as well as Student's t-test of female and male students in the years 2004 and 2014

Somatic features and body build components	2004		2014		Student's t-test value	p-value
	$\bar{x}$	SD	$\bar{x}$	SD		
Females						
Calendar age	21.02	2.34	20.84	2.59	0.53	0.597
Body height	165.84	5.71	166.31	5.75	0.59	0.556
Body mass	59.30	7.18	59.62	8.62	0.29	0.072
Endomorphy	4.08	1.15	4.17	1.36	0.52	0.604
Mesomorphy	3.06	0.90	4.00	3.75	2.57*	0.011
Ectomorphy	2.73	0.99	2.60	1.14	0.88	0.380
Males						
Calendar age	21.11	1.87	20.97	1.21	1.00	0.318
Body height	181.21	6.27	180.58	6.52	1.13	0.259
Body mass	76.77	9.25	78.45	10.63	1.94	0.053
Endomorphy	3.36	1.19	3.75	1.28	3.63*	0.001
Mesomorphy	4.51	0.96	4.00	1.65	4.42*	0.001
Ectomorphy	2.73	0.96	2.55	1.14	1.97*	0.049

Note: $\bar{x}$– mean, SD – standard deviation
* statistically significant differences at the level of $p \leq 05$ and $p \leq 0.001$

component increased slightly by 0.09 points (from 4.08 to 4.17), while the ectomorphy component decreased by 0.13 points (from 2.73 to 2.60). Only the decrease in the mesomorphy component by 0.94 points was statistically significant.

However, statistically insignificant differences were found in the basic somatic features between the studied groups of male students. The men currently studying were 0.65 cm taller and 1.68 kg heavier than students ten years before. Men currently studying had better component endomorphy (by 0.39 points). Moreover, they had significantly lower mesomorphy (by 0.51 points) and ectomorphy (by 0.18 points). All differences in body components were statistically significant.

On the basis of mean absolute values and T scale points, the changes in physical fitness levels of students were determined (Figure 1, Table 2). Women currently studying had significantly better results in the 'standing broad jump' test (by 5.98 cm, i.e. 4.25 T scale points) than females studying a decade before. They also performed better in the 'sit-ups in 30 seconds' test (by 2.45 sit-ups, i.e. 6.97 points) and in the 'endurance shuttle run' test (by 5.73 shuttles, i.e. 3.65 points). Moreover, a slight (statistically insignificant) improvement was noted in the results of the '10 × 5 metre shuttle run' (by 0.42 s, i.e. 2.25 points), 'flamingo balance test' (by 0.18 trials, i.e. 0.88 points), 'sit-and-reach' test (0.24 cm, i.e. 0.44 points) and 'bent arm hang' (by 0.30 s, 0.33 points). However, they had significantly lower results in 'handgrip test' (by 3.80 kg, i.e. 7.68 points) and 'plate tapping' (by 0.85 s, 6.54 points).

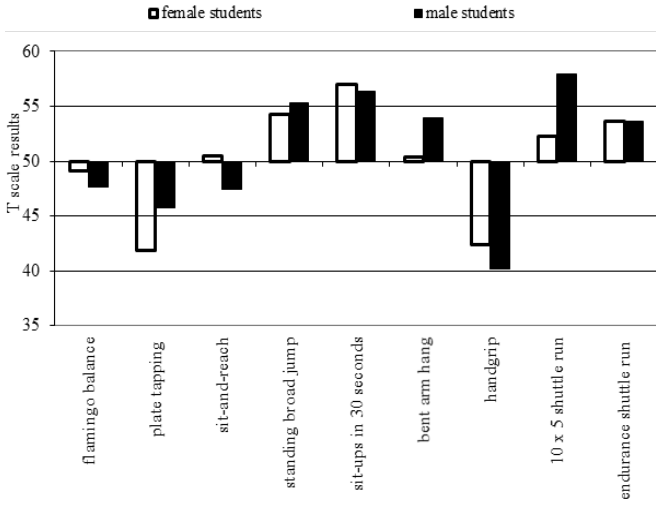

Figure 1. T scale results of Eurofit tests of male and female students from 2014 normalised to the results of students from 2004

Table 2. Results of Eurofit tests and Student's t-test of female and male students in the years 2004 and 2014

