

COMPARATIVE ANALYSIS OF PHYSICAL FITNESS OF PHYSICAL EDUCATION MAJOR ROMANIAN AND UKRAINIAN STUDENTS

Viktoriiia KYRYCHENKO^{1,*}, Grațielia-Flavia DEAK^{1,2},
Nicolae Horațiu POP^{1,3}, Leon GOMBOȘ^{1,4},
Olena ANDRIEIEVA⁵, Inna KHRYPKO⁵

*Received 2023 September 14; Revised 2023 September 28; Accepted 2023 October 2nd;
Available online 2023 September 30; Available print 2023 November 30.*

©2023 Studia UBB Educatio Artis Gymnasticae. Published by Babeș-Bolyai University.



This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License

ABSTRACT. Introduction: The aim of the present study was to compare the level of physical fitness of physical education majors from two universities based in Romania and Ukraine respectively. **Materials and methods:** A total of 201 university students participated in this study. 161 subjects were Romanian students enrolled at the Faculty of Physical Education and Sport, Babeș-Bolyai University (107 males and 54 females), and 40 subjects were Ukrainian students enrolled at the National University of Ukraine on Physical Education and Sport (23 males and 17 females). Anthropometric measurements were performed on all participants. In order to evaluate physical fitness indicators, seven physical tests were applied. **Results:** The main finding of the study was the fact that the physical fitness level of male students was statistically higher ($p < 0.05$) than the physical fitness level of female students in both Ukrainian and Romanian subjects. There were no statistically significant differences ($p > 0.05$) between representatives of the same gender groups of

¹ *Interdisciplinary Research Center in the Domain of Physical Education and Sport, Babeș-Bolyai University, Cluj-Napoca, Romania*

² *Department of Kinesiotherapy and Theoretical Disciplines, Babeș-Bolyai University, Cluj-Napoca, Romania*

³ *Department of Individual Sports, Babeș-Bolyai University, Cluj-Napoca, Romania*

⁴ *Department of Team Sports, Babeș-Bolyai University, Cluj-Napoca, Romania*

⁵ *Department of Health, Fitness and Recreation, National University of Ukraine on Physical Education and Sport, Kyiv, Ukraine*

* *Corresponding author: victoria.kyrychenko@ubbcluj.ro*

Romanian and Ukrainian students. In the case of Modified Sit-and-reach test and Plate tapping test, female subjects of both groups performed better than male subjects. Statistically significant differences ($p < 0.05$) were observed between indicators of physical fitness of Ukrainian and Romanian students in the same gender groups for the Three Minute Step Test, Modified Sit-and-reach test, Plate tapping test and Standing long jump test. Moreover, excluding the Plate tapping test, the results obtained by the Romanian students were statistically significantly higher than those obtained by their Ukrainian counterparts. Simultaneously, there was no statistically significant difference between female groups ($p > 0.05$), except the results in the Plate tapping test, where Ukrainian students had statistically significantly higher results ($p < 0.05$) than their Romanian counterparts. **Conclusions:** According to the findings of this study, the Romanian subjects had statistically significantly higher results than the Ukrainian subjects. For future research, it would be interesting to analyze the differences between the Romanian and Ukrainian curriculum specific to physical education majors.

Keywords: *university students, physical development, physical fitness, comparative analysis.*

REZUMAT. Analiză comparativă a condiției fizice a studenților români și ucraineni de la facultăți cu profil de educație fizică. Introducere: Scopul acestui studiu a fost acela de a compara nivelul de condiție fizică a studenților de la două facultăți de educație fizică din România, respectiv din Ucraina. **Materiale și metode:** La acest studiu au participat 201 studenți. 161 dintre aceștia au fost înscriși la Facultatea de Educație Fizică și Sport, Universitatea Babeș-Bolyai din Cluj-Napoca (107 bărbați și 54 femei), iar 40 de studenți au fost studenți ucraineni înscriși la Universitatea Națională de Educație Fizică și Sport din Ucraina (23 bărbați și 17 femei). S-au efectuat măsurători antropometrice cu toți subiecții. Pentru evaluarea nivelului condiției fizice s-au folosit șapte teste. **Rezultate:** Nivelul de condiție fizică a bărbaților a fost semnificativ mai mare decât nivelul de condiție fizică a femeilor ($p < 0.05$) și în cazul studenților români, și în cazul studenților ucraineni. Nu s-au înregistrat diferențe semnificative statistic între valorile indicilor condiției fizice corespunzătoare grupurilor de studenți bărbați, respectiv femei, din cele două țări ($p > 0.05$). S-au observat diferențe semnificative statistic ($p < 0.05$) atunci când au fost comparate valorile indicilor condiției fizice corespunzătoare studenților români și ucraineni bărbați, respectiv studentelor din România și Ucraina, măsurate cu următoarele teste: 3 minute de urcare și coborâre, flexia longitudinală a trunchiului, lovește plăcile și săritura în lungime de pe loc. Excluzând rezultatele obținute la testul lovește plăcile, studenții români au obținut rezultate semnificativ statistic mai bune decât studenții ucraineni la toate testele efectuate. **Concluzii:** Conform rezultatelor obținute, studenții români la

