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Dimorphism of motor skills of 17-19-year-old students from Bydgoszcz

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Abstract

The purpose of this article was to demonstrate dimorphism in the motor skills of 17-19-year-old students from schools in Bydgoszcz measured using MTSF. The research was conducted among 2,832 students of both sexes (1,686 boys and 1,146 girls) from schools in Bydgoszcz. Dimorphic differences were determined using the Student's t-Test, Mollison's indicators and the T-score. The study results were presented in the graphical and tabular form. The following conclusions were drawn:
1. The older the boys were the better results were achieved in tests including standing long jump, hand-grip dynamometer, pull-ups, 50m sprint, 4 x 10m shuttle run and 1000m sprint, whereas in the case of girls it was hanging on a pull-up bar and 50m sprint. The remaining results were different in terms of the age of respondents.
2. Boys were reported to have better results than girls in all tests and age groups (except for flexibility at the age of 19). Statistical significance at the confidence level of 1% was reported in almost all tests.
3. The largest differences measured by means of Mollison's ratio were observed in the hand-grip test.
4. The results of the students involved in the study expressed in points after calculation according to the T-scale revealed bigger motor skills in girls in all age groups being compared

in relation to their peers and only in the group of 19-year-old boys the results proved to be better.

Key words: dimorphism, adolescents, students, motor skills, the International Physical Fitness Test battery

Introduction

The purpose of this article was to demonstrate sexual dimorphism measured by means of MTSF in the motor skills of students from lower secondary schools in Bydgoszcz taking the calendar age into consideration.

Gender-based differences, especially variability of individual parameters connected with subsequent advancement stages of development regarding the studied population and diversification observed in this respect may have an impact on the functional capabilities of children and adolescents and thus on the level of motor effects achieved by them (Przewęda, 1985; Szopa 1988; Wolański, Pařizkowa, 1976; Żak 1991).

An increase in motor skills in subsequent categories of age comprises – in the opinion of H. Milicer (1964) – a direct evidence that biological maturation of the human organism provides the basis for development of physical fitness. This phenomenon is accompanied by significant dimorphic differences in the development of motor fitness resulting from different biological parameters of the body system of girls and boys as well as different periods of sexual maturation and interests of children (Milicer 1964, Przewęda 1985). Gender-based differences clearly increase in the adolescence (Wolański, Pařizkowa 1976).

The issue of gender dimorphism in the lessons of physical education, in particular in professional and recreational sport, is of very great importance. The differences in the degree of somatic features followed by functional features between men and women provide the basis for diversification of physical skills in the representatives of both sexes. In terms of population,
well-trained men achieve better results in exercise tests than their female counterparts. It is noteworthy that the degree of gender dimorphism is not the same in the entire ontogenesis and varies during different periods of life. The studies have shown (Wolański, 2006) that the largest level appears in early adult life whereas the lowest one can be observed in prenatal life and late old age.

Some indicators of the health condition especially seen in the efficiency of the circulatory and respiratory system, are connected with the size of adipose tissue. The issues presented in this paper have been mentioned in a number of publications in Poland (Drozdowski, 2002; Eksterowicz, Napierała 2007; Szymelfejnik, Jarząbek, Eksterowicz, Cichoń, 2007; Wolański 2006). Particularly valuable appears to be the research concerning school and university youth as based on the research it is possible to construct a development and health projection for a given population.

Material and methods

The study of motor skills was conducted among 2,832 students of both sexes, living in Bydgoszcz (1,686 boys and 1,146 girls) aged 17 to 19 years. Mean values and standard deviations were calculated on the basis of source measurements. Statistical significance between genders was determined using Student's t-Test at the level of 5% and 1%. Additionally, dimorphic differences were determined using Mollison's indicators (Drozdowski, 2002). The study results were displayed in the graphical and tabular form (including descriptions).

The International Physical Fitness Test consisting of eight batteries (Drabik, 1992) was applied to define the degree of motor skills.

The tables indicated $\overline{X}$ as the arithmetic mean, S – standard deviation, D – difference between means, t – Student's t-Test result for independent groups. Optimisation and statistical methods were used using the calculation sheet MS Excel (Microsoft Excel 2010).

The motor parameters of male subjects and their female counterparts were compared and the existing statistical significance of gender differences in the studied sub-population was determined using Student's t-Test. Statistical significance was established at the confidence level of 5% and 1% *(p=0.05) **(p= 0.01).

Findings

In all compared age groups, it was boys that achieved better results in a standing long jump test than the girls involved in the study. 17-year-old girls were reported to have the best results. 19-year-old boys improved their jumping skills on a systematic basis and achieved the best results. Differences between the results of girls and boys were statistically significant at the confidence level of 1%. The biggest differences were recorded at the age of 18 (Table 1 and Table 2).