Eurofit tests	2004		2014		Student's t-test values	p-value
	$\bar{x}$	SD	$\bar{x}$	SD		
			Females			
Flamingo balance test	2.26	2.04	2.44	2.07	0.63	0.529
Plate tapping	10.70	1.30	11.55	1.82	3.93*	0.001
Sit-and-reach	29.16	5.42	29.40	7.47	0.27	0.787
Standing broad jump	190.06	14.07	196.04	24.21	2.22*	0.027
Sit-ups in 30 seconds	24.79	3.53	27.25	3.79	4.87*	0.001
Bent arm hang	13.36	9.02	13.66	12.29	0.20	0.842
Handgrip test	38.18	4.95	34.38	5.32	5.36*	0.001
Shuttle run (10 × 5 m)	19.83	1.87	19.41	1.37	1.83	0.069
20 metre endurance shuttle run	60.30	15.68	66.03	14.79	2.71*	0.007
			Males			
Flamingo balance test	3.40	2.53	4.01	2.76	2.64*	0.009
Plate tapping	9.93	1.43	10.54	1.58	4.63*	0.001
Sit-and-reach	26.95	7.12	25.10	7.94	2.80*	0.005
Standing broad jump	235.06	22.73	247.02	21.01	6.28*	0.001
Sit-ups in 30 seconds	28.36	4.61	31.28	4.25	7.58*	0.001
Bent arm hang	25.91	10.71	30.09	12.59	4.08*	0.001
Handgrip test	60.97	9.39	51.73	8.19	12.09*	0.001
Shuttle run (10 × 5 m)	18.88	1.60	17.61	1.22	10.33*	0.001
20 metre endurance shuttle run	86.99	15.43	92.66	12.30	4.70*	0.001

Note: $\bar{x}$ – mean, SD – standard deviation

* statistically significant differences at the level of $p \leq 0.05$ and $p \leq 0.001$

Bigger differences were noted when comparing the results of male students. In 2014 the participants performed better in the '10 × 5 m shuttle run' (by 1.27 s, 7.94 points), 'sit-ups in 30 seconds' (by 2.92 sit-ups, 6.33 points), 'standing broad jump' (by 11.96 cm, 5.26 points), 'bent arm hang' (by 4.18 s, 3.90 points) and in 'endurance shuttle run' (by 5.67 shuttles, 3.67 points).

However, they obtained significantly lower results in the remaining Eurofit tests, i.e. in the 'handgrip test' (by 9.24 kg, 9.84 points), 'plate tapping' (by 0.61 s, 4.27 points), 'sit-and-reach' (by 1.85 cm, 2.60 points) and in 'flamingo balance' (by 0.61 trials, 2.41 points).

Defining general fitness with the mean of the point differences from all the tests, it may be concluded that female and male participants of the 2014 research demonstrated a slightly higher level of physical fitness compared to their counterparts from a decade before. The differences were at the level of 0.31 points for females and 0.89 points for males, and were statistically significant.

Discussion and Conclusion

The entry requirements at sports universities result in PE students demonstrating higher levels of somatic features as well as physical fitness and efficiency than students from other fields of study [15, 21]. Changes which occurred in the years 2004 and 2014 and regarded body height and mass of female and male students reflect changes in the physical development of children and youth in the whole region of eastern Poland [19, 29]. The sustaining high secular trend in the somatic development of the youth from eastern Poland and the inhibition of this process in other regions of Poland [17] cause developmental differences to diminish.

Lower entry requirements, especially those concerning physical fitness combined with the demographic low led to a limited selection. This, in turn, resulted in the fact that each secondary-school graduate meeting those lowered requirements may become a student of the University of Physical Education. In the long-term these changes lead to an increase in endomorphy and a decrease in ectomorphy and mesomorphy. These tendencies are unfavourable in terms of educating future PE teachers. In the continuous research on American students (Andrews University) Pribis et al. [16] observed an increase in somatic build parameters (especially adiposity) with a simultaneous decrease in the level of physical fitness. Also, a high pace of increase in basic somatic features (height, mass and adiposity) with a simultaneous decrease in the results in a number of Eurofit test trials (FLB, PLT, SAR, SBJ, SUP, SHR) among Hungarian students at the University in Pecs and Kaposvir was noted by Kaj et al. [7].