educație fizică au o mai bună condiție fizică decât studenții ucraineni din același domeniu. O direcție de cercetare utilă ar putea fi analiza comparativă a planurilor de învățământ de la facultățile de educație fizică din cele două țări.

Cuvinte cheie: studenți, dezvoltare fizică, condiție fizică, analiză comparativă.

INTRODUCTION

The modern lifestyle, with its particular challenges, requires a high level of physical fitness from students (Antipova et al., 2020; Nesen & Klymenchenko, 2020). Thus, monitoring the development of students' physical fitness was, and continues to be, a topic of high interest for researchers (Bonilla et al., 2023; Boros-Balint et al., 2015; Deak et al., 2014; Pribis et al., 2010; Sang & Wang, 2022; Sarpong, 2022; Sun et al., 2023).

According to Andrieieva et al. (2020), a decline in the fitness level of Ukrainian students was observed after winter and summer holidays. Moreover, a decrease in motor activity levels was reported in students enrolled in higher education institutions (Gres & Ostroglyad, 2020; Korobeinikova et al., 2021). There is a general tendency for the prevalence of male and female students with below average and low levels of health status (Orikhovska et al., 2020). In recent times, according to different estimates, 49.3 to 75.1 % of higher education students had reduced levels of physical fitness (Gres & Ostroglyad, 2020; Petritsa, 2018).

During the COVID-19 pandemic, the students' physical activity level decreased, and this process wasn't gender based (Kemeryte-Ivanauskiene et al., 2022). One more reason to be accounted for the decline in physical activity levels was the transition of society to information and digital, with students devoting more and more time to studying, communication and entertainment, using information and communication technologies, which sharply limited their physical activity (Siemova, 2018). Unfortunately, this situation has also affected students of physical education majors.

An increased incidence in functional musculoskeletal disorders was reported in Ukrainian students, due to the low social and economic standard of living, poor educational activities, online-studying, and high psychological stress (Hakman et al., 2020). Concerned scientists about the decline in physical fitness levels of university students had regularly highlighted the necessity to take immediate action (Nesen et al., 2020; Pelech & Grygus, 2016; Sydorova & Horina, 2020).

Experts focus on the development of innovative physical education programs for students, offer methods of involving them in an active lifestyle, and increasing their responsible attitude to their own health. In this context, the investigation of the pedagogical experience of European countries is an urgent issue today. Comparison of physical development indicators of European and Ukrainian students will allow us to determine which motor abilities are developing at an accelerated pace and, by analyzing the educational program, to determine which methods and approaches are used to achieve this. This would make possible to take advantage of the positive European Union countries experience by introducing certain means in the process of physical education into the practice of training a Ukrainian student.

The purpose of the present study was to compare the level of physical fitness of physical education majors from two universities based in Romania and Ukraine respectively.

MATERIALS AND METHODS

Participants

A total of 201 university students participated in this study. 161 subjects were Romanian students enrolled at the Faculty of Physical Education and Sport, Babeș-Bolyai University (107 males and 54 females), and 40 subjects were Ukrainian students enrolled at the National University of Ukraine on Physical Education and Sport (23 males and 17 females).

At the beginning of the study, participants were briefed on the evaluation process. The timing of the tests and the testing procedure were the same for all study participants. Written informed consent to participate in this study was obtained from all subjects.

Procedures

This study was conducted between April and June of 2022. Anthropometric measurements and physical fitness evaluation tests (Three Minute Step Test, ml/kg/min; Modified Sit-and-reach test, cm; Wall squat test (right and left legs) sec; Plate tapping, sec; Sit up test, max reps 30 sec; Pushups, max reps; Standing long jump test, cm) were performed by all subjects. The assessment of physical development was carried out based on the calculation of the Kettle–Gould–Kaup weight-growth index (BMI, kg-m⁻²) (Hrynkiv et al., 2015; Majevska et al., 2014).