Table 1. Numerical characteristics in standing long jump (cm)

Age	Gender	N	$\overline{X}$	Min.	Max.	S	D	u	WM
17	♀	798	167.85	91.00	258.00	28.91	31.85	15.17**	0.88
years	♂	386	199.68	100.00	312.00	36.00			
18	♀	483	164.38	87.00	246.00	25.06	36.95	20.67**	1.25
years	♂	463	202.33	130	303	29.63			
19	♀	405	167.40	100.00	255	26.45	36.19	15.21**	1.06
years	♂	297	203.59	145	306	34.19			

Remarks. *(p=0.05) **(p= 0.01), WM - Mollison's ratio

Table 2. Numerical characteristics in hand-grip dynamometer (kg)

Age	Gender	N	$\overline{X}$	Min.	Max.	S	D	u	WM
17	♀	798	20.85	8	49	7.24	19.38	25.15**	1.36
years	♂	386	40.23	15.00	74.00	14.28			
18	♀	483	22.28	8	48	8.39	20.23	29.73**	1.67
years	♂	463	42.51	15	72	12.12			
19	♀	405	21.08	8	49	10.59	27.83	26.99**	1.82
years	♂	297	48.91	15	77	15.28			

Remarks. *(p=0.05) **(p= 0.01), WM - Mollison's ratio

Boys in all age groups achieved better hand-grip test results then their female counterparts (Table 2). Boys tended to have increasingly better results whereas girls turned out to achieve the best results in the group of 18-year-olds. The most important differences in this test were observed at the age of 19. Differences between the results of girls and boys were statistically significant in all tests at the confidence level of 1%.

The sit-and-reach test was reported to be more favourable in all age groups for boys who achieved better results than their peers of the opposite sex. Differences between test results were statistically significant at the confidence level of 1%. Girls achieved the best results at the age of 17 and the results decreased on a systematic basis. Boys were reported to have the best results at the age of 19. The biggest differences in the group involved in the study were observed at the age of 19 (Table 3).

Table 3. Numerical characteristics in sit-ups (number of cycles)

Age	Gender	N	$\overline{X}$	Min.	Max.	S	D	u	WM
17	♀	798	22.43	5.00	40.00	7.28	5.07	13.26**	0.91
years	♂	386	27.50	10.00	45.00	5.55			
18	♀	483	22.42	8	37	5.99	3.01	7.59**	0.49
years	♂	463	25.43	7	46	6.20			
19	♀	405	22.05	11	40	5.61	6.33	16.13**	1.33
years	♂	297	28.38	14	41	4.76			

Remarks. *(p=0.05) **(p= 0.01), WM - Mollison's ratio

Girls were observed to have consistently worse results in the hanging on a pull-up bar test as opposed to boys. The best results were achieved at the age of 17 among girls and at the age of 19 among boys. The results were expressed in points after calculation according to the T-scale and it turned out that the values achieved by girls were better in all age groups (Table 4).

Table 4. Numerical characteristics in bent-arm hang and pulling up on a bar

Age	Gender	N	$\overline{X}$	Min.	Max.	S	T-score
17	♀	798	19.15	1.0	60.0	7.14	55
years	♂	386	5.99	0	21	3.62	50
18	♀	483	18.63	1	61	11.77	55
years	♂	463	6.08	0	20	4.22	50
19	♀	405	17.57	0	58	8.91	55
years	♂	297	6.44	0	23	5.66	49

As regards a 50m sprint test, boys were reported to have better results than girls, systematically improving their results. Yet, girls tended to have consistently worse results. All the differences between the age groups being compared were statistically significant at the confidence level of 1%. The greatest disparity was observed at the age of 19 (Table 5).

Table 5. Numerical characteristics in 50m sprint (s)

Age	Gender	N	$\overline{X}$	Min.	Max.	S	D	u	WM
17	♀	798	9.37	6.2	12.9	1.51	0.84	10.39**	0.71
years	♂	386	8.53	6.3	12.6	1.19			
18	♀	483	9.4	6.2	17.3	1.72	1.21	12.83**	1.07
years	♂	463	8.19	6.4	12.5	1.13			
19	♀	405	9.48	6.2	13.5	1.63	1.69	15.16**	1.40
years	♂	297	7.79	6.1	11.5	1.21			

Remarks. *(p=0.05) **(p= 0.01), WM - Mollison's ratio

In the 800m sprint, girls turned out to have better results at the age of 18. When translating the results into points according to the T-scale, fewer points were scored by girls than boys in the 1000m run. The best results were achieved by female subjects at the age of 18 while boys improved their performance each time and achieved the best results in the group of 19-year-olds (Table 6).