Students surveyed demonstrated somatic build similar to their counterparts from the Medical University in Gdansk [8, 9] or Medical University in Lublin [10]. However, they presented higher physical fitness levels than students from the above-mentioned universities. Students surveyed obtained similar results in physical fitness tests to their peers from Zagreb [22], Kaunas [6] and Hungary [7] but had clearly lower results than students from typical sports universities, e.g. the University of Physical Education in Wroclaw [23] or the sports department at the University in Bratislava [20]. As long as a decade ago it was noted that somatic build of the candidates for the first year of physical education studies, and especially high adiposity accompanied by weak musculoskeletal system, differed significantly from the patterns noted in the youth from the same field of study at other universities or in individuals doing sports actively [28]. In the course of studies at sports faculties an increased number of practical classes exerts an influence on somatic features. Therefore, it may be presumed that more distinct differences between the groups of female and male participants might be noted in the case of older students since physical exercises may affect energetic balance of the system and body tissue composition. This correlation was also noted by Yildiz et al. [30] who observed students from the sports university in Aydın in Turkey. Also, the authors of publications devoted to the correlations between somatic features and the level of physical efficiency and sports results in various disciplines [24, 25] noted that apart from body build typical of a given sport, body composition as well as the proportion of fat tissue and lean body mass were particularly significant. At the same time they highlighted the fact that training effects differentiating tissue components depended on the specificity and duration of a training process, participants' age and the discipline itself.

The analysis of changes in motor skills revealed that physical fitness of the students was similar to the results obtained ten years before and differences were noted only at the level of certain motor skills. It should be highlighted that bigger changes were noted in men than in women. It may have stemmed from the fact that young people adapted to the changing environment and to the requirements of the study programme. Similar changes could be noted among students at sports universities. Mleczko and Januszewski [13] emphasised the fact that students presently beginning studies at sports universities have better somatic features (e.g. adiposity) than motor skills, which is compliant with the national secular trends among the youth graduating from upper-secondary schools [17].

In general, the research revealing 10-year-long changes in body height and mass as well as physical fitness of students are in line with the conclusions of other authors. Contrary observations refer to an increase in adiposity, especially in men, with a simultaneous decrease in muscle

and skeleton mass. The observed secular trends in body build and physical fitness of students may be interpreted as a confirmation of the lowering of biological potential of the youth originating from the areas where students live.