Statistical analysis

Shapiro-Wilk's W-consistency test (Ghorbanzaden et al., 2011) was used to check the compliance of the data with the normal distribution law. Since not all the indicators corresponded to the normal distribution law, structural averages were used - the median of Me and 25 and 75 percentiles - Me (25; 75) to represent these indicators.

Mann-Whitney U-test was used for comparative analysis of gender differences between groups from different countries and their results in different tests (Byshevets et al., 2021; Chakhvadze & Nikitchenko, 2017). The main purpose of this method was to show the differences between male and female groups of studied indicators in general, and differences between the indicators of Romanian and Ukrainian students in the same gender groups (Chakhvadze & Nikitchenko, 2017). Z-statistic was additionally calculated, according to the fact that the volume of individual samples exceeded 60 observations. The data obtained during the research was subject to statistical processing, which was carried out using MS Excel and Statistica 10.0.

At all stages of the experimental data, statistical processing significance level was defined as $\alpha=0.05$ ($p<0.05$), while p was presented as $p<0.05$ in cases when its value did not exceed $1.0 \cdot 10^{-5}$.

RESULTS

The average indicators of physical development and physical fitness of physical education majors were determined, depending on gender and the content of the educational program (Table 1).

Table 1. Indicators of the students' physical development and physical fitness, depending on their educational program (n=201)

№	Test results	Statistical indicators			
		Group 1* (n=107)	Group 2** (n=54)	Group 3*** (n=23)	Group 4***** (n=17)
Weight and height indicators					
1	Height, cm	180 (175; 184)	165 (160; 171)	180 (177; 185)	166 (160; 170)
2	Body weight, kg	75 (68; 88)	57 (54; 63)	72 (68; 83)	56 (54; 62)

№	Test results	Statistical indicators			
		Group 1* (n=107)	Group 2** (n=54)	Group 3*** (n=23)	Group 4***** (n=17)
Indicators of physical fitness					
1	Three Minute Step Test, ml/kg/min	56 (47; 61)	39 (36; 44)	41 (34; 54)	48 (34; 52)
2	Modified Sit-and-reach test, cm	33 (29; 38)	36 (28; 40)	16 (10; 21)	33 (21; 42)
3	Wall squat test right leg, sec	40 (27; 46)	34.5 (18; 56)	43 (36; 48)	35 (25; 39)
4	Wall squat test left leg, sec	37 (25; 44)	32.9 (16; 48)	41 (31; 45)	31 (28; 40)
5	Plate taping, sec	8.37 (7.91; 8.91)	9.41 (8.72; 10.35)	9.23 (8.35; 13.42)	13.45 (11.23; 14.80)
6	Sit up test, rep	25 (22; 27)	21 (19; 23)	31 (21; 37)	20 (19; 22)
7	Push up, max rep	36 (28; 46)	16 (10; 22)	35 (30; 50)	14 (8; 19)
8	Standing long jump test, cm	232 (220; 243)	170 (148; 184)	215 (201; 222)	167 (156; 175)

Note: Me (25; 75) is the median, 25th and 75th percentiles; Group 1* - group of Romanian male students; Group 2** - group of Romanian female students; Group 3*** - group of Ukrainian male students; Group 4***** - group of Ukrainian female students.

It was established that the BMI indicators of Ukrainian male students amounted to 23.04 (21.22;23.80) kg-m-2, and female students - 21.20 (19.96; 22.23) kg-m-2, and the differences between them were 8.66 %. Similarly, in the Romanian male group, the median values of BMI exceed female indicators by 12.32%: 23.66 (21.78; 25.68) kg-m-2 against 21.05 (19.47; 22.84) kg-m-2.

In both cases, the observed differences were statistically significant: for Romanian students, the results of statistical processing were $U=1381$; $Z=5.3976$; $p<0.05$, for Ukrainian – $U=113$; $Z=2.2435$; $p=0.0249$. These results do not allow us to group together students of different genders in the next research.

At the same time, no statistically significant differences were found between the same gender students, regardless of the educational program. So, for male students, the results of the comparative analysis were $U=1007$; $Z=1.3605$; $p=0.1737$, and for female students – $U=452$; $Z=0.0876$; $p=0.9302$.

There were some gender differences between the results of physical fitness characteristics among different gender groups proved the presence of individual differences depending on the educational program. For instance, the results of the Three Minute Step Test among Romanian male students prevailed over the results of Romanian female students by 43.59%. Quite the opposite, the results for Ukrainian male students were 14.58% lower than results of Ukrainian female group (Fig. 1).