Table 6. Numerical characteristics in girls' 800m and 1000m sprint (s)

Age	Gender	N	$\overline{X}$	Min.	Max.	S	T-score
17	♀	798	255.71	155.00	399	62.21	44
years	♂	386	230.49	181.00	378.9	45.82	51
18	♀	483	238.62	153	399	63.02	50
years	♂	463	224.92	156	378.1	32.13	52
19	♀	405	242.12	155	399	66.58	49
years	♂	297	222.1	181	387	31.36	53

In the 4x10m shuttle run test, girls proved to have the best results at the age of 18. Boys tended to have increasingly better results and eventually achieved the best results at the age of 19. The gender-related differences observed in the tests at the age of 17 and 19 proved to be statistically significant at the confidence level of 1%. The greatest disparity was observed at the age of 19 (Table 7).

Table 7. Numerical characteristics in 4 x10m shuttle run (s)

Age	Gender	N	$\overline{X}$	Min.	Max.	S	D	u	WM
17	♀	798	11.86	8.0	21.9	3.20	0.62	3.06**	0.19
years	♂	386	11.24	6.9	21.7	3.31			
18	♀	483	11.49	8.0	21.9	3.23	0.41	1.84	0.11
years	♂	463	11.08	7.0	20.5	3.59			
19	♀	405	11.69	8.3	19.2	2.10	1.86	10.91**	0.51
years	♂	297	9.83	7.1	19.7	2.32			

Remarks. *(p=0.05) **(p= 0.01), WM - Mollison's ratio

In the sit-and-reach test, girls showed increasingly better performance and the best results were achieved in the group of 19-year-olds. As regards boys, they had the best results at the age of 18. In the group of 17 and 18-year-olds, boys were reported to have better results whereas among 19-year-olds it was girls who prevailed. At the age of 18, the difference proved to be statistically significant at the confidence level of 1% (Table 8).

Table 8. Numerical characteristics in sit-and-reach (cm)

Age	Gender	N	$\overline{X}$	Min.	Max.	S	D	u	WM
17	♀	798	7.28	-20	+27	9.15	0.73	1.17	0.07
years	♂	386	9.87	-14	34	10.45			
18	♀	483	7.69	-23	+27	8.83	2.19	3.16**	0.18
years	♂	463	9.88	-22	+34	12.14			
19	♀	405	7.93	-19	+27	7.82	1.19	1.87	
years	♂	297	6.74	-15	+34	8.71			-0.14

Remarks. *(p=0.05) **(p= 0.01), WM - Mollison's ratio

Once the results of all tests were expressed into points according to the T-scale, it turned out that girls aged 17 and 18 achieved better results than their male counterparts. Boys dominated only among 19-year-olds (Table 9).

Table 9. T- score of girls and boys

Test	17 years		18 years		19 years	
	♀	♂	♀	♂	♀	♂
Standing long jump	49	43	48	41	50	42
Hand-grip dynamometer	37	43	40	44	37	49
Sit-ups (30s)	52	53	52	50	52	56
Hang on a bar, pulling up	55	50	55	50	55	49
50m sprint	42	34	42	36	41	44
800m, 1000m sprint	44	51	50	52	49	53
4 x 10m shuttle run	56	49	60	42	58	62
Sit-and-reach	44	52	45	53	45	49
Σ	**379**	**375**	**392**	**368**	**387**	**404**
$\overline{X}$	47.38	46.88	49	46	48.38	50.5

Research results were presented on the profile of standardised values using Mollison's indicators. The greatest disparity was observed at the age of 19. The hand-grip dynamometer test and the 50m run revealed the most differences among the groups involved in the study (Fig. 1).

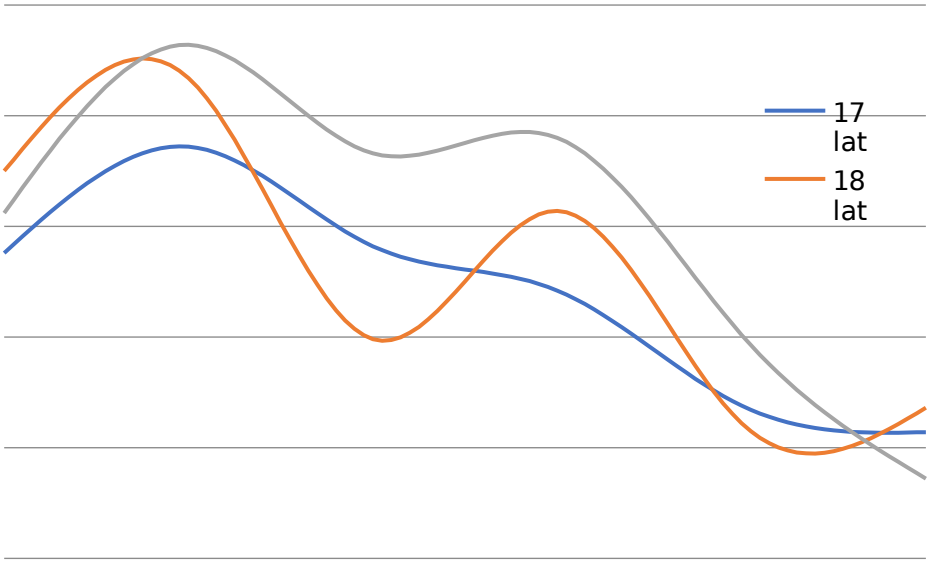

Fig. 1. Profile of standardised values of motor skills with regard to girls and boys involved in the study.