References

1. Avila JA, Avila RA, Goncalves EM, Barbeta VJO, Morcillo AM, Guerra-Junior G. Secular trends of height, weight and BMI in young adult Brazilian military students in the 20th century. Ann Hum Biol. 2013; 40(6): 554-556. DOI: 10.3109/03014460.2013.808696.
2. Eurofit Handbook for the EUROFIT tests of Physical fitness. Rome: Council of Europe; 1988.
3. Ferrari GL, Araújo TL, Oliveira LC, Matsudo V, Fisberg M. Association between electronic equipment in the bedroom and sedentary lifestyle, physical activity, and body mass index of children. J Pediatr. 2015; 91(6): 574--582. DOI: 10.1016/j.jped.2015.01.009.
4. Fuller-Tyszkiewicz M, Skouteris H, Hardy LL, Halse C. The associations between TV viewing, food intake, and BMI. A prospective analysis of data from the Longitudinal Study of Australian Children. Appetite. 2012; 59(3): 945--949. DOI: 10.1016/j.appet.2012.09.009.
5. Heath BH, Carter JEL. A modified somatotype method. Am J Phys Anthropol. 1967; 27: 54-74.
6. Hraski M, Kunješić M, Emelijanovas A. Differences in some anthropological characteristics between Croatian and Lithuanian students and comparison with Eurofit standards. Croat J Edu. 2013; 17(1): 71-79. DOI: 10.15516/ /cje.v17i1.1143.
7. Kaj M, Tékus É, Juhász I, Stomp K, Wilhelm M. Changes in physical fitness of Hungarian college students in the last fifteen years. Acta Biol Hung. 2015; 66(3): 270-281. DOI: https://doi.org/10.1556/018.66.2015.3.3.
8. Kochanowicz B. Physical fitness level of Medical University physiotherapy students and their opinion on various forms of motor activity. Ann Acad Med Gedan. 2007; 37: 53-62.
9. Kochanowicz B, Korewo A, Kubicka A. Changes in the level of physical fitness in students of selected departments at the Medical University of Gdansk. Ann Acad Med Gedan. 2010; 40: 35-53.
10. Kotwica A, Majcher P. Physical fitness level of 1st year medicine and physiotherapy students of Lublin Medical University. Pol J Sport Tourism. 2012; 19(2): 107-118. DOI: https://doi.org/10.2478/v10197-012-0011-4.
11. Livingstone B. Epidemiology of childhood obesity in Europe. Eur J Pediatr. 2000; 159, Suppl. 1: 14-34.
12. Lobstein T, Rugby N, Leach R. Obesity in Europe – 3 International Obesity Task Force. Brussels; March 15, 2005.
13. Mleczko E, Januszewski J. Long-term trends of changes in physical and motor development observed among Cracovian students. Antropomotoryka. 2009; 46: 65-79.
14. Mleczko E, Mirek W. The social structure transformation and inter-generational changeability of somatic and motor development in Cracovian students. Antropomotoryka. 2009; 47: 37-42.
15. Pasiut U. Biological state of the students at the University School of Physical Education on the background of the whole of young adults studying in biggest state universities of Krakow. Antropomotoryka. 2012; 60: 111-122.
16. Pribis P, Burtnack CA, Mckenzie SO, Thayer J. Trends in body fat, body mass index and physical fitness among male and female college students. Nutrients. 2010; 2: 1075-1085. DOI: 10.3390/nu2101075.
17. Przewęda R, Dobosz J. Growth and physical fitness of Polish youths. Warszawa: University of Physical Education Editions; 2005.
18. Rębacz-Maron E. Changes in the body build of students of the Maritime University of Szczecin in the years 1969--2007. Int Marit Health. 2013; 1: 12-17.
19. Saczuk J. Trendy sekularne i gradienty społeczne w rozwoju biologicznym dzieci i młodzieży ze wschodniej Polski na tle zmian środowiskowych w latach 1986--2006 (Secular trends and social gradients in biological development of children and youth from eastern Poland compared to environment changes in the years 1986--2006). AWF Warszawa, ZWWF Biała Podlaska; 2011.
20. Sedláček J, Jablonský T, Pistlová L. Physical fitness and movement activities of university students in Slovakia. J Phys Educ Sport Manag. 2011; 1: 1-10.
21. Smolarczyk M, Wiśniewski A, Czajkowska A, Kęska A, Tkaczyk J, Milde K, et al. The physique and body composition of students studying physical education: a preliminary report. Pediatr Endocrinol. 2012; 18(1), 27-32.
22. Sporis G, Jukić I, Bok D, Vuleta D Jr, Harasin D. Impact of body composition on performance in fitness tests among personnel of the Croatian navy. Coll Antropol. 2011; 35(2): 335-339.
23. Stachoń A, Burdukiewicz A, Pietraszewska J, Andrzejewska J. Changes in body build of AWF students 1967--2008. Can a secular trend be observed? Hum Mov. 2012; 13(2): 109-119. DOI: https://doi.org/10.2478/v10038--012-0011-8.
24. Starkowicz-Przybycień B. Body composition and somatotype of the top of Polish male karate contestants. Biol Sport. 2010; 27(3): 195-201.
25. Tomkinson G. Global changes in anaerobic fitness test performance of children and adolescents (1958-2003). Scan J Med Sci Sports. 2007; 17(5): 497-507.

26. Tomkinson GR, L´Eger LA, Olds TS, Cazorla G. Secular trends in the performance of children and adolescents (1980-2000): an analysis of 55 studies of the 20m shuttle run test in 11 countries. Sports Med. 2003; 33(4): 285-300.
27. Veale JP, Pearce AJ, Buttifant D, Carlson JS. Anthropometric profiling of elite junior and senior Australian football players. Int J Sports Physiol Perform. 2010; 5(4): 509-520.
28. Vernillo G, Schena F, Berardelli C, Rosa G, Galvani C, Maggioni M, et al. Anthropometric characteristics of top-class Kenyan marathon runners. J Sports Med Phys Fitness. 2013; 53(4): 403-408.
29. Wasiluk A, Saczuk J, Litwiniuk S. Selected parameters of body build of candidates for physical education studies in the Institute of Physical Education and Sports in Biała Podlaska. J Physical Edu Sport. 2003; 2: 239-253.
30. Yildiz Y, Karakaş S, Güneş H, Köse H. Reflection of sport awareness on body composition in students at the school of physical education and sports. Trakya Univ Tip Fak Derg. 2009; 26(3): 249-255.