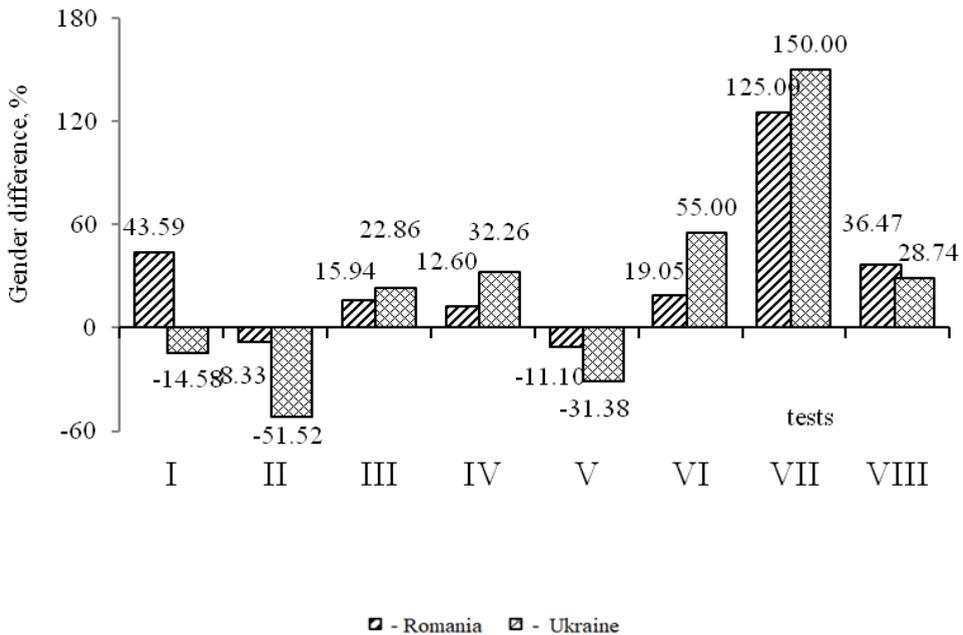


Fig. 1. Gender differences between the results of physical fitness tests among Romanian and Ukrainian group of students, % (n=201)

- I - Three Minute Step Test, ml/kg/min; II - Modified Sit-and-reach test, cm;
- III - Wall squat test right leg, sec; IV - Wall squat test left leg, sec; V - Plate taping, sec;
- VI - Sit up test, rep; VII - Push up, max rep; VIII - Standing long jump test, cm

Regarding other physical fitness indicators, the direction of gender differences between Romanian and Ukrainian students coincides. However, there were significant differences in their absolute value. The maximum differences, which amounted up to 43.18%, were observed in the results of the Modified Sit-and-reach test: Ukrainian male students compared to Ukrainian

female students had average scores lower by 51.52%, and Romanian male students – lower by 8.33%, than Romanian female students. At the same time, the average values of the Sit up test were 55.0% higher among Ukrainian male students than among Ukrainian female students. For Romanian male students, these differences were 33.95% smaller and equal to 19.05%.

The maximum differences, up to 43.18%, were observed in the results of the Modified Sit-and-reach test: Ukrainian students' average scores were 51.52% lower than scores of Romanian students and 8.33% lower than the results for Ukrainian female students. Meanwhile, average results of Ukrainian male students in Sit up test scores were 55.0% higher than those for Ukrainian female students; these results were 33.95% lower for Romanian male students, compared with Romanian female students and equal to 19.05%. At the same time, statistically significant differences weren't observed for results of the Modified Sit-and-reach test, Wall squat test right leg and Wall squat test left leg in Romanian groups of students ($p>0.05$) (Table 2).

Table 2. Analysis of gender differences in physical fitness of students of the Faculty of Physical Education (n=201)

№	Tests results	Statistical indicators					
		Romanian students (n=161)			Ukrainian students (n=40)		
		U	Z	p	U	Z	p
1	Three Minute Step Test, ml/kg/min	708.5	7.8055	<0.05	185.0	-0.2736	0.7844
2	Modified Sit-and-reach test, cm	2474.5	-1.4823	0.1383	69,0	-3.4473	0.0006
3	Wall squat test right leg, sec	2671.5	0.7770	0.4372	96.5	2.6949	0.0070
4	Wall squat test left leg, sec	2547.5	1.2210	0.2221	114.0	2.2161	0.0267
5	Plate taping, sec	1290.5	-5.7216	<0.05	110.5	-2.3119	0.0208
6	Sit up test, rep	1376.5	5.4137	<0.05	88.0	2.9275	0.0034
7	Push up, max rep	622.0	8.1152	<0.05	35.5	4.3639	0.0000
8	Standing long jump test, cm	222.5	9.5456	<0.05	8.5	5.1026	<0.05

Note: U - Mann-Whitney test; Z - z-statistic; p - achieved significance level

We need to highlight that the results of the Plate tapping test for male representatives of Romanian and Ukrainian male students were significantly lower ($p<0.05$) when compared with results of female groups. For the Sit up

test, Push up and Standing long jump test, male groups had significantly better results ($p < 0.05$) than groups of female participants.