Discourse and conclusions

The issue of dimorphism comprises the filed to continuous searches and investigations **(**Carlton, 2007; Drozdowski 1972, 2002; Eksterowicz, Napierała 2007; Szymelfejnik, Jarząbek, Eksterowicz, Cichoń, 2007; Wolański 2006).

The phenomenon of sexual dimorphism appears to be especially important in physical education and sport. Various ways are used for the purpose of numerical assessment of the dimorphism degree, but the ones which aim at replacing subjective evaluations with accounting processes are particularly worthy of notice. These methods include A. Skibińska ratio[9] expressed by*: ratio = (chest circumference – waist circumference): 2 x hip circumference*. According to Skibińska, this ratio is, on average, 961.7 for men and 735.1 for women. Szopa (1989) and Żak (1991) found that gender-based dimorphism within the fitness level, flexibility and functional features was connected with somatic development and was determined by structural properties of an organism to a greater extent than within the coordination level. Their differentiation is rather determined by a number of psychoneurological phenomena.

Sexual dimorphism in the motor skills of children and adolescents in the region of Kuyavia-Bydgoszcz has become the field of interest to the researchers of the Institute of Physical Culture at Kazimierz Wielki University in Bydgoszcz (Napierała 2000, 2005, 2008). Consequently, numerous scientific papers have been developed. The studies revealed that boys achieved better results in the 50m sprint in all age groups than their female peers (statistically significant differences). The older the study subjects the higher increase in the dimorphic differentiation and the biggest difference measured using the index of standardized values was recorded at the age of 17.5. Girls achieved top results sooner than boys. Similar findings were reported by many researchers (Szopa, Mleczko, Żak, 2000). The period of relative stabilization was observed in girls earlier which influenced the progression range of results.

Raczek and Żak (Raczek 1986, Szopa, Mleczko, Żak 2000, p. 84) claimed that boys' results stabilised from the age of 18.5 while girls' results from 12.5 years. Some scientists believe that the period of endurance development in girls lasts only until the age of 9 years. The decline in performance may be caused by girls' unwillingness to a long-term physical activity after the time of puberty and less experience in exercise. Sexual diversity in the endurance development level during the initial years of research increases with age in favour of boys as a result of earlier stabilization or even regression of girls' results. As Mleczko pointed out (Szopa, Mleczko, Żak 2000), better results of the boys involved in the study increase in direct proportion to body height and weight, yet, no similar relations are recorded in girls. The reason behind this may be certain disorders resulting from too much adipose tissue in body mass after the time of pubertal growth (as shown in the findings included in this article).

Differences between the level of agility development in the initial years of study increase with age in favour of girls which is a consequence of previous stabilization and regression of girls' performance. Stabilisation of the results after the age of 13.5 is connected with the growth of body height. Similar findings were recorded in the study conducted in Poznań by W. Osiński (1993).

Test results presented in this study have shown higher levels in male groups. According Szopa, Mleczko and Żak (2000), dimorphic differentiation increases with higher age group. These test results proved that girls achieved top developmental abilities sooner than boys (the completion of the results progression) and had relative stabilization of results sooner. In some tests, regression of results was observed in girls which had an impact on increased dimorphism.

Gender-based dimorphism in terms of motor skills is diversified depending on age (condition of somatic development) and the type of an investigated parameter.

The following conclusions were drawn on the basis of the conducted study:

1. The older the boys were the better results were achieved in tests including standing long jump, hand-grip dynamometer, pull-ups, 50m sprint, 4 x 10m shuttle run and 1000m sprint, whereas in the case of girls it was hanging on a pull-up bar and 50m sprint. The remaining results were different in terms of the age of respondents.
2. Boys were reported to have better results than girls in all tests and age groups (except for flexibility at the age of 19). Statistical significance at the confidence level of 1% was reported in almost all tests.
3. The largest differences measured by means of Mollison's ratio were observed in the hand-grip test.
4. The results of the students involved in the study expressed in points after calculation according to the T-scale revealed bigger motor skills in girls in all age groups being compared in relation to their peers and only in the group of 19-year-old boys the results proved to be better.

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