The next stage of the research involved the establishment and assessment of deviations between the indicators of representatives of the same gender groups depending on their educational program. According to Figure 2, the peculiarities of the educational programs led to significant differences between their physical fitness, such as results of the Three Minute Step Test: the score of Ukrainian students was lower by 26.79%, compared to Romanian students, but the same results of Ukrainian female students were 23.08% higher than the results of Romanian female students. The maximum differences between students' indicators for male groups, which were 51.52% in favor of Romanian students, were determined by the Modified Sit-and-reach test. At the same time, in contrast to Romanian students, Ukrainians showed a 24.0% better result on the Sit-up test. For female students, Ukrainian women outperformed Romanians by 42.86% in the Plate tapping test, but the Romanian female group performed better in the Push up test by 12.50% (Fig. 2).

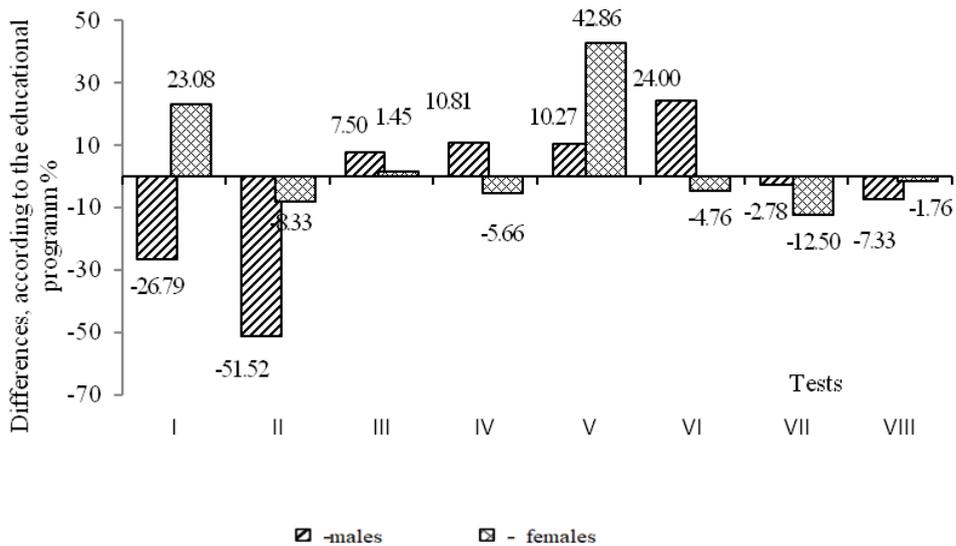


Fig. 2. Differences in physical fitness tests between Romanian and Ukrainian students, % (n=201)

I – Three Minute Step Test, ml/kg/min; II – Modified Sit-and-reach test, cm;
 III – Wall squat test right leg, sec; IV – Wall squat test left leg, sec; V – Plate tapping, sec; VI – Sit up test, rep; VII – Push up, max rep; VIII – Standing long jump test, cm

When the indicators of physical fitness of Ukrainian and Romanian students (male groups) were compared, statistically significant differences ($p < 0.05$) were found in the following indicators: Three Minute Step Test, Modified Sit-and-reach test, Plate taping and Standing long jump test. Moreover, with the exception of Plate taping, the results of Romanian students prevailed over the results of Ukrainian students (Table 3).

For both groups of Ukrainian and Romanian female students, the differences between the results of almost all control tests were statistically insignificant ($p > 0.05$). The exception was only the Plate tapping test, where Ukrainian female students showed a statistically significant ($p < 0.05$) better result than their Romanian colleagues.

The obtained results showed that, using the European experience in organizing the process of physical education majors, special attention should be paid to the physical training of students. It would be useful to investigate, due to which factors, Romanian students performed better in the Three Minute Step Test, Modified Sit-and-reach test, and Standing long jump test, compared with their Ukrainian colleagues, and to make efforts to implement this experience in the practice of physical education of Ukrainian students.

Table 3. Analysis of differences between physical fitness indicators of the students depending on the educational program (n=201)

№	Test results	Statistical indicators					
		Male students (n=130)			Female students (n=71)		
		U	Z	p	U	Z	p
1	Three Minute Step Test, ml/kg/min	691.0	3.2884	0.0010	334.5	-1.6708	0.0948
2	Modified Sit-and-reach test, cm	304.5	5.6465	<0.05	407.0	0.6939	0.4877
3	Wall squat test right leg, sec	923.0	-1.8730	0.0611	459.0	-0.0067	0.9946
4	Wall squat test left leg, sec	1041.0	-1.1531	0.2489	446.5	-0.1617	0.8716
5	Plate taping, sec	790.5	-2.6814	0.0073	124.0	-4.5071	<0.05
6	Sit up test, rep	909.5	-1.9554	0.0505	405.5	0.7141	0.4751
7	Push up, max rep	1109.0	-0.7382	0.4604	433.0	0.3436	0.7312
8	Standing long jump test, cm	578.0	3.9778	0.0001	426.0	0.4379	0.6615

Note: U - Mann-Whitney test; Z - z-statistic; p - achieved significance level

DISCUSSION

Current scientific data shows a decrease in the general level of physical fitness of university students. Special attention was given to the physical development and physical fitness assessment of physical education majors (Asauliuk & Kashuba, 2021; Kashuba et al., 2019; Kashuba et al., 2020). In addition, it was observed that the level of physical fitness of physical education majors is on a decreasing trend. Therefore, active research is currently underway to overcome this negative trend.

The results of previous research highlight the fact that the level of physical fitness of physical education majors needs special attention as the basis of professional competence (Kyrychenko et al., 2023). Finding ways to improve the physical fitness of students of higher education institutions was widely discussed in the scientific and methodological literature (Olenev & Kanishevskiy, 2019; Pelech & Grygus, 2016; Petritsa, 2018). However, in the context of the digitization of society and the limitation of students' motor activity, these issues continue to be relevant.

Our study was aimed at making a comparative analysis of indicators of physical development and physical fitness between Romanian and Ukrainian physical education majors in order to evaluate the effectiveness of two different educational programs.

The physical development of both Romanian and Ukrainian male groups of students was statistically significantly higher ($p < 0.05$) than the physical development of female groups of students. At the same time, the difference between the Body Mass Index (BMI) in Romanian students of different genders was 12.32%, and in Ukrainian students of different genders was - 8.66%. However, in both cases, the statistical significance ($p < 0.05$) of the identified differences was proven. No statistically significant differences ($p > 0.05$) were found between Romanian and Ukrainian students of the same gender. This seems to imply that the physical development of students occurs in a similar way, which indicates similar living conditions, lifestyle and nutrition.

Results of individual tests of both Romanian and Ukrainian students differed statistically significantly ($p < 0.05$) depending on the gender. The exceptions for Romanian students were the Modified Sit-and-reach test, Wall squat test right leg and Wall squat test left leg, and for Ukrainian students, the Three Minute Step Test, where statistically significant differences ($p > 0.05$) between male and female students weren't found. Moreover, not all indicators of

physical fitness of male students prevailed over female students. In particular, both Romanian and Ukrainian female students, compared to male students, showed better results on the Modified Sit-and-reach test and Plate taping tests.

Statistically significant differences ($p < 0.05$) were established between the indicators of physical fitness of Ukrainian and Romanian students according to indicators such as Three Minute Step Test, Modified Sit-and-reach test, Plate taping and Standing long jump test. And, with the exception of Plate taping, the results of Romanian students outweighed the results of Ukrainian students. However, no statistically significant differences ($p > 0.05$) were found between the indicators of Ukrainian and Romanian female students, except for the results of the Plate tapping test, where Ukrainian female students showed a statistically significant better result ($p < 0.05$).

From our perspective, the absence of differences between indicators of physical development of Ukrainian and Romanian students of higher education institutions indirectly indicates similar lifestyles and nutrition habits of Romanian and Ukrainian students. At the same time, unlike groups of female students, who did not show statistically significant differences in the performance of physical tests, with the exception of the Plate tapping test, where Ukrainian female students performed significantly better, Romanian male students performed significantly better in the Three Minute Step Test, Modified Sit-and-reach test and Standing long jump test. Therefore, there is a need to establish by which factors their results exceed the indicators of Ukrainian students in order to generalize, systematize and introduce positive experience into the practice of physical education of Ukrainian students.

CONCLUSION

In the context of full-scale accelerated digitalization of society, the lifestyle of modern higher education students is changing, and their motor activity is constantly decreasing. Therefore, the issue of improving the physical fitness of students is very urgent and requires an immediate solution. Research aimed at determining the differences between the development of physical abilities of the students from sports institutions depending on the educational program will allow researchers to investigate and systematize advanced pedagogical experiences and use it in further implementation into the practice of physical education of both Romanian and Ukrainian students.

Conflict of interests. The authors declare that there is no conflict of interest in this research.

REFERENCES

- Andrieieva, O., Yarmak, O., Palchuk, M., Hauriak, O., Dotsyuk, L., Gorashchenko, A., & Galan, Y. (2020). Monitoring the morphological and functional state of students during the transition from middle to high school during the physical education process. *Journal of Physical Education and Sport*, 20(3), 2110-2117. <https://doi.org/10.7752/jpes.2020.s3284>
- Antipova, Z. I., Barsukova, T. O., & Kucherenko, G. V. (2020). Physical training of first-year students as an important component of their success in the future profession. *Pedagogy of Creative Personality Formation in Higher and Secondary Schools*, 1(73), 177-181. <https://doi.org/10.32840/1992-5786.2020.73-1.33>
- Asauliuk, I., & Kashuba, V. (2021). Theoretico-methodological bases of professional and applied physical training of students of art specialties. *Theory and Methods of Physical Education and Sports*, 1, 37-43. DOI: 10.32652/tmfvs.2021.1.37-43
- Bonilla, D. A., Sánchez-Rojas, I. A., Mendoza-Romero, D., Moreno, Y., Kočí, J., Gómez-Miranda, L. M., Rojas-Valverde, D., Petro, J. L., & Kreider, R. B. (2023). Profiling physical fitness of physical education majors using unsupervised machine learning. *International Journal of Environmental Research and Public Health*, 20(1), 146. <https://doi.org/10.3390/ijerph20010146>
- Boroş-Balint, I., Gomboş, L., Deak, G. F., & Ciocoi-Pop, D. R. (2015, April 16-19). *Physical activity index and stress level in Romanian university students* [Conference presentation]. 6th LUMEN International Conference Rethinking Social Action. Core Values, Iasi, Romania.
- Byshevets, N., Iakovenko, O., Stepanenko, O., Serhiyenko, K., Yukhno, Y., Goncharova, N., Blazhko, N., Kolchyn, M., Andriyenko, H., Chyzhevska, N. & Blystiv T. (2021). Formation of the knowledge and skills to apply non-parametric methods of data analysis in future specialists of physical education and sports. *Sport Mont*, 19(S2), 171-175. DOI: 10.26773/smj.210929.k
- Chakhvadze, N. Y., & Nikitchenko, A. M. (2017). Characteristics of physical development and physical fitness of male and female athletes specializing in judo. *Scientific Journal of the NPU named after M.P. Drahomanova*, 4(85), 130-134.
- Deak, G. F., Boroş-Balint, I., Ciocoi-Pop, D. R., & Grosu, E. F. (2014). Correlations between physical activity and Ruffier indices in Romanian university students. *Studia Universitatis Babeş-Bolyai Educatio Artis Gymnasticae*, 59(4), 61-72.
- Ghorbanzaden, B. [et al.] (2011). Determination of Taekwondo national team selection criterions by measuring physical and physiological parameters. *Annals of Biological Research*, 2(6), 184-197.
- Gres, M. Y., & Ostroglyad, A. E. (2020). Comparative characteristics of physical fitness of students of physical education faculties in Ukraine and Poland. *International Scientific Journal "Internauka"*, 13. <https://doi.org/10.25313/2520-2057-2020-13-6254>
- Hakman, A., Andrieieva, O., Kashuba, V., Nakonechnyi, I., Cherednichenko, S., Khrypko, I., ..., & Moldovan, A. (2020). Characteristics of biogeometric profile of posture and quality of life of students during the process of physical education. *Journal of Physical Education and Sport*, 20(1), 79-85. <https://doi.org/10.7752/jpes.2020.01010>

- Hrynkyv, M. Y., Vovkanych, L. S., & Musica, F. V. (2015). *Sports morphology (with the basics of age-related morphology): Teaching manual*, L.: LDUFK, 304 p.
- Kashuba, V. O., Byshevets, N. G., Alyoshina, A. I., & Bychuk, O. I. (2019). *Health-saving technology of training future teachers of physical culture in the conditions of informatization of education* [monograph], Lutsk: Vezha-Druk, 222 p.
- Kashuba, V., Stepanenko, O., Byshevets, N., Kharchuk, O., Savliuk, S., Bukhovets, B., Grygus, I., Napierała, M., Skaliy, T., Hagner-Derengowska, M., & Zukow, W. (2020). The formation of human movement and sports skills in processing sports-pedagogical and biomedical data in masters of sports. *International Journal of Human Movement and Sports Sciences*, 8(5), 249-257. DOI: 10.13189/saj.2020.080513
- Kemeryte-Ivanauskienė, E., Brandisauskienė, A., Cesnaviciene, J., & Daugirdiene, A. (2022). The significance of students' physical activity for their engagement in learning activities during the Covid-19 pandemic. *Physical Education Theory and Methodology*, 22(4), 522-529. <https://doi.org/10.17309/tmfv.2022.4.10>
- Korobeinikova, L. G., Djamil, M-S. A., Cynarski, W. J., Ulizko, V. M., & Stavinskiy, Y. (2021). Change of psychophysiological indices in female students of creative occupations. *Health, Sport, Rehabilitation*, 7(4), 98-110. <https://doi.org/10.34142/HSR.2021.07.04.08>
- Kyrychenko, V., Deak, G-F., Pop, N-H., & Gomboș, L. (2023). Features of physical development and physical fitness of students from the Faculty of Physical Education and Sport, Babeș-Bolyai University. *Journal of Physical Education and Sport*, 23(2), 510-516. DOI:10.7752/jpes.2023.02063
- Majevska, S., Kutserib, T., Vovkanych, L., Hrynkyv, M., & Muzyka, F. (2014). Morphological profile of WKF karate fighters. *Physical Activity, Health and Sport*, 2(16), 35-43.
- Nesen, O., & Klymenchenko, V. (2020). Assessment of physical fitness of students of a higher education institution of a pedagogical profile: Actual problems of physical education of different population strata. *Kharkiv: KhDAFK*, 114-118.
- Olenev, D. G., & Kanishevskiy, S. M. (2019). Analysis of the level of physical fitness of students of higher education institutions. *Scientific Journal of the NPU named after M.P. Drahomanova*, 3K(110), 410-413.
- Orikhovska, A., Andrieieva, O., Kashuba, V., Lazarieva, O., Lytvynenko, Y., Kyrychenko, V., Arefyiev, V., & Khrypko, I. (2020). Social integration of hearing-impaired students by means of health-enhancing and recreational activities. *Teoriã ta Metodika Fizičnogo Vihovannã*, 20(2), 86-94. <https://doi.org/10.17309/tmfv.2020.2.04>
- Pelech, I. V., & Grygus, I. M. (2016). The level of physical fitness of students. *Health and Sport*, 6(2), 87-98. DOI: 10.5281/zenodo.46057
- Petritsa, P. (2018). Physical fitness of students and ways to improve it. *Sport Science of Ukraine*, 6(88), 39-44.
- Pribis, P., Burtnack, C. A., McKenzie, S. O., & Thayer, J. (2010). Trends in body fat, body mass index and physical fitness among male and female college students. *Nutrients*, 2(10), 1075-1085. doi:10.3390/nu2101075
- Sang, Y., & Wang, L. (2022). Physical fitness data monitoring of college students based on the internet of things and blockchain. *Frontiers in Public Health*, 10, 940451. doi:10.3389/fpubh.2022.940451

COMPARATIVE ANALYSIS OF PHYSICAL FITNESS OF PHYSICAL EDUCATION MAJOR ROMANIAN AND
UKRAINIAN STUDENTS

- Sarpong, E. O. (2022). Assessing the physical fitness level of students in senior high schools. *International Journal for Innovation Education and Research*, 10(8), 159-169. <https://doi.org/10.31686/ijer.vol10.iss8.3865>
- Siemova, S. G. (2018). Peculiarities of physical fitness of students at the university. *Physical culture. Sport. Tourism. Motor recreation*, 3(3), 28-32.
- Sun, J., Chang, J., Zhu, E., Sun, X., Tao, Y., & Chen, X. (2023). Comparative research on the development of college students' physical fitness based on online physical education during the COVID-19 pandemic. *BMC Public Health*, 23, 742. <https://doi.org/10.1186/s12889-023-15599-7>
- Sydorova, T. V., & Horina, V. V. (2020). Comparative analysis of the physical fitness of students of the KhDAFC specializations Ski racing and Eastern martial arts. *Martial Arts*, 2(16), 52-60.

